ASDC
AMERICAN SOCIETY OF DENTISTRY FOR CHILDREN
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SEPTEMBER–OCTOBER 1992

If the well-being of its children is the proper measure of the health of a civilization, the United States is in grave danger. Of the 65 million Americans under 18, fully 20 percent live in poverty, 22 percent live in single-parent homes, and almost 3 percent live with no parent at all. Violence among the young is so rampant that the American Academy of Pediatrics calls it a public health emergency. The loss of childhood innocence is a recent phenomenon, affecting all income levels and all ethnic groups. Playground fights that used to end in bloodly noses now end in death. Schools that once considered talking in class a capital offense are routinely frisking kids for weapons, questioning them about drugs. AIDS has turned youthful experimentation with sex into Russian roulette. A good public education, safe streets, and family dinners—with both mother and father present—seem like quaint memories of a far distant past. The bipartisan National Commission on Children wrote in "Beyond Rhetoric," its 1991 report, that addressing the unmet needs of American youngsters "is a national imperative as compelling as an armed attack or a natural disaster."

Louis S. Richman


ONLY HEALTHY FAMILIES HEADED BY RESPONSIBLE PARENTS IN CARING COMMUMTIES CAN SUCCEED IN RAISING HEALTHY KIDS.

—William Bennett

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**POSTMASTER**
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Society must not write off a whole generation of children, if the nation is to survive as a leader among nations.

Cover art and design by Sharlene Nowak-Stellmach.



## CLINIC






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346 The author tested the validity of predicting the eruption-sequence of permanent teeth from orthopantomograms taken during the early mixed dentition, based on criteria of root formation.

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A case of bilateral paradental cysts affecting the first permanent molars is described. Radiographic characteristics and differential interpretations of the lesion are discussed.

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The treatment and observation of a child with fused mandibular primary lateral incisor and canine are presented. Asymmetries such as those caused by fusions can lead to serious malocclusion.

**Differences in the health status of black and white children—page 369**

There is a need for dentists who treat children to be aware of the differences that exist between the populations of children that increasingly will seek needed care.

**Juvenile arrests - it's a crime—page 373**

Crime committed by children is on the increase. Den-

tists who treat children should be acquainted with the extent of criminal activities in which children in our cities, suburbs, and rural areas participate.

**Mexican-American parents with children at risk for baby bottle tooth decay: Pilot study at a migrant farmworkers clinic—page 376**

Treatment of severe BBTD in very young children often requires the use of general anesthetic. In 1987, the cost was estimated at $700-$1,000; add another $1,000, if hospitalization is needed. Informal surveys of dentists across the country indicate that in 1991-1992, the cost of treatment has increased substantially.

**Prevalence of dental caries in school children in Al-Khobar, Saudi Arabia—page 384**

The author collected base-line data on the prevalence of dental caries in Al-Khobar. He submits that examination of children's teeth should be part of clinical examinations by pediatricians.

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**CORRECTION**

The figures shown on page 265 of the July-August, 1992 issue, in an article entitled, "Sealing of occlusal hidden caries lesions: An alternative for curative treatment?" by K.L. Weerheijm *et al* were inadvertently transposed. They should appear as shown below.

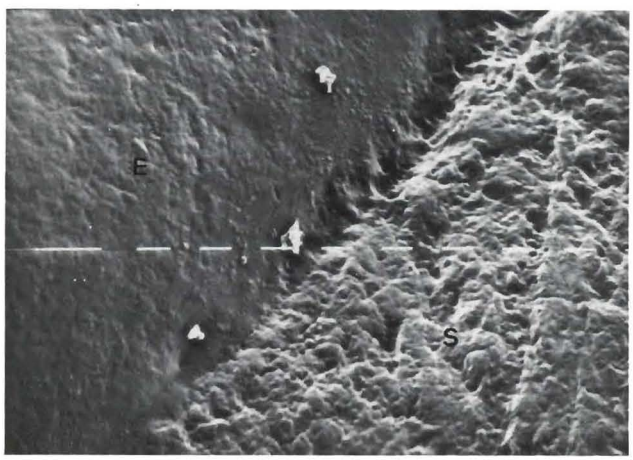


*Figure 1. Correct SEM marginal adaptation (640x). E = enamel, S = sealant.*

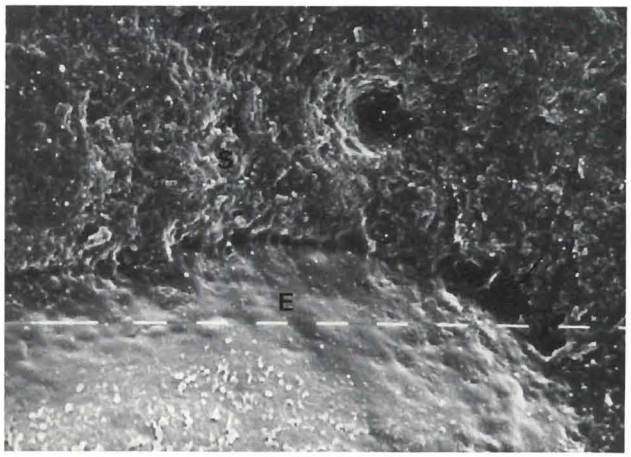


*Figure 2. Incorrect SEM marginal adaptation (640x). E = enamel, S = sealant, lmm = 1.4 μm. Arrow points at the defect.*

# CLINIC

# Bonding to dentin: Evaluation of three adhesive materials

**Homayoun Sedighi, DMD**
**Jorge M. Davila, DDS, MS**
**A. John Gwinnett, PhD, BDS, LOSRCS, FADM**

From a compositional point of view, dentin resembles bone. It has approximately 30 percent organic matter, which is largely collagen and water and an inorganic calcium apatite component of approximately 70 percent, which is chemically similar to the inorganic phase of enamel. The latter contains 96 percent mineral and 4 percent enamel in matrix and water. The viability and biological integrity of dentin and pulp, the transport of tissue fluids from the pulp throughout the dentin, and the structure and composition of the dentin itself are all factors of paramount importance in bonding to this tissue.[1]

Significant advances have been made in developing dental materials that will bond to dentin, since Buonocore *et al* (1956) described a "chemical bridge" as the basic requirement.[2] They stated that bonding to this tissue could be achieved with a bifunctional molecule containing a dimethacrylate group and a reactive phosphate group that will form an ionic bond with the calcium in dentin, while the dimethacrylate would copolymerize with the restorative resin.

Dr. Davila is Senior Clinician, Department of Pediatric Dentistry, Eastman Dental Center, Rochester, New York. Dr. Gwinnett is Professor, Department of Oral Biology and Pathology, State University of New York at Stony Brook, Stony Brook, New York. Dr. Sedighi is a Pediatric Dentist in St. Louis, Missouri.

This study was completed thanks to a grant of the American Society of Dentistry for Children for the cost of the scanning electron microscopic evaluation and to the generous contribution of materials by the manufacturers.

Enamel bonding is now a universally established procedure, and its use in all phases of dentistry has increased. A number of laboratory studies have shown, however, significantly lower bond strengths to dentin in comparison with enamel bonding.[3-6] Dentinal bond strength of most second generation bonding agents have not exceeded 4-5 MPa compared to enamel bonding in excess of 14 MPa. Low bond strength to tissue yields to interfacial stress caused by shrinkage from polymerization.[7] The clinician cannot always depend on establishing a permanent bond, therefore, between the resin and the dentinal walls.

The bonding agent (including tissue primers), sandwiched between composite resin and dentin, should serve two purposes:

- ☐ Enhance wetting of the composite resin to the walls of the prepared cavity.
- ☐ Bond the restorative materials to dentin with enough strength to overcome the stress generated by the shrinkage.[7]

Several reports have shown that forces created by volumetric contraction during polymerization probably overcome the strength of the bond with dentin in the three dimensional form of a cavity preparation.[8-10] Donly *et al*, 1987, detected lesser shrinkage, however, when the resin is placed in several increments.[10] Clinicians have adopted this practice in placing restorations.

The main factor responsible for undesirable microleakage seems to be the result of contraction and expansion of the restorative material, when exposed to

changes in temperature. It is postulated that reduced temperatures cause a negative interfacial pressure, creating a gap that encourages the movement of fluids into the interface. As the temperature increases, the interfacial pressure is enhanced, closing the gap and squeezing fluids out to the surface. This fact demonstrates the great need for a strong bonding agent and resin with low thermal coefficient.[11]

The purpose of this investigation was to evaluate the degree of penetration in gaps and the formation of the latter in the interface between three commercially available posterior resin composite restorative materials and the dentinal walls in Class I preparations in human, extracted molars. The results were compared with those obtained in a previous study, using an earlier generation of dentin bonding agents.[9]

## METHODS AND MATERIALS

The study consisted of two parts. The first was an evaluation of the samples for the presence of gaps between the dentin and restorative material, using scanning electron microscopy (SEM), and the second was an evaluation of dye-penetration at the restoration interface with the dentin.

Class I deep cavity preparations were made in fifty-four extracted, caries-free, human permanent molar teeth. Calcium hydroxide, Dycal® (L.D. Caulk/Dentsply) was applied, replicating clinical conditions for pulp protection, only to the deepest portion on the floor of the cavity. The specimens were distributed between the following groups at random: Group 1. Thirty-six (36) specimens for SEM to study gap formation. Group 2. Eighteen (18) specimens to study microleakage at the dentin-resin interface.

An equal number of preparations were filled with the following combinations of posterior resin composites and dentin bonding agents: P50/Scotchbond 2 (3M Co.), Lumifor/Gluma (Columbus Dental Co.), and Marathon V/Tenure (Den-Mat Co.). The specimens were assigned at random to each material.

Half the specimens in each group were thermocycled for four hours at temperature extremes of 4°C and 80°C. The dwell time was one minute. A 0.5 percent solution of basic fuchsin dye was used for leakage evaluation. The specimens were covered with wax, except for the restorations and a region 2 mm beyond their margins, before immersion into the dye solution. The remaining specimens were stored in a moist environment at room temperature.

Evaluation of dye-penetration was conducted on sections cut longitudinally through the restoration using a water-cooled, rotating diamond blade. Microleakage evaluation was assessed by light optical stereomicroscopy at 20X magnification. The dye penetration was recorded (Table 1) according to the method of Eriksen and Buonocore:

0 - No marginal penetration

1 - Penetration of dye limited to the dentin-enamel junction.

2 - Penetration of dye limited to the walls of the cavity.

3 - Penetration of dye to include walls and floor of the cavity.

4 - Penetration of dye partly or completely through dentin to the pulp.

Specimens were prepared for SEM using a method previously reported in which polyvinyl siloxane impressions were taken of the exposed dentin-restoration interface to minimize desiccation artifacts.[9]

The results of the marginal leakage study are summarized in Table 1. Dye penetration was clearly evident in all specimens from the axial wall to the pulpal floor, and in some cases, to the pulp chamber. It was difficult to differentiate any effect of thermocycling on the dye penetration since both groups, thermocycled and nonthermocycled, showed similar degrees of microleakage at the dentin-resin interface.

The results of the SEM evaluation are summarized in Table 2. Photomicrographs of the most representative section are displayed in Figures 1 and 2. All specimens showed the presence of either continuous or

Table 1 □ Eighteen specimens were equally divided into two groups: Thermocycled and non-thermocycled. Each group of six specimens was filled with one of the three materials to be tested.

| | Nonthermocycled | | | |
|---|---|---|---|---|
| Bonding material | Number of teeth | Number of sections examined | Range of dye penetration | |
| | | | Low | High |
| Scotchbond 2 | 3 | 14 | 2 | 3 |
| Gluma | 3 | 12 | 2 | 4 |
| Tenure | 3 | 12 | 2 | 3 |
| | **Thermocycled** | | | |
| Bonding material | Number of teeth | Number of sections examined | Range of dye penetration | |
| | | | Low | High |
| Scotchbond 2 | 3 | 13 | 2 | 3 |
| Gluma | 3 | 13 | 2 | 4 |
| Tenure | 3 | 15 | 2 | 4 |

Table 2 □ Thirty-six specimens were equally divided into two groups: Thermocycled and nonthermocycled. Each group of eighteen specimens was filled with one of the three materials to be tested.

| | | Nonthermocycled | | |
|---|---|---|---|---|
| | | Gap evaluation | | |
| Dentin bonding material | Number of teeth | Pulpal floor | Right wall | Left wall |
| Scotchbond 2 | 6 | Gap | Gap | Gap |
| Gluma | 6 | Gap | Gap | Gap |
| Tenure | 6 | Gap | Gap | No gap |
| | | Thermocycled | | |
| | | Gap evaluation | | |
| Dentin bonding material | Number of teeth | Pulpal floor | Right wall | Left wall |
| Scotchbond 2 | 6 | Gap | No gap | Gap |
| Gluma | 6 | Gap | No gap | Gap |
| Tenure | 6 | Gap | No gap | No gap |

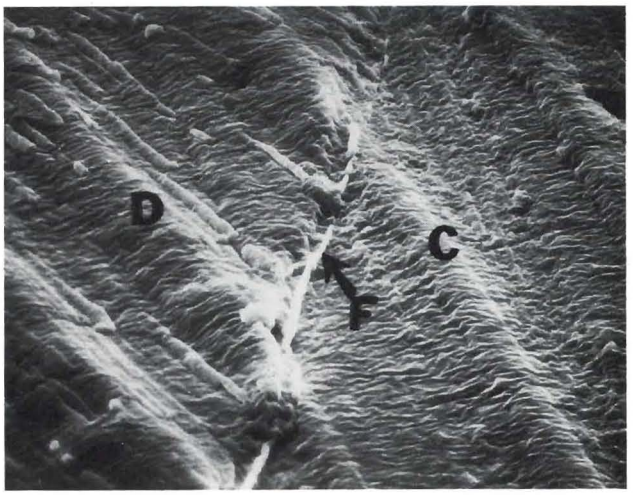


*Figure 1. Scanning electron micrograph showing the impression of the left axial wall of a Class I preparation. The presence of a flash of impression material (F) demonstrates the gap at the interface between dentin (D) and composite material (C). Original magnification 750X.*

discontinuous gaps at the interface between the dentinal wall and the restorative resin, in both the thermocycled and nonthermocycled specimens. Some isolated areas of continuity between the resin and the tissue were present, suggesting an intact bond between the resin and dentin.

## DISCUSSION

Shear bond-strength data have shown a statistically significant improvement in some of the currently available dentin bonding agents. Three of these were used in the present study. The presence of gaps and the degree of microleakage found strongly suggest, however, that the improved bond strengths are still unable to compete with forces generated during polymerization that disrupt the bond with dentin. This would be particularly true in the three dimensional preparations used in this study.

Not all the dentin surface was available for interaction with the dentin bonding agent, since calcium hydroxide was placed on the floor of the preparation to simulate clinical situations. Nonetheless, the available surface area for dentin bonding did not produce a durable bond between restorative material and dentin and was comparable to the findings reported in a previous study.[9] The bonded integrity of a restoration, particularly where a cavosurface margin ends in the root and not in enamel, is important in preventing marginal leakage and possible pathologic sequelae. In the present study, using posterior resin composites, it can be concluded that preparations with a cavosurface margin in the root may not be optimally bonded and leakage

Improved bond strengths still appear unable to compete with forces of polymerization.

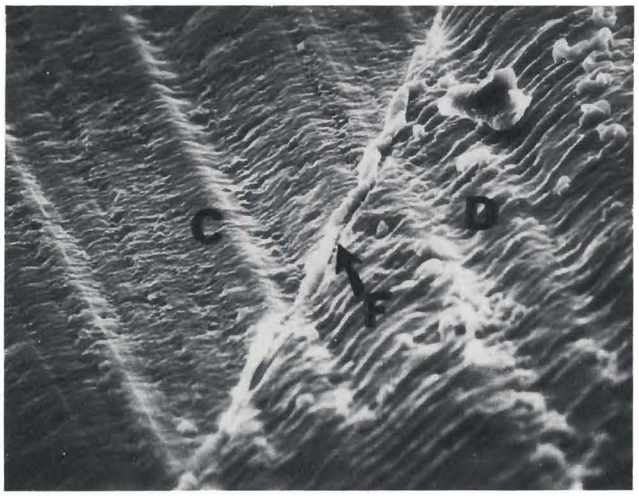


*Figure 2. Scanning electron micrograph of the right axial wall of the same specimen in Figure 1. The presence of the flash (F) of impression material is also visible. D = dentin. C = composite material. Original magnification 750X.*

is to be expected. The clinical consequences for this require further investigation.

## SUMMARY AND CONCLUSIONS

- ☐ Dye penetration was observed in all specimens.
- ☐ SEM demonstrated isolated areas with no gap formation, suggesting a partial bond with dentin.
- ☐ A correlation is evident from the results of both techniques.
- ☐ Since dye-penetration was found to be similar in all the specimens, it was difficult to assess the effect of thermocycling on the amount of dye penetration.
- ☐ The use of posterior composites should be considered as a short-term tested procedure. It should be utilized carefully, following the manufacturer's instructions, and monitored routinely. Undoubtedly, the utilization of posterior composite materials is a very technique-sensitive procedure.
- ☐ Comparing the results of this in vitro study with those previously reported suggests that little improvement has been made in the bonding of the materials tested.
- ☐ Development of new materials and improved techniques are necessary.

## REFERENCES

1. Buonocore, M.G.: Bonding to hard dental tissues. Chapter 15, *Adhesion in biological systems*, New York: Academic Inc., 1970.
2. Buonocore, M.G.; Willeman, W.; Brudevold, F.: A report on resin composition capable of bonding to human dentin surfaces. J Dent Res, 35:846-851, December 1956.
3. Asmussen, E. and Munksgaard, E.C.: Formaldehyde as bonding agent between dentin and restorative resin. Scand J Dent Res, 92:480-483, 1984.
4. Bullard, R.H.; Leinfelder, K.F.; Russell, C.M.: Effect of coefficient of thermal expansion on microleakage. JADA, 116:871-874, June 1988.
5. Buonocore, M.G.: Retrospections on bonding. Dent Clin N Am, 25:241-255, April 1981.
6. Nakamichi, I.; Iwaku, M.; Fusayama, T.: Bovine teeth as possible substitutes in the adhesion test. J Dent Res, 62:1076-1081, October 1983.
7. Davidson, C.L.; DeGee, A.J.; Feilzer, A.: The competition between the composite dentin bond strength and the polymerization contraction stress. J Dent Res, 63:1396-1399, December 1984.
8. Leinfelder, K.F.: Posterior composite resins. JADA (special issue), 21E-26E, September 1988.
9. Davila, J.M.; Gwinnett, A.J.; Robles, J.C.: Marginal adaptation of composite resins and dentinal bonding agents. J Dent Child, January-February 1988.
10. Donly, K.J.; Jensen, M.E.; Reinhardt, J. *et al*: Posterior composite polymerization shrinkage in primary teeth: as in vivo comparison of three restorative techniques. Ped Dent 9,:22-25, March 1987.
11. Hegdahl, T. and Gjerdet, J.: Contraction stress of composite resin filling materials. Acta Odont Scand, 35:191-195, 1977.
12. Eriksen, H.; and Buonocore, M.G.: Marginal leakage with different composite restorative materials "in vitro". J Oral Rehab, 3:3315-3322, October 1976.

# Evaluation of treatment times for class II resin composite inlays

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

Until now, few studies have focused on the cost of restorative treatment in terms of the time needed to perform the specific operation.[1-5] In addition, a previous paper dealt with the treatment times for Class II resin composite restorations.[6] In the case of indirect resin composite inlays, the fee of the dental technician forms an additional cost component. Nevertheless, it is still the dentist's fee which largely determines the cost of the restoration, based mainly on the working time.

This paper presents the results of time registrations for indirect Class II resin composite inlays. The treatment times registered were studied for influences such as those coming from the particualr dentist involved and from the cavity size. The findings were compared to treatment times for direct Class II resin composite restorations.

The authors would like to thank Miss I.J. de Jong for her assistance in the dental treatment, Professor C.L. Davidson and Dr. M.A. van 't Hof for their advice, and Kerr and Kuraray/Cavex Holland for their financial support.

The authors are with the Department of Pediatric Dentistry, Academic Centre for Dentistry Amsterdam, Louwesweg 1, 1066 EA Amsterdam, The Netherlands.

## MATERIAL AND METHODS

This study forms part of a clinical trial on direct and indirect Class II resin composite restorations, the design of which was described in a previous paper.[7] In the present study, three posterior composite materials as used in an indirect restorative technique were tested. Patients received three (where applicable six) two- or three-surface Class II resin composite inlays of "standard" size. In this way fifty-eight patients (ages 17 - 35 years) received a total of 180 indirect restorations. The three materials were randomly allocated to the teeth to be restored. Each patient was treated by one of three dentists, and in order to ensure uniformity all three were asked to adhere to a detailed treatment protocol.

A comprehensive description of the time-recording procedure has already been given in the paper on treatment times for direct resin composite restorations.[6] The restorative procedure for the inlays was accordingly divided into several steps, and the time needed to perform each step (rounded off to the nearest whole minute) was recorded by the dental assistant. Treatment time

[a]Herculite XR (Kerr)
Clearfil CR Inlay (Cavex Holland/Kuraray)
Visiomolar (ESPE)

was recorded for each inlay individually. Each inlay was constructed in three sessions and Table 1 describes the various stages of the restorative technique. Additional considerations were as follows: The decision as to whether to apply a calcium hydroxide lining was left to the dentist in charge. In all cases, however, the dentin removed was replaced by a glass ionomer lining cement. The inlay was produced by the dental laboratory.

The following factors were studied to determine their influence on the treatment times recorded:

- ☐ (Experience of) the dentist. This factor is reflected in the number of postgraduate years, which was determined at the start of the operative phase of this study (Table 2).
- ☐ Learning effect of the dentist. At the beginning of this study none of the three dentists had had any experience with indirect resin composite inlays; thus a learning effect was to be expected. By dividing the restorations into two sequential groups for each dentist, an 'inexperienced' period and a more 'routine' period were created.
- ☐ Type of tooth (molar or premolar).
- ☐ Type of restoration (two- or three-surface).
- ☐ Presence or absence of an amalgam restoration at the time of treatment.

Table 3 shows the percentages of 'type of restoration' and 'type of tooth' for each dentist during the two periods of experience. On the whole, more two-surface restorations were made, and more premolars were restored. Dentist C made relatively more three-surface restorations, and restored more molars during the second period than during the first. For Dentists A and B the reverse was true. Combinations of the variables 'type of restoration' and 'type of tooth' provide an indication of the size of the restoration. In this way four combinations, of which the sizes range from small to large, can be made:

- ☐ Two-surface restoration in a premolar.
- ☐ Two-surface restoration in a molar.
- ☐ Three-surface restoration in a premolar.
- ☐ Three-surface restoration in a molar.

Treatment times for this 'combination variable' are presented.

As observed in various studies, the distribution of treatment times is positively skewed, and an ln-transformation makes it possible to use analyses of variance.[2,3,6] Retransformation of the ln-mean results, however, in geometric rather than arithmetic means. The geometric mean can be interpreted as the median of the raw data. Thus the comparison of treatment times was carried out using geometric means. Due to the ln procedure, the effects of the influencing factors are presented as percentages rather than time differences. Since outliers in working time largely determine daily activities, it is realistic to take arithmetic means into account. For practice management, therefore, arithmetic means will be presented.

Table 1 ☐ Stages in the restorative process of Class II resin composite inlays.

| Treatment stage | Treatment procedure |
|---|---|
| 1. Preparation | Preparation of a standard Class II inlay-cavity (slightly conical orientation of the enamel walls of the cavity), removal of carious dentin. |
| 2. Preliminary work, first session | Application of rubber dam, $Ca(OH)_2$[b], glass ionomer cement[c] and retraction cord if necessary. |
| 3. Impressions/temporary restoration[e] | Making of full arch impressions[d] and temporary restoration[e]. |
| 4. Preliminary work, second session | Removal of temporary restoration, application of rubber dam, trying the fit of the inlay. Application of acid-etch, bonding and dual cure resin composite cement[f]. |
| 5. Application | Placing of the inlay, removal of the excess of resin composite cement and light curing. |
| 6. Finishing | Removal of the remaining excess of cement; removal of rubber dam, and verification and adjustment of occlusal height. |
| 7. Polishing, third session | Verification of marginal adaptation/occlusal height and adjustment if necessary; polishing with EF-diamond stones, rubbers and polishing paste. |

[b] Life (Kerr)
[c] Fuji lining cement (GC)
[d] Provil (Bayer)
[e] Fermit (Vivadent)
[f] As prescribed by the manufacturers of the restoratives used

Table 2 ☐ Experience of the dentists.

| Dentist | A | B | C |
|---|---|---|---|
| Postgraduate years | 12 | 16 | 3 |
| General practice | part-time | negative | negative |
| Lecturer | part-time | full-time | full-time |

Table 3 ☐ Percentages of the variables 'type of restoration' and 'type of tooth' for each dentist and each period of the study. Period 1 represents the individual dentist during the first – the least skilled – period, while Period 2 refers to the second – routine – period.

| | | Type of restoration | | Type of tooth | | |
|---|---|---|---|---|---|---|
| Dentist | Period | Two-surface | Three-surface | Premolar | Molar | N |
| A | 1 | 64% | 36% | 75% | 25% | 28 |
| | 2 | 72% | 28% | 78% | 22% | 32 |
| B | 1 | 58% | 42% | 74% | 26% | 31 |
| | 2 | 59% | 41% | 83% | 17% | 29 |
| C | 1 | 65% | 35% | 74% | 26% | 31 |
| | 2 | 38% | 62% | 66% | 34% | 29 |
| N | | 107 | 73 | 135 | 45 | 180 |

## RESULTS

Table 4 presents the mean treatment time (with the standard deviation), the geometric mean, and the 90 percent concentration interval per stage. Due to the manner in which the distributions are skewed, the calculated geometric means are smaller than the arithmetic means observed. As shown in the table, the construction of a resin composite inlay takes over an hour (60.3 minutes); there is a considerable scatter of this overall time (SD 12.9 minutes). After application of the ln-procedure, the resulting geometric mean is 58.9 minutes, with 90 percent of the observations ranging from 41.5 to 83.8 minutes. The most time-consuming step is the preliminary work during the second session, and much of the overall scatter occurs during this stage (geometric mean 12.9 minutes, 90 percent interval 6.5-25.5).

Table 5 shows the effects of the variables 'dentist', 'type of restoration' and 'type of tooth', following ANOVA. The influence of the levels of each variable has been expressed as the relative difference between the two levels; as regards the dentists, this can be read as the relative difference of each level with the geometric mean working-time. Each factor has been weighted, meaning that adjustments have been made, if a factor was unevenly distributed over the two levels to be determined. The influence of each of the three factors on the overall treatment time was found to be highly significant. The working tempos of the three dentists differed, and this was of particular influence on the preparation time and the preliminary work during the second session of the treatment. Furthermore, there are differences in working-times between the restoration of premolars and molars, and between two surface and three-surface restorations. Most of these discrepancies occur during preparation of the cavity, application of the inlay, and finishing. The preliminary work during the second session in the case of three surface restorations takes more time than that of two-surface restorations.

When the first and second periods of experience are compared, it appears that Dentist A reduced his overall treatment time by 15 percent and Dentist B by 9 percent (these are the raw effects). Dentist C, by contrast, did not reduce his overall working time. This factor, the 'learning effect', showed, however, no significant interaction with the factor 'dentist', and had no substantial influence on the geometric means. With respect to the preparation and overall treatment time, the presence of an amalgam restoration at the time of treatment did not significantly influence the times recorded, and this factor, therefore, has not been illustrated by means of a table.

Finally, the indication of the size of a restoration was based on a combination of the variables 'type of restoration' and 'type of tooth'. Table 6 shows the geometric mean treatment time for each of the four combinations. The treatment time for a small restoration (two-surface restoration in a premolar) is 53.5 minutes, while the construction of a large one (three-surface restoration in a molar) takes 72.5 minutes.

Table 4 ☐ Average treatment times (arithmetic means, standard deviations in parentheses), geometric means and their 90 percent concentration intervals, in minutes (n = 180).

| Treatment stage | Arith. mean (std.dev.) | Geometric mean | 90% concentration interval |
|---|---|---|---|
| 1. Preparation | 10.2 (4.3) | 9.3 | 4.5 - 19.3 |
| 2. Preliminary work, 1st | 8.6 (3.1) | 8.1 | 4.3 - 15.0 |
| 3. Impressions/temp.rest. | 13.0 (3.2) | 12.6 | 8.3 - 19.1 |
| 4. Preliminary work, 2nd | 13.9 (5.2) | 12.9 | 6.5 - 25.5 |
| 5. Application | 5.5 (1.4) | 5.4 | 3.6 - 8.0 |
| 6. Finishing | 5.6 (2.0) | 5.3 | 2.9 - 9.5 |
| 7. Polishing | 3.5 (1.4) | 3.2 | 1.6 - 6.3 |
| Totals | 60.3 (12.9) | 58.9 | 41.5 - 83.8 |

The calculated geometric means are smaller than the arithmetic means.

Table 5 ☐ Effect of the variables on the treatment time. In case of the variable 'dentist' this should be read as the relative effect of each of the three 'dentist-levels' on the geometric mean treatment time. In case of 'type of restoration' and 'type of tooth' the effect of the two levels of each variable has been expressed as the relative difference of the one level to the other.

| Treatment stage | Dentist | | | | Type of restoration (two/three-surfaces) | | Type of tooth (premolar/molar) | |
|---|---|---|---|---|---|---|---|---|
| | A | B | C | p | | p | | p |
| 1. Preparation | −30 | 4 | 25 | <.001 | 31 | <.001 | 26 | <.001 |
| 2. Preliminary work, 1st | −13 | 5 | 8 | <.01 | 2 | N.S. | 8 | N.S. |
| 3. Impressions temp.rest. | −9 | 6 | 3 | <.01 | 5 | N.S. | 5 | N.S. |
| 4. Preliminary work, 2nd | −38 | 12 | 26 | <.001 | 10 | <.05 | 6 | N.S. |
| 5. Application | 2 | 0 | −2 | N.S. | 14 | <.001 | 14 | <.001 |
| 6. Finishing | −10 | 1 | 9 | <.05 | 15 | <.01 | 22 | <.001 |
| 7. Polishing | −17 | 5 | 12 | <.001 | 8 | N.S. | 5 | N.S. |
| Totals | −18 | 6 | 13 | <.001 | 12 | <.001 | 12 | <.001 |

## DISCUSSION

As stated, comparisons were made between the results of time registrations for direct resin composite restorations in a previous study, and those for indirect resin composite inlays in the present study.[6] The overall designs of both studies were identical; working conditions and operative procedures were established. In the following, 'Study I' represents the first study, while 'Study II' refers to the present study.

Observations on working time are admissible, if the work-tempos of the participating dentists are representative of the general dentist. The measure of characterization adopted in this study is the treatment time for amalgam Class II restorations of "standard" size.[7] On average, two-surface amalgam restorations were made in 22.3 minutes (SD 6.2, n=33), while three surface restorations took an average of 26.1 minutes to complete (SD 6.1, n=27) (arithmetic means, data not shown in the results). These working times are on the order of those recorded by Advokaat (Advokaat: two-surface restoration 24.3 minutes and three-surface restoration 30.0 minutes).[2] It should be noted that Advokaat did not include the polishing time in his results. The average cavity size in the present study is expected to be smaller as, according to the selection-and-treatment protocol, the cervical extension of the proximal outline should not extend beyond the cementoenamel junction (see Kreulen *et al*).[7] This could contribute to shorter treatment times. In addition, the working time for three-surface amalgam restorations in the present study (Study II) is 4.2 minutes shorter than those observed in Study 1.[6] This may be due to the ratio of premolars and molars in the case of three-surface restorations; in Study II more premolars were restored. Obviously, the time needed to construct an amalgam restoration is an indicative measure rather than a pure standard. This should be taken in account, when the working times for composite restorations in this study are translated to general practice.

The factor 'dentist' proved to be of influence (Table 5); there was a difference of 31 percent between the dentists. The 'dentist effect' may be caused by differences in the speed at which observations and decisions were made, manual skills, and a desire to perform the task conscientiously. There seemed to be a learning effect, but the influence was not significant. This may be due to the skewed distribution of the variables 'type of tooth' and 'type of restoration', when the first and second periods of experience were compared (Table 3). Dentist A, for instance, made more small restorations during the second period, thus reducing his working time. Due to a lack of experience, the learning effect in Study I was created primarily by one dentist, during

Table 6 ☐ Overall treatment times for the combination of the variables 'type of restoration' and 'type of tooth' (geometric means, in minutes).

| Combination variable (restoration + tooth type) | Geom. mean | 90% concentration interval | n |
|---|---|---|---|
| Two-surface + premolar | 53.5 | 39.8 - 71.9 | 78 |
| Two-surface + molar | 60.8 | 42.2 - 87.5 | 29 |
| Three-surface + premolar | 62.5 | 45.3 - 86.1 | 57 |
| Three-surface + molar | 72.5 | 52.6 - 99.9 | 16 |

≈Tytin (Kerr).

The cost for is approximately 145 percent of the cost for direct restorations.

the preparation stage. At the time of Study II, he had been in practice for a longer period. With respect to the dentists involved, it should be noted that Dentist 3 (in Study I) had been replaced by Dentist B (in Study II).[6]

Obviously, the type of restoration determines the time spent on preparing the cavity; it takes more time to inspect and, if necessary, correct two boxes (i.e. three-surface restoration) instead of one (i.e. two surface restoration). The influence of this factor, and the 'type of tooth', on the duration of the treatment is comparable to the effects observed in Study I. The presence of an amalgam restoration at the time of treatment did not influence the working time, in contrast to the results of Study 1.[6] This may be caused by the inlay-cavity form required; the difficulty of making slightly conical enamel walls may be of more influence than the relative ease of preparation, due to the presence of a grey amalgam restoration.

The treatment times required for indirect Class II resin composite inlays in this study show a reasonable agreement with the clinical working times for direct resin composite inlays recorded by Plasmans *et al* (mean 60 minutes).[5] Plasmans used no rubber dam. He included onlays in the study, however, which extends the treatment times recorded. The overall geometric means of Study I and Study II are 41.0 and 58.9 minutes respectively, with their 90 percent ranges of 26.5 and 42.3 minutes (Table 4). Due to the differences in restorative technique, it is difficult, however, to make a detailed comparison. As regards the so-called 'combination variable', a three-surface restoration in a molar in Study I (direct technique) takes roughly the same time as a two-surface restoration in a premolar in Study II (indirect technique), with comparable ranges. The wide 90 percent intervals, especially with three-surface restorations in molars in Study ll (Table 6), may be due to working conditions. For instance, when the visibility is poor, this affects all stages in the restorative procedure. Thus problems can accumulate and outliers are the result. This is more likely to occur, if the tooth is located to the end of the dental arch. Moreover, these intervals include 'easy' teeth restored by the fastest dentist and 'difficult' ones restored by the slowest.

Although no in-depth analyses are possible at this stage, some indication of the cost of the restorative product can be made on the basis of the time needed to perform the operation. For practice-building purposes, calculations with arithmetic means are useful. Thus restoring teeth with Class II resin composite inlays takes considerably more time than placing direct resin composite restorations (on average 60.3 minutes versus 41.8 minutes). Disregarding the cost of the dental laboratory, the dentist's cost for the placement of indirect resin-composite inlays, based on the working time involved, is roughly 145 percent of that for direct resin composite restorations.

**REFERENCES**

1. Hendriks, F.H.J.: Letzel, H.; Vrijhoef, M.M.A.: Cost benefit analysis of direct posterior restorations. Community Dent Oral Epidemiol, 13:256-259, October 1985.
2. Advokaat, J.G.A.: Amalgaamrestauraties nader bekeken/Closer look at amalgam restorations. Specieel deel: Het restauratieve proces. Amsterdam: Free University, thesis, 1985.
3. Plasmans, P.J.J.M. and Van 't Hof, M.A.: Treatment time analysis for extensive amalgam restorations. Community Dent Oral Epidemiol, 15:192-196, August 1987.
4. Verzijden, C.W.G.J.M.; Creugers, N.H.J.; Van 't Hof, M.A.: Treatment times for posterior resin-bonded bridges. Community Dent Oral Epidemiol, 18:304-308, December 1990.
5. Plasmans, P.J.J.M.; Van 't Hof, M.A.; Creugers, N.H.J.: Fabrication times for indirect composite resin restorations. J Dent, 20:27-32, February 1992.
6. Kreulen, C.M.; Van Amerongen, W.E.; Akerboom, H.B.M. *et al*: Evaluation of treatment times for Class II composite resin restorations. J Dent Child, 58:372-377, September-October 1991.
7. Kreulen, C.M.; Van Amerongen, W.E.; Akerboom, H.B.M. *et al*: A clinical study on direct and indirect Class II posterior composite resin restorations: Design of the investigation. J Dent Child, 58:281-288, July-August 1991.

# Mandibular movements and their relationship to age and body height in children with or without clinical signs of craniomandibular dysfunction: Part IV. A comparative study

**Apostole P. Vanderas, DDS, JD, MPH, MDS**

The limitations of mandibular movements have been considered as one of the definitional symptoms of craniomandibular dysfunction (CMD).[1] In epidemiologic studies, the lower limits of mandibular movements have been used as rigid standards and the inability of the patient to reach these standards constituted a dysfunctional movement. The values of the mandibular movements, however, can be above the standards applied in epidemiologic studies, although the ability to open the mouth and move the mandible to the right, left, and forward may be reduced due to CMD.[2] Also, it has been reported that age and body height are correlated with the mandibular movements in subjects without clinical signs of CMD.[3,4] There is no study on children to investigate for differences in the values of mandibular movements and their relationship to age and body height in subjects with and without clinical signs of CMD.

The purpose of this study was twofold: first, to compare the values of the mandibular movements between children with and without clinical signs of CMD and second, to examine the relationship between mandibular movements and age and body height.

## MATERIALS AND METHODS

The sample consisted of 355 white children, six to ten years old. The subjects were classified by the parents into a "calm" group (N = 250) and a "not-calm" group (N = 105) according to the emotional state of the children based on recent life events[5,6] Since no statistically significant differences on the mean values of the mandibular movements and body height were found between the subjects with and those without clinical signs of CMD within each group and between them, the patients were treated in this study as one group. Fourteen children were excluded from the statistical analysis of the lateral movements and protrusion, because the maxillary and/or the mandibular central incisor were not in the mouth to be used as landmarks for the measurements of these movements. Thirty children were reexamined within three months from the first examination and an intra-individual reliability test was conducted.

The children were examined clinically for signs of dysfunction of the masticatory system. The recorded clinical signs were temporomandibular joint (TMJ) sounds (clicking and crepitation), TMJ tenderness, and muscle tenderness. The clinical examination and the selection and classification of the subjects were described in detail previously[6,7] The mandibular movements were measured in the following manner:

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Dr. Vanderas is currently in the private practice of pediatric dentistry in Athens, Greece.

I would like to thank my committee members, Dr. R. Rapp, Dr. T. Zullo, Dr. M. Elliot, Dr. Y. Ismail, Dr. R. Mundell of the University of Pittsburgh, and Dr. R. Sears of Georgetown University, for their advice, guidance, and constructive comments during the course of this research.

- ☐ Maximal opening was determined by measuring the distance from the tip of the interdental papilla of maxillary central incisors to the tip of the interdental papilla of the mandibular central incisors with a Boley gauge[4]
- ☐ Maximal lateral movement was measured to the right and left with the aid of pencil markings on the labial surfaces of maxillary and mandibular incisors and a Boley gauge.
- ☐ Maximal protrusion was determined by measuring the distance between labial surfaces of maxillary and mandibular central incisors plus the overjet.

All measurements were performed twice and the highest value was recorded. All values were rounded to the nearest millimeter or half millimeter. Body height values were rounded to the nearest inch or half inch. Inches were transformed to centimeters to achieve consistency of the values of the measurements.

## STATISTICAL METHODS

The analysis of variance was used to test for differences in the mandibular movements between subjects with and without clinical signs and by age. The correlations and inter-correlations between body height and mandibular movements as well as differences and correlations related to mandibular movements between the first and second examination were tested by the 2-tail Student's t-test. The 95 percent probability level was used.

## RESULTS

### Mandibular movements

Table 1 shows the mean values of mandibular movements between subjects with and without clinical signs,

Table 1 ☐ Mean values of mandibular movements between subjects with (N = 204) and without (N = 137) clinical signs.

| Groups | Maximal mouth opening mm | Lateral movements R mm | Lateral movements L mm | Mandibular protrusion mm |
|---|---|---|---|---|
| Subjects with clinical signs | 55.07 | 9.21 | 9.03 | 9.28 |
| Subjects w/out clinical signs | 54.84 | 9.36 | 9.16 | 9.08 |

Table 2 ☐ Mean values of mandibular movements in males and females with (N = 204) and without (N = 137) clinical signs.

| Groups | Maximal mouth opening M mm | Maximal mouth opening F mm | Lateral movements R M mm | Lateral movements R F mm | Lateral movements L M mm | Lateral movements L F mm | Mandibular protrusion M mm | Mandibular protrusion F mm |
|---|---|---|---|---|---|---|---|---|
| Subjects with clinical signs | 54.81 | 54.87 | 9.48 | 8.96 | 9.31 | 8.77 | 9.22 | 8.95 |
| Subjects w/out clinical signs | 54.63 | 55.43 | 9.39 | 9.34 | 9.24 | 9.10 | 9.35 | 9.22 |

while Table 2, reveals the mean values of the movements between males and females. There were no statistically significant differences in any of the mandibular movements between those with and without clinical signs of between males and females. Table 3 shows the mean values of mandibular movements in children with and without clinical signs by age. The analysis of variance showed highly significant differences in all mandibular movements by age at $p = 0.001$.

### Body height

The mean value of the body height of the patients was 131.72 cm for the entire group. The corresponding val-

No statistically significant sex difference was found in the entire group.

Table 3 ☐ Mean values of mandibular movements between subjects with and without clinical signs by age.

| Groups | Age | Maximal mouth opening mm | Lateral movements R mm | Lateral movements L mm | Mandibular protrusion mm |
|---|---|---|---|---|---|
| Subjects with clinical signs | 6 | 50.3 | 8.72 | 8.62 | 8.84 |
| | 7 | 53.6 | 8.97 | 8.97 | 8.90 |
| | 8 | 56.0 | 9.34 | 9.34 | 9.33 |
| | 9 | 57.0 | 9.46 | 9.13 | 8.85 |
| | 10 | 57.0 | 9.56 | 9.02 | 9.48 |
| Subjects w/out clinical signs | 6 | 51.1 | 8.75 | 8.50 | 8.85 |
| | 7 | 54.7 | 8.95 | 8.63 | 8.91 |
| | 8 | 54.9 | 9.38 | 9.15 | 8.90 |
| | 9 | 55.8 | 9.83 | 9.66 | 9.80 |
| | 10 | 58.4 | 9.80 | 9.77 | 9.89 |

Table 4 ☐ Correlations and intercorrelations between body height and mandibular movements in the entire group (N = 341).

| Variables | Height | Maximal mouth opening | Maximal lateral movements Right | Maximal lateral movements Left | Mandibular protrusion |
|---|---|---|---|---|---|
| Height | 1.00 | 0.45 | 0.36 | 0.32 | 0.22 |
| Maximal mouth opening | 0.45 | 1.00 | 0.32 | 0.26 | 0.28 |
| Maximal lateral movements | | | | | |
| Right | 0.36 | 0.32 | 1.00 | 0.79 | 0.58 |
| Left | 0.32 | 0.26 | 0.79 | 1.00 | 0.57 |
| Mandibular protrusion | 0.22 | 0.28 | 0.58 | 0.58 | 1.00 |

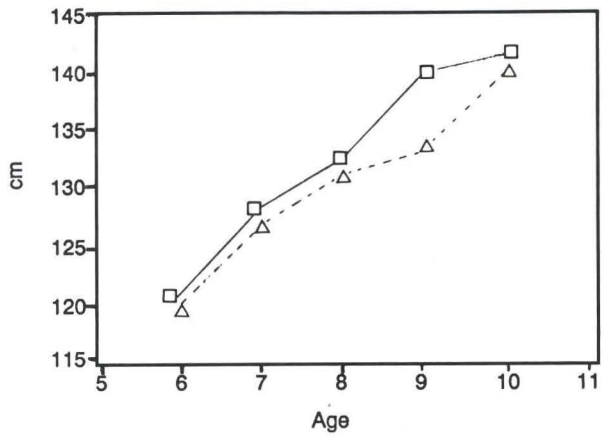


*Figure. Mean body height by age and sex.*

ues for males and females were 132.9 cm and 130.5 cm, respectively. No statistically significant sex difference was found in the entire group. Figure 1 reveals the mean values of body height by age and sex.

The analysis of variance showed highly significant differences of the body height by age at $p < 0.001$, while statistically significant sex differences were found only at age nine years, when males were taller than females. In none of the subjects was the height below the 5th percentile, while the height of 13 males, nine years old, was above the 95th percentile. A 2-tail Student's t-test revealed significant correlations at $p = 0.001$ between body height and mandibular movements for the entire group (Table 4). For both males and females the correlations were strongly positive (Tables 5 and 6).

## Intra-individual reliability test

The Student's t-test revealed that the correlation between the first and the second examinations ranged from 0.998 to 0.985 with respect to the mandibular

Table 5 ☐ Correlations and intercorrelations between body height and mandibular movements in females (N = 181).

| Variables | Height | Maximal mouth opening | Maximal lateral movements Right | Maximal lateral movements Left | Mandibular protrusion |
|---|---|---|---|---|---|
| Height | 1.00 | 0.56 | 0.32 | 0.30 | 0.18 |
| Maximal mouth opening | 0.56 | 1.00 | 0.40 | 0.38 | 0.27 |
| Maximal lateral movements | | | | | |
| Right | 0.32 | 0.40 | 1.00 | 0.76 | 0.57 |
| Left | 0.30 | 0.38 | 0.76 | 1.00 | 0.54 |
| Mandibular protrusion | 0.18 | 0.27 | 0.57 | 0.54 | 1.00 |

Table 6 ☐ Correlations and intercorrelations between body height and mandibular movements in males (N = 160).

| Variables | Height | Maximal mouth opening | Maximal lateral movements Right | Maximal lateral movements Left | Mandibular protrusion |
|---|---|---|---|---|---|
| Height | 1.00 | 0.38 | 0.38 | 0.33 | 0.24 |
| Maximal mouth opening | 0.38 | 1.00 | 0.26 | 0.18 | 0.29 |
| Maximal lateral movements | | | | | |
| Right | 0.38 | 0.26 | 1.00 | 0.81 | 0.59 |
| Left | 0.33 | 0.18 | 0.81 | 1.00 | 0.61 |
| Mandibular protrusion | 0.24 | 0.29 | 0.59 | 0.61 | 1.00 |

If movements are unrestricted, the comfortable and maximal movements are the same.

movements. A statistically small but not clinically significant difference in maximal mouth opening was found at $p = 0.05$ between the first and the second examination. The mean value of maximal mouth opening was 52.975 mm in the first examination, while in the second examination, it was 53.150 mm.

## DISCUSSION

Dysfunctional movements of the mandible are caused by either extracapsular or intracapsular sources. The former include generally the muscles while the latter are usually associated with the disc-condyle function and the surrounding ligaments.[7] The dysfunctional movements, therefore, must be associated with clinical signs of CMD. To date, epidemiologic studies related to CMD in children have focused on the limited mandibular movements defined as rigid standards, irrespective of whether the limitations of the movements are dysfunctional.

In this study, a comparison of the values of the mandibular movements between subjects with and without clinical signs did not reveal any statistically significant differences. These findings show that the clinically detected signs related to CMD did not affect the mandibular movements of this group, which can be explained by the fact that the severity of these signs was mild. Since, however, on an individual basis, reduction of the mandibular movements in children with CMD might take place, it is advisable, in recording dysfunctional movements, to measure the comfortable movement that is not associated with pain and the maximal movement that may be associated with pain. If the movements are not restricted by the signs of CMD, the comfortable and maximal movements are the same. On the contrary, any difference between comfortable and maximal movement should be considered as dysfunctional. In addition, the patient should be considered whether the movements are felt to be reduced.

In the present study, age was significantly correlated with all mandibular movements. The correlation was equally significant for both series. This finding is in agreement with the results of previous studies.[3,4] Body height was also strongly correlated with the mandibular movements. Landtwing (1978) found strong correlation between body height and maximal mouth opening in children and adolescents without CMD, while Agerberg (1974) reported almost significant correlation in six-year-old children.[3,4]

It has been reported that limited mandibular movements may be dysfunctional, while dysfunctional movements may not be limited.[5] In addition, this study showed that it is not possible to fix minimal values of the mandibular movements for all patients, since age and body height have a considerable influence upon these values. It is suggested, therefore, that future epidemiologic studies measure the dysfunctional mandibular movements instead of the limited movements.

### REFERENCES

1. Vanderas, A.P.: Prevalence of craniomandibular dysfunction in children and adolescents: a review. Pediatr Dent, 9:312-316, December 1987.
2. Hanson, T. and Nilner, M.: A study of the occurrence of symptoms of diseases of the temporomandibular joint, masticatory musculature, and related structures. J Oral Rehab, 2:313-324, 1975.
3. Agereberg, G.: Maximal mandibular movements in children. Acta Odont Scand, 32:147-159, 1974.
4. Landtwing, K.: Evaluation of the normal range of vertical mandibular opening in children and adolescents with special reference to age and stature. J Maxillofac Surg, 6:157-162, 1978.
5. Vanderas, A.P.: Part I: Calm group. Prevalence of craniomandibular dysfunction in white children with different emotional states. J Dent Child, 55:441-448, November-December 1988.
6. Vanderas, A.P.: Prevalence of craniomandibular dysfunction in white children with different emotional states. Part II. Not calm group. J Dent Child, 56:348-352, September-October 1988.
7. Okeson, P.J.: Signs and symptoms of temporomandibular disorders. In *Fundamentals of Occlusion and Temporomandibular Disorders.* St. Louis: The C.V. Mosby Co., 1985, pp 164-237.

# Craniomandibular dysfunction in children: Part V. Correspondence between signs and symptoms

**Apostole P. Vanderas, DDS, JD, MPH, MDS**

A number of studies have reported statistically significant correlations between clinical signs and subjective symptoms of craniomandibular dysfunction (CMD).[1-5] The subjective symptoms were recorded by an interview or a questionnaire, while the clinical signs were determined by a clinical examination.[1-5] Recently the clinical validity of the relationship between subjective symptoms and clinical signs has been questioned.[6]

In this study an attempt was made to investigate the correspondence between subjective symptoms and clinical signs of CMD in children.

## MATERIALS AND METHODS

Three hundred fifty five white children six to ten years of age were examined clinically and interviewed by the same investigator for clinical signs and subjective symptoms of CMD. The subjects were classified by the parents according to their emotional states based on unpleasant life events in two groups: the "calm" (N = 250) and the "not calm" groups (N = 105).[4] Twenty children were randomly reexamined and reinterviewed within three months from the first examination and an intra-individual reliability test was made.

The interview was designed to gain information about headaches occurring once a week or more, difficulties in opening the mouth wide, pain in temple region, pain when opening the mouth wide or chewing, and temporomandibular joint (TMJ) sounds. All questions were answered "yes", "no", or "do not know" and addressed to the subjects in the following manner:

1. Do you get headaches?
2. Does it bother you to open your mouth wide?
3. Does it hurt you in the temple region?
(The temple region was shown).
4. Does it hurt you to open your mouth wide or when chewing?
5. Does your jaw make a popping or clicking noise?

Recorded clinical signs of CMD were limitations of mandibular movements, TMJ sounds, muscle and TMJ pain/tenderness. The interview and the clinical examination related to the function of the masticatory system as well as the selection and the classification of the subjects into groups were explained in detail in Part I and II of the study.[4,5]

## STATISTICAL METHODS

The chi-square test was applied to test the relationship between subjective symptoms and clinical signs of CMD. Sensitivity, specificity, false-positive and false-negative rates were computed to measure the correspondence of each subjective symptom (screening criterion) to a clinical sign (validation criterion). The following formulae were used:

$$\text{Sensitivity} = d/(b+d) \times 100$$
$$\text{Specificity} = a/(a+c) \times 100$$
$$\text{False-positive rate} = c/(c+d) \times 100$$

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This study is based on a thesis conducted at the University of Pittsburgh, School of Dental Medicine, Department of Pediatric Dentistry.

Dr. Vanderas is currently in the private practice of pediatric dentistry in Athens, Greece.

False-negative rate = b/(a+b) x 100
where a, b, c, and d were defined as follows:
a: no signs or symptoms;
b: signs only;
c: symptoms only; and
d: both signs and symptoms.

The same formulae were used by Riolo *et al.*[6] The intraindividual agreement for the clinical examination and the interview was calculated in percentages.

## RESULTS

Table 1 shows the number of children with and without each clinical sign and symptom of CMD, while Table 2 reveals the values of sensitivity, specificity, false-positive, and false-negative rates, as well as the p-values of the correlations between each subjective symptom and clinical sign. The values of sensitivity and false-positive rates were low, while the values of specificity were high. The false-negative rates were relatively high. The intra-individual reliability test showed that the percentage of agreement between the first and second examination was 90 for the clinical examination and 95 for the interview.

## DISCUSSION

There are several advantages in obtaining information on the prevalence of a disease from a population by an interview. The two major problems associated with this information, however, are inaccuracy and variability.[7] To control the uncertainty of the information collected by an interview, the clinical epidemiology suggests the application of two tests. The first deals with the evaluation of the accuracy or validity and, the second one with the variability or reproducibility. The indices used to assess the accuracy of a test are sensitivity, specificity, false-positive and false-negative rates, while the reproducibility is evaluated by the intra-and inter-individual tests.

Ideally, the values of sensitivity and specificity must be 100, to indicate a perfect correspondence between the tested variables, while the false-positive and false-negative rates must be zero. It must be very difficult, however, to get the values of a perfect screening test in biological data. In this study, the values of specificity and false-positive rates conform to the expected values of the test, while the values of sensitivity and false-negative rates seem to be low and relatively high respectively. Low sensitivity shows that, of the number of children with clinical signs, a small number of them reported subjective symptoms, while a relatively high false-negative rate reveals that of the number of subjects who did not report symptoms, a relatively high

Table 1 ☐ Number of children with and without each clinical sign and symptom of craniomandibular dysfunction in the calm (N = 250) and not-calm (N = 105) groups.

| | Calm group (N = 250) | | Not-calm group (N = 105) | |
|---|---|---|---|---|
| | Number with | Number without | Number with | Number without |
| Clinical signs | | | | |
| TMJ sounds | 36 | 214 | 13 | 92 |
| Muscle tenderness | 117 | 133 | 71 | 24 |
| TMJ tenderness | 18 | 232 | 20 | 85 |
| Symptoms | | | | |
| Difficulties in opening wide | 30 | 220 | 15 | 90 |
| Pain in temple region | 18 | 232 | 6 | 99 |
| Pain on movements | 55 | 195 | 13 | 92 |
| Reported sounds | 16 | 234 | 9 | 96 |
| Headaches | 27 | 233 | 12 | 93 |

Table 2 ☐ Sensitivity, specificity, false-positive and false-negative rates for each subjective symptom and clinical sign.

| Correspondence | | "Calm" group (N = 250) | | | | |
|---|---|---|---|---|---|---|
| Subjective | Clinical | Sens. | Spec. | FP | FN | p-value |
| Difficulties in opening wide | Muscle/TMJ tenderness | 23 | 97 | 10 | 40 | .0001 |
| Pain in temple region | Muscle/TMJ tenderness | 12 | 97 | 16 | 42 | .002 |
| Pain on movement | Muscle/TMJ tenderness | 41 | 94 | 12 | 43 | .0001 |
| Headaches | Muscle/TMJ tenderness | 14 | 91 | 39 | 45 | NS |
| Reported sounds | Muscle/TMJ tenderness | 12 | 98 | 12 | 43 | .001 |
| Headaches | Clinically detected sounds | 19 | 90 | 75 | 13 | NS |
| Reported sounds | Clinically detected sounds | 36 | 98 | 18 | 9 | .001 |
| Correspondence | | "Not-Calm" group (N = 105) | | | | |
| Subjective | Clinical | Sens. | Spec. | FP | FN | p-value |
| Difficulties in opening wide | Muscle/TMJ tenderness | 19 | 97 | 6 | 63 | .04 |
| Pain in temple region | Muscle/TMJ tenderness | 10 | 94 | 28 | 18 | NS |
| Pain on movement | Muscle/TMJ tenderness | 25 | 88 | 14 | 60 | NS |
| Headaches | Muscle/TMJ tenderness | 12 | 91 | 25 | 66 | NS |
| Reported sounds | Muscle/TMJ tenderness | 8 | 94 | 25 | 67 | NS |
| Headaches | Clinically detected sounds | 46 | 97 | 25 | 7 | NS |
| Reported sounds | Clinically detected sounds | 50 | 98 | 12 | 7 | .0001 |

Sens. = sensitivity, Spec. = specificity, FP = false-positive, FN = false-negative.
p-value = it shows the level of significance of correlations between the corresponding subjective symptoms and clinical signs.
NS = not significant.

number of individuals had clinical signs.

To interpret these results, the spectrum of CMD defined as the sequence of events that occurs in the different parts of the masticatory system, from the time of exposure to the etiologic agent(s) to severe dysfunction, must be taken into consideration. This spectrum, as in other diseases, is composed of two phases, the subclinical one and the clinical illness. During the subclinical phase, incipient pathologic changes like microtraumatic lesions of the connective tissue of the muscles, tendons, and joints and/or accumulation of cellular waste by-products take place.[8,9] These changes manifest themselves by the subclinical signs found during the clinical examination without causing yet subjective symptoms. The introduction of a patient from the subclinical phase to the clinical illness is associated with subjective symptoms and depends on the nature of the etiologic agent (frequency, intensity) and the adaptability of the masticatory system.

In general, the purpose of an epidemiologic study is to identify not only individuals in need of treatment but also individuals with subclinical signs.[10] Since the subclinical signs are manifested before the subjective symptoms, it is not surprising that more children had clinical signs than subjective symptoms, as indicated by the low sensitivity and relatively high false-negative rate. Also, the intra-individual test showed high degree of agreement for both the interview and clinical examination, which reduces the variability of the information and strengthens the results of this study.

In contrast, the results reported by Riolo *et al* showed a high false-positive rate, which reveals that, of the number of children who reported subjective symptoms, a high number of them did not display a clinical sign.[6] In other words, the subjects of their study overreported symptoms, although the major disadvantage of an interview survey is underreporting. As a result of the low values of sensitivity and high false-positive rates, Riolo *et al* questioned the validity of the relationships between subjective symptoms and clinical signs. No intra- and inter-individual tests to show the reproducibility of the information obtained by the interview were reported, however, although the subjects were interviewed by three teams.

The results of this study are in agreement with the biological process of the development of CMD as described above and they are based on a low variability as measured by the intra-individual test. In addition, the values of the indices used in the present study to test the validity of the relationship between clinical signs and subjective symptoms are consistent in both groups (Table 2). The high false-positive rate found in the relationship between headaches and clinically detected sounds in the calm group might not be meaningful since the clinical experience shows that headaches are not usually associated with TMJ sounds. Also, the higher values of false-negative rates in some relationships of the not-calm group reveals that the frequency of these clinical signs is higher in the not-calm group than that in the calm group.

As a conclusion, it is suggested that the biological process of the development of CMD as well as the low variability of the tested information should be taken into consideration in evaluating the validity of the statistically significant correlations between clinical signs and subjective symptoms.

**REFERENCES**

1. Brandt, D.: Temporomandibular disorders and their association with morphologic malocclusion in children. In: *Developmental aspects of TMJ disorders*, D.S. Carlson; J.A. McNamara, Jr.; and K.A. Ribbens, Eds., Monograph 16, Ann Arbor, 1985, pp 279-288.

Ideally, the values of sensitivity and specificity must be 100, for a perfect correspondence between the tested variables.

2. Magnusson, T.; Egermark-Eriksson, I.; and Carlsson, G.E.: Four-year longitudinal study of mandibular dysfunction in children. Community Dent Oral Epidemiol, 13:117-120, 1985.
3. Nilner, M.: Functional disturbances and diseases of the stomatognathic system: A cross-sectional study. J Pedod, 10:211-238, Spring 1986.
4. Vanderas, A.P.: Prevalence of craniomandibular dysfunction in white children with different emotional states. Part I. Calm group. J Dent Child, 55:441-448, November-December 1988.
5. Vanderas, A.P.: Prevalence of craniomandibular dysfunction in white children with different emotional states. Part II. Not calm group. J Dent Child, 56:348-352, September-October 1989.
6. Riolo, M.L.; Tenttave, T.R.; and Brandt, D.: Clinical validity of the relationship between TMJ signs and symptoms in children and youth. J Dent Child, 55:110-113, March-April 1989.
7. Lilienfeld, A.M. and Lilienfeld, D.E.: *Foundations of epidemiology*. 2nd ed, New York: Oxford University Press, 1980.
8. Awad, E.A.: Interstitial myofibrositis: hypothesis of the mechanism. Arch Phys Rehabil, 54:449-453, 1973.
9. Christensen, L.V.; Mohamed, S.E.; and Harrison, J.D.: Delayed onset of masseter muscle pain in experimental tooth clenching. J Prosth Dent, 48:579-584, 1982.
10. Vanderas, A.P.: Prevalence of temporomandibular dysfunction in white children six to ten years of age in a dental school population: A cross-sectional study. Thesis, University of Pittsburgh, 1987.

## PEDIATRIC POISONING HAZARDS

Over the past several decades, a heartening decline in the number of pediatric poisoning deaths has occurred. This decline can be attributed to child-resistant closures, product reformulations, heightened parental awareness and vigilance, and more sophisticated intervention by poison centers and health professionals when a poisoning actually occurs. Despite these measures, AAPCC data demonstrate that several products continue to cause pediatric poisoning fatalities. Current prevention efforts need to be redirected toward these products. Remarkably, though much recent popular and legislative attention has focused on a possible role of aversive agents in the prevention of poisonings, few of the most serious hazards listed herein are amenable to the addition of such agents. Instead, many of these products are either pharmaceuticals, already inherently noxious, or strongly acidic or alkaline in composition.

Iron supplements emerge as the single most frequent cause of pediatric unintentional ingestion fatalities. Iron supplements, either as iron tablets or as a component of prenatal vitamins, were responsible for 16 pediatric fatalities over the 8-year period and 30.2 percent of reported pediatric pharmaceutical unintentional ingestion fatalities. 1991 AAPCC data, accumulated after completion of this study, reveal 11 additional pediatric iron poisoning fatalities, more than twice the number reported in 1990. This high fatality rate is likely the result of multiple factors, including the ready availability of prenatal vitamin and iron supplements in homes with very young children, the similar appearance of many brightly colored iron tablets to popular candies, and the unrestricted, over-the-counter marketing of high-strength iron, a phenomenon which undoubtedly increases home availability of iron. Elimination of the iron hazard will likely require a multifaceted approach of parental education, regulatory restriction of iron to prescription status, repackaging and reformulation of iron supplements, and conspicuous labeling which clearly warns of the pediatric unintentional ingestion hazard. Simultaneously, additional resources should be directed toward the identification, testing, and marketing of improved antidotes. The toxicity of the currently available deferoxamine antidote limits its administration in adequate doses to children who have ingested massive doses of iron.

Litovitz, T., M.D. *et al*: Comparison of pediatric poisoning hazards: An analysis of 3.8 million exposure incidents.
Pediatrics, 89:999–1006, June, 1992.

# The prediction of eruption-sequence from panoramic radiographs

**K.K.K. Lew, BDS, MDS, AM**

The value of panoramic radiographs in the diagnosis of dental problems, as well as of mandibular and maxillary bony morbidity, is well recognized.[1-6] Their accuracy in determining mandibular morphological dysplasias, especially in the vertical dimension, has also been demonstrated.[7-8] One of the principle advantages of panoramic radiography lies in its relatively low patient radiation dosage. White and Rose reported that the average patient radiation dose to the bone marrow from a panoramic radiograph is approximately equivalent to that of four bite-wings.[9] The relative convenience, ease and speed with which a broad anatomical region can be imaged has also led to its wide usage in clinical practice.[6]

In their study of 874 healthy Caucasian children, Gron showed that in 70-80 percent of subjects at the time of clinical emergence of the teeth, three fourths of root length had been achieved.[10] He also showed that tooth-emergence appeared to be more closely associated with the stage of root formation than with the chronological or skeletal age of the child. Moyers found that different teeth had dissimilar magnitudes of root formation at the time of alveolar crestal penetrance.[11] For the canine, approximately 70 percent of the root was developed at the time of alveolar crestal emergence. He also found that premolars, first molars and second molars had 50 percent, 35-40 percent, and 25-30 percent, respectively, of their roots developed at the time of alveolar crestal penetrance.

Fanning found that the mean interval for root formation from a quarter root-length to half root-length was 2.0 years and 1.7 years for canine and premolar teeth, respectively. The corresponding time for half root-length to three-quarter root-lengths in canines, first premolars and second premolars was 1.3 years for all these teeth.

The purpose of this study was to test the validity of predicting the eruption-sequence of permanent teeth from orthopantomograms taken during the early mixed dentition, based on criteria of root formation from various studies.[10-13]

## MATERIALS AND METHODS

The sample was composed of ninety-two healthy female children (ages 7-9 years at the time of initial consultation) who presented for treatment at the National University Hospital. Selection of subjects for the study was based on the following criteria:

- ☐ They were in the mixed dentition phase with permanent canines, premolars, and second molars unerupted.
- ☐ They had no contributory medical or dental history.
- ☐ An attempt was made to avoid inclusion of children with factors that might influence the eruption of permanent succedaneous teeth (e.g. loss

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Dr. Lew is Senior Lecturer, Department of Preventive Dentistry, Faculty of Dentistry, National University of Singapore.

of primary teeth, pulpitis, severe periodontal problems, severe lack of space).

The teeth that were erupted intraorally were noted at the time of initial examination. Orthopantomograms were taken with the Siemens Orthoceph 10 machine, using 18cm x 24cm Fuji RXO-G films at an exposure time of two seconds at 12mA And 77Kv.

Care was taken to ensure that the patient's head was aligned using the forehead positioner and lateral head holders. Using the vertical light line built into the machine as a guide, proper positioning of the midsagittal plane of the patient's head to the midline was obtained.[14] Before the radiographs were taken, demonstration of the machine by cycling was conducted and the need for patients to remain still during the procedure emphasized.

All earrings, necklaces, hairpins and any metallic objects in the head and neck region were removed. Proper patient positioning and the use of a notched positioning device for the maxillary and mandibular incisors (bite block) ensured that the dental arches were located in the middle of the focal trough. The patient's occlusal plane was positioned so that the Frankfort Horizontal Mandibular plane was almost parallel to the floor. Molar crowns were compared bilaterally in both the mesiodistal and occlusogingival measurements. If one tooth was more than 20 percent wider than the other tooth, the radiographs were assumed to be distorted and retaken. These patients were subsequently recalled at three- to four-month intervals, to check clinically for the emergence time of the unerupted teeth. Tooth-emergence was defined as the time when the tooth just pierced the gingiva, but no more than 3mm above the gingival level, estimated from cuspal tip or incisal margin.[10]

As fourteen patients were lost during the longitudinal study to verify the eruption-sequence, the final sample was composed of seventy-eight subjects. Orthopantomograms taken at the initial examination were studied and the eruption-sequence in both arches determined, using criteria based on the extent of root formation at time of emergence, and the average time for developmental quarter stages of root-length.[11,12] Should the root-lengths indicate that the teeth may erupt almost concurrently, then the distance of unerupted crypts to alveolar bone level was used to assess which tooth would erupt first. The closer the unerupted crypt appeared to alveolar margin as measured off a millimeter rule, the sooner it was assumed to erupt. The percentage root formation of each unerupted tooth from the initial orthopantomogram was evaluated and the predicted eruption-sequences for the unerupted teeth in each of the four quadrants were determined. Nondental assessors, briefed in the criteria of evaluation, were used to compute the eruption-sequence, to eliminate bias arising from known eruption-sequences.

The eruption-sequence in each quadrant based on the initial orthopantomogram and the actual emergence sequence in each quadrant were compared for each patient. Intraexaminer and interexaminer variability were determined by recomputing the eruption-sequences in twenty randomly selected orthopantomograms.

**The predicted eruption sequence was 95.8 percent accurate.**

Table 1 ☐ Actual eruption sequence matching predicted sequence in each quadrant.

| | Upper Left | Upper Right | Lower Left | Lower Right | Total |
|---|---|---|---|---|---|
| Actual sequence matching predicted sequence | 72 | 74 | 76 | 77 | 299 |
| Number | 78 | 78 | 78 | 78 | 312 |
| Percentage | 92.3% | 94.9% | 97.4% | 98.7% | 95.8% |

## RESULTS

The results (Table 1) showed that the predicted eruption-sequence was 95.8 percent accurate. The eruption-sequence in the lower right quadrant was more predictable than the lower left quadrant, which, in turn was more predictable than the upper right and upper left quadrants. Using the student's 't' test, the eruption-sequence in the upper arch was statistically more predictable than that in the lower arch ($p<0.01$). The

accuracy in prediction of eruption-sequence between the maxillary right and maxillary left quadrants as well as the mandibular right and mandibular left quadrants, however, were not statistically different. Both the intra- and interexaminer variability were small, being 0.8 percent and 1.2 percent, respectively.

## DISCUSSION

It was important to exclude periapical lesions, pulpitis, endodontically treated primary teeth or early loss of primary teeth, as these factors are known to alter eruption of the succedaneous teeth.[15] To a lesser degree, crowding and traumatized primary teeth also affect the eruption of the permanent teeth.[11,16] Owing to the variation among individuals in the amount of root formation at the time of the clinical emergence of the teeth, several authors have stated that it may not be possible to predict the exact time of emergence solely from root-lengths.[12,13] By incorporating root-formation data and crypt distances to alveolar emergence, the eruption-sequence based on cross-sectional orthopantomograms appears, however, to correlate well with the sequence of tooth eruption observed clinically.

Gratt studied the image magnification of objects placed at varied positions in the focal trough.[6] He found that vertical dimensions, in contrast to horizontal dimensions, were not significantly altered by positional variations. Variation in root-lengths due to image distortion are not as critical, therefore, as in root-widths. This could at least partly explain the accuracy in the prediction of the eruption-sequence in the present study.

The greater accuracy in the prediction of eruption-sequence in the mandibular arch as compared to the maxillary arch could be due to closeness of emergence times between the maxillary canine and maxillary second premolar, coupled with the fact that accurate estimation of percentage root formation is difficult in dissimilar tooth types (i.e. canines and premolars). A large proportion (77 percent) of inaccuracies were in the prediction of maxillary canine-second premolar sequence (Table 2).

The value in predicting tooth-emergence-sequence from cross-sectional material like orthopantomograms may be useful in elucidating diagnostic aspects pertaining to the indication and timing of serial extraction. The favorable eruption-sequence favoring self-alignment in a serial extraction program would be canine, first premolar, second premolar followed by second molar.[17] This sequence can be predicted with sufficient accuracy at an early age, with the use of an orthopantomogram.

The most common morphological characteristic of malocclusion is crowding, in either Caucasian or Mongoloid samples.[18-20] Certain eruption-sequences, like the emergence of the second molar ahead of the canines or premolars has a tendency to shorten arch-length.[21] Predicting the eruption-sequence at an early age would allow the clinician to initiate measures to preserve arch-length when indicated.

Table 2 □ Predicted eruption sequences compared to actual eruption sequence (3 = canine, 4 = 1st premolar, 5 = 2nd premolar, 7 = second molar)

| | Eruption Sequence | | Number of mispredicted sequence | Percentage of mispredicted sequence |
|---|---|---|---|---|
| | Predicted Sequence | Actual Sequence | | |
| Maxilla | 4357 | 4537 | 4 | 30.8% |
| | 4537 | 4357 | 6 | 46.2% |
| Mandible | 3457 | 4357 | 2 | 15.4% |
| | 4357 | 3457 | 1 | 7.6% |

Prediction of eruption-sequence is more accurate for the mandibular teeth than for the maxillary.

## CONCLUSION

The validity of using orthopantomograms in the prediction of eruption-sequences of the permanent canines, premolars and second molars was found to be 95.8 percent accurate. The prediction was statistically ($p<0.01$) more accurate for the mandibular arch than for the maxillary arch. Such prediction would be useful in cases of arch-length deficiencies.

Determining the eruption-sequence from orthopantomograms taken at a mixed dentition stage would simplify the process of determining eruption-sequences, as the eruption-sequences can be determined without tedious longitudinal, periodic clinical examinations. Comparative data of eruption-sequences between racial types can, therefore, be determined readily. Future studies in our department will focus on the eruption-sequences in various ethnic types in our multiracial population.

### REFERENCES

1. Updegrave, W.J.: The role of panoramic radiology in diagnosis. Oral Surg Oral Med Oral Pathol, 22:49-57, January 1966.
2. Thorpe, J.O.: Panoramic radiographic in general practice of dentistry. Oral Surg Oral Med Oral Pathol, 24:781-792, November 1966.
3. Graber, T.M.: Panoramic radiography in orthodontic diagnosis. Am J Orthod, 53:799-821, 1967.
4. Phillips, J.E.: Panoramic radiography. Dent Clin North Am, 1968, pp 561-570.
5. Lyon, H.E.: Reliability of panoramic radiography in the diagnosis of maxillary sinus pathosis. Oral Surg Oral Med Oral Pathol, 35:124-128, January 1974.
6. Gratt, B.M.: Panoramic radiograph. In: *Oral radiology—principles and interpretation* (ed. Goaz, P.W. and White, S.C.) pp 261-285. St. Louis: The C.V. Mosby Company, 1982.
7. Habets, L.L.M.H.; Benzur, J.N.; van Ooij, C.P. *et al*: The orthopantomogram, an aid in diagnosis of temporomandibular joint problems. I. The factor of vertical magnification. J Oral Rehab, 14:475-480, September 1987.
8. Larheim, T.A. and Svanaes, D.B.: Reproducibility of rotational panoramic radiography: Mandibular linear dimensions and angles. Am J Orthod Dentofac Orthod, 90:45-51, July 1986.
9. White, S.C. and Rose, T.C.: Absorbed bone marrow dose in certain radiographic techniques. J Am Dent Assoc, 98:555-558, April 1979.
10. Gron, A.M.: The prediction of tooth emergence. J Dent Res, 41:573-585, May-June 1962.
11. Moyers, R.E.: *Handbook of Orthodontics.* pp 111-117 and Chicago: Year Book Medical Publishers, Inc., 1988, pp 226-228.
12. Fanning, E.A.: The effect of extraction of deciduous molars on the formation and eruption of their permanent successors. Angle Orthod, 32:44-53, January 1962.
13. Moorrees, C.F.A.; Fanning, E.A.; Gron, A.: The consideration of dental development in serial extraction. Angle Orthod, 33:44-59, January 1963.
14. Manson-Hing, L.R.: *Fundamentals of dental radiography*, 2nd ed. Philadelphia: Lea & Febiger, 1985, pp 133-163.
15. Lauterstein, A.M.; Pruzansky, S.; and Barber, T.K.: Effects of deciduous mandibular molar pulpotomy on the eruption of succedaneous premolar. J Dent Res, 41:1367-1372, November-December 1962.
16. Bradley, R.E.: The relationship between eruption, calcification and crowding of certain mandibular teeth. Angle Orthod, 31:230-236, October 1961.
17. Dale, J.G.: Guidance of occlusion: serial extraction. In: *Orthodontics-current principles and techniques.* (Graber, T.M. and Swain, B.F.) St. Louis: The C.V. Mosby Company, 1985, pp 259-366.
18. Gardiner, J.H.: A survey of malocclusion and some aetiological factors in 1000 Sheffield schoolchildren. Dental Practitioner and Dental Record, 6:187-198, February 1956.
19. Foster, T.D. and Day, A.J.W.: A survey of malocclusion and the need for orthodontic treatment in a Shropshire school population. Brit J Orthod, 1:73-78, April 1974.
20. Johnson, J.S.; Soetamat, A.Z.; and Winoto, N.S.: A comparison of some features of the Indonesian occlusion with those of two other ethnic groups. Brit J Orthod, 5:1830188, October 1978.
21. Lo, R.T. and Moyers, R.E.: Studies in the etiology and prevention of malocclusion. I. The sequence of eruption of the permanent dentition. Am J Orthod, 39:460-467, June 1953.

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## BUCKET-RELATED DROWNINGS

Infants appear to be at particular risk of drowning in 5-gallon industrial buckets because of the large capacity and stability of this type of bucket. These containers are about 14 inches high, about half the height of the typical "top-heavy" toddler, with the rim just below the child's upright center of gravity. In addition, containers weigh more than most 8- to 12-month-old infants when filled with just a few gallons of liquid. Although this research provides no data dealing with survival after near-drowning episodes, bucket-related injuries may be particularly dangerous because of the toxic material that is often in the buckets at the time of injury.

Mann N. C. *et al*: Bucket-related drownings in the United States, 1984 through 1990.
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# Tooth eruption in failure-to-thrive infants

**S. Reilly, BAppSc**
**D. Wolke, PhD**
**D. Skuse, MRCP**

Former studies on the relationship between primary-tooth eruption, somatic growth, and nutritional status reported conflicting results. Longitudinal studies with infants whose growth factors are within the normal range showed some weak positive associations between infant height, weight and primary-tooth eruption.[1] Significant, but generally only moderate to weak associations between protein-calorie malnutrition and delayed tooth eruption were reported by studies in developing countries.[2] Investigations of the relationship between poor weight gain, nutritional status and primary-tooth eruption in affluent societies are rare. In a recent Israeli study no differences were found between primary-tooth eruption in infants with nonorganic-failure-to-thrive and Israeli standardization norms.[3] The investigation did not include a control group, however, and infants who suffered from nonorganic-failure-to-thrive varied greatly in age at the time of the assessment (six - thirty months of age).

The purpose of this study was to investigate whether any differences were to be found between the number of erupted teeth of infants who were failing to thrive and their matched controls. The reported study forms part of a prospective epidemiological investigation into social, psychological, and medical correlates of failure to thrive.[4]

## SUBJECTS AND METHODS

A prospective whole-population survey was conducted of all 2608 infants born in 1986, within an ethnically diverse, socioeconomically disadvantaged, defined inner-city area of South London (population estimate 140,000). The sampling frame comprised all births in the year 1986 who were registered with child health clinics or group practices within the district. Leaflets for parents had formerly been circulated to all health visitors, explaining the purpose of the survey and the fact that information from clinic records would be abstracted for comparative analysis. A computerized database was established, and updated monthly. Demographic, developmental and growth data were obtained by systematic and regular perusal of clinic records. In this way the growth trajectory of each attender could be monitored prospectively.[5]

Criteria for the identification of failure to thrive included:

- ☐ Full-term singleton birth (≥ 38 weeks gestation).
- ☐ No severe intrauterine growth retardation (standardized birthweight above the 3rd population percentile.[6]
- ☐ Weight for age at or below the third population percentile at twelve months of age, a growth trajectory sustained for at least three months.[7]

The authors are with the Behavioral Sciences Unit, South London Growth and Development Study, University of London, Institute of Child Health, London.

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Premature and low birthweight infants were excluded, because of the known association with below average, early postnatal growth.[8]

Detailed descriptions of the sampling procedures and subjects are reported elsewhere.[5]

There were 1554 infants who were still resident in the district at twelve months and who met the above criteria to be potential cases of failure-to-thrive. Fifty-two subjects (3.3 percent) met the case criteria, forty-nine of whom were diagnosed as nonorganic-failure-to-thrive, after appropriate medical investigations. Of these only nine (19.1 percent) had already been referred to a pediatrician.

All but two of the parents of these infants gave full consent to participate in the study. Accordingly, forty-seven nonorganic-failure-to-thrive infants were matched pairwise with control infants, selected from the analysis of the original birth register, according to birthweight (within 200g), gestation, sex, birth order, and ethnic group. No significant differences existed between the groups in socioeconomic circumstances or quality of housing.[5] All infants and their families were visited at home for medical, psychological, and anthropometric procedures.

Eruption was established, if the cusp tip had penetrated the gum tissue at the time of examination. Dates of eruption were also recorded wherever possible.

Full data regarding the number of erupted teeth were available for forty-four nonorganic-failure-to-thrive infants and their matched controls, and are reported here. The samples' characteristics are shown in Table; the statistical analysis included nonfactor (McNemar and Wilcoxon tests) and factor related sample tests (paired t-test).

Table ☐ Details of the pairwise matched sample.

| | Nonorganic failure to thrive (n=44) | Controls (n=44) | p |
|---|---|---|---|
| Sex (boys/girls) | 23/21 | 23/21 | ns |
| Birth order (1st/later-born) | 21/23 | 21/23 | ns |
| Socioeconomic status[1] | | | |
| Mean | 43.3 | 42.1 | ns |
| SD | 8.5 | 6.67 | |
| Gestation (weeks) | | | |
| Mean | 39.5 | 39.5 | ns |
| SD | 1.1 | 1.3 | |
| Birthweight (Kgms) | | | |
| Mean | 3.068 | 3.150 | |
| SD | .481 | .373 | |
| z-score[2] | −.53 | −.75 | ns |
| Age (months) | | | |
| Mean | 15.9 | 15.2 | * |
| SD | 1.5 | 1.6 | |
| Weight (Kgms) | | | |
| Mean | 8.199 | 10.524 | |
| SD | .635 | 1.274 | |
| z-scores | −2.1 | .13 | *** |
| Height (cm) | | | |
| Mean | 74.7 | 78.4 | |
| SD | 2.9 | 2.8 | |
| z-scores | −.12 | .2 | *** |
| Head circumference (cm) | | | |
| Mean | 45.6 | 47.1 | |
| SD | 15.6 | 14.3 | |
| z-score | −.84 | .29 | *** |

[1] A wide range of variables was coded, based upon those factors that were used by Osborn.[11] Osborn's social index is a sensitive indicator of socioeconomic position computed from seven independent variables by totalling weighted scores on items such as: parental education, overcrowding, occupation, type of accommodation, car and telephone ownership.

[2] A z-score is a standardized normal deviate. The distribution of weights for age at fifteen months is approximately normal.[12] Probabilities under various parts of the normal distribution thus can be summarized by an age-independent measure. For example, 2.3 percent of the population are more than two z-values below the mean (50th centile).

ns = not significant; * = $p<0.05$; *** = $p<0.001$.

There may be a relationship between the eruption of the primary tooth and postnatal growth.

## RESULTS

The mean number of erupted teeth was higher in the controls (M = 10.07; SD:3.66) than in the nonorganic-failure-to-thrive infants (M = 8.82; SD:2.99). The difference just failed to reach statistical significance (Paired t-test, $t(43) = -1.71$; $p = 0.09$). Although nonorganic-failure-to-thrive and control infants were seen at the same age, within seven days for the first of several research assessments, the controls were significantly younger by an average of twenty-two days at the time the number of teeth was determined (see Table). Mean differences in number-of-erupted-teeth were reanalyzed, therefore, using repeated measurement analysis of variance with age as the covariate. The difference in mean number-of-erupted-teeth was highly significant, when age was controlled for statistically ($F(1,42) = 8.96$; $p < 0.01$).

## DISCUSSION

The wide variation in the speed of tooth eruption in individual children is believed to be multifactorial.[9]

In this study of two groups of infants with matched birth-weights, but very different growth-rates, the number of erupted teeth was significantly lower in nonorganic-failure-to-thrive infants than their comparisons. The results suggest a relationship between primary-tooth eruption and postnatal growth in infancy.

This study has employed a prospective epidemiological approach and used a pairwise matched control design. The reported findings cannot be attributed, therefore, to sample biases that have bedeviled previous investigations based on unrepresentative hospital samples.[3]

Previous research indicated that protein-calorie malnutrition leads to the delay in primary-tooth eruption.[2] There is growing evidence that nonorganic-failure-to-thrive in infancy is the result of undernutrition, because the infants are not offered, refuse, or cannot utilize food adequately.[4] Nonorganic-failure-to-thrive infants in this study were severely underweight, short in stature, and had a reduced head circumference for age, compared to controls and national norms.[4] Our findings are consistent with those studies reporting delayed primary-tooth eruption that is attributed to malnutrition.[2,10] Malnutrition in infancy affects skeletal growth and results in poor growth. Similarly early nutritional status may influence tooth formation and eruption. There appears to be a physiological connection between skeletal development and tooth eruption.[9] The number of erupted teeth may be considered as a clinical growth factor in infants with a low rate of weight gain, in conjunction with other anthropometric data.

### REFERENCES

1. Ounsted, M.; Moar, V.; Scott, A.: A longitudinal study of tooth emergence and somatic growth in 697 children from birth to three years. Arch Oral Biol, 32:787-791, 1987.
2. Delgado, H.; Habicht, J-P,; Harborough, C. *et al*: Nutritional status and the timing of deciduous tooth eruption. Am J Clin Nutr, 28:216-224, March 1975.
3. Shuper, A.; Shohat, M.; Sarnat, H. *et al*: Deciduous tooth eruption in children who fail to gain weight. Helv Paediat Acta, 41:501-504, March 1986.
4. Skuse, D.; Wolke, D.; Reilly, S.: Failure to thrive. Clinical and developmental aspects. In: Remschmidt, H. and Schmidt, M. *Child and Youth Psychiatry. European Perspectives. Vol II: Developmental psychopathology.* Gottingen: Hogrefe & Huber (in press).
5. Skuse, D.; Wolke, D.; Reilly, S. *et al*: Racial influences upon birth statistics, health clinic usage and infant growth in inner London (submitted for publication).
6. Tanner, J. and Thomson, A.M.: Standards for birthweight at gestation periods from 32 to 42 weeks, allowing for maternal height and weight. Arch Dis Child, 45:566-569, August 1970.
7. Tanner, J. and Whitehouse, R.H.: Standards for height and weight from birth to five years: British children 1970. Growth and development charts nos. 28/29. Ware: Castlemead Publications, 1972.
8. Brothwood, M.; Wolke, D.; Gamsu, H. *et al*: Mortality, morbidity, growth and development of babies weighing 501-l000g and 1001-1500g at birth. Acta Paed Scand, 77:10-18, January 1988.
9. Alvarez, J.O. and Navia, J.M.: Nutritional status, tooth eruption, and dental caries:a review. Am J Clin Nutr, 49:417-426, March 1989.
10. Barrett, M.J. and Brown, T.: Eruption of deciduous teeth in Australian Aborigines. Aust Dent J, 11:43-50, February 1966.
11. Osborn, A.F.: Assessing the socio-economic status of families. Sociology, 21:429-448, 1987.
12. Mathisen, B.; Skuse, D.; Wolke, D. *et al*: Oral-motor dysfunction and failure to thrive amongst inner-city children. Dev Med Child Neurol, 31:293-302, June 1989.

# Readiness for toothbrushing of young children

**T. Ogasawara, DDS, DDSc**
**T. Watanabe, DDS, DDSc**
**H. Kasahara, DDS, DDSc**

The guidance given to young children in toothbrushing is important not only for preventing caries and gingivitis, but also for teaching young children the concept of hygiene, as a first step toward acquiring regular hygienic habits in their daily lives. The necessity of such guidance has been emphasized frequently, therefore, over the years[1,2]

Tsamtsouris *et al* and Sutcliffe *et al* have pointed out that effective guidance in brushing is possible even with kindergarten children.[3,4] Stepen *et al* have also reported on effective guidance sessions given to two- to four-year-olds, with guidance for three- and four-year-olds proving especially worthwhile.[2]

In order to teach young children toothbrushing and to achieve effective behavior modification, thereby, it is important to establish appropriate targets in accordance with each child's degree of readiness for toothbrushing. No reports, however, have so far been published on this subject.

The authors, aiming to establish what types of guidance in toothbrushing are suitable for young children based on their ages, have examined the ability of preschool children to learn toothbrushing and in addition sought to clarify the readiness of each age-group.

The authors are with the Department of Dentistry for the Handicapped, Matsumoto Dental College, 1780 Gobara Hirooka Shiojiri, Nagano, Japan 399-07.

## METHOD OF STUDY

### Subjects Examined

The examination was conducted on ninety-seven normal preschool children (fifty boys and forty-seven girls) under six years of age, selected from among those examined at a dental clinic (public) during the period from December 5, 1988 to March 28, 1989. The ages of the subjects ranged from O to 6 years and the average age was 3 years and 10 months (Table 1).

### Method of Examination

In order to clarify which brushing actions can be performed under guidance and also to obtain a grasp of the children's ability to learn toothbrushing, a brushing test was conducted to find out how well the children were able to brush their teeth for themselves.

Table 1 □ Subjects examined.

| Age | Boys | Girls | Total |
|---|---|---|---|
| 0 | 2 | 3 | 5 |
| 1 | 3 | 6 | 9 |
| 2 | 4 | 6 | 10 |
| 3 | 10 | 9 | 19 |
| 4 | 12 | 11 | 23 |
| 5 | 11 | 7 | 18 |
| 6 | 8 | 5 | 13 |
| Total | 50 | 47 | 97 |

(Persons)

☐ Test items

The test items were classified broadly into two stages; the stage at which the child can brush and the one at which the child cannot. The former was further divided into three substages and the latter into a total of sixteen regions within the oral cavity; upper and lower, right and left, anterior teeth and molars. In the test, evaluations were made to determine whether or not a child was able to brush each of the sixteen regions and these were conducted with regard to nineteen different test items. Regarding the standards for judging whether a region of the oral cavity had been brushed, the authors considered brushing to have been performed, if the tip of the brush was noticed to have reached that region and observed to have repeated the same movement more than once (Table 2 and Figure 1).

☐ Method of guidance used at the time of the test

The brushing test was conducted with respect to each test item. For guidance, the authors first gave a verbal instruction and, if there was no response from the child within five seconds, gave the same instruction again. If this second instruction still failed to obtain any response from the child, the child was shown how the particular region in the oral cavity should be brushed. If there was still no response from the child after the demonstration brushing had been conducted ten times, the demonstration was repeated. And if such repetitive "modeling" still failed to obtain a response from the child, the instructor took the hand of the subject and helped him (her) brush the region in question twice, moving the brush ten times on each occasion. This guidance was given in stages and each time the subjects succeeded, a positive reinforcement, such as verbal praise, was given immediately. By conducting a series of instruction techniques on each test item and having the children actually execute what they were taught, the authors confirmed the degree to which young children were able to learn toothbrushing (Figure 2).

The responses of the children were watched by a single observer for judgment and evaluation. The entire process was also recorded on videotape so that the behavior of the subjects would be reviewed and confirmed afterwards.

## Method of Analysis

In order to explore the trends in the results of the brushing test, an analysis was conducted based on the third class of Hayashi's quantifying theory. Samples and categories were classified into patterns, and each sam-

Table 2 ☐ Evaluation table by region reached with a toothbrush in brushing behaviors.

(The subject. . .)
1. Hold a toothbrush
2. Only puts the toothbrush in the mouth
3. Moves the toothbrush in his mouth but the brush does not reach the tooth-surface
4. Brushes the occlusal surface of lower left molars
5. Brushes the occlusal surface of lower right molars
6. Brushes the occlusal surface of upper left molars
7. Brushes the occlusal surface of upper right molars
8. Brushes the buccal surface of lower left molars
9. Brushes the buccal surface of lower right molars
10. Brushes the labial surface of upper foreteeth
11. Brushes the labial surface of lower foreteeth
12. Brushes the buccal surface of upper left molars
13. Brushes the buccal surface of upper right molars
14. Brushes the lingual surface of lower left molars
15. Brushes the lingual surface of lower right molars
16. Brushes the lingual surface of upper foreteeth
17. Brushes the lingual surface of lower foreteeth
18. Brushes the lingual surface of upper left molars
19. Brushes the lingual surface of upper right molars

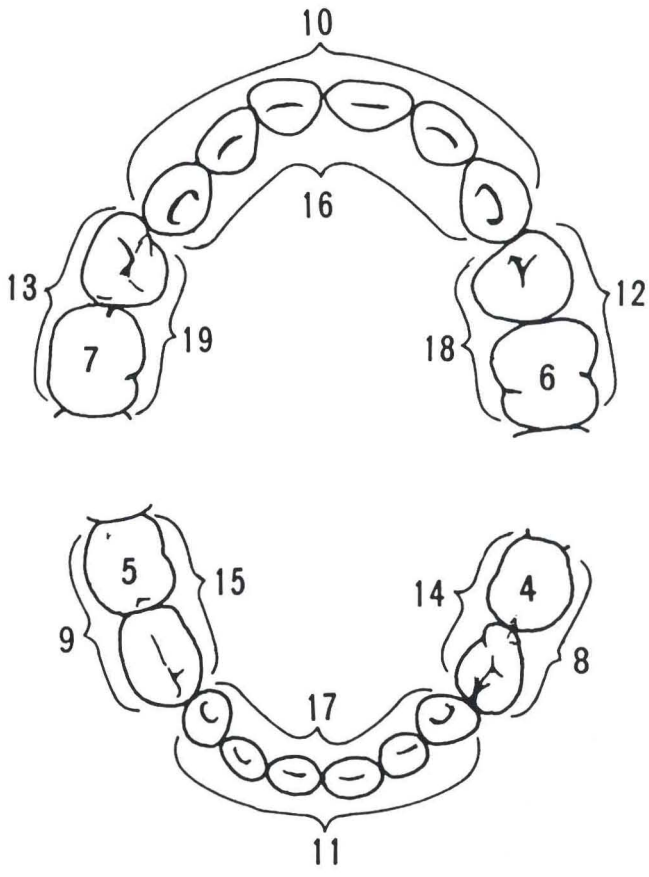


Figure 1. Diagram attached to the Evaluation Table compiled according to the regions reached with a Toothbrush

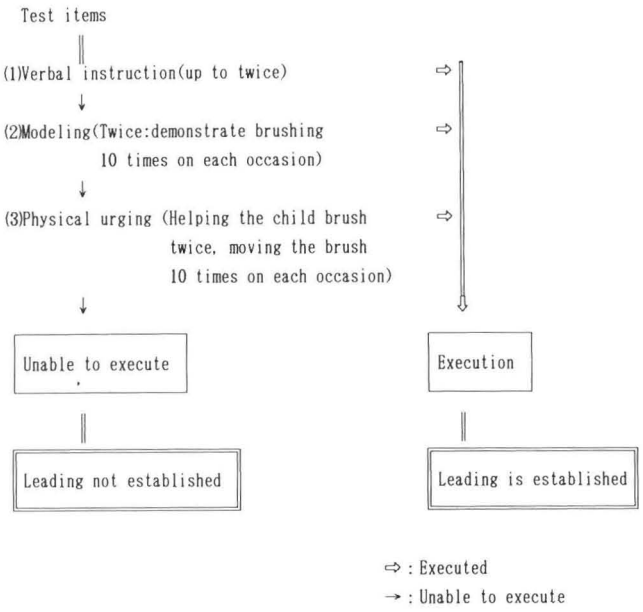


Figure 2. Flow chart of test method (guidance)

ple was given a qualitative attribute. The border age for the accorded qualitative attribute was identified using Akaike's Information Criterion (AIC).[5,6]

Table 3 □ Category score by the third class of Hayashi's Quantifying Theory.

| Category | 1st-axis | 2nd-axis |
|---|---|---|
| 1. Holds a toothbrush | −0.052 | −0.033 |
| 2. Only puts the toothbrush in the mouth | −0.052 | −0.033 |
| 3. Moves the toothbrush in the mouth | −0.026 | 0.007 |
| 4. Occlusal surface of lower left molars | −0.006 | 0.026 |
| 5. Occlusal surface of lower right molars | −0.006 | 0.026 |
| 6. Occlusal surface of upper left molars | 0.010 | 0.020 |
| 7. Occlusal surface of upper right molars | 0.009 | 0.020 |
| 8. Buccal surface of lower left molars | 0.013 | 0.015 |
| 9. Buccal surface of lower right molars | 0.016 | 0.012 |
| 10. Labial surface of upper foreteeth | −0.006 | 0.025 |
| 11. Labial surface of lower foreteeth | −0.011 | 0.021 |
| 12. Buccal surface of upper left molars | 0.021 | 0.004 |
| 13. Buccal surface of upper right molars | 0.021 | 0.004 |
| 14. Lingual surface of lower left molars | 0.040 | −0.059 |
| 15. Lingual surface of lower right molars | 0.040 | −0.057 |
| 16. Lingual surface of upper foreteeth | 0.013 | 0.016 |
| 17. Lingual surface of lower foreteeth | 0.021 | 0.002 |
| 18. Lingual surface of upper left molars | 0.040 | −0.057 |
| 19. Lingual surface of upper right molars | 0.036 | −0.043 |
| Eigenvalue | 0.387 | 0.262 |

## RESULTS

### Classification of the Test Results into Patterns

From the analysis made according to the third class of Hayashi's quantifying theory, the category score of the extracted 1st and 2nd correlation components has been produced as shown in Table 3. A scatter diagram of the category score is given in Figure 3, with the 1st correlation components showing the maximum eigenvalue

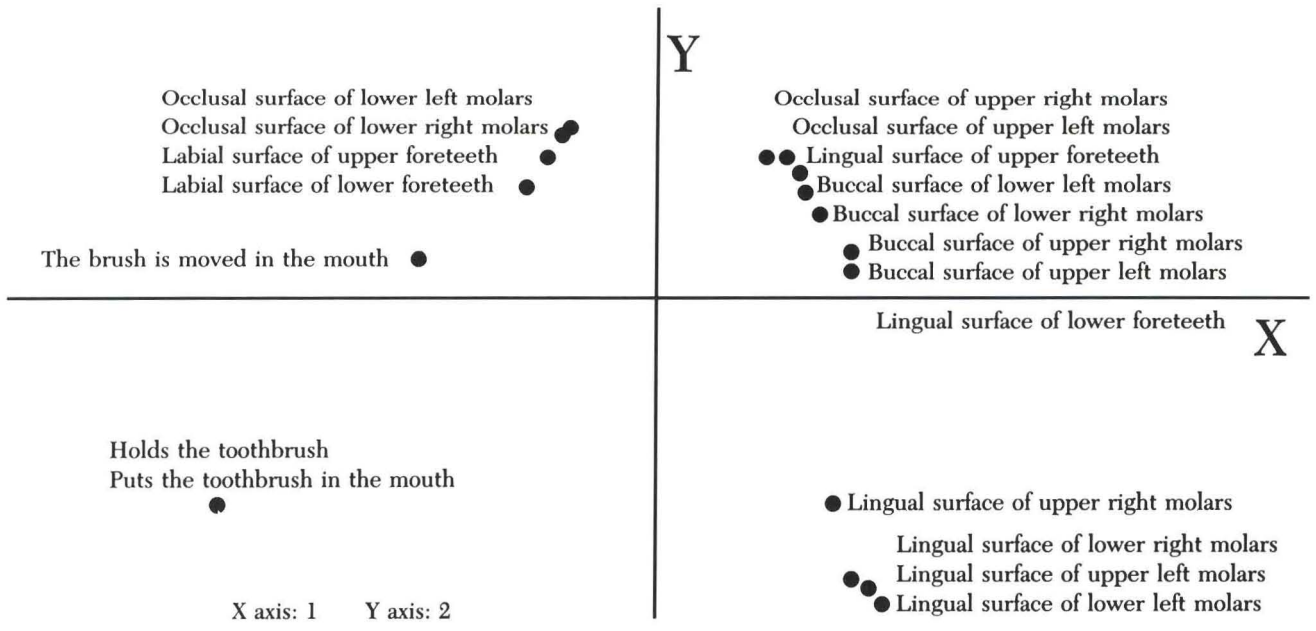


Figure 3. Scatter diagram of category score (The 1st axis and the 2nd axis)

of 0.387 plotted on the X axis and the 2nd correlation components showing the second largest eigenvalue on the Y axis. The plotted points form a secondary curve and can be perceived to have a sequential structure.[7] It is thus clear that the data can be interpreted by using the X axis as the scale factor.[8] Figure 4 shows the result of arranging the category score on the X axis unidimensionally and classifying it. It was possible to classify the brushing behavior in five groups.

It was also possible to classify the samples in five groups in the order of the classified categories, as shown in Table 4.

### Identification of the Border Ages

In order to clarify how well a child can be expected to brush his (her) teeth at different ages, the border ages were extrapolated from the five groups classified by the authors. When doing this, the calendar ages of the children were divided into groups of six-month intervals and a contingency table was drawn up for each group, showing whether they were over or under the border age. The AIC was obtained for each group. Those with the smallest AIC were considered to be the optimum category division and an automatic selection was made using the ages in that category as the border (Table 5).

The border age between the 1st group, identified as "can't brush", and the 2nd to 5th groups was one year and six months. This showed the smallest AIC at -70.61. Those under one year and six months tended to be unable to brush.

The border age between the 2nd group, identified as "can brush mandibular occlusal surface and fore teeth labial surface" and the 3rd to 5th groups was three years and six months, (AIC = -27.90). It was concluded that those under three years and six months old were able to brush as far as the mandibular occlusal surface and the fore teeth labial surface.

The border age between the 3rd group identified as "can brush occlusal and buccal surfaces and the fore teeth lingual surface" and the 4th and 5th groups was four years and six months (AIC = -47.75).

The discriminating age between the 4th group, identified as "can brush a part of the molar lingual surface" and the 5th group, identified as "can make the brush reach all regions" was five years (AIC = -11.33). It became clear that children age five or older can brush all regions of the teeth. From the above and as shown in Figure 5, the authors were thus able to clarify the developmental stages of young children's brushing.

## DISCUSSION

Hitherto, in evaluating the effects of brushing by young children, Tsamtsouris *et al*, Sangnes, and McClure *et al* used plaque indices.[3,910] In the case of young children, there are inevitably regions of the teeth that can-

Table 4 ☐ Accomplishments of samples (5 groups)

| Attributes | Score | Number of regions the brush can reach | Number of samples |
|---|---|---|---|
| 1st Group: Cannot brush | 1~3 | 0 | 12 |
| 2nd Group: As far as the lower occlusal surface of molars and labial surface of foreteeth | 4~7 | 1~4 | 9 |
| 3rd Group: As far as the occlusal and the buccal surfaces, and the labial surface of foreteeth | 8~15 | 5~12 | 28 |
| 4th Group: As far as a part of molars | 16~18 | 13~15 | 13 |
| 5th Group: The brush reaches all regions in the mouth | 19 | 16 | 35 |

Table 5 ☐ Detection of discriminating ages in different groups.

| Age | Discrimination between. . . the 1st group and 2nd-5th groups | the 2nd group and 3rd-5th groups | the 3rd group and 4th-5th groups | the 4th group and the 5th group |
|---|---|---|---|---|
| 1 year | −20.09 | – | – | – |
| 1.5 year | −70.61 | – | – | – |
| 2 year | −59.12 | − 7.42 | – | – |
| 2.5 year | −45.60 | −24.26 | − 0.02 | – |
| 3 year | −37.33 | −20.79 | − 8.60 | – |
| 3.5 year | −28.27 | −27.90 | −14.63 | − 1.36 |
| 4 year | −19.69 | −18.08 | −25.42 | − 2.41 |
| 4.5 year | −13.40 | −11.78 | −47.75 | − 5.22 |
| 5 year | − 8.02 | − 6.77 | −38.37 | −11.33 |
| 5.5 year | − 4.31 | − 3.45 | −21.80 | − 4.36 |
| 6 year | − 1.71 | − 1.17 | −11.48 | − 7.89 |
| 6.5 year | 0.92 | 1.08 | − 1.80 | − 0.66 |

Figures: Akaike's Information Criterion (A I C)

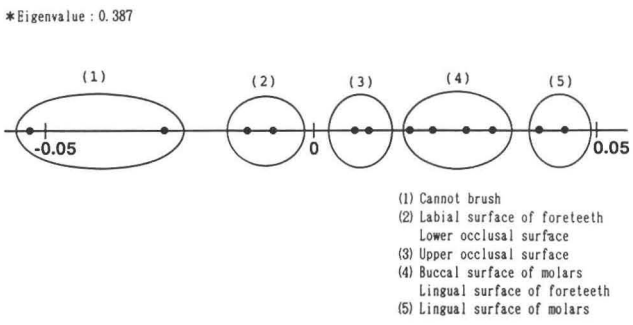


Figure 4. Category score of the 1st axis

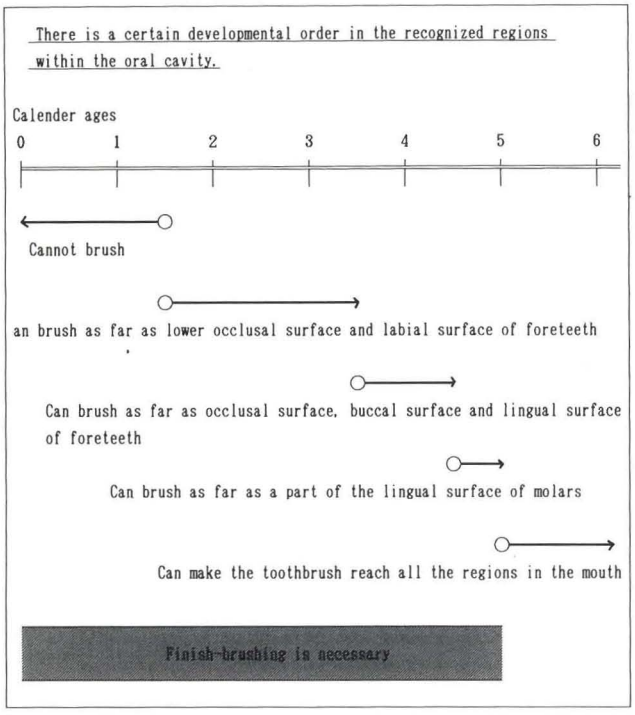


Figure 5. Development process of brushing behaviors (readiness)

not be reached with a brush. This makes it only natural that the plaque indices tend to be high for such children, with the result that evaluation of such indices does not provide any useful data for giving guidance in tooth brushing to young children.

Rateitschak *et al* and Kuroiwa say that the objective of brushing is to remove bacterial plaque and that as long as this objective can be achieved, any method or means will do. The authors, too, believe that the primary objective of young children's brushing is to ensure that the tip of the brush reaches all the regions of the teeth. Accordingly, the authors decided to evaluate the young children's brushing from the point of view of the reach of the brush; that is, which of the regions in the teeth are reached by the tip of the brush. This is why, in the test, the observer watched for brushing behavior in which the brush hit the surface of the teeth and made the same movement twice. The developmental stages of young children's brushing were thus identified not by the plaque indices, but by evaluating the regions reached by the toothbrush.

As a result of the analysis made on the results of this study using the third class of Hayashi's quantifying theory, it was recognized that there was a sequential structure for each category of the brushing test. This formed a stepped arrangement consisting broadly of five steps: *can't brush, can brush fore teeth labial surface and mandibular occlusal surface, can brush maxillary occlusal surface, can brush molar buccal surface and maxillary fore teeth lingual surface,* and *can brush molar lingual surface,* in that order, from the easy to the more difficult regions. For example, it was noted that for those who cannot brush the mandibular occlusal surface, it is also difficult to brush the molar buccal surface. Unless one has completed each previous step, it is difficult to advance to the next stage.

For any region of the teeth, it was concluded that there is no difference in the degree of difficulty in brushing, depending on whether the region is on the right or left side of the teeth. If young children are able to brush either the right or the left occlusal, buccal or lingual surface, they can easily brush the opposite side as well. This appears to be because of the similar-

Developmental stages of toothbrushing were identified by evaluating the regions reached by the toothbrush.

ities of the structures and techniques. If children can understand what they are taught for one, they can do so for the other as well with comparative ease. A transfer of learning can occur as long as what children are being taught concerns the same surface, that is, occlusal, buccal or labial.

As to the degree of difficulty in brushing the upper and lower teeth, there was, on the occlusal surface, a notable difference. On the buccal and lingual surfaces, however, the upper and the lower teeth were found to involve no distinct difference in the degree of difficulty. It is considered that this was true because children are able to brush the mandibular occlusal surface at a low developmental stage. Accordingly, although it may be difficult as yet for these children to recognize the maxillary occlusal surface, they can nevertheless learn to comprehend the difference between the upper and lower teeth as they advance to further developmental stages. This reduces the difference in the degree of difficulty in recognizing the regions in the upper and the lower teeth to nil; the children recognize regions in both the upper and the lower teeth alike.

Furthermore, as a result of the analysis of the tests done by AIC, it was found that the subjects' ages and their brushing abilities were interrelated and a border age for each brushing level was identified. Figure 4 shows the developmental stages in toothbrushing as obtained by this analytical study.

### Under one year and six months of age

At this developmental level, infants cannot put the tip of the brush on the surface of a tooth even when told how to do so. This is the *Can't brush* level. At this stage, infants cannot understand what toothbrushing means; all they can recognize is the crude action of putting the end of a toothbrush into the mouth and moving it. It seems that one cannot expect guidance in brushing to enable such infants to learn to brush their teeth on their own.

### Over one year and six months and under three years and six months of age

Young children at this developmental level can brush at least the mandibular occlusal surface and the fore teeth labial surface. This is the stage at which children become able to learn specific brushing techniques. It is considered that guidance in brushing begins to take effect from this stage.

### Over three years and six months and under four years and six months of age

Young children who have reached these ages can be considered to possess readiness for toothbrushing from the occlusal and the buccal surface to the fore teeth lingual surface. At this stage, the children can brush almost anywhere in the oral cavity but still that ability is not quite adequate. At these ages, it would be advisable to avoid giving the children the excessively ambitious target of brushing their own teeth completely.

### Over four years and six months and under five years of age

Some children under five years of age can brush a part of the molar lingual surface but, even for them, there are regions they cannot brush. It is considered that children under five years old can still brush their teeth only partially. By region, the molar lingual surface was found to be the most difficult to brush. This result was also found by Stephen *et al*, Shove *et al* and MacGregor *et al*[2,13,14] The reasons why the molar lingual surface is so difficult can be surmised as follows; it happens to be the region that is most difficult to recognize and, hitherto, it has not been customary to brush this particular region of the teeth.

### Five or older

When the children pass the age of five, they have the ability to brush all regions within the oral cavity. It is necessary to encourage them to establish the habit of brushing all regions within the mouth; that is, to give them guidance aimed at achieving self-sustained toothbrushing. Since the ability to learn toothbrushing and establish the habit of brushing teeth regularly are two different things, the authors believe that guidance in brushing should be given to children on a continuous basis until an appropriate toothbrushing habit has taken root in the children's daily lives. The results of this study also show that, since young children under the age of five are able to brush their teeth only partially, (as indicated by the results of the tests), there is a need for guardians to give a finishing touch to their children's tooth-brushing, at least up to the age of five years or until the children enter primary school.

## CONCLUSION

Ninety-seven normal preschool children (fifty boys and forty-seven girls) ranging from birth to six years of age,

were evaluated for their success in reaching various regions of their mouths with a toothbrush. The results were analyzed according to the third class of Hayashi's quantifying theory and the AIC. The authors were able to identify the developmental stages of the brushing behavior of normal preschool children and recommend appropriate guidance standards. It seems certain, by making use of the chart showing the developmental stages in toothbrushing, that it will be possible to give effective guidance in brushing to preschool children according to their ages.

**REFERENCES**

1. Ozaki, I.: The efficiency of toothbrushing in young children. J Hokkaido Dent Assoc, 40:295-301, February 1985.
2. Simmons, S.; Smith, R. *et al*: Effect of oral hygiene instruction on brushing skills in preschoolchildren. Community Dent Oral Epidemiol, 11:193-198. August 1983.
3. Tsamtsouris, A.; White, G.E. *et al*: The effect of instruction and supervised toothbrushing on the reduction of dental plaque. J Dent Child, 46:204-209, May-June 1979.
4. Sutcliffe, P.; Wishart, W.A. *et al*: Supervised toothbrushing in a nursery school. Brit Dent J, 142:192-194, March 1977.
5. Akaike, H.: *Information theory and extension of the maximum likelihood principle.* 2nd Inter. Symp. on Information Theory, Budapest: Akademiai Kiado:267-281, September 1973.
6. Sakamoto, Y. and Ishiguro, M.: *The statistics of information criterion,* Tokyo: Kiyouritsu, 1985, pp 42-64.
7. Iwatsubo, S.: Multivariate analysis method for n-way qualitative data. Electrotechnical laboratory, 801:1-87 March, 1980.
8. Akaike, K.; Komazawa, T.; Hashiguchi, K.: *The Analysis of quantification by Personal Computer,* Tokyo: Asakura, 1988, pp 90-103.
9. Sangnes,G.; Zachrisson, B.; Gjermo, P.: Effectiveness of vertical and horizontal toothbrushing techniques in plaque removal. J Dent Child, 39:94-97, March-April 1972.
10. McClure, D.B.: A comparison of toothbrushing technics for the preschool child. J Dent Child, 33:205-210, May 1966.
11. Rateitschak, M.; Wolf, H.F.; Edith, H.K.: *Color atlas periodontology.* Niigata: Nishimura, 1987, p 114.
12. Kuroiwa, M.: *The diagnosis of your toothbrushing,* Tokyo: Ishiyaku, 1988, p 40.
13. Shove, C.L. and Blinkhorn, A.S.: An evaluation of toothbrushing movements in a sample of primary school children. Dent Health, 20:6-8, September-October 1981.
14. MacGregor, I.D.M. and Rugg-gunn, A.J.: Survey of toothbrushing duration in 85 uninstructed English school children. Community Dent Oral Epidemiol, 7:297-298, February 1979.
15. Shirasa, T.: *Text of developmental psychology,* Tokyo: Kawashima, 1986, p 159.

## STANDARD OF MEDICAL CARE

In sum, we have described an inherent flaw in our system of malpractice litigation wherein anecdotal testimony by medical experts is preferred over empiric data. Medical malpractice is generally defined as a failure to "use the skill and care that is *ordinarily used* by reasonably well-qualified doctors in similar cases." We suggest that, in most circumstances, a data-based determination of "ordinarily used" is more appropriate than anecdotal recollection by individual witnesses.

Using this line of reasoning, there is *no data-based standard* by which any individual physician can be faulted for not prescribing HAM (Home Apnea Monitoring) for a graduate of the NICU (neonatal intensive care unit). Expert medical-legal testimony offered concerning the "standard of care" for HAM should reflect the lack of consensus in this practice. If there is no accepted standard of medical practice for a given procedure, there cannot be medical malpractice—it is, a priori, impossible to violate a medical standard that does not exist.

Meadow, W., MD, PhD: What is the legal "Standard of medical care" when there is no standard medical care?
Pediatrics, 89:1083–1088, June 1992.

# REPORTS

# The paradental cyst of the mandibular permanent first molar: Report of a bilateral case

**Richard N. Bohay, DMD**
**Simon Weinberg, DDS, FRCD (C), FICD**
**Paul S. Thorner, MD, PhD, FRCP (C)**

In 1976 Craig described the paradental cyst.[1] This odontogenic cyst occurred in relation to partially erupted mandibular third molars with an associated pericoronitis. Since then, paradental cysts occurring in relation to other teeth, especially the first mandibular molar, have been reported.[2-6] The lesions have been described as dentigerous cysts by Swerdloff *et al* and mandibular infected buccal cysts by Stoneman and Worth.[2,3] This report describes a case of bilateral paradental cysts affecting the mandibular first molars. The radiographic characteristics and differential interpretation of the lesion, in this location, are discussed.

## CASE REPORT

### History

A seven-year-old, Caucasian male was referred to The University of Toronto Dental Clinic by his general dentist. Previously, the child's mother had noticed a swelling in his lower left jaw.

### Clinical findings

The patient had no complaints of pain, paresthesia, or suppuration; and he appeared well. Intraorally, the buccal aspects of the mandible were expanded, but covered by normal appearing mucosa. The swellings were covered by bone and were only slightly tender to firm palpation. The lower permanent first molars were not visible within the oral cavity.

### Radiographic

Panoramic, standard mandibular occlusal and right and left mandibular occlusal radiographs were obtained. Bilateral lesions were observed about the permanent first mandibular molars (Figure 1). The right and left lesions measured 45mm X 30mm X 20mm, and 33mm X 25mm X 15mm, respectively. Both lesions were delineated by a hyperostotic periphery. Buccal expansion was noted on both sides; and a thin, finely etched cortex was apparent (Figures 2 and 3). The lesions had displaced the unerupted right and left permanent second mandibular molars distally. The right second premolar was mesially displaced. Despite displacement, the follicle cortices remained intact. On both sides, the lamina dura and periodontal ligament spaces of the first permanent mandibular molars remained unaltered. The roots of these teeth, however, had been pushed lingually. The inferior aspect of the mandibular cortex appeared thinned, but no expansion was noted. The right mandibular canal was displaced inferiorly. The left mandibular canal was observed running through the lesion. No root resorption was detected.

Dr. Bohay was Senior Resident, Oral and Maxillofacial Radiology, Faculty of Dentistry; Dr. Weinberg is Professor, Oral and Maxillofacial Surgery, Faculty of Dentistry; and Dr. Thorner is Assistant Professor, Pathology Hospital for Sick Children, University of Toronto.

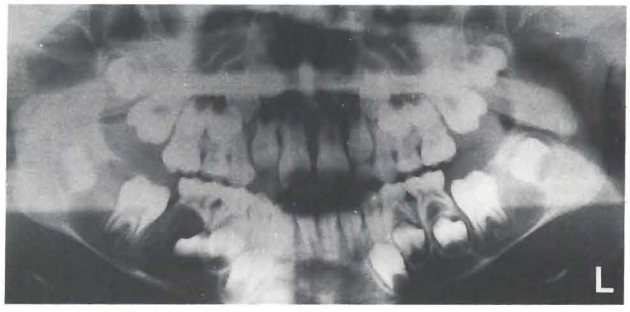


*Figure 1. The panoramic radiograph demonstrates bilateral paradental cysts about the permanent first molars. Note the displacement of teeth, maintenance of follicle cortices and lamina dura, thinning of inferior mandibular cortex and the absence of root resorption.*

*Figure 2. A right mandibular occlusal radiograph demonstrates thinning of the buccal cortex, marked buccal expansion and lingual displacement of permanent first molar roots.*

## Surgery

Using general anesthesia, mucoperiosteal flaps were raised to expose thin bone covering the lesions. The bone was easily penetrated and removed with rongeurs. Beneath the buccal bone there was a tough, resilient soft tissue lining surrounding a cavity filled with a bloody fluid. The lesions were easily enucleated

*Figure 3. A left mandibular occlusal radiograph demonstrates thinning of the buccal cortex, buccal expansion, and lingual displacement of the permanent first molar roots.*

(Figure 4). The resulting cavities were smooth and entirely surrounded by bone except on the lingual aspects where a portion of the buccal surface of the mandibular permanent first molar could be seen (Figure 5). The first permanent molars were firmly seated within the bone. The inferior alveolar nerve could be seen running along the inferior aspect of the cavities. The cavities were packed with gelfoam and the mucosa sutured back into place. The patient recovered without incident.

## Pathology

Both specimens appeared similar and consisted of a cystic lesion surrounded by a thin wall of loose fibrovascular connective tissue. The cysts were lined by nonkeratinizing squamous epithelium. In noninflamed areas, the lining consisted of three to five layers of cells, with the basal layer flat and similar in appearance to more superficial layers (Figure 6a). In inflamed areas, the lining became hyperplastic and measured up to three times as thick. The basal layer extended downward and into the connective tissue in the form of papillary pegs (Figure 6b). Lymphocytes and plasma cells

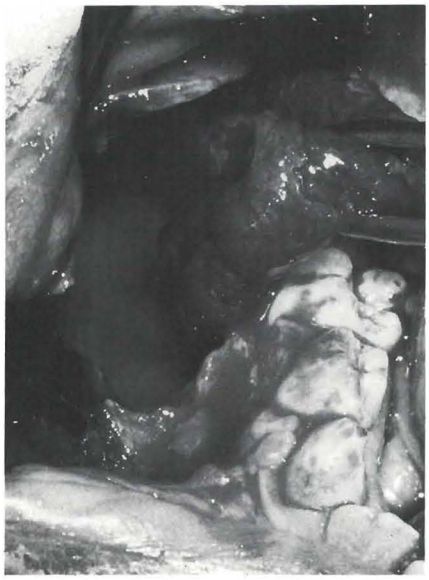

*Figure 4. Surgical enucleation of the right cyst.*

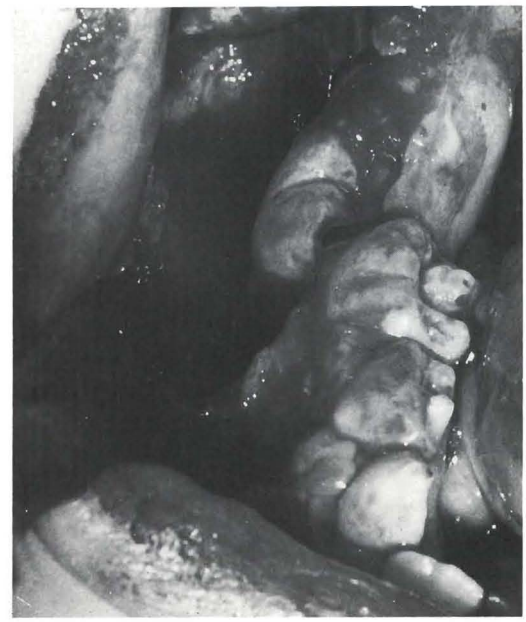

*Figure 5. The bony defect after enucleation. Note the position of the unerupted permanent first molar.*

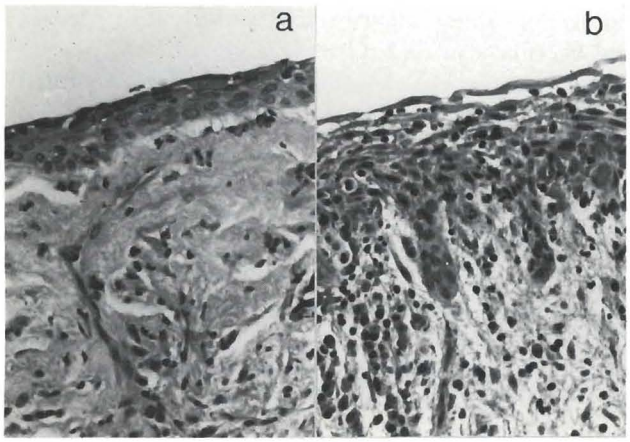


*Figure 6a. The microscopic appearance of the lesion. The cyst is lined by a flattened nonkeratinizing squamous epithelium overlying a fibrovascular connective tissue (X460).*

*Figure 6b. The microscopic appearance of the lesion. In areas of inflammation the epithelial lining becomes hyperplastic with an increased number of layers of squamous cells, and a downgrowth of the basal layer into the connective tissue (X460).*

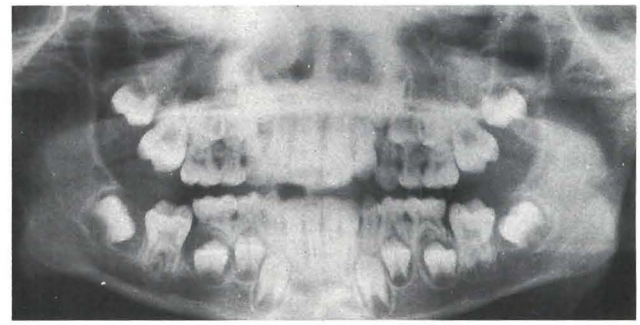

*Figure 7. A panoramic radiograph at eight months follow-up. Note the bony fill, increased thickness of the inferior mandibular cortex and the improved position of unerupted teeth.*

were seen infiltrating the connective tissue and overlying epithelium. No cystic contents were detectable in either specimen.

## Follow-up

At the eight-month recall, the patient had no complaints. A panoramic radiograph revealed good bony fill of the lesions (Figure 7). The inferior mandibular cortex had returned to its normal thickness and the developing right second premolar returned to its normal position beneath the roots of the primary second molar. The mandibular first molars were erupting into

The average age of patients with this cyst is eight years.

the mouth. The mandibular second molars appeared somewhat mesially inclined and these will be observed for possible mesial impaction.

## DISCUSSION

The average age of patients with this cyst is eight years according to Vedtofte and Praetorius.[4] Stoneman and Worth recognized the similarity of this lesion and those involving the third molar, but on the basis of radiographic and clinical findings suggested a separate classification.[2]

Often the cyst is discovered as an incidental finding during a routine dental examination. Occasionally, the patient may report symptoms such as pain, tenderness, pain on occlusion, delayed eruption, or actual suppuration. Others may present with a swelling causing facial asymmetry, as in the present case.

Vedtofte and Praetorius found a communication with a buccal periodontal pocket and the cyst in all cases involving the first mandibular molar.[4] This communication may occur during cyst formation and often prevents the gingiva from attaching once eruption is complete.[4] Stoneman and Worth state that the lesions are always situated on the buccal surface of a mandibular molar after partial or complete eruption.[2] In this case, the teeth were not exposed, however, to the oral environment. Packota *et al* have suggested a microscopic intraoral communication might exist with the cyst.[6]

An important radiographic feature of this cyst is its buccal location. This can produce two effects, both demonstrated in the present case. First, the roots of the involved tooth are displaced lingually. Second, expansion of the buccal plate of bone is a common feature. The cyst appears radiolucent with a radiopaque border. This border may vary in its degree of sharpness depending on the duration and degree of inflammation associated with the cyst.[2] This lesion is capable of displacing the inferior alveolar canal and teeth. Follicle cortices, lamina dura, and periodontal ligament spaces, however, usually remain unchanged. A characteristic feature, described by Stoneman and Worth and demonstrated in the present case, is the thinning of the inferior border of the mandibular cortex without expansion.[2]

Radiographs should include periapical, panoramic and occlusal views. Occlusal radiographs will demonstrate the buccal location of the lesion, the expansion of the buccal plate and the lingual tipping of the roots. These features are valuable in the radiographic interpretation of these cysts. If a first-permanent-molar, paradental cyst is discovered on one side, the contralateral side should be carefully evaluated for a second lesion. The size of lesions varies significantly from patient to patient and can also be of variable size from right to left in bilateral cases. Stoneman and Worth stress the possibility of bilateral lesions; and Vedtofte and Praetorius, and Packota *et al* report bilateral cases.[2,4,6]

Since the cyst develops buccal to the permanent first molar, it is often possible to enucleate the lesion, leaving the tooth firmly seated within the remaining bone. Unless there is radiographic evidence of infection of the involved tooth or the tooth lacks sufficient bone support it should be left in place.

The histology of this cyst is like that of the paradental cyst involving the third molar or that of a dentigerous cyst. The epithelium is nonkeratinized stratified squamous epithelium and becomes hyperplastic in inflamed areas. An inflammatory infiltrate is often present in the connective tissue wall. Foci of hemosiderin and cholesterol clefts may be present.[4]

The radiologic, differential interpretation includes eosinophilic granuloma involving the bone of the alveolar process, dentigerous cyst, and radicular cysts arising from primary molars. Eosinophilic granuloma within the alveolar process produces bone loss similar to periodontal bone loss, except that the epicenter of the lesion is below the alveolar crest. This produces a scooped out appearance, leaving a ledge of crestal bone superior to the lesion. A periosteal reaction may be observed and the roots of teeth may be resorbed.[10] A peripheral sclerosis may be seen. This tends to be more diffuse, however, than that seen in cases of the paradental cyst.

Dentigerous cysts are developmental cysts that oc-

cur about the crown of an unerupted tooth. The lesion cortex arises from the cementoenamel junction and surrounds the crown. Thus, the follicular space and cortex around the crown of the tooth are lost. If the paradental cyst of the permanent first molar happens to be superimposed on the cementoenamel junction, the interpretation may be more difficult. The follicular space and cortex should appear, however, in the normal relationship to the crown.

Lustmann and Shear and Wood *et al* describe radicular cysts arising from primary teeth.[8,9] The radiographic appearance and effect on the permanent tooth of these radicular cysts may appear very similar to the paradental cyst involving the first permanent molar. In the case of the radicular cyst, however, the permanent tooth involved is the premolar. Usually, caries, pulpotomy, or pulpectomy is seen in the primary molar, if present. Shaw has described similar lesions as inflammatory follicular cysts.[7]

The etiology of the paradental cyst is unknown. Inflammation may play a role. The epithelium may be derived from the dental lamina, rests of Malassez, or the epithelium that migrates apically to cover the cementum.[2] Stoneman and Worth suggest that as the tooth begins to erupt, localized inflammation occurs beneath the epithelial attachment.[2] This inflammation stimulates the epithelium from one of the above sources and the cyst forms. Craig suggests the presence of an enamel projection may predispose to the development of the paradental cyst.[1] No information is available regarding the frequency of its presence in lesions involving the permanent first molar.

The paradental cyst of the permanent first molar is most similar to the paradental cyst described by Craig.[1] The paradental cyst is usually associated, however, with the mandibular third molar that has an associated pericoronitis. Lesions in this site are most often found in patients during the third decade. Bilateral lesions in this location have not been reported. While some communication with the oral environment has frequently been observed with the paradental cyst of the permanent first molar, it was not present in this case.

The lesion described appears to be a variation of the usual paradental cyst. There are clinical and radiographic features, however, that make it unique. For now, it is reasonable to include it as a variation of the paradental cyst. With increasing recognition of the lesion and further delineation of its characteristics, it might, however, warrant a separate classification, as suggested by Stoneman and Worth in 1983.[2]

**REFERENCES**

1. Craig, G.T.: The paradental cyst. A specific inflammatory odontogenic cyst. Br Dent J, 141:9-14, July 1976.
2. Stoneman, D.W. and Worth, H.M.: The mandibular infected buccal cyst-molar area. Dental Radiography and Photography, 56:1-14, 1983.
3. Swerdloff, M.; Alexander, S.A.; Ceen, R.F.*et al*: Bilateral mandibular dentigerous cysts in seven-year-old child. J Pedod, 5:77-84, Fall 1980.
4. Vedtofte, P. and Praetorius, F.: The inflammatory paradental cyst. Oral Surg Oral Med Oral Pathol, 68:182-188, August 1989.
5. Shear, M.: Cysts of the jaws. Recent advances. J Oral Path, 14:43-59, January 1985.
6. Packota, G.V.; Hall, J.M.; Lanigan, D.T. *et al*: Paradental cysts in mandibular first molars in children: report of five cases. Dentomaxillofac Radiol, 19:126-132. August 1990.
7. Shaw, W.; Smith, M.; Hill, F.: Inflammatory follicular cysts. J Dent Child, 47:97-101, March-April 1980.
8. Lustmann, J. and Shear, M.: Radicular cysts arising from deciduous teeth. Int J Oral Surg, 14:153-161, April 1985.
9. Wood, R.E.; Nortje, C.J.; Padayachee, A. *et al*: Radicular cysts of primary teeth mimicking premolar dentigerous cysts: Report of three cases. J Dent Child, 55:288-290, July-August 1988.
10. Dagenais, M.E.: An analysis of the radiographic characteristics of histiocytosis X of the jaws. Thesis. University of Toronto, 1988.

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## BREAST-FED CHILDREN WITH RAMPANT CARIES

This study indicates that breast-feeding allows the colonization and proliferation of mutans streptococci and lactobacilli on teeth of young children and that rampant caries can occur in breast-fed children in the absence of nursing bottles or any other form of feeding abuse during weaning.

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

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# Fusion of primary mandibular teeth: Report of case

**Benjamin Peretz, DMD**
**Naphtali Brezniak, MD, DMD, MSD**

Fusion of teeth is the embryological union of two dental organs during development. Clinically, crown appearance depends upon the stage at which the process occurs. A normal sized or slightly bigger crown is the result of a fusion that occurred in the early developmental stages, while a large tooth with or without a bifid crown is a result of a later union.[1-3] Radiographically, fused teeth may have separate, partly fused or fully fused root canals.[4] Fusion is more common in the primary dentition and is most often seen in the mandibular primary incisors.[5,6]

Root resorption and shedding of fused primary teeth may be retarded, followed by an impaired eruption sequence of the permanent successor(s). This is especially of great concern in those cases where there is normally sufficient time-lag between the eruption of the permanent successors. Aplasia or malformation of the permanent successor(s) may occur.

The present case report describes the treatment and the follow-up in a child with fused mandibular primary lateral incisor and canine.

## CASE REPORT

Y.R., a healthy eight-year-old boy reported to the dental clinic for routine pedodontic-orthodontic checkup after moving from another city.

Clinical examination showed a mixed dentition with no caries or periodontal involvement. Some fillings and stainless steel crowns were present. All four first permanent molars were fully erupted.

In the mandible, there was an asymmetry in the tooth number. There were six teeth on the left side and five teeth on the right side. The permanent central incisors and the left permanent lateral incisor were present while an enlarged bifid crown was present on the right side (Figure 1). Radiographic examination revealed the enlarged bifid crown to be a fusion of the primary lateral incisor and the primary canine (Figure 2). Two separate crowns and roots were evident, part

*Figure 1. The fused right mandibular primary canine and lateral incisor.*

Dr. Peretz is a clinical lecturer, Dept. of Pediatric Dentistry, Hadassah Faculty of Dental Medicine, P.O.B 12000, Jerusalem, Israel.

Dr. Brezniak is head of the Orthodontic Department, Israel Defence Forces, and instructor, Maurice and Gabiella Goldschleger School of Dentistry, Tel-Aviv University, Israel.

*Figure 2. A radiograph of the fused teeth.*

of the root of the primary lateral root was resorbed, while the pulpal canals appeared to be joined at one place, close to the pulp chambers. The permanent lateral incisor and the permanent canine were evident in the bone. The lateral incisor had a crown to root ratio of 1:1. An orthodontic evaluation revealed that the fused tooth had interfered with the eruption of the permanent lateral incisor.

After the diagnosis was made, it was decided to attempt separation of the fused teeth, and to extract the primary lateral incisor to allow the eruption of the impacted permanent lateral incisor. Using local anesthesia the teeth were separated using a very thin, E5 diamond burr, and the primary lateral incisor was extracted. Since the fusion was at the lower part of the pulp chambers, a formocresol pulpotomy and a composite restoration were performed on the canine. A radiograph was taken immediately following the procedure (Figure 3).

The child was seen a week later, followed by appointments at two-month intervals. A radiograph and a clinical photograph were taken each visit (Figure 4). Seven months after the separation, the permanent lateral incisor erupted in place (Figure 5).

*Figure 3. A radiograph taken immediately following the separation. A formocresol pulpotomy and composite restoration were performed on the primary canine.*

## DISCUSSION

The dentist has to be aware of patients with dental unit asymmetries, or different shapes, even during the mixed dentition period. Both might indicate the presence of abnormal dental development or oncoming malocclu-

*Figure 4. Four months after the separation. An elevation of the gums is noted in the area of the permanent lateral incisor.*

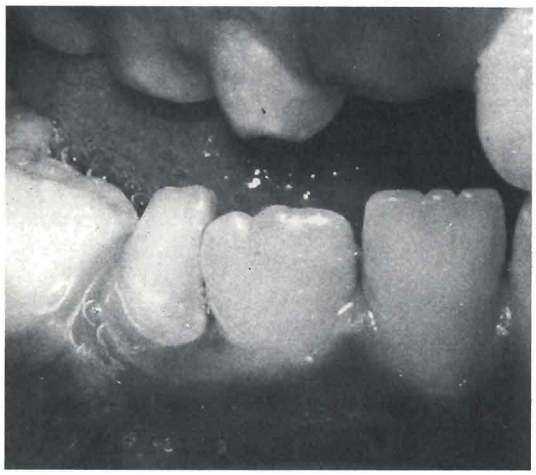

*Figure 5. The erupted lateral incisor.*

sion. In the described case report, a fusion of primary mandibular lateral incisor and primary canine, mainly the difference in tooth number and partly the different tooth shape arouse the pediatric dentist's awareness that there might be a problem. The child's parents were never informed by the previous dentist that their son had a dental anomaly.

In the described case, a few treatment plans were discussed:

- ☐ Leaving the fused teeth in place. This would have caused the approximation of the left central incisor to the fused teeth, loss of the midline, delaying the eruption of the lateral incisor, and need for future orthodontic treatment to be necessary.
- ☐ Extracting the fused teeth as a whole. This would have enhanced the eruption of the permanent lateral incisor, but the canine space and the midline would have been lost, unless a space maintainer had been placed.[7] This early extraction of primary teeth might cause delay in the permanent canine eruption.[8] Extraction of a fused maxillary primary lateral and central incisors was also suggested.[9]
- ☐ The performed treatment: Separation of the fused teeth, extraction of the mesial part, and retaining the distal part enable copying as close as possible, the natural developmental process, with possible interception of a future local malocclusion.

Separation of fused permanent teeth with or without pulp therapy has been suggested by some authors, while others warned of furcation too far apically as a possible reason for failure after separation of fused teeth.[10,11]

A simple procedure of separating the fused teeth and extracting the primary lateral incisor and retaining the primary canine solved the problem esthetically and functionally.

**REFERENCES**

1. Shafer, W.G.; Hine, M.K.; Levy, B.M.: Disturbances of development and growth, in *A textbook of oral pathology,* 3rd ed. Philadelphia: W.B. Saunders Co., 1974, p 36.
2. Mader, C.: Fusion of teeth. J Am Dent Assoc, 98:62-64, January 1979.
3. Levitas, T.C.: Gemination, fusion, twinning and concrescence. J Dent Child, 32:93-100, Second Quarter 1965.
4. Stewart, R.E.: The dentition and anomalies of tooth size, form, structure, and eruption, in *Pediatric Dentistry,* Stewart, R.E. *et al* eds. St. Louis: C.V. Mosby Co, 1982, p 100.
5. Grahnen, H. and Granath, L.E.: Numerical variations in primary dentition and their correlation with the permanent dentition. Odont Rev, 12:348-57, 1961.
6. Ravn, J.J.: Aplasia, supernumerary teeth and fused teeth in the primary dentition. An epidemiologic study. Scand J Dent Res, 79:1-6, 1971.
7. Moyers, R.F.: *Handbook of Orthodontics,* 3rd ed. Chicago: Mosby-Yearbook Medical Publishing Co., 1980, pp 262-64.
8. Proffit, W.R.: *Contemporary orthodontics.* C.V. Mosby Co, 1982, pp 63-72.
9. Surmont, P.A.; Martens, L.C.; De Craene, L.G.: A complete fusion in the primary human dentition: a histological approach. J Dent Child, 55:362-367, September-October 1988.
10. Clem, W.H. and Natkin, E.: Treatment of the fused teeth. Oral Surg, 21:365-371, March 1966.
11. Hasiakos, P.S.; Weine, F.S.; Elleng, D.G. *et al*: Treatment of an unusual case of fusion. J Dent Child, 53:205 208, May-June 1986.

# Differences in the health status of black and white children

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

Minority population children increasingly will become a reality in pediatric dental practices as evolving population dental disease patterns lead practitioners to provide care to groups in our communities that traditionally were underserved. But just as there is no "single" white population, so too are there extensive social, economic, cultural and health variations in the minority populations of black-Americans, Hispanic-Americans, Asian-Americans and Native-Americans.[1-4] Nevertheless, the tendency is to stereotype groups with a series of assumed attributes.

For example, in general population terms, black persons tend to be younger and in lower economic conditions than are white persons. Since we often associate youth with better health and lower family income with poorer health, 1) in terms of age, we might expect that blacks would be healthier than whites, and 2) from the perspective of family income alone, we might expect that whites would be healthier than blacks. But even for particular population cohorts, generalizations tend to mask the variability in our communities.

The need is for pediatric dentists to develop an awareness of the differences that exist between the populations of children that increasingly will seek needed care. It is to this end, that the following presentation on the variability in the health status of black and white children is provided.

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

## SOURCE OF DATA

Information was drawn from the National Health Interview Survey (NHIS) developed by personnel of the U.S. Bureau of the Census. During 1985, 1986, and 1987, interviews were conducted in 105,922 households containing 276,442 persons. The total non-interview rate was 4.3 percent.[5]*

## GENERAL NUMBERS

Between 1985 and 1987, 85 percent of the population classified itself as white, 12 percent as black: and 7 percent as "other" (i.e. for the most part these persons classified themselves as "Aleut, Eskimo or American Indian" or as "Asian or Pacific islander.") Approximately one quarter of the white population was less than eighteen years of age (51 million children). One third of black population was less than eighteen years of age (9.6 million children) (Table 1). (Note: in 1990, there were thirty million black-Americans.[6])

Table 1 ☐ U.S. civilian noninstitutionalized population by race: 1985–1987.[5]

| | Number | Percent |
|---|---|---|
| | (in millions) | |
| White | 200.6 | 84.9% |
| Black | 28.6 | 12.1 |
| Other | 7.2 | 3.0 |
| Total | 236.3 | 100.0% |

*Unless otherwise stated, all data for this presentation were drawn from the National Health Interview Report.

## HEALTH STATUS

### Acute conditions

The overall white population reported far more acute health conditions[7]** than did the black population. (This difference in the incidence of acute conditions was consistent with the results from previous NHIS surveys.) The difference was particularly large for children under eighteen years of age for whom the reported acute conditions incidence rates were 293 per year for one hundred white children and 179 per year for one hundred black children. The difference in the number of acute conditions between black and white children was reported in families with incomes above and below $20,000. It should be noted that black children in lower income families and white children in higher income families had greater numbers of acute health conditions than their respective counterparts (Table 2).

Table 2 ☐ Annual number of acute health conditions per 100 children less than eighteen years of age by family income and race: 1985–1987.[5]

| | Less than $20,000 | $20,000 or more | Totals |
|---|---|---|---|
| Black | 183.2 | 176.1 | 178.9 |
| White | 280.6 | 305.2 | 293.2 |

Note: In this and all subsequent tables, totals include respective "unknown" categories.

Table 3 ☐ Annual number of acute health conditions per 100 children less than eighteen years of age by respondent assessed health status and race: 1985–1987.[5]

| | Fair or poor health | Good to excellent health | Totals |
|---|---|---|---|
| Black | 322.2 | 172.2 | 178.9 |
| White | 505.1 | 288.7 | 293.2 |

Possible explanations for the differences in acute condition rates reported for black and white children may include:

☐ Black children are in poorer health than white children and there tends to be an inverse relationship between overall health status and the incidence of acute health conditions.

This explanation fails to explain the difference, since the high incidence rates for white children compared to black children does not change significantly when children in fair and poor health and children with good to excellent health are considered separately (Table 3).

☐ In the NHIS survey, acute conditions are defined partially in terms of receipt of medical services. Black children may have received less medical attention for health problems.

Once again, this explanation fails to explain the difference since black children had a higher percent of acute conditions medically attended than did their white counterparts.

☐ White persons tend to report illnesses and injuries of a more minor nature than do black persons.

If this situation prevailed, one would find that on average blacks would have a greater number of restricted activity days associated with acute conditions than their white counterparts. Indeed this was the reported finding. Such a finding could indicate that a) black children experienced proportionately fewer but more serious acute conditions than white children, or b) acute conditions of a more minor nature are less liable to be reported by black children. "However, no

**An acute health condition is defined by NHIS as a type of illness or injury that ordinarily lasts less than three months, was first noticed less than three months before the interview, was serious enough to have had an impact on behavior and required reduced activity or consultation with a health provider.

The overall white population reported many more acute health conditions than did the black population.

evidence from the survey can conclusively explain it (i.e. the difference in acute condition rates)."[5]

### Limitation of activities due to chronic conditions

There were no statistically significant differences between the average annual percent of black and white children with limitation of activities as result of chronic conditions (Table 4).

### School days missed associated with acute and chronic conditions

White children had a higher rate of missed school days plus days spent in bed as a result of acute and chronic health conditions than did black children. This difference between white and black children held in families above and below $20,000 (Table 5).

### Assessed health status

A greater percent of black children than white children were viewed as being in fair or poor health. For both groups of children, a greater percent of children in families with incomes below $20,000, than in higher income families, were reported to be in fair or poor health (Table 6). A greater incidence of a fair or poor health status for blacks was reported for all adult age-groups and economic cohorts.

## USE OF HEALTH SERVICES

### Physician contacts

Blacks have a lower rate of physician contact (in person or by telephone for examination, diagnosis, treatment or advice) per person per year (4.7) than whites (5.5). Among the various age-cohorts, the greatest difference was between children under eighteen years of age in families with incomes above and below $20,000 (Table 7).

### Hospital usage

Overall, blacks reported greater annual numbers of hospital days than whites. Black children had a greater average annual number of short-term hospital days (8.8) than white children (6.4). The greatest difference was for black and white children in fair or poor health (19.1 vs. 12.8 days per year).

Table 4 ☐ Average annual percent of children less than eighteen years of age with limitations of activity due to chronic conditions by family income and race: 1985–1987.[5]

| | Less than $20,000 | $20,000 or more | Totals |
|---|---|---|---|
| Black | 6.6% | 3.8% | 5.6% |
| White | 6.5 | 4.5 | 5.0 |

Table 5 ☐ For children less than eighteen years of age, average annual number of missed school days plus days in bed as a result of acute and chronic conditions by family income and race: 1985–1987.[5]

| | Less than $20,000 | $20,000 or more | Totals |
|---|---|---|---|
| Black | 8.2 | 6.5 | 7.5 |
| White | 10.2 | 9.4 | 9.4 |

Table 6 ☐ Average annual percent of children less than eighteen years of age assessed by respondents to be in fair or poor health by family income and race: 1985–1987.[5]

| | Less than $20,000 | $20,000 or more | Totals |
|---|---|---|---|
| Black | 6.0% | 2.2% | 4.8% |
| White | 3.7 | 1.4 | 2.1 |

Table 7 ☐ Average annual number of physician contacts per person by family income and race: 1985–1987.[5]

| | Less than $20,000 | $20,000 or more | Totals |
|---|---|---|---|
| Black | 2.9 | 3.0 | 2.8% |
| White | 4.2 | 4.9 | 4.5 |

### Dental care need and use of services

Finding from the 1986-87 national survey of dental caries in U.S. children noted wide variations between different regions of the nation for the mean DMFT and DMFS rates of minority and nonminority children.[7] A higher incidence of gingival bleeding, and greater numbers of bleeding sites were reported for minority children.[8]

But most important were the findings that,

- ☐ Minority children had lower filled ratios (F/DMFT and F/DMFS) than nonminority children.
- ☐ A smaller percent of minority children than nonminority children visited a dentist in the previous year.
- ☐ Minority children had fewer dental visits per child than their nonminority counterparts.

☐ For a smaller percent of minority children than nonminority children, the last dental visit was for a "check-up."[9]†

### Summing it up

☐ White children have more acute medical conditions, but black children have a greater number restricted activity days associated with acute conditions. There is some evidence that illness and injuries of a more minor nature are reported for white children.
☐ White children have a higher rate of missed school days plus days spent in bed as a result of acute and chronic health conditions.
☐ A greater percent of black children are reported to be in fair or poor health.
☐ Black children have less contact with physicians.
☐ Black children make more use of hospitals.
☐ Black children are in need of more dental services.

## GENERAL THOUGHTS

It was noted previously that, in general, black persons are in lower economic conditions than are white persons. The extent of the economic differences, particularly for children, however, should be considered in any review of the health status, of this population. For example, since 1970, more than 40 percent of black children lived in families with incomes below the poverty line; compared to between 10 and 15 percent of white children.[11]‡

Black children may be at reduced levels of health, but the combination of widespread poverty and the (resultant?) tendency to use health services, when conditions are more advanced, presents a challenge to pediatric dental practitioners. The need is for care, but what of the finances?

As I write these words in the final days of 1991, our nation is passing through a serious recession. The expansion of health and social programs surely cannot be anticipated at this juncture. But as with all economic cycles, demand for health services (in particular dental care) will once again become a priority. If pediatric practices are to thrive, the dentists must provide services to children who do not conform to the traditional patient patterns, and most important, practitioners must be aware of the differences in the health status of these children.

† For more detailed presentation on minority children's need for and use of dental services, see a previous report by this writer in the *Journal of Dentistry for Children.*[10]

‡For a more detailed presentation on the numbers of children living in conditions of poverty, see a previous report by this writer in the *Journal of Dentistry for Children.*[12]

### REFERENCES

1. Waldman, H.B.: Hispanic children: an increasing reality in pediatric dental practice. J Dent Child, 59:221-224, May-June 1992.
2. Waldman, H.B.: A increasing Hispanic population and the practice of dentistry. Illinois Dent J, 61:81-85, March-April 1992.
3. Waldman, H.B.: Asian Americans: an increasing reality in the population and the dental profession, but there is limited information. Ohio Dent J, in press.
4. Waldman, H.B.: "Rediscovering" the health status of Native Americans. J Dent Child, 59:216-220, May-June 1992.
5. Ries, P.: Health of black and white Americans, 1985-87. Vital and Health Statistics, Series 10, No. 171. DHHS Pub. No. (PHS) 90-1509. Hyattsville, MD: National Center for Health Statistics, 1990.
6. Barringer, F.: Census shows profound change in racial makeup of the nation. NY Times, March 10, 1991, pA1, B8.
7. U.S. Department of Health and Human Services, National Institute of Dental Research: *Oral Health of United States Children: National and Regional Findings 1986-1987.* NIH Pub. No. 89-2247. Bethesda, MD: National Institutes of Health, 1989.
8. Bhat, M. and Brunelle, J.: Gingival status of 14 to 17 year old school children. Abstract No. 704. J Dent Res, 68:955, June 1989.
9. U.S. Department of Health and Human Services, Centers for Disease Control: *Use of Dental Services and Dental Health: United States, 1986.* Data from the National Health Interview Survey. Series 10, No. 165. DHHS Pub. No. (PHS) 88-1593. Hyattsville, MD: National Center for Health Statistics, 1988.
10. Waldman, H.B.: Are minority children getting their fair share of dental services. J Dent Child, 57:380-384, September-October 1990.
11. U.S. Department of Commerce. Statistical Abstract of the United States, 1991. 111th ed. Washington, D.C.: Government Printing Office, 1991.
12. Waldman, H.B.: There really are a lot of poor children in the United States. J Dent Child, 59:123-125, March-April 1992.

# Juvenile arrests—it's a crime

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

Boys are still far more likely to be arrested and convicted for violence than are girls...[1] But, "In New York City, the number of girls arrested for felonies increased 48 percent over four years... In New Jersey the number of girls arrested for violent crimes like robbery and aggravated assault increased 67 percent from 1980 to 1990. In Connecticut, from 1986 to 1990 the number of girls arrested ... went up 62 percent for aggravated assault."[1]

As a result of the changing patterns of dental disease, the successful pediatric dental practitioner increasingly must provide services to segments of the population that were beyond the pale of traditional dental practice. In addition, practitioners have learned that providing care for any and all children demands an awareness of developments in their patients' socioeconomic environment that historically seemed of limited concern to many dentists: including single parenting, two working parents, day care services, a latchkey childhood, use of drugs, and juvenile arrests for criminal activities.

While there is some good news – the use of illicit drugs by youngsters is down (Table 1); the bad news is that crime carried out by youngsters is up (Table 2).

The following presentation is offered in an effort to acquaint pediatric dentists with the extent of criminal activities in which youngsters in our cities, suburbs, and rural areas participate. Yes, even by your patients.

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

## NUMBER OF ARRESTS

In 1990, there were more than 1.7 million arrests of youngsters (less than eighteen years of age) for violent, property, and delinquency crimes. More than 42,000 of these arrests were of children less than ten years of age. Almost 0.6 million arrests were of children less than fifteen years of age. While the number of arrests increased with the increasing age, children under ten years were arrested for acts of crime, including murder, forcible rape, robbery assault, theft, arson, vandalism and drug abuse (Table 3).

Table 1 ☐ Percent of children 12 to 17 years by the use and type of drug: 1974, 1988.[2]

| | Ever used | | Current user | |
|---|---|---|---|---|
| Type of drug | 1974 | 1988 | 1974 | 1988 |
| Marihuana | 23.0% | 17.4% | 12.0% | 6.4% |
| Inhalants | 8.5 | 8.8 | 0.7 | 2.0 |
| Hallucinogens | 6.0 | 3.5 | 1.3 | 0.8 |
| Cocaine | 3.6 | 3.4 | 1.0 | 1.1 |
| Heroin | 1.0 | 0.6 | na | na |
| Analgesics | na | 4.2 | na | 0.9 |
| Stimulants | 5.0 | 4.2 | 1.0 | 1.2 |
| Sedatives | 5.0 | 2.4 | 1.0 | 0.6 |
| Tranquilizers | 3.0 | 0.2 | 1.0 | 0.2 |
| Alcohol | 54.0 | 50.2 | 34.0 | 25.2 |
| Cigarettes | 52.0 | 42.3 | 25.0 | 11.8 |

Table 2 ☐ Delinquency cases disposed of by juvenile courts: 1975, 1980, 1986.[2]

| Year | Total | Case rate* |
|---|---|---|
| | (in 000s) | |
| 1975 | 1,050 | 33.8 |
| 1980 | 1,093 | 38.3 |
| 1986 | 1,154 | 44.3 |

* Number of cases per 1,000 youths ages 10 to 17 at risk.

## DEMOGRAPHICS

- ☐ In each age-group, males represented 75 percent or more of children who were arrested for "delinquency offenses" (Table 4). (Note: a delinquency offense is an act committed by a juvenile for which an adult could be prosecuted in a criminal court. Disposition of a case could involve a definite action such as referring the case to juvenile courts, transferring the case to a criminal court, dismissing the case, placing the youth on probation, placing the youth in facility for delinquents, or such actions as fines, restitution, and community service.[2])
- ☐ White children represented 71 percent of children who were arrested in 1990; 26 percent were black and approximately 1 percent, respectively, were Native Americans or Asian and Pacific Islanders (Table 5).
- ☐ More than 84 percent of the children arrested were residents of city areas; over 10 percent were residents of suburban counties; and 4 percent were residents of rural counties (Table 6).

## SOME OUTCOMES OF CRIMES BY AND AGAINST CHILDREN

- ☐ In 1987, more than 94,000 juveniles were held in custody (an increase from 82,000 in 1983). The children were held in detention centers, shelters, reception and diagnostic centers, training schools, halfway houses, group homes, ranches, forestry camps, and farms. More than 75 percent were males and more than 60 percent were white (Table 7).
- ☐ In 1987, the annual cost per juvenile held in custody was more than $27,000 dollars (Table 7).
- ☐ In 1990, approximately 2,000 children less than twenty years of age were murdered. Almost 600 murdered children were less than five years of age (Table 8).

Table 3 ☐ Total arrests by age: 1990.[3]

| Offense charged | Ages Under 10 | Ages Under 15 | Ages Under 18 |
|---|---|---|---|
| Total arrests | 42,782 | 593,869 | 1,754,542 |
| Violent crimes | 1,270 | 25,622 | 91,317 |
| Murder & nonnegligent manslaughter | 5 | 283 | 2,555 |
| Forcible rape | 89 | 1,605 | 4,628 |
| Robbery | 209 | 8,874 | 32,967 |
| Aggravated assault | 967 | 14,860 | 51,167 |
| Property crime | 18,204 | 236,649 | 564,060 |
| Burglary | 3,674 | 44,466 | 112,437 |
| Larceny-theft | 13,278 | 167,741 | 372,133 |
| Motor vehicle theft | 227 | 20,146 | 72,930 |
| Arson | 1,025 | 4,296 | 6,560 |
| Delinquency crimes | 23,308 | 331,598 | 1,099,196 |
| including assaults, vandalism, drug abuse, liquor laws, disorderly conduct, etc. | | | |

Note: data are from 10,206 reporting agencies for a population of 193,507,000.

Table 4 ☐ Total arrests by age and gender: 1990.[3]

| | Ages Under 10 | | Ages Under 15 | | Ages Under 18 | |
|---|---|---|---|---|---|---|
| Offenses charged | Male | Female | Male | Female | Male | Female |
| Total arrests | 36,060 | 6,722 | 442,954 | 150,915 | 1,355,638 | 398,904 |
| Percent distribution | 84.3% | 15.7% | 74.6% | 25.4% | 77.3% | 22.7% |
| Type of crime | | | | | | |
| Violent | 1,165 | 105 | 21,723 | 3,899 | 80,591 | 10,726 |
| Property | 15,280 | 2,924 | 182,717 | 53,932 | 441,199 | 122,861 |
| Delinquency | 19,615 | 3,693 | 238,514 | 93,084 | 833,848 | 265,317 |

Table 5 ☐ Total arrests by race for children less than 18 years of age: 1990.[3]

| | Number | Percent distribution |
|---|---|---|
| White | 1,239,241 | 71.3% |
| Black | 455,164 | 26.2 |
| American Indian or Alaskan Native | 18,416 | 1.1 |
| Asian or Pacific Islander | 25,859 | 1.5 |

Table 6 ☐ Arrests by residence and age of children: 1990.[3]

| | Ages Under 15 | | Ages Under 18 | |
|---|---|---|---|---|
| Residence | Number | Percent | Number | Percent |
| City | 509,432 | 85.8% | 1,471,431 | 83.9% |
| Suburban counties | 61,369 | 10.3 | 197,257 | 11.3 |
| Rural counties | 23,068 | 3.9 | 85,854 | 4.9 |
| Totals | 593,869 | 100% | 1,754,542 | 100% |

Table 7 ☐ Juveniles held in custody: 1983, 1987.[2]

| | 1983 | 1987 |
|---|---|---|
| Total number | 82,272 | 94,281 |
| Gender | | |
| Male | 78.3% | 77.0% |
| Female | 21.7% | 23.0% |
| Race | | |
| White | 60.9% | 61.5% |
| Black | 39.1% | 38.5% |
| Annual cost per resident | $21,700 | $27,300 |

Table 8 ☐ Murder victims by age and race: 1990.[3]

| Age | White | Black | Other | Total* |
|---|---|---|---|---|
| < 1 year | 159 | 98 | 5 | 264 |
| 1–4 years | 169 | 136 | 10 | 317 |
| 5–9 years | 61 | 51 | 2 | 118 |
| 10–14 years | 138 | 125 | 7 | 270 |
| 15–19 years | 918 | 1,376 | 28 | 2,348 |
| Totals | 1,445 | 1,786 | 52 | 3,317 |

*Includes victims of unknown race.

Table 9 ☐ Reported child neglect and abuse cases: 1980, 1985, 1987.[2]

| Year | Reported cases | Reports per 1,000 population |
|---|---|---|
| 1980 | 785,100 | 3.5 |
| 1985 | 1,299,400 | 5.4 |
| 1987 | 2,025,200 | 8.3 |

☐ In 1980, more than three quarters of a million cases of child neglect and abuse were reported. By 1987, the number of cases had increased to more than two million (an increase from 3.5 to 8.3 cases per one thousand population (Table 9). (Note: child maltreatment includes the deprivation of necessities, physical injury, sexual maltreatment and emotional maltreatment.)

## BUT I'M A PEDIATRIC DENTIST

No matter how distant the pediatric dentist may feel that these criminal events are beyond the realm of his or her practice, the reality is that pediatric patients are not divorced from the tragedies and events that fill our daily newspapers. In fact one of your patients may be the center of tomorrow's headline and story. Providing dental services for children (and adults) in our evolving environment demands increasing attention to the social and psychological world beyond the confines of the proverbial four walls of one's operatory.

In the past, many may have assumed that their pediatric patients were "just kids." Unfortunately, these youngsters may be involved in events far beyond anything that many of us could have imagined. Crimes by and against children are an unfortunate reality in our world and even our practices. Yes, even your practice.

### REFERENCES

1. Lee, F.R.: For gold earrings and protection, more girls take road to violence. NY Times, November 25, 1991, pA1, B7.
2. Bureau of the Census. *Statistical Abstract of the United States: 1991.* 111th ed. Washington, D.C.: Government Printing Office, 1991.
3. Federal Bureau of Investigation: *Crime in the United States: 1990.* Washington, D.C.: Government Printing Office, 1991.

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## VALIDITY OF DIAGNOSIS OF OCCLUSAL CARIES LESIONS

The diagnostic outcome of adding results from two or more of the diagnostic methods led to a higher disease detection rate (80% being achieved when VI and $DR_c$ were combined), but was also followed by an increase in false-positive scorings. A combination of methods should therefore be preferred when lesion detection is weighted above overscoring.

In the future, true digital equipment for intra-oral radiography will be part of everyday clinical dental practise. Such a system [Benz and Mouyen, 1989; Mouyen et al, 1989] has been documented to perform as well as the digitisation and contrast enhancement of conventional radiographs [Wenzel et al, 1991b], and present results indicate that visual inspection, in combination with digital radiographic examination, may provide improved accuracy in occlusal caries diagnosis.

Wenzel, A. and Fejerskov, O.: Validity of diagnosis of questionable caries lesions in occlusal surfaces of extracted third molars. Caries Res, 26:188-194, May-June 1992.

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# Mexican-American parents with children at risk for baby bottle tooth decay: Pilot study at a migrant farmworkers clinic

**Philip Weinstein, PhD**
**Peter Domoto, DDS, MPH**
**Kyoko Wohlers, DDS, MPH**
**Mark Koday, DDS**

Baby bottle tooth decay (BBTD), a term endorsed by the Healthy Mothers - Healthy Babies Coalition, is a disease of young children, characterized by a distinctive pattern of severe tooth decay in the primary dentition. BBTD has been reported for children as young as eleven months. The term itself was selected to emphasize the frequent association of this form of caries with improper feeding practices. The four maxillary incisors are most affected, while the four mandibular incisors usually remain unaffected. Explanations for this pattern identify the pooling of milk or sweetened liquid from the bottle around maxillary incisors and other teeth of a sleeping child as the major etiologic factor. The tongue protecting the lower incisors explains the relative immunity of these teeth to caries. A necessary predisposing factor is the presence of high counts of *S. mutans*, usually transmitted from caretakers to infant. Many articles have identified the clinical appearance and etiology of the disease.[1,2]

Treatment of severe BBTD in very young children often requires the use of general anesthetic. The cost of treatment is high. In 1987, Kelly and Bruerd noted that the USPHS Indian Health Service and Head Start Bureau estimate cost of treating one child to be between $700 and $1000, another $1000 would be needed if hospitalization is necessary.[3] Informal surveys of colleagues across the country indicate that in 1991-92 the cost of treating BBTD is substantially higher than Kelly and Bruerd's estimates. Management procedures for the child less than two and a half years of age require physical restraint, sedation, or general anesthesia.

Numerous data regarding prevalence exist; problems in establishing true prevalence, however, are rife: accessibility and examination of preschool children are difficult and criteria for BBTD may be more or less stringent. Moreover, many samples of children attach various biases to the data, e.g., children examined at maternal and child health facilities.

Researchers have recognized that infant feeding patterns are influenced by cultural and ethnic factors and that results of studies of children within a given culture do not generalize. Results of studies from predominantly western-type cultures found with few exceptions the BBTD prevalence to be approximately 5 percent or less (Ripa, 1988).[2] Disadvantaged children, however, are more vulnerable. Data from Head Start Surveys indicate that 20 percent of our poor urban children in nonfluoridated and 15 percent in fluoridated communities, may be affected.[4,5]

The highest rate of BBTD appears to be from Native-

Dr. Weinstein is Professor, Dental Public Health Sciences; Dr. Domoto is Associate Professor and Chairman, Pediatric Dentistry; and Dr. Wohlers is a Postdoctoral Fellow, Dental Public Health Sciences and Pediatric Dentistry at the University of Washington. Dr. Koday is Dental Director, Yakima Valley Farmworkers Clinic, Toppenish, Washington.

A prevalence rate of 70 percent BBTD occurred in Eskimo children.

American children. Kelly and Bruerd (1987) examined 514 Native-American children at Head Start programs in Alaska and Oklahoma and found the prevalence of BBTD to average over 50 percent.[3] An even higher rate was found in children of the Navaho tribe from Arizona and the Cherokee tribe from Oklahoma: Broderick *et al* (1989) reported an overall prevalence rate of 70 percent.[6] The most disastrous rate was found for Eskimo children: with Albert *et al* (1988) reported over 80 percent of 260 forty-nine-month old children required treatment.[7]

Immigrants are also vulnerable to this disease. It was reported that of two-year-old immigrants, 22.2 percent had caries compared to 4.5 percent of nonimmigrants in Sweden.[8] Even among the disadvantaged group, there are some differences in the risk for developing BBTD. Hispanic children are reported to have significantly higher proportion of nursing caries compared to black children (21 percent vs. 8 percent).[9] Furthermore, children of Hispanic migrant farm workers are reported to have twice the decay rates of general populations.[10] A problem with many of these studies is that the subjects were older Head Start children, between the ages of three and five years. This introduces retrospective and recall bias for studying the problem that manifests itself as early as eleven months of age.

## DESCRIPTIVE STUDIES

Targeting preventive measures for children and their parents/guardians who are at greater risk appears to be a promising strategy; studies of individual differences of children and parents within a given population, with the clear exception of identifying children who sleep with a bottle after age one, however, have been very limited. Dilley *et al* (1980) studied seventy-five BBTD children in North Carolina and found that in almost half of these low-income children the mother was not the caretaker.[11] Mean age of initiation of oral hygiene activities was nineteen months, with a half of the children brushing without supervision. Mean age of discontinuation of the bedtime bottle was twenty-three months. No controls were included. Johnsen (1982) found in a study based in a pediatric dental clinic in a medical center in rural Morgantown, West Virginia that parents of children with no carious incisors, compared to parents of children with carious incisors, were more likely to be aware of potential problems sleeping with a bottle.[12] Forty percent of the parents of children with incisor lesions, however, were also aware of potential problems. Eighty-one percent of parents in this group had attempted substitution of water, 68 percent of them unsuccessfully. While ratings of general activity or curiosity were not associated with disease, perhaps because of technical problems with the scale, parents of caries-free children were more likely to give a higher rating to their ability to say "No" to the child when necessary. Children with lesions were also more likely to have parents who were obese and themselves were more likely to have a significant medical condition. In all, this important study provided the initial evidence that providing the parents with information often is not sufficient to change their parenting behaviors. In fact, these parents may have difficulty in managing both their own and their child's lifestyle-related behaviors.

In a 1984 study, Johnsen *et al* again found that simply making parents aware of BBTD may not lead to a successful outcome.[5] Results also indicated that children with smooth surface caries were more likely to be cared for by grandparents and were more likely to have mothers who permitted eating sweets without restrictions than in the case of caries-free children. Marino *et al* (1989), in a recent urban investigation, reported the results of twenty-four consecutive BBTD patients in a private pediatric dental office; controls were children receiving routine pediatric care at a University-based clinical office.[13] Children with BBTD were more likely to be living in a single parent household and reported a higher incidence of sleep difficulties and a strong child temper. BBTD cases also reported less professional advice as well as less fluoride supplementation. This was the first study that specifically implicated sleep problems in the etiology of BBTD.

## INTERVENTION STUDIES

The literature provides many suggestions for preventing BBTD. These strategies focus on information despite the findings of the modest success of this as a stand-alone approach. Prenatal classes; orientations at dental (and medical) visits at about twelve months of age, the critical time for prevention of BBTD and a naturally occurring time for discontinuing bottle feeding; and even Head Start programs with older children are all promoted.[1,14,15] Unfortunately, few programs are evaluated; even short-term and controls of any sort are almost nonexistent.

Only one study attempted to intervene within Native American and Alaska native communities. Bruerd *et al* (1989) developed intervention methods that combined training of volunteer parents, health professionals, and child caretakers with a media campaign for twelve Native American communities.[16] While in four years an overall decrease in BBTD prevalence from 57 percent to 43 percent was reported for Head Start children, controls were lacking.

Few studies attempted to target and identify high-risk children and their parents/caretakers. Most recommendations and intervention have focused on providing all parents/caretakers with the same information. On the other hand, Johnsen (1988) noted the heightened risk for children who sleep with the bottle beyond age one and who have a parent, especially the mother (or perhaps more appropriate for some subcultures "the caretaker"), who has a history of a high caries-rate.[1] Johnsen (1988) notes that the parent who is aware of the risk and allows the child to sleep with a bottle "presents a different challenge.[1] The role of the dentist (health care professional) then becomes one of behavior modifier." We concur with this approach and believe that, while the descriptive literature provides hints concerning strategies that may be efficacious, little work has been accomplished.

While the importance of weaning at one year is often stated, the dental literature offers the parent/caretaker little actual help in managing this problem. Johnsen (1988) recommends that the parent sign a contract to get the child off the bottle within a month and that parents be counseled to anticipate and tolerate "several nights of crying through much of the night."[1] As an alternative he recommends sequential dilution of bottle contents over a two- or three-week period, realizing that immediate substitution of water is not acceptable to the child. Johnsen notes weaning at one year, however, may not be culturally appropriate for many high-risk families.

**Parental awareness of BBTD does not assure a successful outcome.**

Rather than promote weaning, it may be more productive to help the parent/caretaker disassociate nursing from sleeping behaviors. While the association of nursing and sleeping is considered a sleep disorder, it is not difficult to treat.[17] Ferber's recommendations are to decrease gradually (and for some to water down) the amount of milk or juice the child takes when falling asleep. "Cold turkey" is not a reasonable alternative. Crying is managed by allowing the child to cry for a little longer each day until he or she falls asleep without nursing and without much fussing.[18] Some children respond well to back rubbing or rocking during this process. Other psychological interventions are possible. Mothers and caretakers of at-risk children may benefit from developing both behavior change and self-management skills. These caretakers report permissive behaviors and seem to view child behavior as difficult to change (how do you alter temperament?). They may have difficulty controlling weight and have other life-style related problems that require self-control or self-regulation. It would not be far fetched to believe that they have difficulty managing stressful situations, i.e., demands made by a crying child, and perhaps an impatient spouse. It is believed by the authors that caretakers may benefit from the mastery of a few simple stress management strategies.

While noting the inability of many parents/caretakers of BBTD children to manage effectively their own and/or their children's problem behaviors, there have been no recommendations or studies aimed at this problem. It may not be necessary to insist on weaning

at one year, a process that may fly in the face of subcultural or cultural norms and/or may prove to be very difficult for the single parent/caretaker with a difficult (defined by temperament or illness) child. In fact, it may be that when individuals do not comply with professional recommendations, "They are in compliance with other social, emotional, or economic factors more central to well-being..."[19] Moreover, given the above difficulties of parents/caretakers in modifying their childrearing practices to lower the risk of BBTD, it is surprising that there is a paucity of professionally applied interventions. Köhler *et al* (1982) have reduced high salivary counts of *S. mutans* in mothers by a program consisting of dietary counseling, professional tooth-cleaning with a fluoride-containing prophylaxis paste, oral hygiene instruction, topical fluoride application, at-home use of sodium fluoride mouth rinse, the treatment of large cavities, and in some cases the use of a chlorhexidine gel daily for two weeks.[20]

At present we have limited knowledge of effective interventions for individuals from populations where BBTD is of epidemic proportions. Before development and testing of an intervention-strategy, it is necessary to study a targeted sample of individuals from a high-risk population(s). Given that ethnic, cultural, and economic factors are influential in determining childrearing practices, especially in regard to infant feeding practices, it may be important to study a specific high-risk group before intervening to better understand risk factors and to better formulate acceptable intervention.[6,21,22]

## METHOD

Subjects for this pilot study were parents and caretakers who enrolled a child less than four years of age in a Women Infant Children (WIC) or Maternal Child Health (MCH) program for migrant families in the Yakima Valley of central Washington.[23] These farmworkers are of Mexican descent, and many of them are recent immigrants. One hundred twenty-five children, eight* to forty-seven months, and their parents/caretakers participated.

All subjects were interviewed at the Yakima Valley Farmworkers Clinic by one of two trained bilingual interviewers. Interviewers were trained in interview skills, utilizing a training videotape made explicitly for this purpose.

The interview instrument attempted to assess demographic variables, child caretaking behaviors relevant to feeding and sleeping, knowledge and belief about BBTD, and willingness to comply with possible BBTD intervention strategies. Self-assessment of the dental health of child and caretaker, self-regulation questions, and the short form of the Parental Stress Index (Spanish version) were included.[24,25] The interview instrument was translated into Spanish and back-translated in English for accuracy. Interviews were given in the language of the subject's choice. The interview took about forty-five minutes to administer. Immediately afterwards, each child was examined by a dentist with a mouth mirror, while seated in a dental chair with dental light. All the dental examinations were done by the author Mark Koday. Children were classified to have BBTD if two or more anterior teeth were decayed.

## RESULTS

Overall, 37 of 125 children (29.6 percent) were found to have BBTD. Table 1 presents demographic information from the sample studied. The age of the baby was related to disease status, BBTD babies being older (33.0 months) than non-BBTD babies (25.3 months). Compared to non-BBTD babies, BBTD babies also had mothers with more education, a greater percentage, for example, having completed high school (16.2 percent vs. 11.6 percent).

The results of baby care questions are presented in Table 2. Less help with child care was found to be associated with BBTD. Surprisingly, the identity of the caregiver was important. Babies fed by other than mother and father in the P.M. were less likely to have BBTD; father putting baby to sleep during workdays was associated with BBTD. Giving the bottle to aid sleep and propping up the bottle were related to BBTD.

Table 1 ☐ Demographics of farmworker sample.

| Variable | Total | BBTD | No BBTD |
|---|---|---|---|
| Sex (female) | 56.0% | 59.5% | 54.5% |
| Baby's age (mos)** | 28.2 | 33.0 | 25.3 |
| Mother's age (yrs) | 25.9 | 25.2 | 26.2 |
| Father's age (yrs) | 30.2 | 29.8 | 30.5 |
| Number of persons in the household | 5.4 | 5.2 | 5.5 |
| Current address in months | 34.7 | 27.4 | 37.7 |
| Spanish preferred | 66.1% | 59.5% | 69.0% |
| Mother born in Mexico | 65.8% | 60.0% | 68.2% |
| Father born in Mexico | 82.3% | 81.8% | 82.5% |
| Single family in residence | 73.0% | 81.1% | 70.5% |
| Marital status (single mother) | 45.2% | 48.6% | 43.7% |
| Mother's education (completed highschool)* | 13.0% | 16.2% | 11.65 |

* Differences significant at 05 level.
** Differences significant at .001 level.

*This eight-months-old case is one of the youngest reported of having BBTD.

Table 2 ☐ Baby care questions.

| Variable | BBTD | No BBTD | Test statistics |
|---|---|---|---|
| Hours of help caring for baby | 23 | 41 | $t = -2.50$, $p = .03$ |
| Baby fed by other than parent in PM | 0% | 10.5% | $X^2 = 4.56$, $p = .05$ |
| Father puts baby to sleep workdays | 13.9% | 3.4% | $X^2 = 4.56$, $p = .03$ |
| Father puts baby to sleep weekends | 13.9% | 8.0% | $X^2 = .987$, $p = .32$ |
| Giving bottle as baby falls asleep | 77.1% | 46.5% | $X^2 = 13.24$, $p = .00$ |
| Bottle propped up | 63.9% | 47.7% | $X^2 = 3.67$, $p = .05$ |
| Age bottle stopped (less than 1 year) | 8% | 30% | $X^2 = 10.32$, $p = .06$ |

Table 3 ☐ Baby and parent characteristics.

| Variable | BBTD | No BBTD | Test statistics |
|---|---|---|---|
| Baby | | | |
| Easy-going | 89.2% | 75.0% | $X^2 = 3.18$, $p = .07$ |
| Strong-willed | 70.3% | 86.4% | $X^2 = 4.49$, $p = .03$ |
| Sucks pacifier or thumb | 6.1% | 29.8% | $X^2 = 8.40$, $p = .00$ |
| Hours of sleep | 8.43 | 9.29 | $t = -3.21$, $p = .00$ |
| Parent | | | |
| Self-control (1 = very much like me, 5 = very much unlike me) | | | |
| Need help to stick to diet | 3.09 | 2.20 | $t = 2.44$, $p = .02$ |
| Like to write down baby's height, weight, day he first spoke, etc. | 2.64 | 3.43 | $t = 2.10$, $p = .05$ |
| Can ignore baby's urging when I have to | 2.79 | 3.44 | $t = -1.72$, $p = .08$ |
| Parenting Stress Index items (1 = strongly agree, 5 = strongly disagree) | | | |
| Don't enjoy things as used to | 4.33 | 3.72 | $t = 2.02$, $p = .05$ |
| My child does things to bother me just to be mean | 3.46 | 4.46 | $t = -3.42$, $p = .00$ |
| My child acts strongly when something happens he dislikes | 2.60 | 3.47 | $t = -2.31$, $p = .02$ |

Table 4 ☐ Dental questions.

| Variable | BBTD | No BBTD | Test statistics |
|---|---|---|---|
| Awareness of baby dental problems | 91.4% | 20.9% | $X^2 = 50.98$, $p = .00$ |
| Remember being told about BBTD | 66.7% | 84.5% | $X^2 = 4.63$, $p = .03$ |
| When told about BBTD (before birth) | 52.2% | 61.3% | $X^2 = 13.17$, $p = .00$ |
| Bottle used now | 32.4% | 54.5% | $X^2 = 5.1$, $p = .02$ |
| Baby has own brush | 77.85 | 48.8% | $X^2 = 8.69$, $p = .00$ |
| Baby has own toothpaste | 62.9% | 42.4% | $X^2 = 4.17$, $p = .04$ |
| Mother cleans child's teeth | 78.1% | 44.0% | $X^2 = 10.81$, $p = .00$ |
| Mother's last visit to dentist in years | 2.8 yrs | 1.4 yrs | $t = 2.14$, $p = .04$ |

Table 5 ☐ Ratings of unlikely/likely to follow specific recommendations. (1 = very unlikely, 5 = very likely)

| Recommendation | BBTD X (SD) | No BBTD X (SD) |
|---|---|---|
| A. Immediately substitute cup for bottle for all feedings | 3.62 (1.93) | 4.40 (1.40)* |
| B. Substitute cup slowly, once a day for first week | 3.71 (1.90) | 4.15 (1.64) |
| C. Water down milk or juice slowly | 4.10 (1.66) | 4.16 (1.63) |
| D. Substitute artificial sweetener for sugar | 4.07 (1.65) | 4.10 (1.68) |
| E. Immediately cut out nighttime feedings, even if baby cries | 4.07 (1.62) | 3.94 (1.76) |
| F. Slowly reduce amount in nighttime bottle and increase time between feedings | 3.97 (1.72) | 4.20 (1.59) |
| G. Put fluoride drops in bottle once a day | 3.93 (1.77) | 3.96 (1.76) |

* t value significant at .021 level

Not weaning at an early age was also found to be related to BBTD.

Table 3 presents results of questions assessing baby and parental characteristics. Babies with BBTD were viewed as more easy-going and less strong-willed than those children with no BBTD. BBTD babies were viewed, however, as reacting more strongly in a disagreeable situation than non-BBTD babies; similarly, BBTD babies are said to harass their caretakers more than non-BBTD babies. Non-BBTD babies were also reported to suck a pacifier or thumb much more frequently and to sleep slightly more hours (8.4 vs. 9.3 hours a day).

Non-BBTD parents reported a stronger feeling of being trapped by responsibilities as a parent than BBTD parents. Non-BBTD parents also noted a greater lack of enjoyment of life than BBTD parents. BBTD parents indicated they needed more help sticking to a diet than non-BBTD parents and that they were more likely to keep records of baby's height, weight, etc.

BBTD parents reported a greater ability to ignore baby crying when they have to than non-BBTD parents.

Table 4 presents the results of dentally related questions. Over 90 percent of BBTD parents and 20 percent of non-BBTD parents were aware of their babies' dental problems. Two thirds of BBTD parents and 84.3 percent of non-BBTD parents remembered previous information about the consequences of putting the baby to sleep with a bottle. The BBTD group reported that they learned about BBTD when the child was older. For example, 52.2 percent of the BBTD group and 61.3 percent of the non-BBTD group were told about BBTD before the birth of the child.

BBTD parents report less frequent use of the bottle (32.4 percent) than non-BBTD parents (54.5 percent). BBTD parents also profess to clean the child's teeth regularly (62.9 percent for BBTD vs. 44.0 percent for non-BBTD parents). Similarly, BBTD parents report baby has his/her own brush and uses toothpaste at a much greater rate than non-BBTD parents.

BBTD parents visited a dentist on average 2.8 years ago, while non-BBTD parents reported 1.4 years between visits.

Table 5 presents the similarity of BBTD and non-BBTD parents in following a range of recommendations to "help the baby keep his or her front teeth from becoming decayed and toothachy." Only one difference was manifest for the seven recommendations: BBTD parents were less likely than non-BBTD parents to substitute immediately the cup for the bottle for all feedings.

## DISCUSSION

Mexican-American farmworkers face multiple postimmigration stresses associated with acculturation. While childrearing practices are culturally determined, they are often modified during this stressful process of acculturation. Results of this study suggest that when Mexican-American mothers receive more help in child care their babies have less BBTD. This finding is buttressed by the finding that Hispanics, especially those who are less acculturated, rely on family support to lessen the impact of stress.[26] The identity of the caregiver, however, is important. When the baby is fed in the evening by someone other than mother or father, the baby is less likely to have BBTD. It may be that this other person is careful not to give the bottle while the baby falls asleep, or to prop the bottle, both practices found to be associated with BBTD in the study. On the other hand, when the father puts the baby to sleep in the evening, he may be less knowledgeable about BBTD or less skilled in putting the child to sleep without reliance on bottles. It is interesting that this relationship was found for week nights and not for weekends, when the father may have more interest or energy.

The temperament of the baby presents puzzling results. While babies who are reported to be more easygoing and less strong-willed were found to have BBTD, those babies with BBTD were also viewed as reacting strongly "when something happens that my child doesn't like" and as doing "things that bother me just to be mean." Such seemingly contradictory observations may make more sense in light of parent-child management practices. Busy and stressed parents may not attend to children who are not usually demanding. Such children may react very strongly, however, when frustrated by inconsistent and inattentive childrearing practices and may respond by engaging in negative attention-seeking behavior. This interpretation is supported in part by the finding that parents of BBTD children are more able to ignore baby's crying, when they have to.

Results indicate that parents whose children do not have BBTD face greater stress and perhaps even depression. Those parents who wean at an early age and do not provide nighttime bottles must face the wrath of the baby. The price of following the childrearing practice of the new culture is high. Moreover, the dominant Anglo culture provides few alternatives.[27] Usually, the health providers recommend the substitution of a cup for a bottle at one year with no exceptions. The common-sense alternative of substituting water for cariogenic liquid is not likely to be of much help. Johnsen (1982) found that while the majority of parents of children with lesions reported they had attempted substitution, 68 percent were unsuccessful.[12] It appears that BBTD parents are much less willing to expose themselves to the stress of early weaning and sleeping without the bottle. In not following the health providers recommendations they reap other benefits, e.g., sleep, lack of conflict, etc. It may now not be so surprising to note the greater maternal education was associated with BBTD; overall education levels, however, were very low (16.2 percent completed high school in BBTD group; 11.6 percent for non-BBTD group). Nationally, the percent of Mexican-American mothers completing high school is 19.3.[28] This finding is contrary to that of Johnsen *et al* (1984), where Head Start mothers of caries-free children were more likely to have completed high school than mothers of children with smooth-surface lesions.[5] Other studies have agreed with Johnsen's findings.[29-31]

These responses may indicate that BBTD parents may require special support, in order to achieve behavior change objectives. Health professionals who are interested in altering feeding patterns in infants and toddlers must realize that any change in feeding routine will affect the entire household or family system. A change in the child's feeding routine will initiate other changes that will affect nearly every member of the family system. Some of these effects will be viewed as at least disruptive, and certainly some of the effects will be judged as unacceptable, and ultimately the change in the child's feeding pattern will be rejected. Parents are aware that there are substantive decisions to be made regarding child rearing and dental caries. They are also aware that not all babies who use a nursing bottle at night get BBTD. Caries as an infection of multifactorial etiology has a relatively long "incubation" period between its initiation and the observed cavitation of enamel. Parents and caretakers may be lulled into complacency, therefore, during this incubation period. The parents may have also perceived that the particular nursing-bottle-feeding practice has resulted in a "quieter baby, healthier baby" etc. Thus, parents may be left with the dilemma of risking dental disease, if a perceived beneficial feeding pattern is maintained. We believe that parents often choose to take the "gamble" and continue the dentally problematic behavior, in lieu of altering the feeding pattern. Obviously, the "cost" of changing the behavior is deemed excessive in light of the disruption and upset in the household that it would cause. Given the infrequent

contact with dentists that the average of a visit every 2.8 years implies, these parents are simply making the best choice available to them.

We believe that future interventions to prevent and reduce the damaging sequelae of BBTD should include effective professionally supervised therapies that do not depend on parent or patient compliance and behavioral interventions that are presented as a menu of alternatives from which parents can choose. We propose that topical applications of fluoride and chlorhexidine hold great promise for preventing BBTD for infants at high risk for the disease. In addition, parents of these high-risk children should choose one or more behavioral approaches which they would be willing to initiate within their household. Parents who are allowed to choose from a number of practical and effective behavioral interventions would be more likely to agree to comply over time. Obviously, both the "hands-on" professional intervention and the household intervention will require considerable support and structure. Contracting, reminders, contingency management and other proven aids to behavioral change may prove useful. The high risk parent can be guided through these difficult childrearing tasks.

In order to solve behavioral problems and to change habits that are health-related, individuals need self-control skills.[32,33] BBTD parents indicated that they need help in sticking to a diet and that they like to write down baby's height, weight, etc. These responses may indicate that BBTD parents may need and may respond to pragmatic assistance in coping with the dilemma of either upsetting baby, who disrupts the household, in an attempt at preventing dental disease or allowing traditional placating childrearing practice to result in disfiguring dental disease. At present BBTD parents seem to opt for the latter alternative: they choose to manage the sequela of the disease. After the child has the disease they clean his or her teeth and profess to stop using the bottle. To our way of thinking, they close the barn door too late; we doubt they believe that metaphor applies, given the low dental IQ that visits every 2.8 years implies; they are simply making the best choice possible. On the other hand, a program that offers viable (and tested) alternatives to approaches that are not too unattractive to choose may prove to be successful. Such programs must provide considerable support and structure, i.e. step-by-step procedures with forms to check off and reminders. The high risk parent can be guided through this difficult childrearing task.

It must be noted that this is a pilot study, with relatively small numbers of subjects and a large number of significance tests. Clearly, this work must be replicated. In addition, BBTD children were found to be older than those for whom we locate non-BBTD. It may be that a more limited age-range should be studied; the wide age-range may contribute to mask findings, as some younger children in the non-BBTD group will acquire BBTD as they mature.

**REFERENCES**

1. Johnsen, D.C.: Baby bottle tooth decay: a preventable health problem in infants. Update in Pediatric Dentistry, II:1-6, 1988.
2. Ripa, L.W.: Baby bottle tooth decay (nursing caries: a comprehensive review). American Public Health Association, 1988.
3. Kelly, M. and Bruerd, B.: The prevalence of baby bottle tooth decay among two Native American populations. J Public Health Dent, 47:94-97, 1987.
4. Holt, R.D. *et al*: Caries in pre-school children: the Camden study. Br Dent J, 153:107-109, 1982.
5. Johnsen, D.C. *et al*: Caries patterns in Head Start children in a fluoridated community. J Pub Health Dent, 44:61-66, 1984.
6. Broderick, E. *et al*: Baby bottle tooth decay in Native American children in Head Start centers. Pub Health Reports, 104:50-54, 1989.
7. Albert, R.J. *et all*: Nursing caries in the Inuit children. Can Dent Assoc J, 54:751-768, 1988.
8. Wendt, I.-K.; Hallonstein, A.-L. and Koch, G.: Dental caries in one- and two-year-old children living in Sweden. Swed Dent J, 15:1-6, 1991.
9. Hardwick, F.K.; McIlveen, L.M.; Forrester, D.J.: A comparison of nursing caries prevalence in Black and Hispanic children. Abstract, AAPD, 1991.
10. Koday, M.: Yakima Valley Oral Health Status Survey. Unpublished manuscript, 1990.
11. Dilley, G.J. *et al*: Prolonged nursing habit: a profile of patients and their families. J Dent Child, 47:102-108, 1980.
12. Johnsen, D.C.: Characteristics and backgrounds of children with "nursing caries." Pediatric Dentistry, 4:218-224, 1982.
13. Marino, R.V. *et al*: Nursing bottle caries: characteristics of children at risk. Clinical Pediatrics, 28:129-131, 1989.
14. Goepferd, S.J. *et al*: Infant oral health: a protocol. J Dent Child, 53:261-266, 1986.
15. Phillips, M.G. and Stubbs, P.E.: Head Start combats baby bottle tooth decay. Children Today, 16:25-28, 1987.
16. Breurd, B. *et al*: Preventing baby bottle tooth decay in American Indian and Alaska Native communities. Public Health Reports, 104:631-640, 1989.
17. Ferber, R.: Solve your child's sleep problems. New York: Simon and Schuster, 1985.
18. Rolider, A. and Van Houton, R.: Training parents to use extinction to eliminate nighttime urging by gradually increasing the criteria for ignoring urging. Education and Treatment of Children, 7:119-124, 1984.
19. Gallatin, S. *et al*: An approach to the resolution of Mexican-American resistance to diagnostic oral remedial pediatric heart care. In: *Clinically applied anthropology* Chrisman, N.J. and T.W. Maretzki (eds). D. Reidel Publishing Co.,1982, pp 225-350.
20. Kohler, B. *et al*: Effects of caries preventive measures on *Streptoccus mutans* and lactobacilli in selected mothers. Scand J Dent Re, 90:102-108, 1982.
21. Bryant, C.A.: The impact of kin, friend, and neighbor networks on infant feeding practices: Cuban, Puerto Rican and Anglo families in Florida. Soc Sci and Med, 16:1757-1765, 1982.
22. Baranowski, T. *et al*: Attitudes toward breastfeeding. J Dev Behav Pediatr, 7:367-377, 1986.

23. Koday, M.; Rosenstein, D.I. and Lopez, G.M.N.: Dental decay rates among children of migrant workers in Yakima, WA. Public Health Rep, 105(5):530-533, 1990.
24. Abidin, R.R.: *Parenting stress index: short form test manual.* Charlottesville, Va.: Pediatric Psychology Press, 1990.
25. Loyd, B.H. and Abidin, R.R.: Revision of the Parenting Stress Index. J Ped Psychol, 10:169-177, 1985.
26. Taylor, V. *et al*: The influence of acculturation upon the adjustment of preschool Mexican-American children of single-parent families. Family Therapy, 13:249-256, 1986.
27. Wright, A.L. *et al*: Infant-feeding practices among middle-class Anglos and Hispanics. Pediatrics, 82:490-503, 1988.
28. Ventura, S.J. and Taffel, S.M.: Child bearing characteristics of U.S. and foreign-born Hispanic mothers. Public Health Reports, 100:647-652, 1985.
29. Koch, G. and Martinsson, T.: Socio-odontologic investigation or school children with high and low caries frequency. I. Socioeconomic background. Odontol Rev, 21:207-228, 1970.
30. Stadt, Z.M. *et al*: Socio-economic status and dental caries experience of 3911 five-year-old natives of Contra Costa, California. J Public Health Dent, 27:2-6, 1967.
31. Zodils, D.: Epidemiology of dental caries in 5-year-old children in Israel. Comm Dent Oral Epidemiol, 6:91-96.
32. Rosenbaum, M.: A schedule for assessing self-control behaviors: preliminary findings. Behav Ther, 11:109-121, 1980.
33. Rosenbaum, M.: Self-control under stress: the role of learned resourcefulness. Adv Behav Res Ther, 11:249-258, 1989.

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## BREAST-FED CHILDREN WITH RAMPANT CARIES

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

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

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# Prevalence of dental caries in school children in Al-Khobar, Saudi Arabia

**Gadi Magbool, MD**

Dental caries ranks among the most significant of human diseases, because of its high prevalence. Although the prevalence is increasing in developing countries, over 95 percent of the population in developed countries are also affected.[1-4] The objective of this study was to collect base-line data on the prevalence of dental caries among school children in Al-Khobar. It will be argued that the inspection of children's teeth should become part of routine clinical examinations by pediatricians.

## MATERIALS AND METHODS

A cross-sectional survey was conducted in Al-Khobar, a town in the Eastern Province of Saudi Arabia with a population of approximately 100,000. A multistage sampling plan was used to select randomly fourteen schools for boys and fourteen schools for girls, and then two classes from each grade. Dental examination was conducted by two independent observers who calibrated themselves against each other and found minimal observer variation.

Using natural light, simple mouth mirror, and number 23 explorer, all teeth were examined without first attempting to dry or clean them. Standard definitions were employed. The decayed-missing-filled-teeth index was used as a measure of existing dental pathology.[5] Similarly, "care index of dentition" was taken as the percentage of filled teeth in relation to the total number of decayed-missing-filled teeth.

## RESULTS

From the twenty-eight randomly selected schools, a total of 43,634 teeth in 1,665 pupils were examined. Figure 1 shows their distribution by age-group, sex, and nationality; 79.3 percent were Saudis. Table 1 shows the distribution of the 43,634 teeth examined; 35.5 percent of the primary, and 13.6 percent of the permanent teeth were either carious, missing, or filled. Table 2 gives the average number of teeth per child for each age-group. For the whole sample, only 12.5 percent were caries-free. The average number of decayed teeth per child was 1.97 and 1.60 for permanent and primary teeth, respectively. The rate of decay for permanent teeth increased with age from 0.48 in six- and seven-year-olds to 4.03 in the sixteen- and seventeen-year-olds (Figure 2), while carious primary teeth decreased with age from 3.6 to almost nil (0.01) in the same age-groups (Figure 3). The average number of filled teeth per child was only 0.21 and 0.20 for permanent and primary teeth, respectively.

Total values for decayed-missing-filled teeth were as follows. For permanent teeth, there was a steady rise with increasing age from 0.78 in the six- and seven-year-olds to 4.59 in those who had reached sixteen and seventeen years of age. In contrast, for the primary teeth, the highest total dmft value, 5.11, occurred in

I thank the administrators and the pupils of all twenty-eight schools for their cooperation, and Drs. Hussein Zaki and G. Absood for technical advice.

Dr. Magbool is Associate Professor in Pediatrics, King Faisal University, College of Medicine and Medical Sciences, P.O. Box 2114, Dammam 31451, Saudi Arabia.

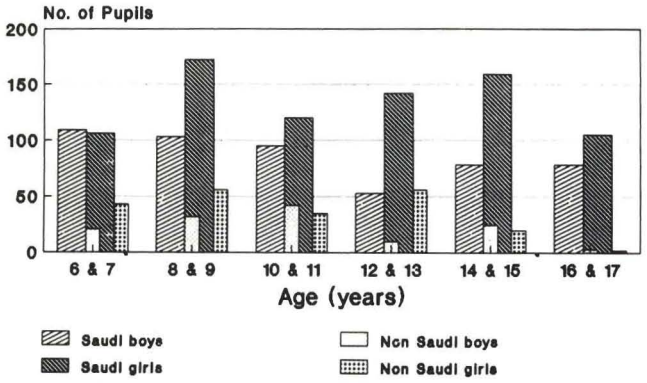


*Figure 1. Distribution by age, sex, and nationality in 1,665 school children surveyed.*

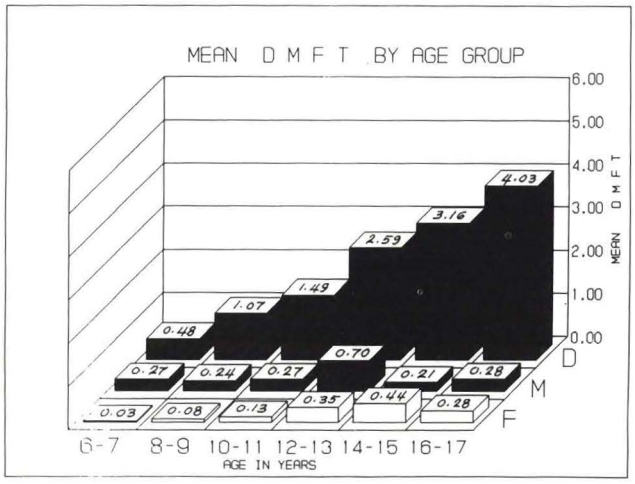


*Figure 2. Mean DMFT (Decayed-Missing-Filled-Teeth) index by age-group.*

the six- and seven-year age-group, and the lowest, 0.03, in the oldest age-group.

The distribution of individual teeth according to their condition (sound, decayed, missing, or filled) is shown in Tables 3 and 4. For primary teeth, the anterior teeth had the fewest caries lesions. Maxillary anterior teeth had consistently higher caries-rates, however, compared with mandibular teeth. Mandibular molars had a higher caries-rate than maxillary molars. The second primary molars had the highest incidence of caries-attack, while the mandibular incisors had the lowest. For individual permanent teeth, anterior teeth were the soundest and the mandibular molars were the most frequently attacked by caries, especially the first molars, which had the highest incidence of caries-attack. The care indices for primary and permanent teeth of this survey were 8.5 percent and 8.4 percent, respectively.

Table 1 ☐ Total number of sound, decayed (d), missing (m), and filled (f) teeth examined.

| Teeth | Dentition: Primary Sound | Primary dmft | Permanent Sound | Permanent DMFT | Grand totals |
|---|---|---|---|---|---|
| Maxillary | 4494 | 2001 | 13,346 | 1919 | 21,760 |
| Mandibular | 3446 | 2369 | 13,727 | 2332 | 21,874 |
| Totals | 7940 | 4370 | 27,073 | 4251 | 43,634 |
| Percentages | 64.5 | 35.5 | 86.4 | 13.6 | 100 |

Table 2 ☐ Distribution of average of teeth per child under various conditions, by age.

| | Age (years) 6&7 | 8&9 | 10&11 | 12&13 | 14&15 | 16&17 | All |
|---|---|---|---|---|---|---|---|
| No. of Pupils | 279 | 363 | 292 | 261 | 282 | 188 | 1665 |
| Permanent | | | | | | | |
| Sound | 5.72 | 10.05 | 14.85 | 21.75 | 23.66 | 23.15 | 15.79 |
| Decayed | .48 | 1.07 | 1.49 | 2.59 | 3.16 | 4.03 | 1.97 |
| Missing | .27 | .24 | .27 | .70 | .21 | .28 | .32 |
| Filled | .03 | .08 | .13 | .35 | .44 | .28 | .21 |
| Primary | | | | | | | |
| Sound | 11.48 | 7.91 | 4.67 | .81 | .12 | .11 | 4.63 |
| Decayed | 3.60 | 2.89 | 1.73 | .35 | .04 | .01 | 1.60 |
| Missing | 1.11 | 1.33 | 1.27 | .30 | .08 | .02 | .76 |
| Filled | .40 | .44 | .24 | .03 | .02 | .00 | .20 |
| Unerupted | 4.92 | 3.99 | 3.35 | 1.12 | .27 | .12 | 2.52 |
| Totals | 28 | 28 | 28 | 28 | 28 | 28 | 28 |

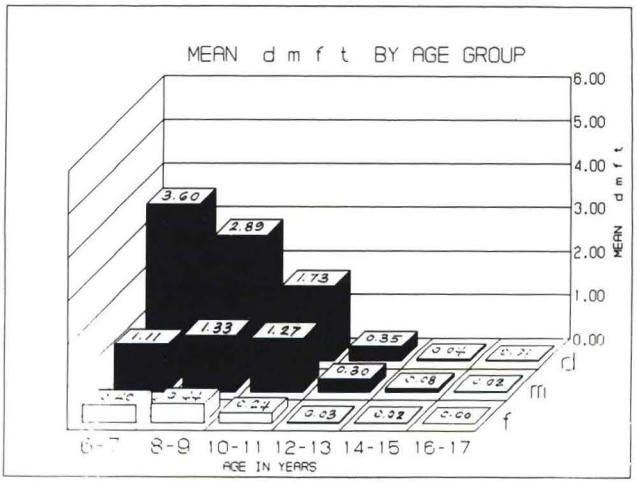


*Figure 3. Mean dmft (decay-missing-filled-teeth) index by age-group.*

## DISCUSSION

Dental caries is one of the most prevalent chronic diseases of man. Once it occurs its manifestations persist for life. There are few published reports on the assessment of dental pathology, however, in Saudi Arabia.

Table 3 ☐ Sound and dmft* index for each primary tooth.

| | Central Incisor | Lateral Incisor | Canine | 1st Molar | 2nd Molar | Totals |
|---|---|---|---|---|---|---|
| Maxillary teeth | | | | | | |
| Sound | 281 | 706 | 1573 | 981 | 953 | 4494 |
| Decayed | 79 | 76 | 121 | 376 | 641 | 1293 |
| Missing | 60 | 143 | 90 | 169 | 107 | 569 |
| Filled | 0 | 0 | 2 | 55 | 82 | 139 |
| Totals | 420 | 925 | 1786 | 1581 | 1783 | 6495 |
| Mandibular teeth | | | | | | |
| Sound | 147 | 438 | 1385 | 706 | 770 | 3446 |
| Decayed | 7 | 14 | 110 | 576 | 707 | 1414 |
| Missing | 28 | 55 | 135 | 293 | 213 | 724 |
| Filled | 0 | 0 | 7 | 87 | 137 | 231 |
| Totals | 182 | 507 | 1637 | 1662 | 1827 | 5815 |

* d = decayed; m = missing; f = filled; t = teeth.

Table 4 ☐ Sound and DMFT* index for each permanent tooth.

| | Central Incisor | Lateral Incisor | Canine | 1st Premolar | 2nd Premolar | 1st Molar | 2nd Molar | Totals |
|---|---|---|---|---|---|---|---|---|
| Maxillary teeth | | | | | | | | |
| Sound | 2952 | 2404 | 1595 | 1746 | 1520 | 2160 | 969 | 13346 |
| Decayed | 22 | 34 | 8 | 70 | 98 | 932 | 338 | 1502 |
| Missing | 27 | 59 | 34 | 17 | 16 | 45 | 106 | 304 |
| Filled | 3 | 2 | 1 | 10 | 6 | 83 | 8 | 113 |
| Total | 3004 | 2499 | 1638 | 1843 | 1640 | 3220 | 1421 | 15265 |
| Mandibular teeth | | | | | | | | |
| Sound | 3233 | 2899 | 1773 | 1720 | 1472 | 1774 | 856 | 13727 |
| Decayed | 7 | 6 | 7 | 27 | 84 | 1204 | 517 | 1852 |
| Missing | 2 | 12 | 7 | 12 | 32 | 100 | 69 | 234 |
| Filled | 0 | 0 | 0 | 3 | 9 | 187 | 47 | 246 |
| Total | 3242 | 2917 | 1787 | 1762 | 1597 | 3265 | 1489 | 16059 |

* D = Decayed; M = Missing; F = Filled; T = Teeth.

Reports from Riyadh, Saudi Arabia, showed that 78 percent and 68 percent of the populations surveyed had caries; our figure was 87.5 percent.[6,7]. A prevalence of dental caries of 68 percent and a DMFT index of 2.0 would place the district of Riyadh in the category of "low caries level", along with Egypt, and Iraq.[7,8] Unfortunately, there are scant recent dental epidemiological surveys from other Middle East countries.

This study also confirms that dental caries is a progressive disease and its prevalence increases with age. The permanent first molars contributed more than 60 percent of the caries in the permanent teeth, while the second primary molars contributed 50 percent in the primary teeth.

The DMFT scores for the school children surveyed in Al-Khobar are higher than those reported in the literature, including the *World Health Organization* goal of "health for all by the year 2000", which recommends a DMFT score of not more than 3.00 for twelve-year-olds.[1-5,7-9] Furthermore, with only 12.5 percent of the school children free of caries, our population is far below the WHO goal of 50 percent, for that age-group. Unfortunately, the goals of the WHO pertaining to dental caries exclude a minimum of dental care services.

In this study, the care index, which expresses the extent of restorative treatment done in a given group, was about 8 percent for both primary and permanent teeth. This value is low, and reflects either very low interest in dental care, or unavailability of dental services for school children, or both.

It is concluded that dental caries is a major problem among school children in the Al-Khobar area, and presumably, therefore, in the Eastern Province of Saudi Arabia. Since a significant decrease of the DMFT index in primary schools can be achieved through appropriate dissemination of dental health information the need to plan and implement preventive dental health programs in our schools is emphasized.[10,11] It is suggested that dental health education should be directed to this target population, to encourage them to adopt habits and attitudes essential for optimal dental health.

Furthermore, studies have shown that most Saudis visit physicians' office and that, in contrast, only a small percentage visit dentists' office. It is the primary responsibility of the medical profession in general and pediatricians in particular, therefore, to advise and educate parents in order to intercept and prevent the ravages of dental decay. Examination of teeth should become a routine part of the general medical examination, especially in the schools. Furthermore more attention should be directed to oral health by all concerned with health delivery, including school health authorities.

**REFERENCES**

1. Hlece, L.A. and Haugejorden, O.: The rise and fall of dental caries: Some global aspects of dental caries epidemiology. Community Dent Oral Epidemiol, 9:294-299, December 1981.
2. Sheiham, A.: Changing trend in dental caries. Int J Epidemiol, 13: 142-147, June 1984.
3. Greene, J.S. and Suomi, J.D.: Epidemiology and public health aspects of caries and periodontal disease. J Dent Res, Special Issue C, 65:20-26, 1977.
4. Barmes, D.E. and Infirri, J.S.: WHO activities in oral epidemiology. Community Dentistry and Oral Epidemiology, 5:22-29, January 1977.
5. World Health Organization: *Oral health surveys: Basic methods* (2nd ed.). Geneva: WHO, 1977, pp 1-36.
6. Zaki, H.A. and Al-Tamimi, T.M.: The acute shortage of dental health manpower in Saudi Arabia. Saudi Med J, 5:17-20, January 1984.
7. Al-Sekait, M.A. and Al-Nassar, A.N.: Dental caries prevalence in primary Saudi School children in Riyadh district. Saudi Med J, 9:606-609, November 1988.
8. Zahran, M.: The pattern of dental caries in Egypt school children. Egypt Dent J, 2: 13-26, October 1974.
9. McNulty, J.A. and Fos, P.J.: The study of caries prevalence in children in a developing country. J Dent Child, 56: 129-136, March-April 1989.
10. Manji, F. and Fejerskov, O.: Dental caries in developing countries in relation to the appropriate use of fluoride. J Dent Res, 69:733-741, February 1990.
11. Miller, C.M. and Canter, A.B.: A comparison of mass media effectiveness in health education. Int J Health Ed, 23: 49-54, January 1980.

# ABSTRACTS

**Sedighi, Homayoun; Davila, Jorge M.; Gwinnett, A. John: Bonding to dentin: evaluation of three adhesive materials. J Dent Child, 59:329-332, September-October 1992.**

The amount of dye penetration and the formation of gaps at the interface between posterior composite restorative material, dentin bonding agent, and the dentinal walls were determined. The experimental design consisted of two parts: 1) to identify the presence of gaps, using scanning electron microscopy; and 2) to observe and map the penetrations of 0.5 percent solution basic fuchsin dye. Class I cavity preparations were made in fifty-four extracted human permanent molar teeth. Dycal (Caulk/Dentsply) was applied to the floor of the preparation. The restorations were either of P50/Scotchbond 2 (3M Co.), Lumifor/Gluma (Columbus Dental Co.); or Marathon V/Tenure (Den-Mat Co.). Half of the specimens were thermocycled for four hours at 4°C and 80°C, with a dwell time of one minute. Gaps were detected at the interface of the axial dentinal wall and all the resins, as well as the floor where calcium hydroxide was placed in both the thermocycled and nonthermocycled samples. Stereomicroscopy at 20X magnification showed dye penetration in all specimens. Results of this *in vitro* study compared with the results previously reported demonstrate little improvement in the integrity of the bonded interface between the three systems tested and the dentin.

**Dye penetration; Gap formation; Bonding; Stereomicroscopy**

**Kreulen, C.M.; van Amerongen, W.E.; Gruythuysen, R.J.M.** *et al*: Evaluation of treatment times for class II resin composite inlays. J Dent Child, 59:333-337, September-October 1992.

One indication of the cost of dental treatment is based on the time needed to perform a specific operation. In this study, the working time for indirect Class II resin-composite inlays proved to be one hour for a restoration of standard size. The restorations studied were made in a clinical trial, and as far as possible under standardized conditions. The stage in the restorative procedure that involves checking the fit of the inlay and making preparations before luting takes up a large part of the overall working time. The influence of the dentist carrying out the treatment, the number of surfaces, and the type of tooth to be restored, determine to a large extent the length of the treatment. The difference in the time investment required for direct and indirect composite techniques was roughly 45 percent.

**Indirect resin-composite inlays; Time required; Compared with direct technique**

**Vanderas, Apostole P.: Mandibular movements and their relationship to age and body height in children with or without clinical signs of craniomandibular dysfunction: Part IV. A comparative study. J Dent Child, 59:338-341, September-October 1992.**

A comparative study was conducted on white children to investigate for differences in the values of the mandibular movements and the relationship to age and body height in subjects with and without clinical signs of craniomandibular dysfunction.

The results showed no statistically significant differences in any of the mandibular movements between children with and without clinical signs or between males and females. Highly significant differences were found between mandibular movements and age ($p = 0.001$). Body height was strongly correlated ($p = 0.001$) with all mandibular movements in the entire group as well as in males and females.

It was concluded that dysfunctional mandibular movements are dependent on the severity of the symptoms and age and body height should be taken into consideration in evaluating these movements.

**Mandibular dysfunction; Age; Body height**

**Vanderas, Apostole P.: Craniomandibular dysfunction in children. Part V. Correspondence between signs and symptoms. J Dent Child, 59:342-345, September-October 1992.**

The correspondence between clinical signs and subjective symptoms of craniomandibular dysfunction was investigated. Three hundred fifty-five white children six to ten years of age were examined clinically and interviewed for signs and symptoms of dysfunction.

The results showed low values of sensitivity, low false-positive rate, a relatively high false-negative rate, and high values of specificity. These findings are in agreement with the biological development of craniomandibular dysfunction.

**Craniomandibular dysfunction; Clinical signs; Subjective symptoms**

**Lew, K.K.K.: The prediction of eruption sequence from panoramic radiographs. J Dent Child, 59:346-349, September-October 1992.**

Standardized orthopantomograms (OPG) of seventy-eight healthy female children in the early mixed dentition stage (seven to nine years old) were taken. Based on root development stages and crypt positions in the alveolar bone, the eruption sequence for each quadrant was predicted from the initial OPG. The subjects were then followed up until all the permanent teeth (except the third molars) erupted, so that the actual eruption sequence could be determined. Results showed that this method of predicting eruption sequences from OPGs taken at seven to nine years of age is 95.8 percent accurate, with the accuracy for the mandibular arch being

statistically more accurate than for the maxillary arch ($p < 0.01$). The accuracy in prediction of eruption sequence from a single OPG at the early mixed dentition phase allows the clinician to detect abnormalities of eruption sequences and their possible effects on arch-length problems.

**Orthopantomograms; Eruption sequence, prediction**

**Reilly, S.; Wolke, D.; Skuse, D.: Tooth eruption in failure-to-thrive infants. J Dent Child, 59:350-352, September-October 1992.**

Primary-tooth eruption was studied in forty-four infants who were failing to thrive without associated organic disorder and forty-four pairwise matched controls. The number of erupted teeth in nonorganic-failure-to-thrive infants was significantly lower than in their matched controls.

**Tooth eruption, primary; Nonorganic failure-to-thrive-infants**

**Ogasawara, T.; Watanabe, T.; Kasahara, H.: Readiness for toothbrushing of young children. J Dent Child, 59:353-359, September-October 1992.**

The readiness of young children to brush their teeth was investigated. The purpose was to give them effective guidance in brushing. The study sample consisted of a total of ninety-seven normal preschool children ranging in age from birth to 6 years. It was attempted to determine which regions of the mouth were reached with a toothbrush. The child's ability to control a toothbrush was classified in order from the easiest to the most difficult step, in accordance with the child's age. Usually a child under one year and six months of age cannot brush, while a child older than one year and six months, but under three years and six months can brush the occlusal surfaces of lower molars and labial surfaces of the anterior teeth. A child over five years of age is expected to brush all aspects of various tooth surfaces.

**Toothbrushing, quality; Children**

**Bohay, Richard N.; Weinberg, Simon; Thorner, Paul S.: The paradental cyst of the mandibular permanent first molar: Report of a bilateral case. J Dent Child, 59:360-365, September-October 1992.**

The paradental cyst was reported by Craig in 1976. He described the lesion as occurring in relation to the mandibular third molars with an associated pericoronitis. Since then, a number of cases have been described occurring in relation to the permanent first molars. This report presents a case of bilateral first permanent molar cysts which were discovered prior to the teeth erupting into the oral cavity. The radiographic characteristics of the lesion are discussed and a differential interpretation is presented.

**Paradental cyst; Third molars**

**Peretz, Benjamin; Brezmak, Naphtali: Fusion of primary mandibular teeth: Report of case. J Dent Child, 59:366-368, September-October 1992.**

Treatment of fused primary teeth can be challenging. At times, a simple procedure of separation of the fused teeth enables the clinician to imitate normal dental development, normal exfoliation of the primary teeth and the normal eruption sequence of the permanent teeth, thus solving an esthetic and functional problem, and intercepting a most probable local malocclusion.

**Fusion, incisor, canine; Separation; Interception**

**Waldman, H. Barry: Differences in the health status of black and white children. J Dent Child, 59:369-372, September-October 1992.**

There are numerous differences between the health status and use of services by black and white children. Some details of these variations are provided for pediatric dental practitioners who increasingly will be caring for more diverse populations within their communities.

**Health status; Pediatric dental care for diverse populations**

**Waldman, H. Barry: Juvenile arrests—it's a crime. J Dent Child, 59:373-375, September-October 1992.**

Increasing numbers of children are being arrested for, and affected by, criminal activities. A demographic review is provided of those involved in this growing problem.

**Crime and children**

**Weinstein, Philip; Domoto, Peter; Wohlers, Kyoko; and Koday, Mark: Mexican-American parents with children at risk for baby bottle tooth decay: Pilot study at a migrant farmworkers clinic. J. Dent Child, 59:376-383, September-October 1992.**

One hundred twenty-five Mexican-American children, eight to forty-seven months of age, and their parents/caretakers were studied at the Yakima Valley Farmworkers Clinic. All subjects were interviewed by bilingual interviewers and information relating to demographics, child care practices, knowledge and belief about BBTD and willingness to comply with BBTD intervention strategies was collected. Each child received a dental examination. Results showed 29.6 percent of the children had BBTD. BBTD was associated with lack of sufficient child care, father putting baby to sleep during workdays, giving the bottle to aid sleep, and bottle propping. Non-BBTD parents reported greater stress of parenting, and BBTD parents indicated they required more help in sticking to a diet than non-BBTD parents and that they

were more likely than non-BBTD parents to keep records of baby's height, weight, etc. While BBTD parents had a higher level of education attainment than non-BBTD parents, time between their dental visits was much greater than with non-BBTD parents. BBTD parents were less likely than non-BBTD parents to follow recommendations to immediately substitute the cup for bottle for all feedings. Other results are reported and suggestions were made for potential interventions.

**Baby bottle tooth decay; Children of Mexican migrant farmworkers; Parental responses to instructions**

**Magbool, Gadi: Prevalence of dental caries in school children in Al-Khobar, Saudi Arabia. J Dent Child, 59:384-386, September-October 1992.**

A cross-sectional survey was conducted to determine the prevalence of dental caries among school children in Al-Khobar, Saudi Arabia. From fourteen schools for boys and fourteen schools for girls, a sample size of 1,665 was studied. The prevalence of dental decay was 87.5 percent. The DMFT indices were 1.97 for permanent and 1.60 for primary teeth. It was concluded that dental caries is a major problem in the population surveyed, and that the need exists for planning and implementing preventive dental care in schools in the Eastern Province of Saudi Arabia. It is suggested that examination of children's teeth should become a routine part of medical examinations, especially in the schools.

**Dental caries prevalence**

**HEALTH CARE LAW** continued from page 327

rare to find an American informed consent decision that does not at least cite to the *Schloendorff* opinion. Nonetheless, despite its endorsement of patient autonomy, the *Schloendorff* court actually ruled for the defendant.

## MODERN DEVELOPMENT OF "INFORMED CONSENT" DOCTRINE

Modern development of the legal doctrine of "informed consent" is the confluence of a number of different ideas and influences reflecting societal changes that extend well beyond the legal system. To be properly understood, the doctrine must be viewed in its larger context.

## GROWTH OF RIGHTS-ORIENTED THINKING

The last three decades or so have seen widespread developments in the area of individual and civil rights. The decade of the 1960s, in particular, was a period of substantial expansion of personal rights-oriented thinking—e.g., the federal Civil Rights Act of 1964, the consumer rights movement, and a general decline in the average American's willingness to defer to authority figures. By the end of the '60s, this philosophy had invaded even the previously sacrosanct world of medical professional judgment. Patients were questioning their physicians, to some extend at least, and a new era was dawning in which it was plausible to consider the doctor-patient relationship as a joint venture in which the patient had significant decisionmaking power, or at least a right to have input into the decisional process.*