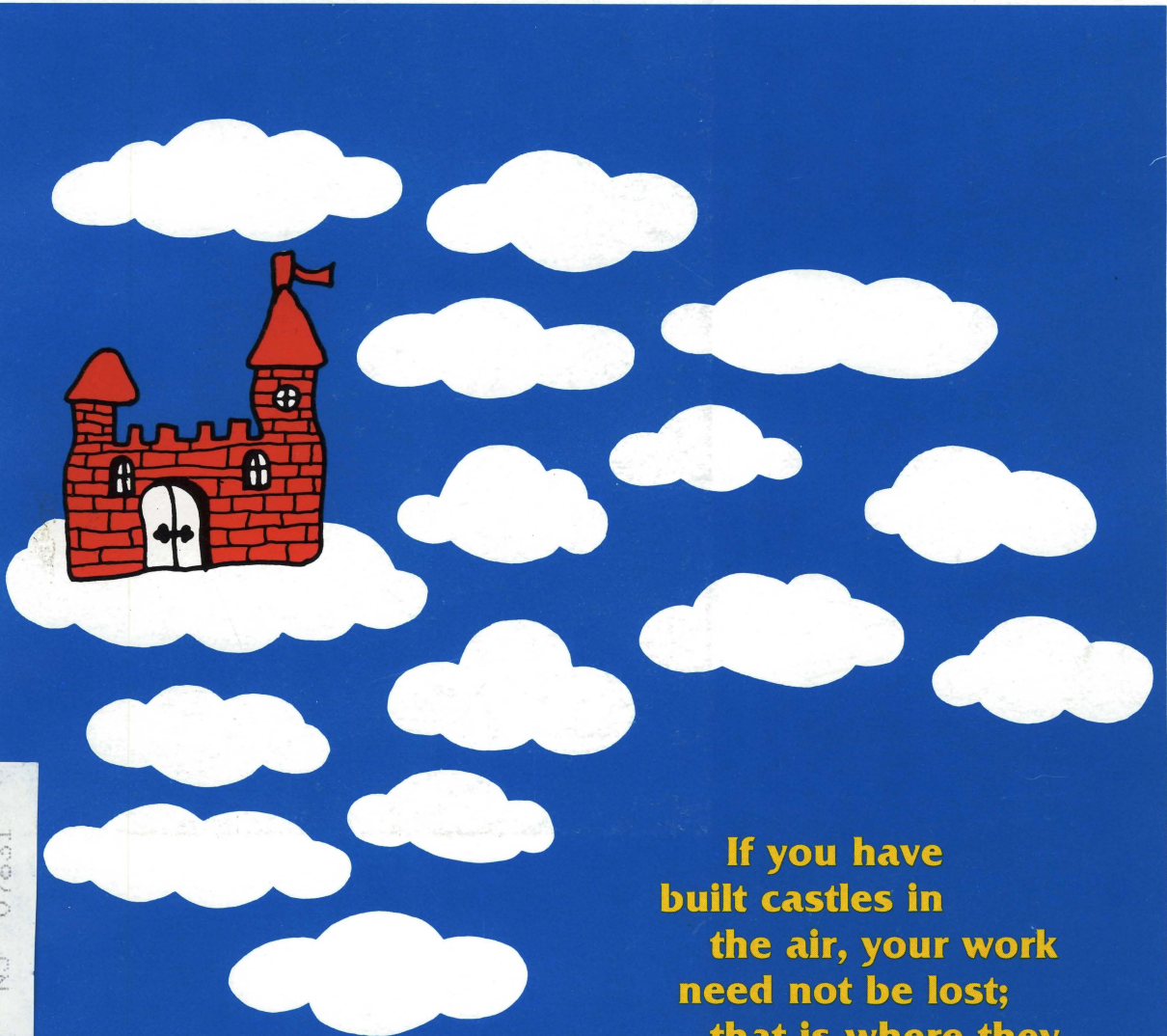


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MAY-JUNE 1985

JOURNAL OF DENTISTRY FOR CHILDREN



**If you have
built castles in
the air, your work
need not be lost;
that is where they
should be.**

**Now put the
foundations
under them.**

Thoreau: Walden

/MU 0022215
DR. Milton I Houpt
251 Maple St
Englewood
NJ 07631

TODAY A DREAM, TOMORROW A REALITY



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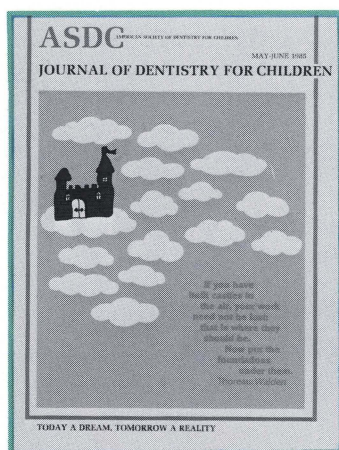
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The cover suggests that dreams of future accomplishments are elements of a normal life. It implies, however, that for those dreams to be realized, careful and realistic planning must occur. The foundations must be built from knowledge, application, and hard work.

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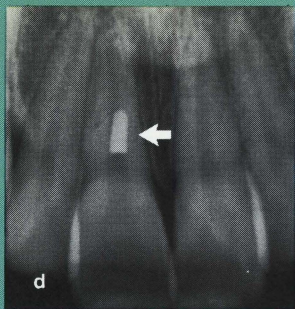
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Morphology of dentin surfaces in prepared cavities

Johan Friskopp, DDS
Ulf Larsson, DDS

Clinic

Many investigators have shown that prepared dentin surfaces are covered with a smear layer.¹⁻⁴ Carborundum stones, diamond points and carbide burs rotating at speeds from 15,000 to 200,000 rpm can produce smear. Finishing the cavities with hand chisels may also produce it.^{2,5} All preparation techniques have produced smear layers covering the cut dentin, regardless of rpm and cutting instrument used. The smear layers may contain bacteria potentially harmful to the pulp.⁴ These layers also prevent close contact between restorative materials and the dentin. Surface active solutions, chelating agents, and acids have been used for removal of the smear with varying effects to the morphology of the dentin surface.^{4,6,7} For instance, some of the peritubular dentin is removed by acids, thus widening the apertures of the dentinal tubules, increasing the potential harm to the pulp.^{4,8} It has been proposed that a clean, cut surface with plugs of dentin in the apertures of the tubules would be the ideal result of the preparatory procedures.⁸

Several investigators have shown that considerable heat may be generated, when dental hard tissues are cut at high speed.^{9,10} It has been proposed that the interface temperature rises in spite of good cooling. The water spray has an overall cooling effect rather

The study was conducted by Dr. Friskopp and Dr. Larsson in the Department of Periodontology, Stockholm County Council and the Department of Oral Pathology, School of Dentistry, Karolinska Institutet, Box 4064, S-141 04 Huddinge, Sweden.

than one directed at the interface between cutting instrument and dentin, where temperatures as high as 70°C have been demonstrated.⁹ It has been shown, however, that with ample watercooling there is no risk of pulpal damage, regardless of cutting speed, load or cutting instrument.¹¹ The intrapulpal temperature might rise 3 to 5°C after prolonged cutting (five minutes) with high cutting pressure.^{10,12} Recently developed handpieces and rotating instruments have greatly increased cutting efficiency; and high energy preparation techniques may be harmful to the dentin.¹³

Many different instruments are available for cutting dental hard tissues. Among them are diamond tips with coarse abrasive coating and strong tungsten carbide burs. The instruments may differ considerably, however, in efficiency. The various cutting capacities may have different effects on the dentin surfaces. The objectives of this study were to:

- Compare the morphologies of dentin cut at different speeds.
- Compare the morphologies of dentin cut by different rotary instruments.
- Try to establish whether harmful heat is generated at different cutting speeds.
- Check the useful rpm-ranges of current high-speed handpieces working under load.

MATERIAL AND METHODS

Thirty third molars with or without caries were used. The cavities were prepared with undercuts, suitable for amalgam fillings. Each preparation was made with a bur, fresh from stock, using the water cooling facilities of the handpieces. The pressured air and the water were filtered. Water and debris were removed through a suction tip located close to the preparation site. The teeth were extracted immediately after the preparation. The patients were not allowed to rinse until the procedures of preparation and extraction were completed. The cavities were rinsed with a five-second air and water spray after extraction and were then immersed in buffered formalin.

The handpieces were grouped in four categories according to the rpm under load, as measured in this study. Category 1 consisted of a conventional hand-

piece, rpm 15,000.* Category 2 was a conventional handpiece geared 1:4, rpm 140,000.** Category 3 consisted of air-turbines, rpm 200,000.*** Category 4 was an air-turbine with rpm of 400,000.**** Idle speeds were 20,000; 200,000; 350,000; and 560,000, respectively. The rpm was measured optically; a small black spot painted on the shaft of the rotating instrument was detected by a light-sensitive device and an oscilloscope was used as a counter.

All rpm tests were performed in human teeth with tungsten carbide burs. When the rotating instruments were applied to the tooth surface, the pressure caused a reduction of rpm. The rate of removal of tooth structure, enamel as well as dentin, was increased as the pressure was increased, until there was a sudden drop of rpm. The "efficient cutting rate" was defined to be when the applied pressure was slightly below this stalling limit. The handpieces are shown in the Table.

The rotating instruments used were tungsten carbide burs⁺, diamond points⁺⁺, and carbon steel round burs.⁺⁺⁺ All instruments are shown in the Table.

Heat generation was investigated as follows. Ten teeth were coated with wax with a low melting temperature.⁺⁺⁺⁺ The wax was firm at 25°C and below; it softened and became smeary when heated to temperatures above 42°C and melted at 53°C. The teeth and the wax were sectioned with the various rotating instruments operated at different speeds and with water cooling as described above. The cut surfaces in wax and dentin were then studied in the scanning electron microscope.

RESULTS

Measurements of rpm at idle and at maximum cutting efficiency are shown in the Table. All handpieces showed a reduction of rpm under load. Handpieces of different brands within the same category showed similar behavior, but there were slight differences in cutting capacity.

Scanning electron microscopy revealed that handpieces of category 1, cutting efficiently at 15,000 rpm, produced the most contaminated surfaces in this in-

* MicroMega 40 E, Micro-Mega SA, Besancon, Switzerland.

** W & H Inco 98A, Dentalwerk Burmoos GmbH, Bürmoos, Austria.

*** Midwest Quiet Air, American Midwest, Des Plaines, Illinois, USA and KaVo Supertorque, KaVo DMI GmbH, Biberach, West Germany.

**** Encore 403, Luckman Corp., Abington, Pennsylvania, USA.

+ 1158 R & R Spiral Fluted Fissure Bur, Ransom & Randolph, Toledo, Ohio, USA and Jet no. 5 round, Beavers Dental Products Limited, Morrisburg, Ontario, Canada.

++ Two Striper 253 s c-c, Abrasive Technology Inc., Columbus, Ohio, USA and Dentatus dt 24 a Ra, AB Dentatus, Hagersten, Sweden.

+++ Ash Ra 023 No. 8, Amalgamated Dental, London, England.

++++ Tenax Wax, S.S. White Ltd., Harrow, England.

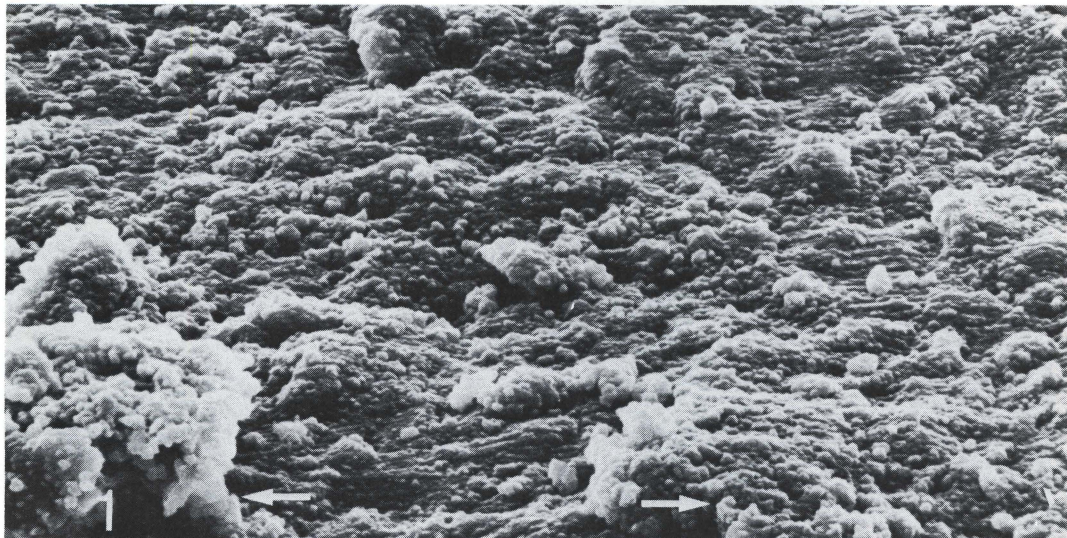


Figure 1. Dentin surface prepared with round bur rotating at 15,000 rpm. Tubular apertures and peritubular dentin are covered with a smear layer that contains large particles. Arrows indicate 100 μ .

vestigation. Smear layers were found in all specimens of this category. These smear layers showed no characteristics of dentin: the apertures of the tubules were completely covered with the smear. The smear contained sharply contoured particles approximately 10 μ wide (Figure 1).

The handpieces of categories 2 and 3, cutting efficiently at 140,000 and 200,000 rpm, respectively, produced cavity surfaces covered with a thin, homogeneous smear. Apertures of tubules were discernible, partly

filled with debris. The peritubular dentin was not visible (Figure 2). Large areas, however, showed no characteristics of dentin. When diamond tips were used the debris contained sharply contoured particles (Figure 3). Although dentin morphologies were similar, there was a marked difference in cutting efficiency between the handpieces of categories 2 and 3.

The handpieces of category 4, with maximum cutting efficiency at 400,000 rpm, produced the cleanest cavity surfaces. The surface morphology was usually charac-

Table □ Handpieces grouped according to rpm.

Category	Idle r. p. m.	Rpm at maximum cutting efficiency	Handpiece/rotating instrument	Cutting efficiency in aluminum mg/min	Dentin surface morphology
1	20,000	15,000	Micro-Mega/diamond tip	170	3
			Micro-Mega/round bur		3
2	160,000	140,000	W&H/fissure bur	1070	1-2
			W&H/round bur		1-2
3	350,000	200,000	Midwest/fissure bur	200	1-2
			Midwest/round bur		1-2
			Midwest/diamond tip	200	3
			KaVo/fissure bur		1-2
			KaVo/round bur		1-2
4	560,000	400,000	Encore/fissure bur	600	0-1
Encore/round bur	0-1				

Classification of dentin surface morphology:

0 = clean, no smear-layer, open apertures of dentin tubules.

1 = clean, no smear layer, apertures of dentin tubules filled with loose material.

2 = thin smear-layer, dentin tubules not discernible.

3 = thick smear layer with large fragments, apertures of dentin tubules not discernible.

Rotating instruments:

Category 1: round bur - Ash steel no. 8, diamond tip - Dentatus dt 24a Ra.

Category 2 & 3: round bur - Jet no. 5, fissure bur - R&R 1158, diamond tip - Two Stripper 253 sc-c.

Category 4: round bur - Jet no. 5, fissure bur - R&R 1158.

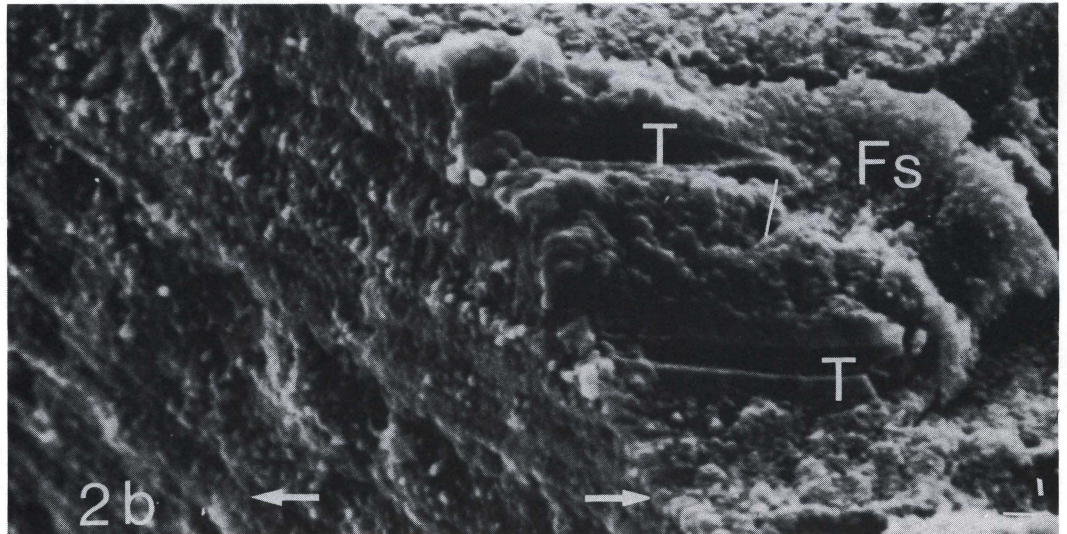


Figure 2a. Dentin surface prepared with round bur at 200,000 rpm. There are distinct traces of the bur. Apertures of the dentin tubules are not open, but seem to be filled with debris that shrunk during the drying procedure before microscopy. Arrows indicate 5 μ .

Figure 2b. Dentin surface prepared with round bur at 200,000 rpm. To the left is the dentin surface of the prepared cavity, to the right is a fracture surface (Fs) created by fracturing the tooth after extraction. The prepared dentin shows distinct traces of the bur. In the fracture, two dentin tubules (T) are seen leading to the dentin surface. The tubules are split open longitudinally and the orifices are filled with loose material. Arrows indicated 10 μ .



Figure 3. Dentin surface prepared with a diamond tip rotating at 200,000 rpm. Apertures of tubules are not discernible and the surface is littered with particles. Arrows indicate 10 μ .



Figure 4. Dentin surface prepared with round bur at 400,000 rpm displaying traces of the rotating instrument and also open dentinal tubules (T). Arrows indicate 10 μ .

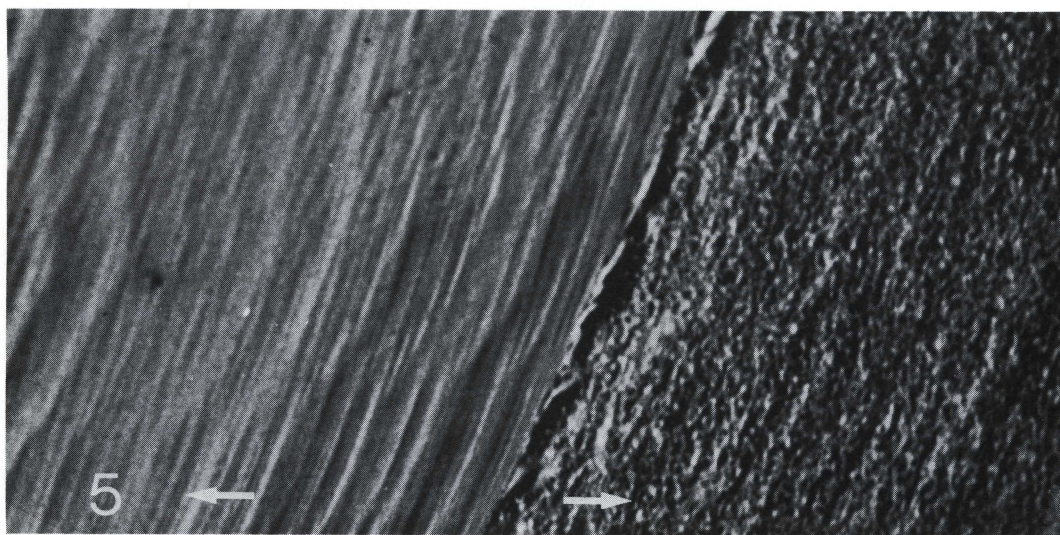


Figure 5. Surface of a tooth, sectioned with a fissure bur at 200,000 rpm. The tooth was covered with wax before sectioning with the bur. To the left is the prepared wax surface; to the right, the prepared dentin (D). Both wax and dentin show distinct traces of the bur. Arrows indicate 100 μ .

terized by obvious, sharply contoured traces of the bur. The apertures of the dentin tubules were partly filled with a material that seemed to have shrunk during the drying procedure. Occasionally dentin surfaces were seen devoid of smear or loose material. In these surfaces tubular apertures and peritubular dentin were clearly visible (Figure 4).

The above description of the surface morphology applies to steel burs in category 1 and to tungsten carbide burs in categories 2, 3 and 4. In addition, diamond points, which were tried in categories 1 and 3, were found to produce heavy smear layers.

The cut wax surfaces showed distinct traces of the rotating instruments used in handpieces working at 200,000 and 400,000 rpm (Figure 5). The traces in the wax were less distinct when handpieces with 15,000 rpm were used.

The cutting efficiency test showed great differences between the different handpieces tested, which are listed in the Table.

DISCUSSION

The rpm test revealed that the differences between the handpieces were greater under load than when idle. The estimation of maximum cutting efficiency might have been influenced by the preferences of the operators. The reduction of air-turbine rpm, however, by approximately 50 percent is consistent with a previous study, where maximum power was delivered at 50 percent of maximum rpm.¹⁴ It is possible of course to cut with very gentle pressure, thus transferring less energy to the tooth surface; there will be, nevertheless, a reduction of rpm.¹³ All preparations in this study were made using the most efficient cutting, since this is one of the aims of rational clinical treatment.

The selection of rotating instruments had to be limited for the following reasons. The handpiece with the highest rpm can only be used with a few makes of tungsten carbide burs that will not break under high rpm and torque. Diamond points cannot be used in

this air-bearing handpiece, probably because of insufficient concentricity. Differences in dentin morphology that could be caused by different bur configurations were not studied, since it was impossible to use many shapes and makes of burs in the high rpm range. For the slow-speed preparations a large carbon steel bur and medium grit diamond tip were chosen, since these instruments are frequently used in the final preparation stages, such as for caries excavation and margin finishing.

Measuring the temperature at the interface between the rotating instrument and the tooth was not possible; an indirect method, therefore, was tried by cutting teeth coated with wax with a low melting temperature. The distinct traces of the tungsten carbide burs rotating at 200,000 and 400,000 rpm indicate that the surface of the wax was not heated above the melting point. The blurred traces seen where steel burs were used at 15,000 rpm indicate a transient rise of temperature in the region below the melting point. Thus injuries of the dentin and pulp tissues caused by heat are unlikely.

The finding that the same rotating instruments produced cleaner cavity surfaces at 400,000 rpm than at 200,000 rpm might be explained by assuming that the debris was not allowed to stick to the surface, but was carried away in the continuous stream of air and water which rinsed the cavities during the preparation. There might be mechanical effects and also ultrasonic effects produced by the bur rotating in the water, and these effects could be enhanced by a high rpm.

The finding that the same handpiece produced cleaner cavity surfaces, when fitted with a tungsten carbide bur, rather than with a diamond tip, might be explained by the possibility that the bur cut comparatively large and uniform pieces, while the diamond tip cut heterogeneously with large and small particles intermixed.

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Frequency of accidental intravascular injection of local anesthetics in children

Curtis G. Kuster, DDS, MS
Richard D. Udin, DDS

Aspiration before injection is a cardinal principal of regional anesthesia and analgesia.¹ The Council on Dental Materials, Instruments, and Equipment, and the Council on Dental Therapeutics of the American Dental Association have stated "that some day a court may find a mere failure to aspirate before making an injection to constitute negligence."²

Aspiration decreases the chance of intravascular injection. Injecting into a blood vessel may affect the proper functioning of the central nervous system on the cardiovascular system.^{3,4}

To aspirate, the operator must create a negative pressure within the cartridge of anesthetic solution. When the thumb ring of the syringe is pulled back, the negative pressure is created. Whatever is lying in the soft tissues around the tip of the needle will be aspirated into the cartridge. Any sign of blood is a positive aspiration. No return at all or an air bubble indicates a negative aspiration.⁵

The purpose of this study was to investigate the frequency of accidental intravascular injection of dental local anesthetics in children as determined by positive aspiration of blood, and the most common sites of occurrence.

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REVIEW OF LITERATURE

The purpose of aspiration during a dental local anesthetic injection is to determine whether the needle tip lies within a blood vessel.⁵ Accidental intravascular injection can occur with any injection, but certain injection sites are more prone to positive aspiration.

Harris reported that 8,534 aspirations using a 25-gauge needle gave a total of 271 positive aspirations.⁶ This is a percentage of 3.2 positive aspirations for all injections.

Sciano and Strambi evaluated 2,401 aspirations in an oral surgery clinic.⁷ Ninety-six positive aspirations occurred for an overall percentage of 4.0. Cohen, Gravitz, and Knappe compared 27-gauge needles to 25-gauge needles, in regard to positive aspirations: 5.6 percent of all aspirations using a 27-gauge needle were positive; while 5.2 percent of all aspirations using a 25-gauge needle were positive.⁸

Barlett reported that 3,727 aspirations produced a total positive aspiration rate of 3.8 percent.⁹ Corkery and Barrett reported a higher percentage of positive aspirations, 8.0 percent.¹⁰ A 27-gauge needle was used in this study. In his discussion of various injection techniques, Malamed discussed his findings of positive aspiration.¹¹

Several of these investigations reported that a small percentage of their subjects were children.^{7,9} The other investigations used an adult population. Table 1 compares the results of this present study in children with

Table 1 □ Comparison of present study with results of other studies (Incidence of positive aspirations given as percentage of total injections for each site of injection).*

Site of injection	Present study	Harris ⁶	Schiano and Strambi ⁷	Cohen, Gravitz and Knappe ⁸ (27-gauge needle)	Cohen, Gravitz and Knappe ⁸ (25-gauge needle)	Bartlett ⁹	Corkery and Barrett ¹⁰	Malamed ¹¹
Buccal infiltration	2.2	4.4	2.6	7.3	4.0	3.1	26.3	3.1
Molars (maxillary)								
Inferior alveolar	3.1	3.6	11.0	10.9	10.2	11.7	16.8	10-15
Long buccal	0.0	—	0.0	—	—	0.5	—	0.7
Labial infiltration	1.4	2.0	0.0	3.1	3.9	0.7	3.7	—
Incisors (maxillary)								
Palatal	0.0	—	—	0.9	3.6	—	0.9	↓ 1.0
Labial infiltration	0.0	—	—	—	—	—	—	—
Incisors (mandibular)								
Lingual infiltration (mandibular)	0.0	—	—	0.6	1.3	0.3	—	—
Buccal infiltration	0.0	—	—	—	—	—	—	—
Molars (mandibular)								
Overall	1.7	3.2	4.0	5.6	5.2	3.8	8.0	—

*All figures shown are percentages.

Table 2 □ Relationship of positive or negative aspiration of blood by site of injection of local anesthetic.

Injection	Total aspirations		Positive aspirations		Negative aspirations	
	Number	Percent	Number	Percent	Number	Percent
Buccal infiltration	1308	31.6	29	2.2	1279	97.8
Molars (maxillary)						
Inferior alveolar	1169	28.3	36	3.1	1133	96.9
Long buccal	733	17.7	0	0.0	733	100
Labial infiltration	355	8.6	5	1.4	350	98.6
Incisors (maxillary)						
Palatal	274	6.6	0	0.0	274	100
Labial infiltration	152	3.7	0	0.0	152	100
Incisors (mandibular)						
Lingual infiltration (mandibular)	130	3.1	0	0.0	130	100
Buccal infiltration	6	0.1	0	0.0	6	100
Molars (mandibular)						
Total	4134	100	70	1.7	4064	98.3

Chi-Square = 38.25146 with 8 degrees of freedom.
Significance = .05

the results of the other investigations.

The gauge of a needle is indicated by number, with a higher gauge number indicating a smaller internal diameter of the lumen of the needle.¹¹ For example, a 27-gauge needle would have a smaller diameter than a 25-gauge needle. Different manufacturers, however, produce a variety of lumen diameters within a particular gauge classification.⁸ A study by Wittrock and Fischer showed that one manufacturer produced a 30-gauge needle with the same diameter as the 25-gauge needle of three other manufacturers.¹²

There is a difference of opinion among authors regarding the gauge of needle and the ability to aspirate. Monheim believes one is not justified to use a 27- or 29-gauge needle.¹³ Forrest concurs with this view.¹⁴ Malamed believes that aspiration is much easier and more reliable through the larger lumen.¹¹

Wittrock and Fischer demonstrated, however, that blood could be aspirated through 30-gauge needles 100

percent of the time.¹² They concluded that fear of lack of aspiration should not be considered a contraindication to their use.

Cohen, Gravitz, and Knappe found no significant difference in rate of positive aspiration between a 27-gauge needle and a 25-gauge needle.⁸

Trapp and Davies investigated the incidence of unsuccessful aspirations in the upper limb of human subjects, when utilizing 23-, 25-, 27-, and 30-gauge needles under semidirect vision.¹⁵ They concluded that *in vitro* human blood may be aspirated through a 23-, 25-, 27-, or 30-gauge needle without a clinically significant difference in resistance to flow.

METHODS AND MATERIALS

The subjects for this investigation were children three to thirteen years of age who were patients at the Pedodontic Clinic at the University of Nebraska College

Table 3 □ Relationship of positive or negative aspiration of blood by sex.

		Male	Female	Row total
Negative aspirations:	Number	1969	2092	4064
	Row percentage	48.4	51.5	98.3
	Column percentage	98.9	97.8	
Positive aspirations:	Number	22	48	70
	Row percentage	31.4	68.6	1.7
	Column percentage	1.1	2.2	
Column total number		1991	2140	4134
Column total percentage		48.2	51.8	100

Chi-square = 8.07620 with 2 degrees of freedom.
Significance = .05

Table 4 □ Relationship of positive or negative aspiration of blood by age.

		Age in years											Row total
		3	4	5	6	7	8	9	10	11	12	13	
Negative aspirations:	Number	67	135	313	423	356	660	594	538	383	364	227	4063
	Row percentage	1.6	3.3	7.7	10.4	8.8	16.2	14.6	13.2	9.4	9.0	5.6	98.3
	Column percentage	100	100	100	99.5	98.1	97.1	97.1	98.4	98.5	98.6	98.7	
Positive aspirations:	Number	0	0	0	2	7	20	18	9	6	5	3	70
	Row percentage	0	0	0	2.9	10	28.6	25.7	12.9	8.6	7.1	4.3	1.7
	Column percentage	0	0	0	0.5	1.9	2.9	1.6	1.5	1.4	1.3		
Column total number		67	135	313	425	363	680	612	547	389	369	230	4134
Column total percentage		1.6	3.3	7.6	10.3	8.8	16.5	14.8	13.2	9.4	8.9	5.5	100

Chi-square = 25.47397 with 12 degrees of freedom.
Significance = <.05.

of Dentistry, or at the Pedodontic Clinic at the University of Nebraska Hospital.

Four thousand, one hundred and thirty-four dental local anesthetic injections administered in these clinics were evaluated. The injections were given by dental students, pedodontic graduate students, and pedodontic department faculty members. An aspirating syringe and a 27-gauge short needle were used for each injection. Eight common injections used in pedodontics were recorded. The injections were as follows:

- Inferior alveolar nerve block.
- Long buccal.
- Lingual infiltration (mandible).
- Labial infiltrations of incisors (mandible).
- Buccal infiltration of molars (mandible).
- Labial infiltration of incisors (maxilla).
- Buccal infiltration of molars (maxilla).
- Palatal.

Aspiration was performed before injection occurred in each case. If a positive aspiration of blood occurred, the needle was withdrawn from the injection site, the anesthetic cartridge was removed from the syringe and

discarded, a new cartridge was inserted, and the needle was reinserted and aspiration took place again.

After each injection was completed, it was recorded whether the aspiration had been positive or negative. The child's age and sex were also recorded.

RESULTS

Tables 2, 3, and 4 show the relationships of positive or negative aspiration of blood to injection site (Table 2), sex (Table 3), and age (Table 4).

A total of 4,134 injections preceded by aspiration were evaluated. Positive aspiration of blood occurred seventy times in the 4,134 injections for a total positive aspiration incidence of 1.7 percent. The injection most likely to produce a positive aspiration was the inferior alveolar block. One thousand, one hundred and sixty-nine inferior alveolar block injections were administered with positive aspiration occurring thirty-six times for a 3.1 percent incidence.

The second most likely injection to produce a positive aspiration was the buccal infiltration of maxillary

molars. This injection was administered 1,308 times with positive aspirations occurring twenty-nine times for a 2.2 percent incidence. The labial infiltration of maxillary incisors produced five positive aspirations out of the 355 injections given for a 1.4 percent incidence.

Fifty-one and four tenths percent of all the positive aspirations occurred in the inferior alveolar block injection. Forty-one and four tenths percent of all the positive aspirations occurred in the buccal infiltration of maxillary molars. Seven and one tenth percent of the positive aspirations occurred in the labial infiltration of maxillary incisors.

Fifty-one and eight tenths percent of the injections were administered to females (2,140 injections) and 48.2 percent were administered to males (1,991 injections). Positive aspiration of blood occurred forty-eight times in female patients and twenty-two times in male patients. Hence, 2.2 percent of all injections administered to females produced positive aspiration of blood, and 1.1 percent of all injections administered to males produced positive aspiration.

When a positive aspiration of blood occurred, 68.6 percent of the time, the patient was a female; and 31.4 percent of the time, the patient was a male. Thus, positive aspiration of blood occurred in females in more than a 2:1 ratio.

Children ages three to thirteen years were evaluated in this investigation. No positive aspiration of blood occurred in the three, four, or five-year-old children. Two and nine tenths percent of all the positive aspirations occurred in the six-year-old children; 10.0 percent occurred in the seven-year-old children; 28.6 percent occurred in the eight-year-old children; 25.7 percent occurred in the nine-year-old children; 12.9 percent occurred in the ten-year-old children; 8.6 percent occurred in the eleven-year-old children; 7.1 percent occurred in the twelve-year-old children; and 4.3 percent occurred in the thirteen-year-old children.

The relationships of positive or negative aspiration in injection site, sex, and age were all statistically significant at the .05 level.

DISCUSSION

This investigation of the frequency of accidental intravascular injection of dental local anesthetic as determined by positive aspiration of blood showed a lower incidence in children than in the adults of previous reports. The total positive aspiration incidence in children was 1.7 percent. Reports of the adult population showed a range of 3.2 percent to 8.0 percent.

The injection most likely to produce a positive aspiration in children was the inferior alveolar block. This finding was consistent with that reported in the adult population.

Fifty-nine and nine tenths percent of all the injections administered in this investigation were either the buccal infiltration of maxillary molars or the inferior alveolar block. These two injections, however, produced 92.8 percent of all positive aspirations of blood.

An interesting finding was that of a statistically significant higher incidence of positive aspiration of blood in females. The sample was well distributed (51.8 percent females and 48.2 percent male). However, 68.6 percent of the positive aspirations occurred in females and 31.4 percent occurred in males. This is more than a 2:1 ratio. There should be no significant anatomic difference or injection technique difference between the male and female, hence the authors offer no explanation for this finding.

There was a statistically significant result relating positive aspiration of blood to age. The eight-, nine-, and ten-year-old patients comprised 44.5 percent of the total sample; the eight-, nine-, and ten-year-old patients, however, contributed 67.2 percent of the positive aspirations. Positive aspiration of blood occurred 2.9 percent of the time in both the eight-, and nine-year-old children. Again, no definitive explanation can be given for this finding of age specificity.

CONCLUSIONS

The purpose of this study was to investigate the frequency of accidental intravascular injection of dental local anesthetic in children as determined by positive aspiration of blood.

The total sample of this study consisted of children three to thirteen years of age. Four thousand, one hundred and thirty-four dental local anesthetic injections administered to these children were evaluated.

The results indicated that positive aspiration of blood occurred 1.7 percent of the time. The injection most likely to produce a positive aspiration was the inferior alveolar block. An incidence of 3.1 percent for the inferior alveolar block was found. The incidence of positive aspiration in the infiltration of the maxillary molars was 2.2 percent.

A statistically significant finding was that of a higher incidence of positive aspiration of blood in females: 2.2 percent of all injections administered to females produced positive aspiration, and 1.1 percent of all injections administered to males produced positive aspiration.

When a positive aspiration of blood occurred, 68.6 percent of the time that patient was a female, and 31.4 percent of the time the patient was a male. Thus, positive aspiration of blood occurred in females in more than a 2:1 ratio. Twenty-eight and six tenths percent of the positive aspirations occurred in eight-year-old children, 25.7 percent of the positive aspirations occurred in nine-year-old children, and 12.9 percent of the positive aspirations occurred in ten-year-old children. It was statistically significant that 67.2 percent of the positive aspirations occurred in eight-, nine-, and ten-year-old children, while these ages comprised only 44.5 percent of the sample.

This investigation indicated that the incidence of accidental intravascular injection of dental local anesthetic in children is low (1.7 percent). A composite make-up of a child most likely to experience positive aspiration of blood would be an eight-, nine-, or ten-year-old female during the administration of an inferior alveolar block or the infiltration of the maxillary molars.

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THE DOCTOR'S MASTER

Through its democratic processes, American society may well choose to ration medical resources. In that event, physicians as citizens and experts will have a key role in implementing the decision. Their advice will be needed in allocating limited resources to provide the greatest good for the greatest number. As experience in other countries has shown, it may be difficult for doctors to separate their role as citizens and expert advisors from their role in the practice of medicine as unyielding advocates for the health needs of their individual patients. They must strive relentlessly to do so. When practicing medicine, doctors cannot serve two masters. It is to the advantage both of our society and of the individuals it comprises that physicians retain their historic single-mindedness. The doctor's master must be the patient.

—Levinsky, N.G.: The Doctor's Master. N Engl J Med, 311:1573-1575, December 1984.

Semi-fixed appliance to treat injurious lip habit: report of case

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Self-mutilation of the lower lip is an uncontrolled condition which appears sometimes in normal children following a block injection with local anesthetics. A similar condition can be seen in developmentally disabled children, such as in children with a psychosis or with cerebral palsy, or in those afflicted with Lesch-Nyhan syndrome.

This condition should be differentiated from exfoliative cheilitis, a chronic superficial disorder of the vermilion borders of the lips and characterized by persistent scaling; or with localized crusting of the lips, which appears mostly in patients who rub and pick their lips. The crusting can be easily removed, using soft paraffin to disclose normal tissue.¹

Treatment of self-injurious conditions depends on the etiology of the injurious behavior. When the lip-biting is accidental, as after an anesthetic injection, it usually heals in a week, without complication. Treatment is mostly palliative. Historically, when self-mutilation, as in Lesch-Nyhan syndrome, or in the syndrome characterized by a congenital indifference to pain, resulted in a lip-biting habit, the treatment consisted of extraction of the maxillary incisor teeth.²⁻⁵ In mentally retarded children, treatment has been preventive in nature, calling for forward displacement of the lower lip with a fixed appliance, thus preventing the maxillary incisors from reaching the lower lip.

CASE REPORT

A 7.5-year-old Caucasian male was referred for evaluation of an ulcerated lower lip. The child's medical history revealed a cerebral hemorrhage at birth, resulting in mental retardation, cerebral palsy and a seizure disorder. The daily medication regimen consisted of an antiepileptic drug, gardenal, (0.3 gm b.i.d.). The child's dentition was in the mixed stage and the primary molars were extensively decayed. The internal edge of the lower lip showed an ulceration 1.5 to 2.5 cm in diameter (Figure 1), extending from the vermilion border almost to the gingivolabial sulcus.

Because of his inability to cooperate, the child was hospitalized. Under general anesthesia, the primary molars were covered with stainless steel crowns. An impression of the mandibular arch was taken, and the stainless steel crowns on the mandibular first primary molars were fitted and removed in the impression. A 0.040-inch horizontal tube was soldered on the buccal aspect of each of the crowns. The tubes extended to the mesial aspect of the mandibular second primary molars, to increase the stability of the arch wire. A 0.040-inch arch wire with an opening vertical loop mesial to each molar was made. An acrylic lip shield was fixed to the interior bar and designed to stand 2 to 3 mm in front of the labial aspect of the lower incisors (Figure 2).

The decision to solder a horizontal tube to the buccal aspect of the first molars and not to the second primary molars was taken for three reasons:

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- Tubes were easy to see and reach, thus facilitating the removal of the arch by the child's caretaker.
- In this position the tubes would not interfere with the eruption of the first permanent molars.
- It is easier to maintain proper oral hygiene, because the arch wire could be removed.

Two days later, the child was premedicated and crowns with their tubes were cemented in place. Orthodontic elastics were used to hold the labial arch wire in position (Figure 3). Patient was examined at one-week intervals. The lesion of the lower lip improved rapidly. Two months later the ulceration was healed (Figure 4).

DISCUSSION

Self-mutilation of the lower lip in handicapped children can be considered as a chronic problem. Potential consequences of this behavior are anorexia and superimposed infections. The trigger zone of this behavior may be cortical, peripheral or psychological. Because of the

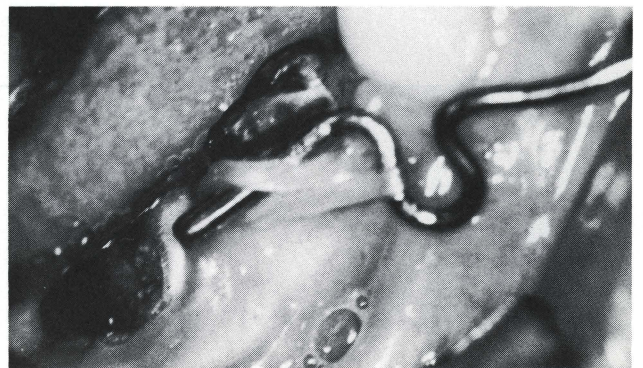
Figure 2. The crowns in place. The lower lip is seriously injured.



Figure 1. Self-mutilation of the lower lip.

difficulty of finding the trigger zone, the choice of the appliance must be considered cautiously. Some authors have used bonded acrylic appliances; and others, fixed appliances.^{6,7} Removable appliances are often contraindicated in handicapped children, because of the risk of breakage; fixed appliances often interfere with oral hygiene techniques. A semi-fixed appliance, as described in this report, allows for proper cleaning of the teeth. Additionally, since lip-biting may be a cyclic

Figure 3. Showing horizontal tube soldered on the stainless steel crown of the mandibular first primary molar. The opening in the vertical loop permits the lip shield to be adjusted while in the mouth.



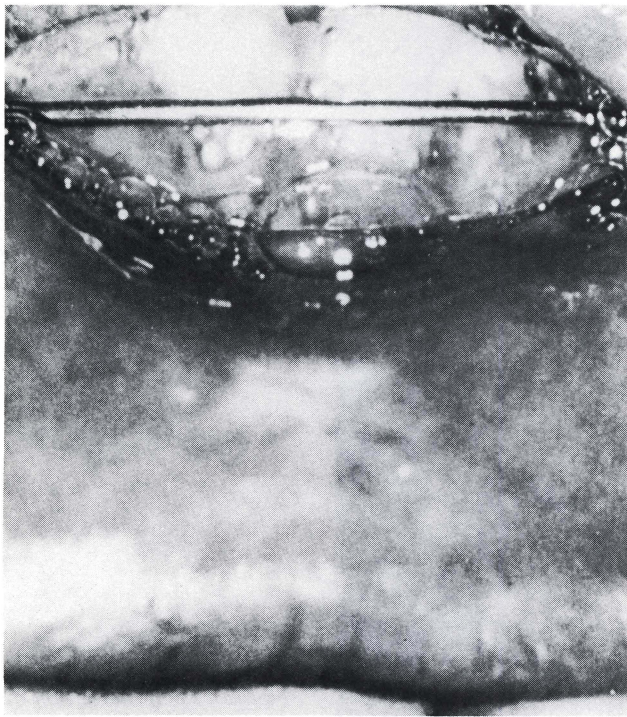


Figure 4. Evidence of healing after two months of use.

problem, the semi-fixed appliance enables the dentist to reinsert it as needed.

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SOLAR CHEILITIS

Solar cheilitis refers to degenerative tissue changes of the lips resulting from exposure to sunlight. Acute injury results in damage to epithelium and underlying connective tissue with vesicle formation and peeling. Repeated injury leads to gradual fibrosis and hyalinization of the lamina propria. Clinically, it results in loss of the vermilion border. The tissues appear more opaque with keratinization, which causes the openings of minor salivary glands to appear as distinct dots. Repeated injury may lead to chronic drying and ulceration. Treatment consists of the use of emollients and sunscreen preparations for prevention.

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Bilateral, asymmetrical, complete oroocular facial clefts and supernumerary teeth in a young Chinese female

Development

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An increasingly important area of pediatric dentistry is the care of children with significant medical conditions and syndromes. The purpose of this paper, therefore, is to describe a rare patient with bilateral oroocular facial clefts and dental abnormalities.

Oblique facial clefts are rare. By 1981, only 78 cases had been reported.¹ The incidence of facial clefts is in the order of 1/1,000.² Racial differences, however, are suggested in a higher incidence in the Oriental races, in the order of 1.7/1,000.³ The incidence of oblique facial clefts has varied from 1/1,000 to 2/1,000 within this pool of patients. Approximately 25 to 35 percent of the facial clefts are bilateral and no sex predilection is reported.⁴⁻⁹

Tessier proposed a numerical classification, 0-14, to describe facial clefts.¹⁰ Using the medial aspect of the orbit as the baseline, clefts are numbered 0 onwards below the orbit in an anti-clockwise direction. Thus, oblique facial clefts are numbered 3 to 5 "southwards"; and forms 8 to 11, "northwards" of the orbit (Figure 1).

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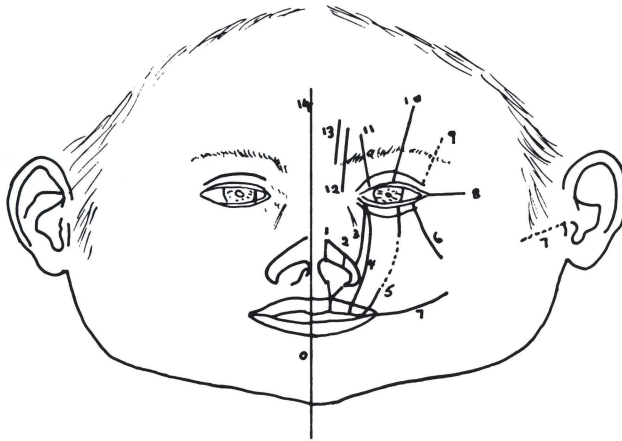


Figure 1. Numerical classification of facial clefts after Tessier (1976).

The oroocular type of oblique facial cleft can be divided into medial and lateral types.¹¹ The medial oroocular cleft lies medial to the infraorbital foramen and lies in the region of the nasolabial groove, terminating at the inner canthus of the lower eyelid. These clefts can be bilateral and involve lips, cheeks, lower eyelid, alveolar process and premaxilla. The medial oroocular cleft may be the result of failure of mesoderm migration or merging to obliterate the embryonic grooves between the medial and lateral nasal processes and the maxillary process.¹²

The lateral oroocular cleft extends from the angle of the mouth to the orbit terminating at the lateral canthus or in a coloboma in the midportion of the lower lid. This cleft has the same origin as the transverse cleft, but its direction is oblique, not corresponding directly to any of the known facial grooves. Karfik proposed that the lateral oroocular cleft corresponds to no embryonic groove and is the true oblique cleft.¹³ It may be that these clefts result from disturbed migration or early necrosis of the neural crest cells.¹⁴ McKenzie and Craig relate these defects to inadequate arterial blood supply, occurring at a time of rapid facial growth.¹⁵

Transverse clefts are considered the result of failure of mesoderm migration or merging to obliterate the embryonic grooves between maxillary and mandibular processes.¹² These clefts (Tessier type 7) extend transversely between the commissure of the lips of the mouth and the tragus of the ear.



Figure 2. Full face view showing positions of facial clefts.

CASE REPORT

During a recent survey of the dental condition of a group of handicapped children in Hong Kong (Brook *et al* 1983), a six-year-old Chinese girl with bilateral, asymmetrical, complete oroocular facial clefts was examined (Figure 2).¹⁶ She had undergone early operative repair and more corrective surgery is planned.

The left facial cleft extended from the upper lip, 1 cm medial to the angle of the mouth, upwards to the lateral canthus of the left eye (lateral to the infraorbital foramen) and then upwards into the temporal region.

The right facial cleft extended from a point on the upper lip, 2.5 cm from the angle of the mouth, upwards to the inner canthus of the eye.

Intraorally, there were clefts of the alveolar processes and the hard palate associated with the facial clefts and a residual palatal fistula (Figure 3). On the left side, clefting of the alveolus and palate occurred mesial to the left lateral incisor. A supernumerary tooth was present, mesial to the cleft. On the right side, the cleft of the alveolar process and palate was distal to the canine tooth. A supernumerary was present distal to the cleft. The full primary dentition was present and all teeth were caries free. There was a Class I occlusion. No abnormalities of tooth size or form, or of the enamel were observed.

A panelpse radiograph (Figure 4) revealed a full developing permanent dentition. The right permanent



Figure 3. Upper mirror view showing positions of palatal clefts.



Figure 4. Panellipase radiograph showing position of developing permanent dentition.

canine appeared to be transposed, crowded and lying distal to the facial cleft; whereas the left permanent canine, also crowded, lay mesial to the facial cleft. Radiographically, her dental age may be slightly behind chronological age.¹⁷

Dental care for this patient is preventive, and her orofacial growth and development are monitored at regular intervals. Restorative orthodontic and prosthetic treatment may become important, in conjunction with further surgical repair.

FAMILY HISTORY

This child is the elder of two siblings. Extra and intraoral examination of the mother, father and younger brother revealed no facial abnormalities. Detailed questioning of the mother revealed that this child was the only member of the family to have any facial clefting as far back as memory would allow. The mother had contracted rubella, however, in the first month of her pregnancy with this child, and had received no specific treatment for the rubella.

DISCUSSION

Contraction of rubella during the first eight weeks of gestation increases the incidence of facial clefts.^{18,19} The

facial clefts in the present patient may well be associated, therefore, with her mother's rubella infection.

The left facial cleft corresponded only in part to the description of a lateral oroocular cleft. The cleft traced in the main the course of the lateral oroocular cleft. There was, however, associated clefting of the upper lip, alveolar process and premaxilla. The nearest Tessier classification would be 5, extending to the lower eyelid at a point roughly midway along it. In this patient, the cleft extended to the lateral canthus of the eye, very similar to the lateral oroocular cleft. The right facial cleft corresponded to the medial oroocular cleft with involvement of the upper lip, alveolar process and premaxilla (type 4 in Tessier's classification)(Figure 1).

The mixture of lateral and medial oroocular clefts in the same patient is very rare. Three examples were previously reported to occur on one side of the face in the mixed group studied by Skoog and Greer Walker.¹¹

The positioning of the supernumerary teeth is of interest, as it corresponds to the asymmetry of the clefting. The upper left supernumerary is mesial to the cleft, while the upper right supernumerary is distal to the cleft. Similarly, the panellipase radiograph shows the left canine mesial to the cleft, and the right canine is distal.

The scarring that resulted from the early surgery is evident in Figure 1. As an ongoing program, surgical

reconstruction of the right orbit and the use of bone grafts in the maxilla are occurring. When seen initially, the right eye was closed over with a graft from the forehead, in preparation for reconstruction of the lower eyelid. To date, reconstruction of the orbit has been partially done, so that the eye is now open, with limited sight, and covered by a protective patch. Dental care is part of the treatment plan. The palatal fistula is causing no problems at present; but should it do so in the future, a prosthesis will be constructed. There will always be facial disfigurement, but the aim is that the patient's appearance will be acceptable, in the long term, for her integration with society.

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AUTOGENOUS BONE TRANSPLANTS

Autogenous bone transplants are better tolerated than other types of bone grafts. Although the mechanisms involved in osseous reconstitution by bone grafting remain unclear, two theories exist. According to the first, survival of osteogenic cells in the graft results in functional new bone formation. However, only a small percentage of osteocytes and osteoblasts survives transplantation. Thus new bone formation may depend more on the ability of osteogenesis-inducing substances to diffuse from the transplant into the host's connective tissue. The latter theory has been termed the inductive matrix theory by Urist and McLean. Both mechanisms probably occur coincidentally.

—Irby, W. B. and Shelton, D. W.: Current advances in oral and maxillofacial surgery. Vol IV. St. Louis: The C.V. Mosby Company, 1983, p 158.

Double-rooted maxillary primary canines

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Double-rooted maxillary canines in the primary dentition are uncommon, but do not appear to be as rare as implied in the literature. Five recent reports mention contralateral bifurcated primary canines discovered through routine radiographic examination.¹⁻⁵ We report here an additional case of bifurcated maxillary canines from our pedodontic clinic. Also, we have found a surprisingly high incidence of deep labial grooves and a case of maxillary canine bifurcation in prehistoric Ohio Indian populations. These findings prompted a review of the general occurrence and developmental implications of bifurcated maxillary primary canines in different populations.

CLINICAL EXAMINATIONS

A 9.5-year-old black male was brought to Columbus Children's Hospital dental clinic for routine recall examination. During clinical examination, it was noted that the permanent maxillary canines were not palpable on the facial aspect of the alveolus as expected for a child of this age. Subsequent radiographs revealed nonresorbed primary canines with bifurcation of the

roots as well as bilateral ectopic eruption of the permanent canines. As part of the patient's treatment plan the primary canines were extracted. The teeth were submitted for morphologic evaluation and histologic examination.

Morphologic evaluation revealed a wide crown (Figures 1-4) with a large crown-width-to-crown-height ratio (1.13 and 1.18). This is in contrast to the near equal dimension reported in a dental morphology manual (1.03) and test (1.09).^{6,7} The roots were bifurcated labially, (Figures 1,2) emanating from a long root trunk which reached from a third to a half of the total length of the root. The mesial root in both cases was wider than the distal root. On the lingual side, a cementodentinal bridge connected the roots, giving the appearance of one very wide root (Figures 3,4). Histologic examination revealed that the lingual bridge consisted of dentin, covered with cementum on both the bifurcated and lingual sides. Radiographically, the pulp chambers were enlarged apicoclusally, reaching almost to the bifurcation, giving a taurodont appearance to the teeth (Figures 5,6).

AMERINDIAN TEETH

Figures 7 and 8 present the maxillary primary canines from a four-to-five-year-old from the Dodge site located in Wood County, Ohio (1650-1530 B.P.). This

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Figure 1. Extracted right primary canine from a 9.5 year-old black male. Note the deep labial groove dividing root into mesial and distal halves.

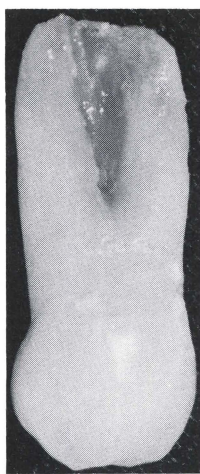


Figure 2. The primary canine from the same child. Note the shallower labial groove.



Figure 3. The lingual view of the tooth in Figure 1. Note the cementodentinal bridge.

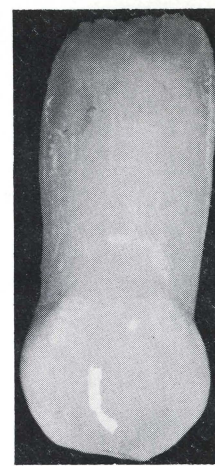
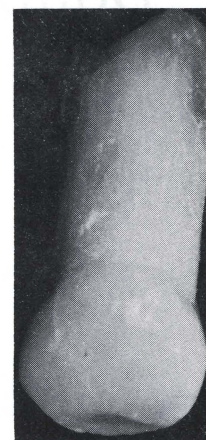


Figure 4. The lingual view of the tooth in Figure 2. Note the similarity to the cementodentinal bridge shown in Figure 3.



individual had a double-rooted right canine, which lacks a dentinocemental lamina on the lingual surface, and a marked labial groove on the left canine. The roots of the double-rooted canine, as in our clinical case, emanate from a long root trunk with the mesial root wider than the distal root. The Amerindian teeth also exhibit an even greater crown-width-to-crown-height ratio, 1.21 and 1.31. The mesiodistal cervical measurement was wide, exhibiting a mesiodistal to buccolingual width ratio of 1.14.

Table 1 summarizes our results from the examination of seventy-one maxillary primary canines from fifty-seven individuals. These individuals are sampled from Ohio sites which date from 3230 B.P. to 500 B.P. All of the individuals are between three and seven years of age and represent the developmental period after root formation and prior to significant root resorption in the primary maxillary canine.⁹ Labial grooves are the most common expression of root morphology in this sample with 77.5 percent of the teeth and 78.9 percent of Amerindians exhibiting the trait.

DISCUSSION

The single conical root is usually considered the most frequent form of the primary maxillary canine. Pedo-

dontic and dental morphology texts offer this as the normal, commonly found form.^{7,10} Jörgensen, however, in looking for a possible racial and evolutionary significance of anatomical structures in the primary dentition of Danish children, found that the maxillary canine root was not always conical or single.¹¹ Examination of primary maxillary canines revealed not infrequently, a labial groove, which ran longitudinal to the root axis, and separated the root into mesial and distal halves. Jörgensen, thus presented three major canine root types:

- A single root without a trace of a labial, longitudinal groove.
- A root with a faint to distinct labial groove, which does not exceed 1 mm in depth.
- A root with a broad and deep (greater than 1 mm) labial groove in the apical portion of the root, that does not always reach the cemento-enamel junction.¹¹

In the third type, the root is divided labially in mesial and distal portions, but is joined by a thin dentinocemental lamina on the lingual. Even though morphologic conformity is common in contralateral teeth, the 9.5-year-old individual in this report, displays an asymmetry, with the right canine (Figures 1,3) complying with type 3 morphology and the left canine

Table 1. Number of individuals and numbers of maxillary primary canines with noted root morphologies in the Amerindian sample.*

Individuals	Teeth				Totals
	Single root no groove	Single root labial groove	Single root lingual groove two apices	Double root	
Contralateral present					
14	6	21**	0	1**	28
Unilateral present					
43	9	32	2	0	43
Total					
57	15	53	2	1	71

*Some of these data are presented in reference 8

**One individual (Figure 1) is not bilaterally symmetrical

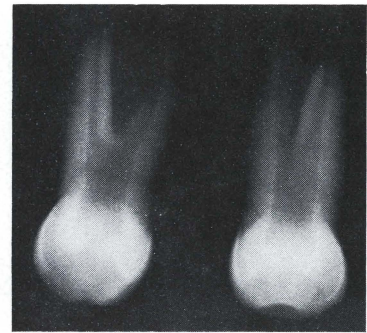


Figure 6. Radiograph of right and left primary canines, after extraction, showing root bifurcation, long root trunk and very large pulp chambers, giving teeth transparent appearance.

(Figures 2,4) complying with type 2 morphology. Jørgensen's classification of root forms did not mention completely bifurcated roots. Three of the recent reports in the literature, however, show radiographic evidence of very widely separated, bifurcated maxillary canines.^{1,2,5} The right canine of the Amerindian child, furthermore, also shows complete separation of the root (Figures 7,8). Possibly another category such as type 4 for complete root separation should be considered.

In the study of dentitions of contemporary Danish children (including 191 right and 238 left canines), Jørgensen, reported an incidence of 82.2 percent with type 1 root morphology, 15.2 percent with type 2 morphology, and 2.6 percent with type 3 morphology for maxillary right canines, with a similar distribution for the left side of the dentition.¹¹ Earlier, Visser reported

a 9.3 percent incidence of maxillary canines with labial grooves in a sample of 700 Dutch children.¹²

Our results indicate that the frequency of labial grooves may be much higher in some ethnic/racial groups. Table 1 shows that 77.5 percent of the teeth and 78.9 percent of the individuals show, at least, a labial groove on the maxillary primary canines in the prehistoric Amerindian sample. The frequency of labial grooves is significantly higher in the Amerindians when compared to the Dutch ($X^2_{(1)} = 221.0, P < 0.001$) and

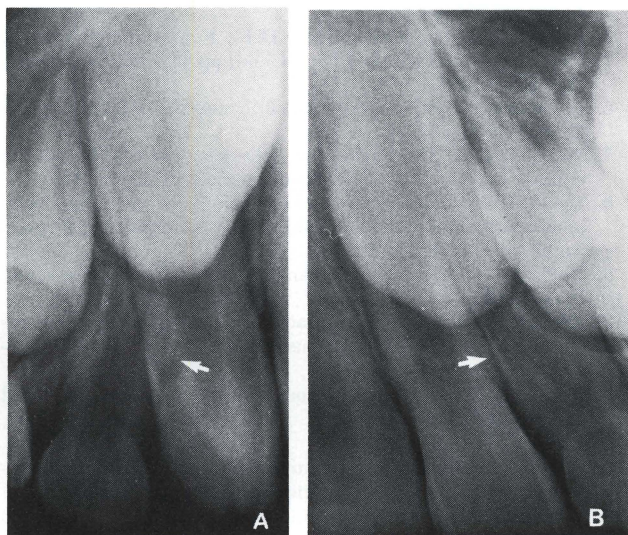


Figure 5A & B. Periapical radiographs of maxillary right and left canine areas, showing bifurcated primary canines prior to extraction and ectopic eruption of permanent canines.

Figure 7. Labial view of maxillary primary canines from a four-to-five-year-old child from the Dodge site located in Wood County, Ohio (1650-1530 B.P.).

Note the complete bifurcation of the right canine and the very deep labial groove of the left canine.

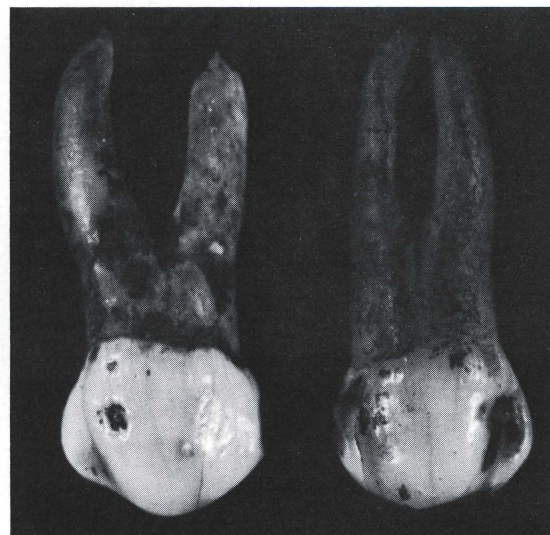




Figure 8. Lingual view of the same contralateral set of canines, showing complete root separation in the right canine and the cementodentinal bridge in the left canine.

Danish ($X^2_{(1)} = 85.6$, $P < 0.001$) samples.¹¹ This suggests that this feature as well as the double-rooted canine also may be more frequent than is commonly considered in some contemporary populations. In support of this, we note that three of the four cases of contemporary maxillary canine bifurcation in the literature and the clinical case reported here are expressed in children of black African descent.^{1,2,4} Black Africans and Amerindians are phylogenetically well separated with respect to the other human populations, but do share the expression of metrically large teeth.^{13,14} This suggests a provisional hypothesis relating size to these features of root morphology. We would expect populations with large teeth, for example, native Australians, native Americans, black Africans, to have higher frequencies of primary maxillary canine labial grooves and bifurcated roots.

Our results have also confirmed earlier reports by Jørgensen of other morphological characteristics common to the primary maxillary canines:

- A relatively sharp canine cusp angle.
- Short proximal surfaces, especially on the mesial side, because of the longer cusp arm on that side.
- Shallow cervical curvatures, especially on the mesial side, where it may be less than 0.5 mm deep.
- Labial bending of the root apices.
- Well developed marginal ridges, especially in the Amerindians.

Root bifurcation has significant developmental implications. Root formation in single-rooted teeth proceeds when the root sheath forms the epithelial diaphragm.¹⁵ Multi-rooted teeth typically develop tongue-like extensions of the root sheath, dividing the root into two or three portions. The cases we described indicate that the bifurcation occurred after a significant portion of the root trunk had formed and may be the result of a relatively wide, and perhaps discontinuous Hertwig's root sheath. In any event, in the clinical case, the tongue-like extension grew in from the labial side only, leaving the lingual wall of the root intact, thus incompletely dividing the root. In the Amerindian child's right canine, extensions grew from both the labial and lingual sides.

Clinical awareness of primary canine root bifurcation may be increased, if the frequency of this phenomenon is associated with a wide root trunk, with a large crown-width-to-crown-height ratio, or, more generally, with large-toothed individuals. Pedodontic and orthodontic practitioners should be aware of possible root bifurcation when treatments are considered.

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Voice control: an old technique reexamined

Behavior

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In his classic essay, "Applied psychology in pedodontics," one of the pioneers of the dentistry for children movement in the United States, Dr. John C. Brauer, noted more than two decades ago that voice control was a useful technique that the dental clinician could use to manage children's behaviors.¹ Specifically, Dr. Brauer noted the following:

"Voice control by the practitioner is an all-important factor in management of the patient. The tone and emphasis employed in talking with the child produce favorable or unfavorable reactions. While many dentists have recognized the value of voice control and have mastered satisfactorily voice techniques, additional research is warranted in this area."

Dr. Brauer concluded his relatively short discussion of voice control with the following:

"Voices and personalities of dentists vary widely, and likewise, the response from children will differ markedly in designated age ranges and different environments. Frequently, a sharp, loud, surprise comment of "Open your mouth and stop crying!" or comparable expressions as the situation warrants, will perform wonders in a few seconds.

"The voice, with certain qualities under control, has motivated nations in peace as well as war; has captured audiences at all age levels, and it can have a profound

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influence in the behavior pattern of the individual. It is a powerful instrument employed in too few instances in child behavior problems. The profession must learn more of the positive value of this technique."

Dr. Brauer's hope for additional research in this area has, since the time of publication of his essay, gone virtually unheeded. This is, probably, because the profession does not question the utility of the technique and because voice control does not appear to be as controversial or even objectional to parents and members of the dental profession as do other assertive measures like hand-over-the-mouth and physical restraint. This is not to say that there have not been parents, waiting in the reception room, who have not been alarmed by the loud reprimands or orders a dentist has given their children. It is assumed, however, that this technique is more universally acceptable than are physical measures taken to intercept a child's misbehavior.

The purpose of this essay is to reexamine exactly what is happening when voice control is utilized by the dentist. It is the conclusion of the authors that this technique has been mislabeled and because of this mislabeling, the technique may be confusing to dental students and other clinicians who have insecurities about whether they have mastered the technique or not.

VOICE CONTROL OR SOMETHING ELSE?

Johnny is a thirty-five-month-old, well-fed, well-nourished developmentally normal white male. His medical and social histories are unremarkable. His family is intact and his middle-class parents are a loving and nurturing couple.

On a given Sunday afternoon in February, John's father and a friend from work are in the family recreation room watching a professional football game. They are also supervising Johnny who is playing with a set of blocks. Eventually, Johnny loses interest in his blocks, stands up and starts to walk toward the fireplace which has a fire blazing in it.

Upon seeing Johnny's proceeding toward the fire, Johnny's father states with a firm voice in a low tone, "Stay away from the fireplace." Johnny stops. He establishes eye contact with his father. He then turns his head toward the fireplace and takes another step. This elicits from his father a second command which is given in the same tone as before but with a slightly brisker rate. "Stay away from that fireplace." Johnny stops again. He looks at his father again. Again he turns his head away and takes another step toward the fireplace. This

time the father speaks with heightened conviction and more loudly. "Stay away from the fireplace!" Johnny again turns around and sees his father. This time he abandons his trip to the fireplace and returns to play with his blocks.

ANALYSIS AND DISCUSSION OF THE EXAMPLE CASE

Johnny's father used the same command three times. In two instances, the command was not useful. In the third instance it was. Why?

It seems reasonable to conclude that the command by itself was not sufficient to stop Johnny's behavior. The first time that it was delivered it did little more than to interrupt Johnny's intention about going to the fireplace. The same is true for the second time.

It would also seem reasonable to conclude that there was something done at the third command that was different and apparently more effective than the first two. Was it the fact that the redundancy of the command finally caught up with Johnny? It is the authors' feelings that the redundancy of the command was not the reason. If the command had been delivered in the same tone and with the same conviction as the first two times, it could have been repeated literally dozens of times and it would not have permanently interrupted Johnny's intentions.

Was it the fact that the third command was given louder and with more conviction? The authors feel that the actual loudness of the voice and the conviction in the voice are partly accountable, but are not the sole reason, perhaps not even the primary reason, for the third command's success.

Instead, we endorse the conclusion that a by-product of the loudness and the conviction of the voice is what actually conveyed a message to Johnny that, indeed, it is in his best interest to stop his behavior. In other words, Johnny heard the voice, just as he had two times before, but in the third instance he saw a different face and, therefore, got a different message than he had previously.

Talking or even yelling at little children frequently accomplishes no more than getting their attention. Sometimes it does not even do that. To have their behavior directed, they often must see facial cues. The father was successful the third time, in theory, because a louder and more convincing voice was paralleled by a facial expression that had conviction. It may be possible that the reason that voice control has been so labeled in dentistry is that the most salient clue to the

clinician that his face is carrying a communicative/authoritative message that a child can understand is when his voice feels and sounds to himself to be authoritative. It would probably be valuable to a clinician, if he had photographs of himself when he was using voice control which was effective and when he was using voice control which was ineffective. The faces no doubt would be different.

In a student clinic, it becomes obvious when a student has mastered the ability not only to speak authoritatively, but also to look authoritatively when speaking. In such clinics, for mastery of this type of management control, it could be argued that a good drama coach might be as effective as a pedodontic academician.

REVIEW OF RELEVANT LITERATURE

Approximately 100 years ago, Darwin wrote that the facial expressions of emotions are universal and are not learned differently in each culture.² They are biologically determined and are the product of man's evolution. Facial expression along with hand and arm gestures, postures, and various movements of the body and the legs and feet have been popularly labeled, nonverbal communication. Mehrabian has argued that nonverbal communication is a misnomer and prefers the term explicit speech to describe communication based solely on words and implicit communication to be that communication which involves facial expression, body and arm movement, as well as the subtle aspects of speech, such as frequency range, intensity range, speech errors or pauses, speech rate and duration.³

Studies with eye movement cameras consistently indicate that the human head tends to be looked at first and most in social encounters. Brandt found that the face "without exception" received the largest amount of attention.⁴ Furthermore, Baker stated in his research that a third of the time is spent in detailed study of the face.⁵ Perhaps this intense interest is not so surprising, considering the prominence of the face in all face-to-face encounters. Allport stated the following:

"By far the most expressive region of the body is the face. Nature has provided it lavishly with nerves and subtle muscles; it is unclothed and therefore the most visible region; the seat of the distance receptors, it is where the person meets the world head-on. As we have seen, most people locate the "self" in close relation to the face. Our voice emanates from the face and so, all in all, it is the region to which we give chief attention when we are observing others."⁶

The brow-eye-mouth combination seems to account for a large part of the expression within a given face. Byrnes observed the following:

"All changes of expression are centered in the mouth, the eyes, and eyebrows—these are the only features that move of themselves. These appear to be the high information areas within the face and not unexpectedly they draw the greatest attention."⁷

Darwin was the first to attempt to provide evidence that facial expressions of the emotions are innate and universal.² Studies on chimpanzees and monkeys by Hebb and Harlow have shown that various emotional reactions of these animals are spontaneous and unlearned.⁸⁻¹⁰

Goodenough using a ten-month-old infant as a subject concluded the following:

". . . however greatly the overt expression of emotional states may be inhibited, modified, or intentionally assumed in social relationships of adult life, the language of expression is nevertheless built upon a core of native reaction patterns which appear so early an age that they can hardly be ascribed to training."^{10,11}

Some investigators concede that once the human face becomes an effective stimulus for socioemotional responsiveness, it is often utilized as a conscious or subconscious primary mode of communication.^{12,13} Birdwhistell estimated that in a normal two-person conversation, the verbal components of the communicative process carry less than 35 percent of the social meaning of the situation, while more than 65 percent of the meaning is transmitted through implicit means of communication.¹¹ Mehrabian also believed that during speech the majority of the impact is mediated through facial expressions.¹³

In children, the recognition of the emotions such as enjoyment, distress, anger and fear will develop more rapidly than the recognition of other emotions such as shame, disgust and contempt.¹⁴

CONCLUSIONS

The literature seems to support the conclusion that young children can interpret meaning from human faces. Although the literature also notes that voice tone and intensity are a part of the implicit communication domain, it would seem reasonable to assume, at least, that the communication afforded by a tone of authority and conviction in a clinician's voice can only be enhanced, if the face also conveys conviction and authority. Voice control by the dentist is somewhat of a misnomer, therefore, if, in fact, the face's appearance

is a vital feature or perhaps the most important feature in the entire communication process. Facial/voice control might be a better term. Facial control could be argued to be a better term than voice control. The most accurate term would probably be implicit communication control.

One important clinical consideration relative to implicit communication control by the dentist is that the child's ability to see the dentist's face is important during this management technique. The dentist is encouraged to place himself so that all features of his face are easily seen by the child, when performing this management technique. Upon recognition of these various facial features, the child then responds accordingly.

Another important conclusion is that facial expression communicates even where there is a language barrier. In fact, implicit communication control can be highly effective with a deaf child who often has a refined ability to understand facial gestures.

Lastly, the old voice control technique was limited to the interception of misbehavior. Implicit communication control implies that a gamut of facial expressions are important in dentistry for children such as the praising face, the relaxing face, the coaxing face, and the sympathetic face. Likewise, a variety of voice intonations and intensities may enhance the accompa-

nying positive facial expressions such as the pleasant, soothing voice and the coaxing voice.

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TALKING WITH PATIENTS

In medicine, disease plays a dominant role. We must, however, always bear in mind that disease is a word or a label and, not a real thing. We cannot go out in nature and find a disease or an illness. We may find an ill person or a patient, but we will never find a disease or an illness. One of these labels is 'pneumonia'. Again, pneumonia is a word, not a thing. In nature we do not find pneumonia. We may find the pneumococcus, one of the bacteria which can be responsible for the processes which have made our patient ill, but we will never find a 'pneumonia'. This is a key observation and it should make it easy for us always to be patient-centered in our approach. The ill person, the patient, is our concern, not the label we have chosen to use. The label may help us to organize our thoughts and our reasoning, but let us always keep in mind that no diseases or illnesses exist on their own, just patients or, if you will, ill persons.

—Harlem, O.K.: *Communication in medicine*. Basel: S. Karger, 1977, p 58.

Food nutrient interactions

Nutrition

Foods are complex combinations of nutrients and other chemicals that can interact with one another to varying degrees. Some interactions can be beneficial to health, while others can be harmful, even fatal. In general, positive interactions increase a nutrient's bioavailability (the extent to which it is available for metabolism), absorption or utilization, while negative interactions inhibit, decrease or totally block any of these effects.

These interactions can take place by various mechanisms:

Binding. One molecule may tie up another molecule, rendering it unusable or available in reduced amounts. Processing of a food can result in removal or destruction of the binding agent.

Inhibition. This is the repression or restraint of a function. Alcohol, for example, can act as an inhibitor by damaging cells and impairing their ability to absorb nutrients properly.

Competition. Some molecules may be more successful than others at entering the competitive pathways of utilization. Iron and zinc, for example, compete for the binding sites of transferrin, an important blood protein needed to transport iron to tissue.

WHO IS AT RISK?

The human body is very adaptable and can compensate for the negative effects of some short-term nutrient

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interactions if a person is in good health. However, for certain groups of people, nutrient interactions can be of particular significance:

- Those who habitually eat diets deficient or excessive in one or more essential nutrients, such as food faddists, dieters and those who unintentionally consume unbalanced diets.
- Those on long-term medication, such as the elderly.
- Those who chronically self-medicate by consuming megadoses of vitamins, minerals or other supplements.
- Those who are alcohol abusers or heavy users of drugs (prescription as well as over-the-counter and street drugs).
- Those who are in any period of greatly increased nutrient requirements, such as infants, adolescents, pregnant and lactating women, and people with certain diseases, such as malabsorption.

INTERACTIONS WITH MACRONUTRIENTS

Macronutrients—protein, carbohydrate and fat—interact with other nutrients. Many of these interactions are essential, normal functions. However, when a macronutrient is consumed in excessive quantities or when intake is grossly deficient, the resulting interactions are of concern.

Protein. Levels of protein intake have a strong influence on absorption, retention and utilization of other nutrients, especially minerals and particularly calcium. Even relatively small increases in dietary protein have been shown to increase urinary calcium excretion to a significant degree in healthy men.¹ Thus, high levels of protein could lead to increased loss of calcium from the body. Over the long term, such losses might contribute to the incidence of osteoporosis. In addition, increased calcium excretion in the urine is a major factor in the formation of kidney stones.^{2,3}

Too much protein intake is a more likely concern than inadequate protein intake for most of the population in industrialized nations. The average dietary protein intake in the U.S. in 1983 was 1.5–2 times higher than the Recommended Dietary Allowance.⁴ Interactions between protein and calcium may therefore be a problem for some segments of the U.S. population.

Carbohydrates. Dietary fiber (complex carbohydrates) and phytates in plant foods bind to minerals to form insoluble complexes not readily absorbable by humans.^{5,6} Phytates reduce zinc bioavailability the most,

but calcium, magnesium, phosphorus, iron and certain trace elements may also be affected.^{7–9} Because phytates are contained mostly in the bran, its removal during the milling of grains greatly increases the bioavailability of minerals, particularly iron and zinc.¹⁰

The increased popularity of high fiber diets in the U.S. is unlikely to result in any clinically significant problems because of the diversity of the general diet.

Simple carbohydrates, such as fructose and glucose, react with the amino acids in protein (the Maillard reaction) during storage of dried foods, causing a loss of protein quality.¹¹ There is no evidence that this creates dietary insufficiencies in those who consume a normally high protein diet.

Fats. Fats are amply represented in the diets of most people, so insufficiency is not a problem. Some fats provide essential fatty acids and aid in the absorption of the fat-soluble vitamins A, D, E and K. Persons with diseases which inhibit fat absorption, such as Crohn's disease and irritable bowel syndrome, can suffer from deficiencies of these vitamins. On the other hand, imbalances of certain of these vitamins can inhibit the absorption of others; e.g., high levels of vitamin E can block the conversion of carotene to vitamin A.¹²

One important storage reaction is the oxidation of essential fatty acids. Usually this causes the food to become rancid before the fatty acid loss becomes significant. Addition of antioxidants slows this reaction.

INTERACTIONS WITH MICRONUTRIENTS

Vitamins and minerals are often referred to as micronutrients because the quantities that are essential to health and well-being are small in comparison to the amounts of macronutrients required. Nevertheless, changes in the balance or ratio of these micronutrients can have clinically significant consequences.¹³

Deficiency states of a particular mineral can be brought about by adding excessive amounts of a second mineral to the diet; and, conversely, signs of mineral toxicity can be reduced by increasing the dietary levels of another mineral.¹⁴

Excessive intake of zinc has been shown to cause copper-deficiency anemia.^{15–17} A high zinc intake can inhibit calcium absorption when dietary calcium intake is low and can also affect the way the body absorbs iron. Conversely, zinc absorption is reduced when iron is present at high levels.^{18–20}

Phosphorus aids absorption of calcium.²¹ Although the optimal dietary ratio of calcium to phosphorus for

humans is unknown, a ratio of between 1:1 and 1:2 is generally recommended.²²

INTERACTIONS WITH ANTINUTRIENTS

A number of naturally occurring nonnutritive factors in foods also interact with nutrients.^{23,24} Most of these are inactivated by processing or are otherwise insignificant to healthy individuals on a varied, balanced diet.

Enzyme inhibitors can interact or interfere with nutrient metabolism. Protease inhibitors, found mainly in uncooked soybeans and other legumes, block the action of digestive enzymes and thereby inhibit the utilization of protein.²⁵ They are destroyed by heat and moisture during food processing.

Other enzyme inhibitors have been shown to have significant effects in animals which have not yet been demonstrated in man. These include the protease inhibitors ovomucoid and ovomucoprotein, which are found in eggs, and amylase inhibitors, which interfere with metabolism of starch. Simple blanching for several minutes at 160°F destroys these enzymes.

Vitamin antagonists interfere with the function of vitamins. Avidin, found in egg white, binds to biotin to make it unavailable.²⁶ However, avidin is heat-sensitive, so that its presence is of nutritional significance only when consumption of raw eggs is high.

Eggs also contain ovoflavoprotein, an antivitamin which binds to riboflavin. However, this does not appear to have any significant antinutritional effect, because the ovoflavoprotein-riboflavin complex dissociates in the gastrointestinal tract.

Thiamin is inactivated by thiaminases, which are found in raw fish (mainly in the viscera), shellfish, some berries, Brussels sprouts and red cabbage. They are active in raw foods but are inactivated by heat. Therefore, cooking or canning of some thiamin-containing foods may actually enhance their nutritional value.

Goitrogens found in plant foods, such as cabbage, broccoli, Brussels sprouts, kale, turnips, rutabagas, cauliflower, mustard seeds and horseradish, interfere with the uptake of iodine by the thyroid gland. Consumption of iodized salt or iodine-containing foods, such as seafood or vegetables grown in iodine-rich soils, will normally offset the negative effects of goitrogens. However, if the diet is high in goitrogens and low in iodine-containing foods, goiter may result.²⁷

Polyphenolics, such as tannins, are found in many plants. Important sources of tannins are tea and red wine. Tannins can inhibit the absorption of iron, re-

duce the bioavailability of protein by binding to enzymes needed in its metabolism and interfere with intestinal uptake of vitamin B₁₂.^{28,29} Gossypol, found in cottonseed protein, can reduce the bioavailability of iron by binding to it.

Oxalates are found in highest concentration in spinach, rhubarb, beets and beet greens, Swiss chard, collard greens, almonds, cashews, chocolate and cocoa. In the balanced diets of most people, oxalates are not of great consequence. However, since oxalates can bind to the calcium in foods, high intake of oxalate in a calcium-deficient diet may further aggravate calcium deficits.³⁰

Saponins are found in many plants, particularly alfalfa and soybeans. In the intestines, they form complexes with cholesterol and thereby reduce plasma cholesterol levels.³¹ However, saponins cause hemolysis (breakage of red blood cells) when taken in large amounts and can also produce diarrhea and vomiting. For this reason, they are not medically approved as a method of reducing cholesterol levels.

Cucurbitacins are complex chemicals in bitter-tasting summer squash. Severe diarrhea, vomiting, anemia and headaches have been reported after consumption of this squash. Nutrient interactions are occurring, but their mechanism is not clearly understood.³²

POSITIVE INTERACTIONS

A number of nutrient interactions are beneficial. Ascorbic acid (vitamin C), for example, increases the absorption of nonheme iron, so consuming citrus or tomato along with iron-containing food will actually help increase iron availability.

Vitamin D is required for the absorption of calcium. It is therefore used to fortify milk and often included in calcium supplements.

CONCLUSIONS

Nutrient interactions may be of little consequence and clinically insignificant as long as an individual consumes a well-balanced, varied diet that fulfills all the requirements for essential nutrients in appropriate amounts. However, when the diet is either deficient or excessive in important nutrients, when long-term drug therapy or heavy drug or alcohol usage is involved, or during periods of increased nutrient requirements, nutrient interactions can be of greater significance. Food processing plays an important role in the control of adverse interactions.

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VITAMIN AND HEALTH PREPARATIONS

Today most vitamins can be synthesized and are produced and sold in different galenic forms in large quantities. In an inquiry of school children aged 6-12 years in a rural part of Switzerland, Gübeli found that 95 percent of the children knew more or less vaguely about the importance of vitamins. Most of them, however, did not know any natural source of vitamins but all easily named several commercial vitamin preparations. Questionnaires distributed to patients in several physicians' and dentists' offices in the Zürich region revealed that out of 230 persons, 129 (56 percent) were regularly taking vitamin or health preparations. Only in 25 percent of the cases had such preparations been prescribed by a doctor.

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The calcium-blood pressure hypothesis: evidence for its validity

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Calcium plays a prominent role in a variety of physiological systems. The earliest clue that dietary calcium was predictive of cardiovascular risk was made about 24 years ago.¹⁻³ Since that time, evidence linking calcium to blood pressure regulation has accrued in the form of epidemiological, experimental and a limited number of clinical trials.

Although mechanisms governing calcium's modulation of blood pressure remain ambiguous, it is becoming increasingly clear that calcium is a major contender among other nutrients for the dietary management of essential hypertension.

Essential hypertension is primarily a genetic disorder that requires environmental impact for expression. Ionic abnormalities involving mainly sodium and calcium have been documented in cells of hypertensive patients and their offspring, in cells of genetically hypertensive animals and in those women whose pregnancies are complicated by preeclampsia. Depending on an individual's level of exercise, body weight, smoking habits, level of psychological stress or dietary habits, these defects may eventually manifest themselves in the form of elevated blood pressure.

Dietary components that have been implicated in the etiology and/or management of hypertension in-

clude sodium, chloride, potassium, calcium, magnesium, protein, fats, calories and alcohol. Among these, sodium has been studied to the greatest extent. An impressively large body of data exists to support the contention that sodium intake is positively associated with blood pressure. This association, however, has not always been demonstrable, leading researchers to postulate that some forms of essential hypertension—probably 30 percent to 50 percent—are dependent for their expression on sodium intake. A relatively new concept appears to point toward a "calcium-sensitive" form of essential hypertension. A brief review of the evidence supporting this concept is provided here.

EPIDEMIOLOGICAL EVIDENCE

Associations between dietary calcium and blood pressure were initially provided by investigations relating malnutrition to pregnancy. East Indian women receiving a supplement containing 440 mg calcium per day exhibited lower incidences of gestational hypertension.⁴ This response was thought to be due to an improvement of general nutrition associated with supplementation. Later, however, a similarly low incidence of preeclamptic hypertension was reported prevalent in societies with suboptimal intakes of most nutrients except calcium.^{5,6}

Studies in osteoporosis have lent further credence to the "calcium sensitive"-blood pressure hypothesis. Thirty-seven percent of osteoporotic women have been

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shown to have elevated systolic and diastolic pressures compared to only 15 percent of non-osteoporotic women.⁷ Even though bone demineralization in osteoporosis is a complex process involving a variety of factors, it is generally accepted that calcium deficiency accelerates bone loss. Suboptimal intakes of calcium may also be responsible for higher blood pressure values observed in men. Hypertensive males have been shown to have a lower rate of dairy product consumption compared to their normotensive counterparts (approximately 70 percent of all dietary calcium consumed in the United States is derived from dairy products).^{8,11}

Perhaps the strongest epidemiological testimony for the calcium hypothesis comes from the analysis of large health data bases within mainland U.S. and Hawaii.⁹⁻¹² In a recent analysis of the Health and Nutrition Examination Survey (HANES I), dietary calcium was identified as the nutrient that had a significant, consistent and independent association with blood pressure among a sample of previously undiagnosed hypertensives.⁹ An independent evaluation of the same data base with a slightly different analytical approach yielded the same information, as did the analysis of two other large data bases.¹⁰⁻¹²

EVIDENCE FROM ANIMAL EXPERIMENTS

Associations suggested by epidemiological investigations have found confirmation in experiments involving animals. Marginal intakes of calcium raise blood pressure in normal and pregnant rats, while supplemental calcium decreases blood pressure in these same animals.^{3,14}

Calcium's actions are manifested to the greatest extent, however, in animals where several abnormalities of calcium metabolism accompany hypertension. These abnormalities include renal calcium wastage, decreased ionized serum calcium values, elevated parathyroid hormone levels and impaired calcium absorption.¹⁷⁻²⁰ These abnormalities have been documented in mineralocorticoid-induced hypertension, in genetic hypertension of the New Zealand strain and in the spontaneously hypertensive rat (SHR).^{15,16,19,20,23} In the SHR, supplemental calcium not only prevents a rise in arterial blood pressure in the young animal, but will reverse established hypertension in the adult rat.²¹ Interestingly enough, total exclusion of calcium from the diets of very young (five-week-old) SHRs results in an initial rise in blood pressure up to seven weeks of age, at which point they stabilize to near normal values. This bimodal response to calcium deprivation is pre-

sumed to be due to an initial rise in parathyroid hormone (PTH), which in turn increases vascular smooth muscle tone and consequently blood pressure. After the seventh week, continued calcium deprivation no longer evokes enhanced PTH production, which results in a decrease in vascular tone followed by attenuation of hypertension.²² Later, growth retardation resulting from calcium deprivation may account for the lower blood pressures.

Some interactive aspects of calcium metabolism with that of other nutrients and the effect of such interactions on blood pressure regulation have been partially investigated. Calcium's hypotensive effects appear to be compromised when high amounts of protein, chloride, and parenteral phosphate are introduced into the diets of SHRs.²³⁻²⁵ Nutritional consequences of increasing calcium for purposes of alleviating hypertension have as yet to be evaluated.

EVIDENCE FROM HUMAN EXPERIMENTS

Few studies have evaluated the effect of calcium on blood pressure regulation in humans. Nevertheless, the inquiries have yielded remarkably similar results, despite divergent methodological approaches. More important, most of the trials have used non-pharmacologic doses of calcium that theoretically could be achieved through dietary means.

In a parallel trial of placebo versus one gram of calcium per day, young normotensive adults experienced blood pressure reductions of 6 percent by the eighth week of the trial when compared to the placebo group.²⁶ Blood pressure reductions of a similar magnitude were achieved in normal pregnant women receiving either 1 g or 2 g elemental calcium when compared to a group receiving a placebo. The 2 g supplementation appeared to prevent the characteristic elevations of blood pressure observed in the third trimester of pregnancy.²⁷

To date, two groups have reported trials involving patients with essential hypertension. Calcium loading in ten patients with essential hypertension produced significantly lowered blood pressures after five days of supplementation. The hypotensive effect of calcium appeared to have a synergistic link with low plasma renin activity and, in a second report by the same researchers, with vitamin D supplementation.^{28,29}

The first randomized, double-blind, placebo-controlled, crossover trial of calcium as therapy for mild to moderate essential hypertension has recently been reported.³⁰ In that study, 48 hypertensives and 32 matched normotensives received either 1 g calcium per

day (as the carbonate salt) or placebo for eight weeks. After a washout period of four weeks, treatments were switched for an additional eight weeks. Compared to placebo, 1 g calcium per day significantly reduced average systolic blood pressure by 6-7 mmHg and average diastolic blood pressure by 3 mmHg in hypertensive patients. It was noted that reductions in blood pressure were not apparent until after the sixth week of supplementation and were still declining when therapy was discontinued.

As with any trial, some of the individuals in this study did not respond to therapy. Using a 10 mmHg or more drop in systolic pressure as criterion for response (a standard often used to evaluate the effectiveness of hypotensive drugs), participants in this study were classified as either responders or nonresponders. Systolic blood pressure was chosen since it is thought to be a better physiological marker for smooth muscle tone. Smooth muscle tone is the component of blood pressure regulation that is most responsive to calcium manipulations. When this criterion was adopted, it was noted that 44 percent of the hypertensives and 19 percent of the normotensives reduced their systolic blood pressure by an average value of 21 mmHg and diastolic pressure by 7 mmHg.

Taken collectively, these data provide strong support for the "calcium sensitive"-blood pressure hypotheses. Yet, a number of issues must be addressed before firm therapeutic guidelines can be formulated. Future research must compare the value of calcium obtained entirely through dietary means to that provided in pill form, i.e., are they equally effective in lowering blood pressure and if so, what doses are desirable? Furthermore, it will be important to determine whether alterations in calcium intake require concomitant alterations in nutrients, such as vitamin D and phosphorus, that are physiologically linked to calcium. The nature of interactions of calcium with other nutrients and/or drugs used to manage hypertension, as well as its interaction with other environmental factors such as stress, needs clarification. Only when these concerns are addressed and independently evaluated by different laboratories can any meaningful alterations in dietary habits be recommended.

SUMMARY

The calcium-blood pressure connection can no longer be considered a mere chance association. A causal relationship

has been postulated based on studies in animals and in clinical human studies. However, more research in the role of calcium from dietary sources, its interaction with nutrients and drugs, as well as its comparative bioavailability and desirable intakes, will have to be done before any therapeutic or preventive recommendations can be made.

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Osteoporosis

Osteoporosis, a major public health problem, affects all bones, typically the spine, wrist and hip. Risk of developing osteoporosis increases with age, is higher in women than men and in whites than blacks. Its cause appears to reside in the mechanisms underlying an accentuation of the normal loss of bone, which follows menopause in women and occurs in all individuals with advancing age. There are no laboratory tests for defining individuals at risk or those with mild osteoporosis. Diagnosis is established by documentation of reduced bone density with a typical fracture syndrome after exclusion of known causes of excessive bone loss. Prevention of fracture in susceptible patients is the primary goal of intervention. Strategies include estrogen replacement in postmenopausal women, adequate nutrition, including an elemental calcium intake of 1,000–1,500 mg/day, and a program of modest weight-bearing exercise. There is great need for additional research on understanding the biology of human bone, defining individuals at risk and developing safe, effective, low-cost strategies for fracture prevention.

WHAT IS OSTEOPOROSIS?

Primary osteoporosis is an age-related disorder characterized by decreasing bone mass and by increased susceptibility to fractures in the absence of other recognizable causes of bone loss.

Osteoporosis affects as many as 15–20 million individuals in the U.S., attributing to 1.3 million fractures annually in people age 45 and older. The cost of osteo-

porosis in the U.S. has been estimated at \$3.8 billion annually.

Bone is composed of a collagen-rich organic matrix impregnated with mineral—largely calcium and phosphate. Two major forms of bone exist: compact cortical bone forms the external envelopes of the skeleton; trabecular or medullary bone forms plates that traverse the internal cavities of the skeleton. The proportions of cortical and trabecular bone vary at different sites. Vertebral bodies contain predominantly trabecular bone, while the proximal femur contains predominately cortical bone. The responses of the two forms of bone to metabolic influences and their susceptibility to fracture differ.

Bone undergoes continuous remodeling (turnover) throughout life. Osteoclasts resorb bone in microscopic cavities; osteoblasts then reform the bone surfaces, filling the cavities. Normally, bone resorption and formation are linked closely in space, time and degree. Mechanical and electrical forces, hormones and local regulatory factors influence remodeling.

Peak bone mass is achieved at about 35 years of age for cortical bone and earlier for trabecular bone. Sex, race, nutrition, exercise and overall health influence peak mass. Bone mass is approximately 30 percent higher in men than in women and approximately 10 percent higher in blacks than in whites. In each group, bone mass varies among individuals. After reaching its peak, bone mass declines throughout life due to an imbalance in remodeling. Bones lose both mineral and organic matrix but retain their basic organization. In women, bone mass decreases rapidly for 3–7 years after menopause. Bone loss also is enhanced in a variety of diseases. Women have more fractures than men and whites have more fractures than blacks. Three factors determine the likelihood of fractures:

- The magnitude, direction and duration of the applied force;

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- The dissipation of that force by muscle contraction and soft tissue absorption; and
- Bone strength.

Injuries are more frequent and energy dissipation diminishes with advancing age. Reduction in bone mass is the most important reason for the increased frequency of bone fractures in postmenopausal women and in the elderly.

Classifying primary osteoporosis into clinical, histological or biochemical subsets may be useful from the standpoint of etiology, prevention and treatment. There is clinical and histological evidence for different subsets. Vertebral fractures occur most often in women aged 55–75 with accelerated loss of trabecular bone. Hip fractures occur most frequently in older men and women who slowly have lost both cortical and trabecular mass. Bone biopsies from some individuals with primary osteoporosis show high turnover rates; biopsies from others show low or intermediate rates of turnover.

CLINICAL FEATURES OF OSTEOPOROSIS

Clinical manifestations of osteoporosis include fractures and their complications. Characteristically, fractures occur in the thoracic and lumbar vertebral bodies, the neck and intertrochanteric regions of the femur and the distal radius. Osteoporotic individuals may fracture any bone more easily than their nonosteoporotic counterparts.

Vertebral compression fractures occur more frequently in women than in men and typically affect T₈-L₃. These fractures may develop during routine activities, such as bending, lifting or rising from a chair or bed. Immediate, severe, local back pain often results. Pain usually subsides within several months. Some individuals experience persistent pain due to altered spinal mechanics. In contrast, some vertebral fractures do not cause pain. Gradual asymptomatic vertebral compression may be detected only upon radiographic examination. Loss of body height and/or the development of kyphosis may be the only signs of multiple vertebral fractures. Discomfort, debility and, rarely, pulmonary dysfunction may accompany thoracic shortening. Abdominal symptoms may include early satiety, bloating and constipation.

Hip fractures are another important manifestation of osteoporosis. The affected population tends to be older and the sex distribution more even than is the case in vertebral fracture. Acute complications—hospitalization, depression and mechanical failure of the surgical

procedure—are common. Most patients fail to recover normal activity and mortality within one year approaches 20 percent. Distal radial fractures limit use of the extremity for 4–8 weeks, although long-term disability is uncommon. These fractures promote fear of loss of independent living, fear of additional falls and fractures and depression.

Detection of low skeletal mass and/or a fracture after minor trauma should alert the physician to the presence of metabolic bone disease and to evaluate further to exclude osteomalacia, hyperparathyroidism, hyperthyroidism, multiple myeloma, metastatic disease, syndromes of glucocorticoid excess and other causes of secondary osteoporosis. No blood or urine test establishes specifically the diagnosis of primary osteoporosis but such tests may exclude secondary causes.

Several noninvasive methods are available to evaluate bone density, varying widely in cost, availability and radiation dose. Roentgenograms are, however, insensitive indicators of bone loss since bone density must be decreased by at least 20 percent to 30 percent before the reduction can be appreciated. Characteristic abnormalities on standard roentgenograms are sufficient for establishing diagnosis of osteoporosis, if secondary causes are excluded clinically or radiographically. If the spine film is not diagnostic but clinical suspicion is high, a variety of other procedures may be indicated. These include radiogrammetry for measurement of cortical thickness, photodensitometry, the Single Index of femoral trabecular pattern, single and dual photon absorptionmetry, neutron activation, Compton scattering and single and dual energy computed tomography. Use of these techniques will depend on their availability, cost and further studies of their discriminatory capabilities and sensitivity. With histomorphometry, usually performed on a bone biopsy from the iliac crest, bone mass can be evaluated and osteomalacia and certain forms of secondary osteoporosis excluded. Bone biopsy is safe but requires specialized equipment and expert analysis that are not widely available.

WHO IS AT RISK?

Bone mass declines with age in all people and is related to sex, race menopause and body weight-for-height. Women are at a higher risk than men because they have less bone mass than men and for several years following menopause, the rate of bone mass decline is accelerated. Early menopause is one of the strongest predictors for the development of osteoporosis. Women who are underweight also have osteoporosis more often

than overweight women. Cigarette smoking may be an additional predictor of risk. Calcium deficiency has been implicated in the pathogenesis of this disease.

Immobilization and prolonged bed rest produce rapid bone loss, while exercise involving weight bearing has been shown to reduce bone loss and to increase bone mass. The optimal type and amount of physical activity that will prevent osteoporosis have not been established. Exercise sufficient to induce amenorrhea in young women may lead to decreased bone mass. The relationship of osteoporosis to hereditary and dietary factors, such as alcohol, vitamins A and C, magnesium and protein, is less firmly established. Some of these factors may act indirectly through their effect on calcium metabolism or body weight.

POSSIBLE CAUSES OF OSTEOPOROSIS

Because primary osteoporosis is characterized by decreased bone mass, the causes of the disorder must be sought among the factors that determine the quantity and quality of bone, including the magnitude of maximum bone mass at maturity and the rate of bone loss with aging. Complex cellular, physiologic and metabolic factors may underlie the pathogenesis of osteoporosis. Discrete cell types, anatomically and functionally connected, are continually renewed and maintain the complex skeletal tissue. Several systemic hormones and an increasingly recognized number of local (paracrine) factors regulate bone cell activity. Diet, as well as intestinal and renal function, influences mineral ion homeostasis needed to maintain the skeleton. Formation and resorption of bone and their coupling also are modified by external physical forces, such as those generated by body weight and exercise.

Osteoporosis is histologically, biochemically and kinetically, heterogenous; rapid bone turnover or reduced rates of bone formation have been documented in patients with primary osteoporosis. Multiple etiologies would not be surprising, considering the complex factors regulating normal bone metabolism. Among the many possible etiologies of primary osteoporosis, current data point to two probable causes: deficiency of estrogen and deficiency of calcium. Rapid bone loss often accompanies menopause and premature osteoporosis follows bilateral oophorectomy. Estrogen replacement prevents bone loss in both conditions. The following observations support a causal relationship between calcium deficiency and osteoporosis: calcium deficiency in experimental animals causes osteoporosis; a low calcium intake is common among the elderly in the U.S.; and, calcium supplementation reduces bone loss.

PREVENTION AND TREATMENT

Physicians must emphasize measures that retard or halt the progress of osteoporosis before irreversible structural defects occur. The mainstays of prevention and management of osteoporosis are estrogen and calcium; exercise and nutrition may be important adjuncts.

Estrogen replacement therapy is highly effective for preventing osteoporosis in women. Estrogen reduces bone resorption and retards or halts menopausal bone loss. Case-controlled studies have shown a substantial reduction in hip and wrist fractures in women whose estrogen replacement was begun within a few years of menopause. Studies also suggest that estrogen reduces the rate of vertebral fractures. Even when started as late as six years after menopause, estrogen prevents further loss of bone mass but does not restore it to premenopausal levels. Oral estrogen protects at low doses, such as 0.625 mg of conjugated equine estrogen, (25 micrograms of mestranol and 2 mg of estradiol valcrate daily exemplify other protective regimens reviewed by the panel).

All of the above data on efficacy are based almost exclusively on studies in white women. Therefore, the following recommendations on therapy for osteoporosis pertain to that group. Cyclic estrogen therapy should be given to women whose ovaries are removed before age 50 in whom there are no specific contraindications. Women who have had a natural menopause also should be considered for cyclic estrogen replacement if they have no contraindications and if they understand the risks and agree to regular medical evaluations. The duration of estrogen therapy need not be limited. There is no convincing evidence that initiating estrogen therapy in elderly women will prevent osteoporosis. The decision to treat women of other racial backgrounds should be determined on a case-by-case basis.

Estrogen-associated endometrial cancer is usually manifested at an early stage and is rarely fatal when managed appropriately. The bulk of evidence indicates that estrogen use is not associated with an increased risk of breast cancer. Adding a progestogen probably reduces the risk of endometrial cancer, but there is little information about the safety of long-term combined estrogen and progestogen treatment in postmenopausal women. Younger patients receiving progestogens in oral contraceptives experienced an increased risk of hypertension and cardiovascular disease. Some progestogens may blunt or eliminate the favorable effects of estrogen on lipoproteins. Until more data on risks and benefits are available, physicians and patients may prefer to reserve estrogen (with or with-

out progestogen) therapy for conditions that confer a high risk of osteoporosis, such as occurrence of premature menopause.

The usual daily intake of elemental calcium in the U.S., 450–550 mg falls well below the National Research Council's (NRC) recommended dietary allowance (RDA) of 800 mg designed to meet the needs of approximately 95 percent or more of the population. Calcium metabolic balance studies indicate a daily requirement of about 1,000 mg of calcium for premenopausal and estrogen treated women. Postmenopausal women who are not treated with estrogen require about 1,500 mg/day for calcium balance. Therefore, the RDA for calcium is evidently too low, particularly for postmenopausal women and may well be too low in elderly men. In some studies, high dietary calcium suppresses age-related bone loss and reduces the fracture rate in patients with osteoporosis. It seems likely that an increase in calcium intake to 1,000–1,500 mg beginning well before the menopause will reduce the incidence of osteoporosis in postmenopausal women. Increased calcium intake may prevent age-related bone loss in men as well.

The major sources of calcium in the U.S. diet are milk and dairy products. Each eight-ounce glass (240 ml) of milk contains 275–300 mg calcium. Skim or low fat milk is preferred to minimize fat intake. For those unable to take 1,000–1,500 mg calcium by diet, supplementation with calcium tablets is recommended, with special attention to their elemental calcium content.

Normal levels of vitamin D are required for optimal

calcium absorption. Requirements for vitamin D increase with age. Persons who do not receive adequate daily sunlight exposure, such as those confined to home or to a nursing facility, are at special risk for vitamin D deficiency. Vitamin D has dangerous effects at high doses. Although the toxic dose varies among individuals, toxicity has occurred at levels as low as 2,000–5,000 I.U. daily. No one should consume more than 15–20 micrograms (600–800 units, twice daily RDA) without a doctor's recommendation.

Inactivity leads to bone loss. Some recent studies suggest that weight-bearing exercise may reduce bone loss. Modest weight-bearing exercise, such as walking, is recommended. Strategies to prevent falls are important in elderly patients who may fall frequently for a variety of reasons, such as from effects of drugs. Specific environmental interventions can minimize home hazards that increase the chances of falling.

DIRECTIONS OF RESEARCH

Future research in osteoporosis should approach the currently unanswered research questions concerning the development and maintenance of bone as a tissue, clinical and epidemiological research for practical prevention and treatment of the disease, factors controlling bone cell activity, regulation of bone mineral, and matrix formation and remodeling. This understanding will permit a more rational choice and evaluation of therapies, even as current treatments are evaluated clinically.

INDIVIDUAL RATE OF CARIES INCIDENCE

Today there is no simple scientific method to predict the individual rate of caries incidence. *In vitro* tests may not be relevant to clinical caries formation. Animal cariogenicity tests of foods are valuable but need final confirmation in man. Clinical caries studies are costly, time-consuming and can present ethical problems. Plaque pH telemetry cannot at present be used to develop a scale of relative cariogenicity of foods but can identify low caries risk dietary components and meal patterns. The product label 'safe for teeth' based on telemetric evaluation of manufactured foods introduced by the Swiss Office of Health in 1969 is the only food regulatory action presently known that serves the aims of preventive dentistry. Food regulatory agencies need the advice of dental science, but they need it now.

—Imfeld, T.N.: Identification of low caries risk dietary components. Basel: S. Karger, 1983, p 6.

Case reports

Incomplete resorption of resorbable zinc oxide root canal fillings in primary teeth: report of two cases

Robert H. Spedding, DDS, MSD

Advocates of root canal therapy for primary teeth say that resorbable root canal fillings should be used that will resorb at the same time as the roots of the exfoliating treated teeth. The most common filling material is composed largely of zinc oxide powder mixed with liquids like eugenol or formocresol or combinations of the two. Resorbable filling materials have been used to fill the root canals of primary teeth for more than twenty years. Critics claim that these materials are not resorbable and while most agree that lack of complete resorption does occur occasionally, most continue to use them. Unless a clinician carefully monitors these treated primary teeth, a false sense of security is obtained, because he may believe the root canal fillings resorbed along with the exfoliating roots, when in fact they did not.

Two cases of incomplete resorption of the root canal fillings are described herein. Both cases were monitored for more than five years. One tooth was a maxillary primary central incisor and the other was a maxillary primary second molar. The root canal filling remnants were clearly visualized on the radiographs.

CASE NUMBER 1

A healthy four-year, four-month-old female (K.S.) was examined (Figures 1,2). Her medical history was es-

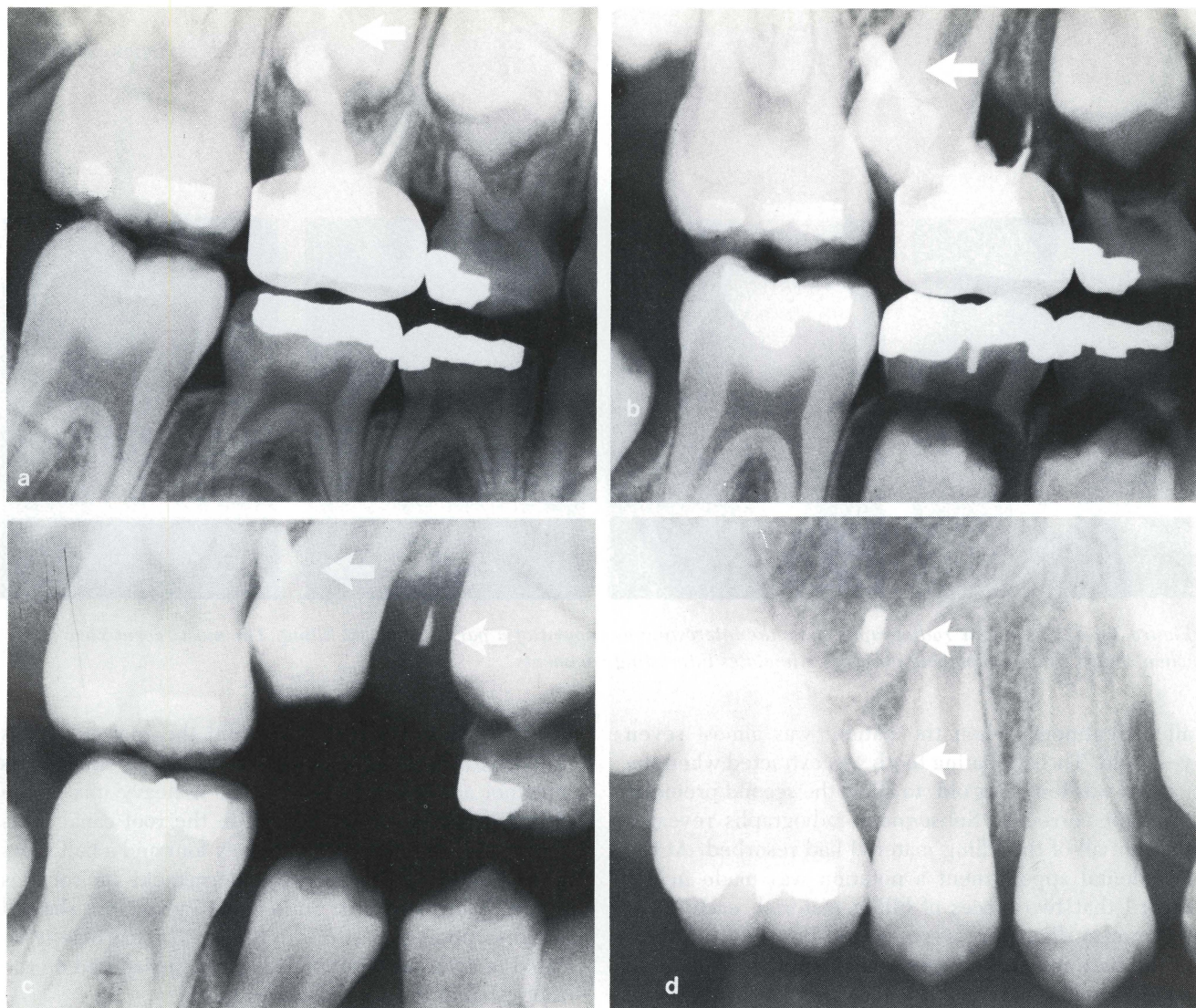


Figure 1 a-d. These four pictures show the zinc oxide filling remnants over a period of time. It appears that they came from two roots.

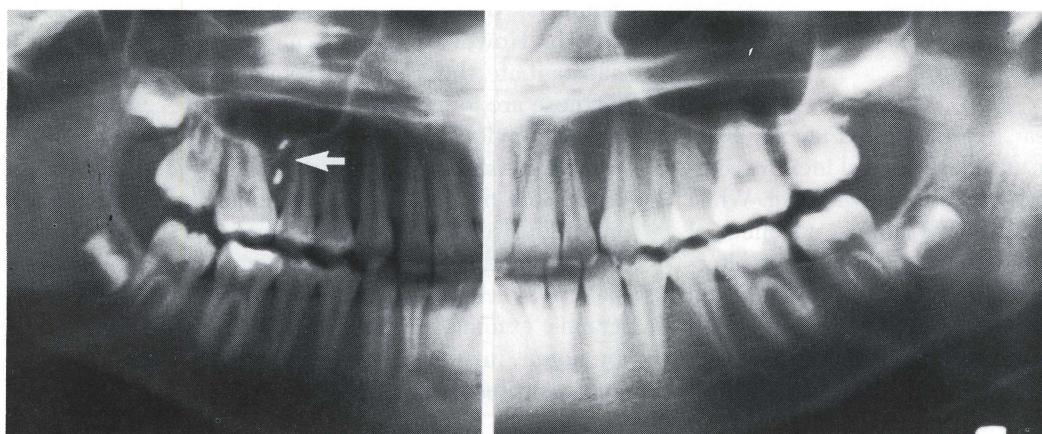


Figure 2. A panoramic view made at the patient's last visit.

sentially normal. She was found to have several carious teeth. At the second appointment a parulis was noted on the buccogingival tissue of the maxillary right second molar. Root canal therapy was completed in two appointments. A heavy mixture of zinc oxide and equal

parts eugenol and formocresol was used as a filling material and inserted into the root canals. Some of the material extruded into the periapical tissues. A stainless steel crown was placed. The first notation that the filling material wasn't resorbing was made 2.5 years

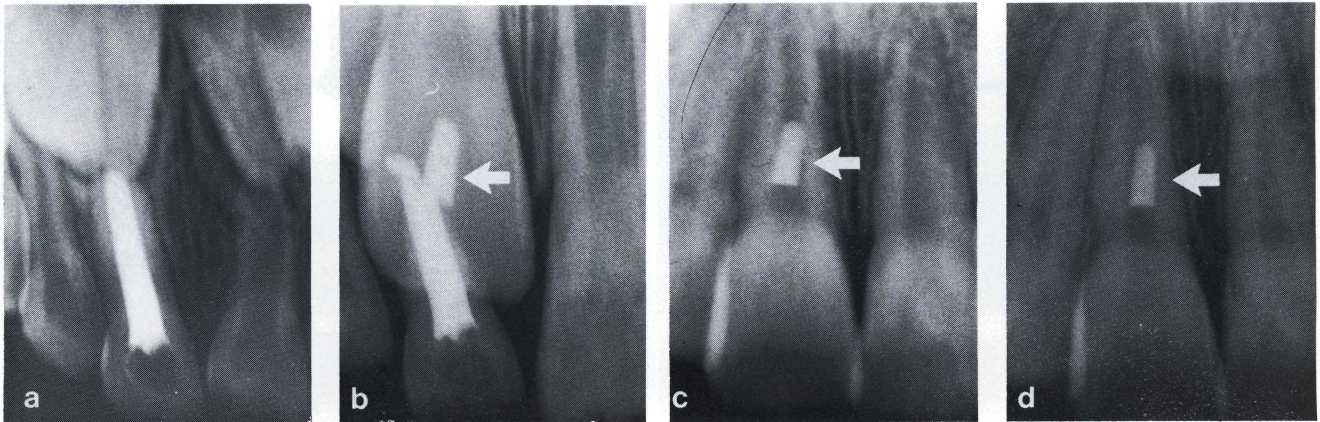


Figure 3 a-d. These four radiographs show the interesting movement of a partly resorbed filling. The most recent view (D) when shown to an unknowing observer stimulates interesting comments.

after treatment, when the patient was almost seven years old. The exfoliating tooth was extracted when the patient was ten years old, to allow the second premolar to erupt correctly. Subsequent radiographs revealed that not all of the filling material had resorbed. At the last dental appointment a notation was made in her record that two pieces of filling material, each about 3.0 mm in diameter, were located between the roots of the first and second premolars. After she moved to South Carolina and sought dental care, her dentist wrote and asked for copies of her radiographs. Copies of all of her radiographs and the notations in her record were sent to the dentist along with an explanatory letter about the remnants of the root canal filling.

CASE NUMBER 2

A well-nourished one-year, ten-month-old female (S.T.) fell and traumatized her maxillary central incisors (Figure 3). Her medical history was essentially normal. While a small incisal edge fracture was noted, no effect of trauma was found radiographically. Treatment alternatives were presented to the mother. The child fell again about three weeks later but the teeth were apparently unharmed. About seven months after the original injury one of the central incisors discolored. Root

canal therapy was performed and the root canal was filled with zinc oxide powder mixed with equal parts eugenol and formocresol liquids. A heavy mix of the filling material was condensed in the root canal. This tooth was extracted approximately four and a half years after treatment, because the permanent incisor was erupting lingually to it. Subsequent radiographs showed nonresorption of part of the filling. This particle is located in a unique position, i.e., it is superposed on the root canal of the succedaneous tooth.

The significance of retention of particles of a zinc oxide root canal filling is unknown. Why most of the filling resorbed and a portion did not is also not known. Some say that dense mixes of filling materials do not resorb. However, there is no conclusive evidence to substantiate this claim. If remnants of materials such as these are found on the radiograph, a careful inquiry about previous dental treatment is in order. Determined questioning would most likely lead one to conclude that the radiopaque substance was a remnant of an original root canal filling. Succinct comments about findings and all previous treatments are entered in the patient's record. The patient is told that periodic radiographic examinations are needed and should any change be noted, further treatment decisions would be made, such as removal of the particles.

Dens invaginatus with partial coronal agenesis: report of case

M. John Hicks, DDS, MS, PhD
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D*ens invaginatus* is a clinical phenomenon due to invagination of odontogenic cells during the developmental stage of tooth formation.^{1,2} Radiographically, it appears to be "a tooth within a tooth" or *dens in dente*. If invagination occurs in the coronal area, an enamel-lined defect will occur; whereas a cementum-lined defect will be present, if the invagination occurs below the cemento-enamel junction.

Dens invaginatus was first described in 1856. Today, cases of this developmental phenomenon are classified in accordance with an established system.³ Three types of invaginations based upon the extent of involvement of the tooth structure are known to occur.

- Type 1 is confined within the crown of the tooth.
- Type 2 extends apically beyond the cemento-enamel junction. It is a blind sac that remains within the tooth and does not communicate with the periodontal ligament or periapical tissues.
- Type 3 extends beyond the cemento-enamel junction also. Although no communication exists between the pulp and the invagination, a periapical or periodontal foramen does exist.

The type 3 invagination provides a direct path of invasion to the periodontal and periapical tissues, for

microorganisms in the oral environment. This situation leads to periodontal and periapical infections.

Even though types 1 and 2 are blind sacs lined by either enamel or cementum, these areas represent stagnation sites where caries may progress rapidly. The progression rate is also affected by the fact that the enamel and cementum lining these defects are poorly formed and do not have the same resistance to caries as normal enamel and cementum. The presence of the invaginations can result in pulpal infection by oral microorganisms and eventual periapical involvement.

Dens invaginatus has been shown to affect the maxillary dentition primarily and only rarely affects the mandibular dentition.⁴⁻⁸ The order of frequency for *dens invaginatus* in permanent maxillary teeth is: 1) lateral incisors, 2) central incisors, 3) premolars, and 4) molars. *Dens invaginatus* may occur in 6.6 to 9.7 percent of maxillary lateral incisors. Bilateral involvement occurs quite often.

CASE REPORT

A twelve-year-old Hispanic male was examined in the Pediatric Dentistry Clinic at the University of Colorado School of Dentistry. The chief complaint of the parents and the patient concerned "failure of the upper right front tooth to come in all the way". The health history and physical examination revealed the adolescent to be a healthy individual with no significant medical or social histories and no history of orofacial trauma. Dental

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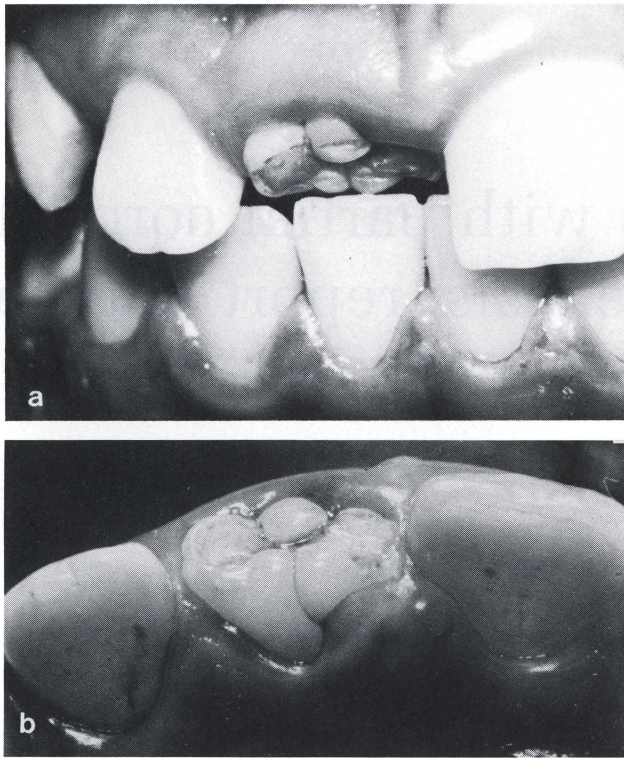


Figure 1. Clinical appearance of maxillary anterior region. a) Frontal view of anterior teeth in occlusion. Note the lack of crown height and partial coronal agenesis of the maxillary right central incisor. b) Occlusal view of maxillary incisors. The right central incisors appears to have deeply fissured, lobulated enamel.

central incisor (Figure 1). The latter appeared to have partial agenesis of the crown. The incisal and middle thirds of the crown had not formed and only a cingulum area composed of deeply fissured and lobulated enamel was present. Panoramic and periapical radiographs were taken. The panoramic radiograph (Figure 2) revealed the presence of an invaginated area in the maxillary right central incisor extending into the root for some distance, retained primary root tips bilaterally between the mandibular first and second premolars, and developing third molars. The periapical radiographs (Figure 3) of the maxillary right central incisor indicated that invagination of the odontogenic cells had occurred during tooth formation, resulting in *dens invaginatus*. This appeared to be a type 2 *dens invaginatus* in which the invaginated area is confined within the root structure and no radiographically apparent communication exists between the invagination and the periodontal or periapical tissues. Root formation of the right central incisor was slower than that of the left central incisor. In addition, a radiolucent area was noted in the periapical region of the right central incisor, indicating that pulpal inflammation and degeneration had occurred.

DISCUSSION

Dens invaginatus is a relatively common defect that occurs during tooth formation. This defect may be present in almost 10 percent of maxillary lateral incisors. Clinical and radiographic examinations of suspect

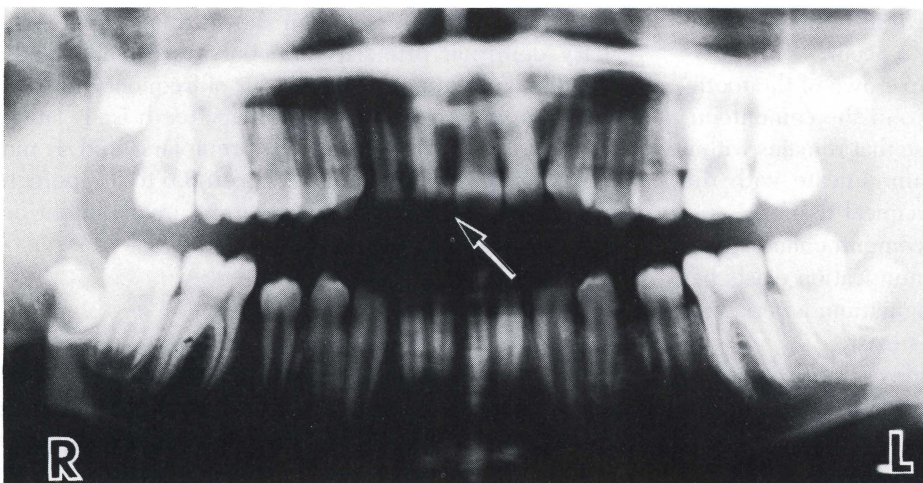


Figure 2. Panoramic radiograph reveals invagination of the maxillary right central incisor (arrow).

examination revealed occlusal caries, a retained primary root tip located between the mandibular left first and second premolars, and a malformed maxillary right

teeth should be made to determine whether the fissured lingual surface represents an invaginated area or a developmental fissure only. If *dens invaginatus* is

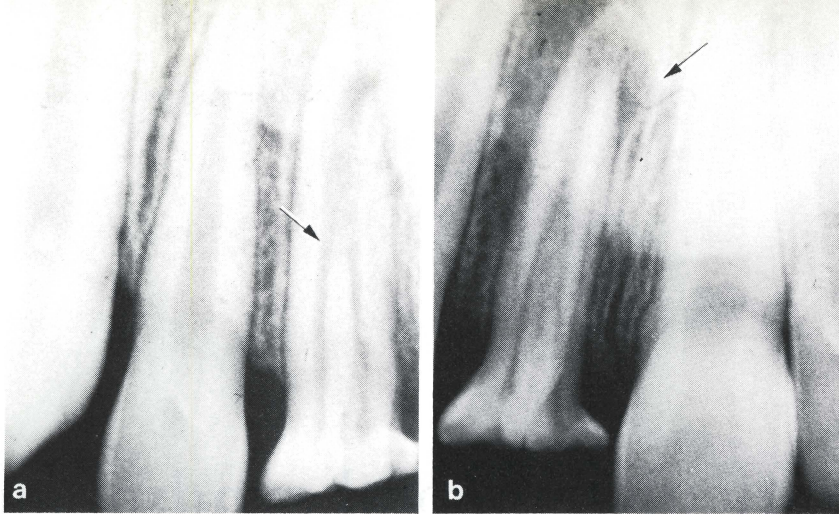


Figure 3. Periapical radiographs of the maxillary right central incisor reveal the dens invaginatus to be of the type 2 variety. a) The invagination (arrow) may be seen to extend to approximately one-half the total root length. The apex of the root appears to be poorly formed with a wide-open foramen. b) A periapical radiolucency (arrow) may be seen in this radiograph, indicating that pulp inflammation and degeneration have occurred. The retardation in root formation is apparent, when the root lengths of the right and left central incisors are compared.

diagnosed, the clinician should determine whether it is a type 1, 2, or 3. It has been suggested that it may be possible to simply debride the blind sacs present in types 1 or 2 and fill them with a restorative material.^{9,10} If caries is present and the pulp is inflamed or exposed, therapy may be necessary either as a palliative pulp capping or conventional endodontics. If a type 3 *dens invaginatus* is diagnosed, apexification may be necessary to complete root formation before endodontic therapy.¹⁰ Conventional endodontic therapy may be the treatment of choice, when a positive apical seat exists.

The clinical case reported offers a number of concerns regarding appropriate treatment. The maxillary right central incisor has a type 2 *dens invaginatus*, incomplete root formation, a periapical radiolucency, and partial coronal agenesis. Because of pulp and periapical involvement, endodontic therapy is necessary. Due to incomplete root formation and a wide-open foramen, however, continued root formation and apical closure would be desirable before conventional endodontic therapy. In a recent report, it was shown that an apexification technique similar to that described by Frank may encourage continuing root formation and the establishment of a positive apical seat for endodontic treatment, in cases of *dens invaginatus*.^{10,11} The present case offers an additional restorative and esthetic problem due to partial coronal agenesis. A number of factors must be considered before restoration of this tooth. The first is the need for access to the pulp chamber, for apexification treatment. Apexification usually requires repeated treatments and periodic replacement of the calcium hydroxide dressing. Access to the pulp chamber is also necessary for completion of conventional endodontic treatment. The second consideration is in relation to the eruptive stage of the dentition. Because the patient is twelve years of age, one would expect further eruption of the teeth to occur with subsequent increase in the vertical dimension and clinical coronal height. The final consideration is the

potential for trauma to the anterior region. Due to the patient's age and his possible involvement in sports activities, a potential for trauma exists. Restoration of the tooth with a pin-retained composite resin would provide an esthetic restoration. Due to the need for access to the pulp chamber, however, the restoration may be weakened by periodic removal and replacement of composite on the lingual surface. Consideration should be given to the use of an open-face stainless steel crown. When access is necessary, the composite resin material forming the facing could be removed and provide facial access to the pulp chamber. This type of restoration would act as an interim restoration until the appropriate age is reached for permanent restoration with a porcelain-fused to metal restoration, retained by a cast post and core.

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The auriculotemporal syndrome: report of case

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The auriculotemporal syndrome, also called Frey's syndrome and localized facial gustatory sweating and flushing (GSF), is a rare condition that has been described as a sequel to penetrating wounds, suppuration and surgical incisions in the region of the parotid gland which sever the auriculotemporal nerve.¹⁻³

The clinical picture of the affected area is quite specific. The region which the auriculotemporal nerve supplies is affected. Some months after an original insult, a series of interesting phenomena can take place whenever the patient takes food into the mouth. An area of skin becomes bright red and can be covered with droplets of sweat. This gustatory sweating and flushing can also be initiated with mere thoughts or smells of certain types of foods. At other times when the patient is not eating, this area of skin is indistinguishable from normal skin.

Although the literature is replete with examples of this syndrome in patients with a history of suppurative parotitis, postsurgical parotidectomy or lesions of the parotid gland, the purpose of this paper is to present a case report of a child in which none of these entities is considered as cause of these unique symptoms.

REPORT OF CASE

A white male, 3.5 years old, was referred to the author

by the Pediatric Service at Kadena AB, Japan, for evaluation and possible suggestions for treatment.

R.B. was born September 10, 1980, after four and a half hours of labor. The patient was the product of a high forceps delivery by a civilian obstetrician. Forceps were used to turn the head prior to delivery and assistance of the delivery itself. In the nursery it was noticed that the patient had a small cut on the right cheek and bruises bilaterally on both cheeks. The patient developed normally and it was not until about eight months later that the parents noticed that when table food was given to R.B. that a definite red streak would appear on the right cheek. The linear erythematous flush would manifest when the patient either ate or smelled food or envisioned eating. All foods would initiate a response, but tart or sour foods produced the most dramatic results.

Upon clinical examination by the author, R.B. appeared to be a healthy, happy child, eager to show us his unique response to eating. Extraoral examination revealed facial contours symmetrical and normal both in color and tone with no muscular dysfunction. Intraorally there was good salivary flow from both Stenson's ducts. The tongue and mucous membranes were all within normal limits. The dental development was normal with no caries and good hygiene (Figure 1).

Within approximately three minutes after mother gave the child a dried apricot (Figure 2), a red erythematous flush appeared on the right cheek, ranging from the top of the ear to the corner of the mouth, about two centimeters in width (Figure 3). This linear

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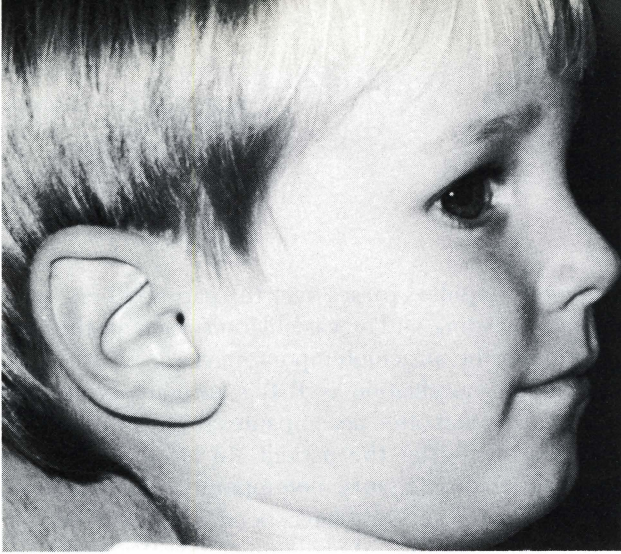


Figure 1. Photograph of patient in normal state with no area of redness.

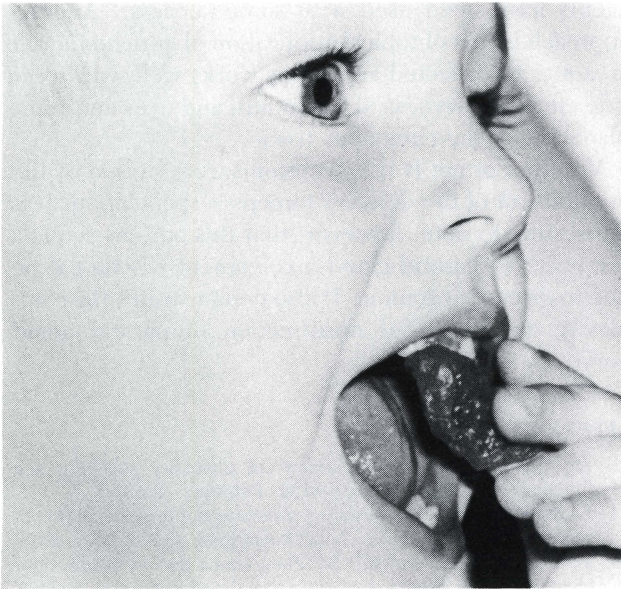


Figure 2. Photograph of patient eating a dried apricot to illicit a response.

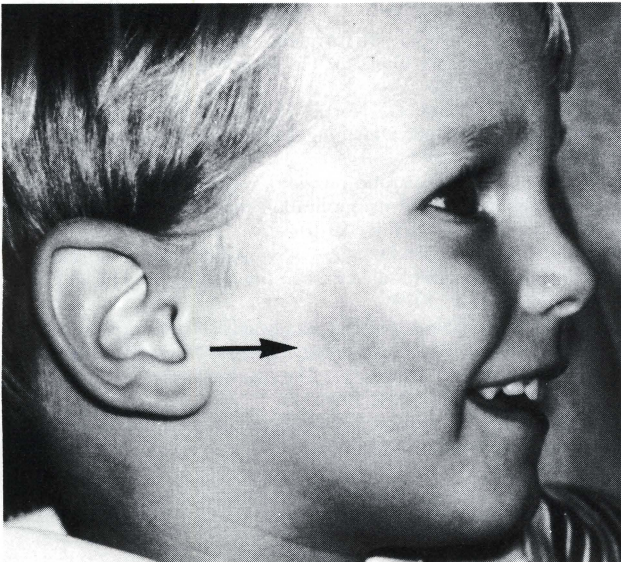


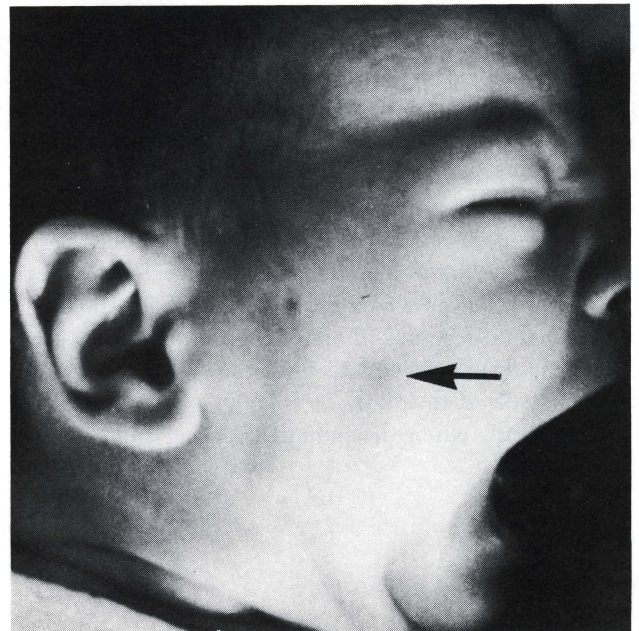
Figure 3. Profile of patient showing area of inflammatory response.

reddening had a clearing spot at about one-third the distance from the ear to the corner of the mouth for about three centimeters. This area of apparent noninvolvement is precisely where the original birth injury was located (Figure 4). There was no associated gustatory sweating, though the skin did feel warm to the touch. Following cessation of eating, the skin gradually returned to normal color and tone, in about twenty minutes.

DISCUSSION

Although this entity is known by several different names, auriculotemporal syndrome, Frey's syndrome, and gustatory sweating, it might be more appropriate to use an exact term such as localized facial gustatory vasosudomotor reflex.² Although too cumbersome, this title would more appropriately conceptualize localiza-

Figure 4. Profile of patient showing area of original birth injury. Note that the area of involvement is over the parotid gland.



tion, the eliciting mechanism, and symptoms. This syndrome has only been reported in association with parotidectomy, suppurative parotitis with associated incision, and lesions of the parotid gland.^{1,2} The patient had none of these initiating factors.

The anatomy of this area is very complex with regard to identifying which nerves provide which specific function. Holmberg suggested the complexity by stating that some secretory fibers reach the gland through unknown channels and that there are still secretory fibers to be discovered.⁴ There are assumed intratemporal anastomosis of secretory fibers between the facial and glossopharyngeal nerves.⁵⁻⁷ These anastomotic areas cloud the issue of specific nerve function.

Another area of question involves whether parasympathetic or autonomic nerves control salivation; vasoconstriction in the parotid gland; or, in this case, cutaneous vasodilation. Both Brown and Patterson contend that the parasympathetic nerves control the secretory activity, but that the sympathetic nerves serve to alter chemical composition and viscosity of the saliva.^{8,9} Patterson also suggested that the secretion or expression of saliva was related to the production of vasoconstriction within the gland.⁹ It soon becomes evident that the parotid is intimately involved with the arterial venous component. In attempting to solve this perplexing anatomical puzzle, various animal models have been used, including the dog and sheep, both of which have their own aberrations from man.

This patient can produce these symptoms by smelling or thinking about food. It has been shown by White, Jenkins, and Pangborn that mental imaging, and to a larger extent, olfactory stimulation, can cause an increase in salivation and, evidently in this case, an associated cutaneous response.¹⁰⁻¹²

The theory proposed by Laage-Hellman and Ford for the mechanics of this aberration is as follows: When the auriculotemporal nerve is injured between the parotid gland and the point at which it receives its communication from the glossopharyngeal nerve, some of these fibers may be severed. In the process of regeneration, these fibers may become misdirected to alternate pathways from which they were originally directed. Some of the secretory fibers of the parotid gland consequently form connections with the sweat glands and blood vessels of the skin.

As a result, when the patient is eating and a volley

of nervous impulses passes over the parotid fibers, paroxysmal sweating and/or vasodilation occur in the distribution of the auriculotemporal nerve.

Although vasodilation is R.B.'s primary symptom, the sweating that often accompanies this syndrome can be embarrassing for the patient. In attempts to alleviate this syndrome, auriculotemporal and glossopharyngeal nerve resections have been tried with mixed results. Systemic use of atropine solves the problem, but causes too many side effects. Ganglionic blocking agents have been used with some success.¹ Another approach is that of topical application of anticholinergic cream to the affected area. This works well with some side effects of dryness of the mouth and eyes and some blanching of the cutaneous tissue.

Whether or not R.B.'s symptoms were caused by the initial insult of the delivery forceps is speculation. It is interesting to note, however, that this curious sequela can occur to parotid gland involvement whether it be due to disease or trauma. It also demonstrates the complexity and potential misdirection of parotid gland nerves.

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Primary talon cusp

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The talon cusp is an accessory cusp-like structure which projects lingually and incisally from the cingulum area of incisor teeth.¹⁻⁴ The term "talon cusp" was chosen for this malformation because these anomalous cusps reportedly resemble an eagle's talon.¹⁻⁴

Clinically, talon cusps are most commonly seen on maxillary incisors and reports of talon cusps on mandibular incisors are uncommon.¹⁻³ Until recently, this anomaly had been reported only on the succedaneous dentition.¹⁻⁴ Henderson as well as Mass, Kaffe and Buchner, however, recently reported cases of talon cusps involving the maxillary incisor teeth of the primary dentition.^{5,6} This condition may be unilateral or bilateral and affects both sexes. The size and shape of talon cusps can vary widely.¹⁻³ Some are small and appear only as a slight enlargement of the cingulum.¹⁻³ Others may be quite large and even extend beyond the incisal edge of the tooth.¹⁻³ Larger talon cusps are often well delineated by prominent fissures or grooves at the lateral aspects of the cusp, where it merges with the lin-

gual surface of the tooth.¹⁻⁴ Talon cusps may cause problems. Larger ones may be visible during speech and may be unesthetic.¹⁻³ They may also cause abnormal occlusal forces that may produce traumatic occlusion and/or displacement of teeth.¹⁻³ Advanced attrition of larger talon cusps may conceivably lead to pulp exposure, because these cusps as reported contain a pulpal horn.¹⁻⁴ The fissure or grooves, which frequently delineate the lateral aspects of larger, well-developed talon cusps, may become carious. Sharp, prominent talon cusps may also interfere with and irritate the tongue during mastication and speech. In addition, a talon cusp on an unerupted tooth may present serious diagnostic problems, as its radiographic image may be mistaken for a supernumerary tooth or a compound odontoma, and lead to an unnecessary surgical procedure.¹⁻³

Radiographically, talon cusps are essentially radiopaque structures, since they are mainly composed of normal enamel and dentin.¹⁻³ Talon cusps also reportedly contain a pulpal horn; they are seldom clearly visible, however, on the radiograph.¹⁻³ Talon cusps typically look like a radiopaque "V"-shaped structure superimposed over the normal image of the crown.¹⁻³ The point of the "V" is always toward the incisal edge of the tooth; consequently the "V" is inverted in mandibular cases.³ The exact radiographic appearance of the cusp, however depends on the size and shape of the cusp as well as the angulation used to take the radiograph.³

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The exact etiology of this condition is unknown.¹⁻⁴ This paper reports a very uncommon case involving a talon cusp in the primary dentition.

CASE REPORT

An abnormally shaped maxillary right lateral incisor was seen during the routine dental examination of the right dentition of a five-year-old white male (Figure 1). A prominent, vertical enamel-covered ridge was seen projecting from the central portion of lingual surface.

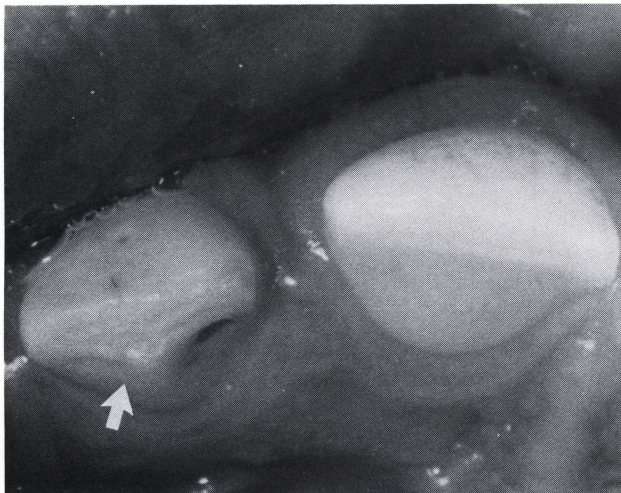


Figure 1. Maxillary, right, primary lateral incisor with talon cusp.

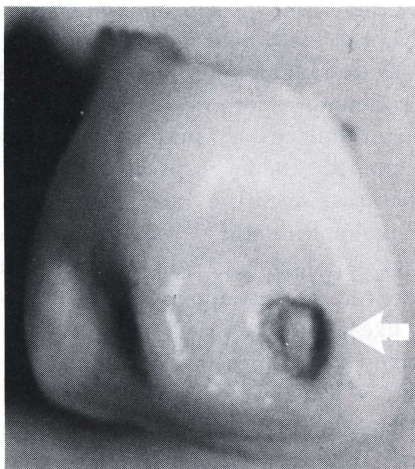


Figure 2. Lingual view of the exfoliated tooth showing the talon cusp and a small, round caries lesion which is not associated with the anomalous cusp.

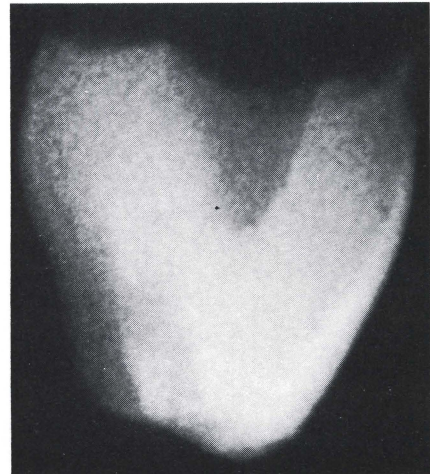


Figure 3. Radiograph taken in a mesiodistal direction. There is no radiographic evidence of a pulpal horn extending into the talon cusp.

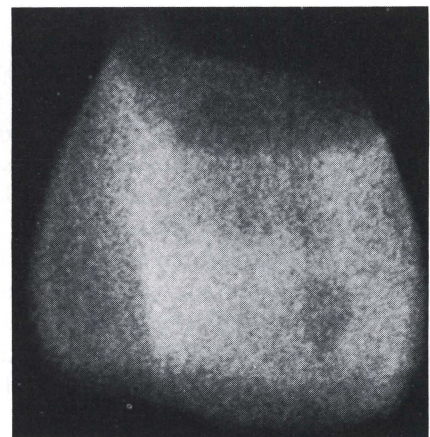


Figure 4. Radiograph taken in a buccolingual direction. Again, no evidence of a pulpal horn in the talon cusp.

It extended from the cingulum area to the incisal edge. The sides of the anomalous structure sloped laterally and downward from the height of the ridge and merged smoothly with the lingual surface of the tooth. There were no grooves or fissures at the lateral aspects of the abnormal structure. A small, round caries lesion was seen on the incisal third of the lingual surface medial to the anomalous structure (Figures 1,2). However, it did not appear to be associated with the anomalous formation in any way. Attrition was seen on the incisal edge of the tooth and the incisal aspect of the abnormal structure. No other abnormal dental or somatic find-

ings were noted. A diagnosis of talon cusp was made. The parents of the child would not grant permission to take diagnostic radiographs. The tooth exfoliated twenty-three months after the initial examination. The incisal edge of the tooth and the incisal aspect of the talon cusp demonstrated considerably more wear at exfoliation than at the initial examination. The parents agreed to give up the tooth for further examination.

Photographs and radiographs of the exfoliated tooth were made (Figures 2-4). The tooth, which had been airdried, was placed in 5.25 percent sodium hypochlorite for a few minutes to remove the remaining remnants of the pulpal tissue. The entire configuration of the pulp chamber could clearly be seen with the pulp tissue removed because of the extensive root resorption. Visual examination of the pulp chamber failed to reveal any clearly defined channel or invagination into the anomalous structure. However, a broad, shallow vertical depression was seen in the central portion of the lingual wall of the pulp chamber. The labial surface of the crown was removed with a disc and the remaining portion of the tooth was prepared for evaluation with the scanning electron microscope (SEM). The pulpal surface of the remaining lingual wall was examined with the SEM using magnifications between 19X and 4360X. The central, shallow, vertical depression, which had been grossly seen, was clearly visible (Figure 5). Further examination of the central aspect of the lingual wall at higher magnifications failed to reveal any chan-

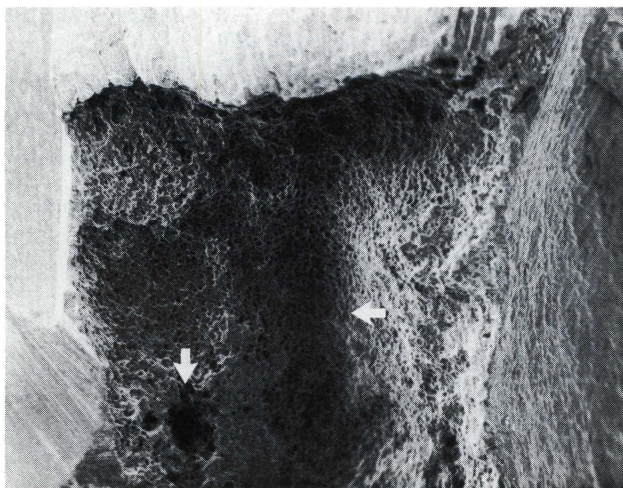


Figure 5. Photomicrograph of the lingual wall of the pulp chamber. Note the shallow, central vertical depression lateral to the base of the central vertical depression. Original magnification 32X.

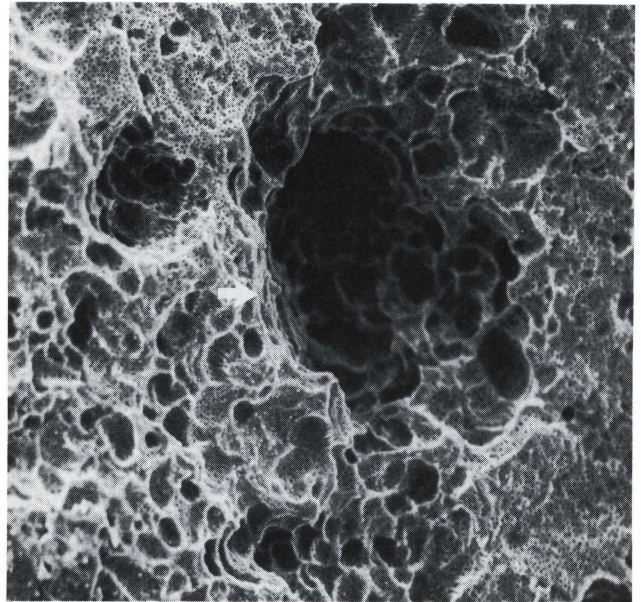


Figure 6. Higher power view of the depression seen lateral to the base of the central depression Figure 5. Original magnification 180X.

nel or invagination into the lingual wall to indicate that a horn of pulp tissue had once extended into the anomalous cusp. Several small depressions were seen randomly distributed on the lingual wall, however (Figure 5). The largest one was approximately 100 microns in diameter and located lateral to the base of the central depression (Figure 6). These depressions were difficult to interpret. They may have represented the normal anatomy of the pulpal wall or they may have been part of some resorptive process.

DISCUSSION

Traditionally, the talon cusp is reported to contain a horn of pulp tissue.¹⁻⁶ Natkin, Pitts and Worthington, however, recently reported two cases where microscopic and radiographic examination of ground sections of extracted succedaneous maxillary lateral incisors with large talon cusps failed to reveal a pulpal horn in the talon cusps.⁷ They also related a third case in which a talon cusp "was ground off during the course of a single treatment appointment without pulp exposure", but no mention was made as to which tooth was involved.⁷ These authors suggested that "perhaps the general presumption that talon cusps routinely contain a pulp horn is not correct."⁷ The primary maxillary lateral incisor

in the case report of this paper also revealed no evidence of a pulpal horn in the talon cusp when examined grossly, radiographically or with the SEM.

Most case reports of talon cusps, in the past, have involved teeth that remained in the mouth. Hence, evaluation of the pulpal configuration was mostly limited to radiographic examination of the tooth in a buccolingual direction. Unfortunately, this is probably the least effective way to evaluate the pulpal configuration inside the talon cusp, as the cusp is superimposed over the normal portion of the tooth with this projection, making interpretation difficult. An accurate, definitive radiographic interpretation of the pulpal configuration in the talon cusp would seem to be nearly impossible under these circumstances. The conclusion that the cusp contained a pulpal horn in these cases was, of necessity, largely subjective radiographic interpretation which could not be confirmed by microscopic examination. This is not to imply that all talon cusps do not contain pulpal tissue. Authors have reported exposure of pulpal tissue when these cusps were removed or reduced.¹⁻⁵ Mellor and Ripa reported in Cases 2 and 3 of their paper that "the extra cusps extended beyond the incisal edges of the teeth, creating occlusal and esthetic problems", and that "the pulp tissue was inevitably exposed" during the necessary removal of these cusps.¹ Henderson also reported exposure of the pulp when "an attempt was made to reduce the talon cusp."⁵ In addition, Mitchell said in the original case report of 1892, that "the pulp extended into the process (talon cusp) almost to the tip."⁸ This observation was made after removal of the remaining portion of the crown (the incisal portion of the crown had been destroyed by caries) and the "horn" (talon cusp). Thus, it is well documented by clinical findings that some talon cusps do, indeed, contain pulpal tissue. Analysis of case reports, in which evaluation of the pulpal configuration in the talon cusp was based upon more than a clinical radiograph, produced some interesting results.^{1,5,7,8} All five teeth involved in the four cases (Case 2 of Mellor and Ripa¹ was bilateral), where pulpal tissue was clinically exposed in the talon cusp, involved succedaneous maxillary central incisors with large, well-defined talon

cusps which extended close to, or beyond, the incisal edge of the tooth. The two teeth with large talon cusps in which Natkin and co-workers could find no pulpal tissue in the talon cusp after evaluation with ground sections, were both succedaneous maxillary lateral incisors.⁷ In addition, no pulpal extension could be found in the talon cusp on the primary maxillary lateral incisor in our report after evaluation with buccolingual and mesiodistal radiographs, visual inspection and examination with the SEM. Review of the findings in these cases suggests that only large, well-defined talon cusps on succedaneous maxillary central incisors contain pulpal tissue.^{1,5,7,8} This suggestion needs to be substantiated, however, by further study. In addition, the association between the size and shape of the talon cusp and the presence of pulpal tissue within the cusp needs further study. It seems probable that small talon cusps, especially those which are confluent with the lingual surface, are less likely to contain pulpal tissue. Large talon cusps, especially those that are separated or stand away from the lingual surface of the normal portion of the tooth, seem more likely to contain pulpal tissue. It is hoped that future documentation of the pulpal configuration will produce reliable guidelines to aid the clinician faced with treating teeth with talon cusps.

Talon cusps may be associated with other somatic and dental anomalies.^{2,7} None could be detected, however, in the patient in our case report.

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Abstracts

Friskopp, J. and Larsson, U.: Morphology of dentin surfaces in prepared cavities. J Dent Child, 52:177-182, May-June, 1985.

Cavities were prepared in human third molars *in situ* by using handpieces working at rpm ranging from 15,000 to 400,000. The cavity surfaces which were studied by scanning electron microscopy differed considerably between specimens prepared with the different handpieces. Dentin prepared at 15,000 rpm showed a smear layer that completely covered the apertures of the dentinal tubules. Dentin prepared at 140,000 and 200,000 rpm also displayed a smear layer. In the latter cases, the apertures were discernible, partly filled with debris. Dentin prepared at 400,000 rpm showed no smear layer. The apertures of the tubules were partly filled, however, with debris. In a few specimens prepared at 400,000 rpm, the tubules were devoid of debris.

**Scanning electron microscopy;
Handpiece, high-speed**

Kuster, C. G. and Udin, R. D.: Frequency of accidental intravascular injection of local anesthetics in children. J Dent Child, 52:183-187, May-June, 1985.

The purpose of this study was to investigate the frequency of accidental intravascular injection of dental local anesthetic in children as determined by positive aspiration of blood.

The total sample of this study consisted of children three to thirteen years of age. Local anesthetic injections were administered to 4,134 children and evaluated.

Positive aspiration of blood occurred 1.7 percent of the time. Positive aspiration occurred 3.1 percent of the time, in the inferior alveolar block; and 2.2 percent of the time, in the infiltration of the maxillary molars.

A statistically significant higher incidence of positive aspiration of blood occurred in females by a more than 2:1 ratio. When a positive aspiration occurred, 68.6 percent of the time

the patient was a female.

It is statistically significant that 67.2 percent of the positive aspirations occurred in eight, nine and ten-year-old children, while these ages comprised only 44.5 percent of the sample.

Local anesthetics, Intravascular injection, Aspiration

O'Donnell, D.; Brook, A. H.; Ma, G.: Bilateral, asymmetrical, complete oroocular facial clefts and supernumerary teeth in a young Chinese female. J Dent Child, 52:191-194, May-June, 1985.

A rare case of bilateral, asymmetrical, oroocular facial clefts in a young Chinese female. In this patient, the clefting also involved the alveolar processes, and palatal supernumerary teeth associated with the clefts were situated mesially to the cleft in the left alveolar process and distally to the cleft in the right. The positions of the supernumerary teeth corresponded to the asymmetry of the clefts. Preventive dental care will be provided, with monitoring of orofacial growth and development at regular intervals.

Clefts, facial; Supernumerary teeth

Paulson, R.; Gottlieb, L.; Sciulli, P. et al: Double-Rooted maxillary primary canines. J Dent Child, 52:195-198, May-June, 1985.

This report includes morphological descriptions of bifurcated maxillary primary canines. The cases of bifurcation exhibit roots emanating from a long root trunk, with the mesial root wider than the distal root. In one case, the roots are connected by a lingual cementodentinal bridge. In the second case, the roots are completely separated. The crowns of these teeth show a great crown-width-to-height ratio. Also, the cervical root measurements are considerably wider mesio-distally, relative to their buccolingual width.

Comparison of the frequencies of

labial grooves demonstrate a significantly higher frequency in prehistoric Amerindians than in modern Dutch and Danish samples. Since most cases of root bifurcation and labial grooves are expressed in individuals from populations with large teeth, we propose a hypothesis relating size to these features of root morphology. Clinical considerations of these results are discussed.

Bifurcated primary canine

Pinkham, J. R. and Paterson, J. R.: Voice control: an old technique reexamined. J Dent Child, 52:199-202, May-June, 1985.

Voice control has proved to be a useful management technique of young children. The argument that voice control is not the most accurate term for the technique is presented. The authors also contend that if the technique were limited just to the utilization of the voice, it would not be very effective in managing the behavior of young children. A new term, *implicit communication control*, is offered as a more exacting term to describe this old and effective technique. Implicit communication control assumes that facial expression is just as important, if not more so, as are voice loudness and tone. Implicit communication control also assumes that there are many ways a dentist can use his face and voice to guide a child through a dental appointment.

Behavior management, Voice control, Implicit communication control

Spedding, R. H.: Incomplete resorption of resorbable zinc oxide root canal fillings in primary teeth: report of two cases. J Dent Child, 52:214-216, May-June, 1985.

Resorbable fillings are used to fill the root canals of primary teeth. Occasionally only partial resorption occurs. Two cases are presented where incomplete resorption of the root canal fillings occurred and management of

these cases is described.

Endodontics, primary teeth; Resorption of root canal fillings

Hicks, M. J. and Flaitz, C. M.: Dens invaginatus with partial coronal agenesis: report of case. J Dent Child, 52:217-219, May-June, 1985.

Dens invaginatus or *Dens in Dente* is a clinical phenomenon that may occur in as many as 10 percent of maxillary lateral incisors. The clinical case reported is of a healthy twelve-year-old male Hispanic with *dens invaginatus* and partial coronal agenesis of the maxillary right central incisor. The etiology, prevalence and diagnosis of *dens invaginatus* are presented.

Dens invaginatus; Agenesis, coronal

Ruemping, D. R.: The auriculotemporal syndrome: report of case. J Dent Child, 52:220-222, May-June, 1985.

Auriculotemporal syndrome is a rare, bizarre neurologic and vascular response to disease or trauma. The theory of etiology and description of this anomalous entity is described. This case demonstrates well the possible sequelae to parotid gland involvement.

Auriculotemporal s., Parotid gland

Mader, C. L. and Kellogg, S. L.: Primary talon cusp. J Dent Child, 52:223-225, May-June, 1985.

An unusual case of a talon cusp on a primary incisor is reported. After exfoliation, the tooth was examined with a scanning electron microscope. It is suggested that pulp tissue may not be found in all talon cusps.

Talon cusp, primary tooth

Clark, D. C. et al: An empirically based system to estimate the effectiveness of caries-preventive agents. Caries Res., 19:83-95, January-February, 1985.

The purpose of this paper was to develop and test an empirically based system to estimate the effectiveness of caries-preventive agents. Using accepted statistical methods, effectiveness predictions for fluoride supplementation, APF gels and solutions, and fluoride varnishes were calculated and used to illustrate the statistical formulation. The resulting predictions were then compared to commonly cited estimates of reduction for the respective procedures. The proposed system could be useful to public health administrators in determining the cost-effectiveness estimates for various preventive programs.

Caries-preventive agents, Effectiveness, Empirically based system, Fluoride topical agents, Supplements

Mellberg, J.R. and Chomicki, W. G.: Effect of soluble calcium on fluoride uptake by artificial caries lesions *in vivo*. Caries Res., 19:122-125, March-April, 1985.

Artificial caries lesions were implanted in the partial dentures of 10 subjects and treated for two weeks by brushing *in vivo* with a monofluorophosphate (MFP) dentifrice, a similar dentifrice containing CaCl₂, or a placebo. Analysis of the lesions for fluoride showed that both MFP dentifrices deposited significant fluoride in the enamel, but that the MFP: CaCl₂ dentifrice was significantly better than the MFP dentifrice.

Caries, artificial; Dentifrice; Fluoride uptake; Monofluorophosphate

Mellberg, J. R. et al: Remineralization *in vivo* of artificial caries lesions by a monofluorophosphate dentifrice. Caries Res., 19:126-135, March-April, 1985.

Blocks of human enamel containing artificial caries lesions covered with Dacron mesh were implanted in the dentures of 14 subjects. Each subject,

according to random design, was instructed to brush his/her teeth, with their dentures in place, three times daily for two months using a sodium monofluorophosphate-dicalcium phosphate dihydrate (MFP/DCPD) dentifrice or a placebo dentifrice containing no fluoride, soluble calcium or phosphate. Every subject used both dentifrices in a crossover, double-blind design. Matched pairs of enamel blocks with artificial lesions were used, one of which was treated with a dentifrice and one kept untreated as a control.

Statistically significant remineralization as determined by several parameters occurred in the artificial lesions treated with both the MFP/DCPD and the placebo dentifrices ($p < 0.01$). The MFP/DCPD dentifrice treatment reduced the depth of the lesion 19 percent which was significantly more ($p < 0.01$) than the placebo group (-3.0 percent).

Caries, artificial; Dentifrice; Monofluorophosphate; Remineralization

Glasrud, P. H.: Insuring preventive dental care: Are sealants included? *Am J Public Health*, 75:285-286, March, 1985.

Lack of third-party reimbursement for pit and fissure sealants has been cited as a barrier preventing increased adoption rates. The extent to which commercial insurance companies and Blue Cross/Blue Shield Associations provide reimbursement for dental sealants is examined with data from a telephone survey. Results indicated that the majority of such third-party payers did not provide reimbursement for sealants.

Sealants, Third-party reimbursement

Wagner, M.: How healthy are today's dentists? *JADA*, 110:17-24, January 1985.

Increased attention to health matters has swelled the list of known occupa-

tional hazards with which dentists must contend. But the profession and allied fields are responding to these concerns with strategies and equipment to meet the new challenges and address long-standing complaints. For example, ergonomically efficient chairs and stools have been developed to ease backstrain among dentists, and a new vaccine cuts dentists' risk of contracting viral hepatitis.

This month's *Emphasis* features a guide to health and safety in the dental office and points the way to areas ripe for further research. And an accompanying article makes the case that dentists—thanks to their generally higher economic status and degree of workplace control—may already be a healthier population than many.

Occupational disorders; Environmental hazards; Stress; Infectious disease

Haugejorden, O.; Lervik, T.; Rioridan, P. J.: Comparison of caries prevalence 7 years after discontinuation of school-based fluoride rinsing or toothbrushing in Norway. *Community Dent Oral Epidemiol*, 13:2-6, February, 1985.

The purpose of this study was to compare caries prevalence in two groups of 21-year-olds 6-7 years after discontinuation of school-based preventive programs consisting respectively of fortnightly rinsing or brushing 3-5 times per year with NaF solutions. Stratified random samples of 125 persons were drawn from appropriate population registers. Non-response was 30 percent. Blind clinical and radiographic examinations were carried out and the subjects were interviewed concerning their dental health related behavior. The results revealed significantly lower mean DMFS score in the rinsing than in the brushing group ($P < 0.001$). Comparisons with results of other studies suggest persistence of benefits of school-based preventive programs after discontinuation.

Dental caries; Dental epidemiology; fluorides; Preventive dentistry

Doessel, D. P.: Cost-benefit analysis of water fluoridation in Townsville, Australia. *Community Dent Oral Epidemiol*, 13:19-22, February, 1985.

The purpose of this paper is to quantify the economic costs and benefits of water fluoridation in the city of Townsville, Australia. The study has been undertaken in such a way as to overcome the problems associated with hypothetical cohort analysis in the economic analysis of health projects. The method utilized involves analyzing the economic effects on the total population subject to water fluoridation, through the systematic disaggregation and valuation of demographic, dental and economic data. The study indicates that significant economic benefits will accrue to the Townsville community through water fluoridation, under a wide range of conditions and assumptions.

Cost-benefit analysis, Economics, Dental caries, Water fluoridation

Katevuo, K. et al: Skeletal changes in dentists and farmers in Finland. *Community Dent Oral Epidemiol*, 13:23-25, February, 1985.

Two groups were studied: dentists and farmers from the Turku area. Radiologic examination of both groups included the spinal column, rib cage and shoulder joint. Spondylosis of the cervical spine was present in 68 (52.1 percent) of the dentists and 59 (19.2 percent) of the farmers. Lumbar spondylosis was more common among farmers than among dentists in the corresponding age-group. Changes in the shoulder joint occurred significantly more often in dentists than in farmers. The findings in this study indicate that dentists appear to belong to the group doing heavy work.

Dentists, Occupational dentistry, Physiology, Skeletal changes

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ABSTRACTS *continued from page 172*

Colquhoun, J.: Influence of social class and fluoridation on child dental health. *Community Dent Oral Epidemiol*, 13:37-41, February, 1985. In this study in oral epidemiology, officially collected statistics are presented which show that, 15 years after fluoridation commenced in Auckland, New Zealand, there was still a significant correlation between dental health of children and their social class. They also show that treatment levels have continued to decline in both fluoridated and unfluoridated areas, and are related to social class factors rather than to the presence or absence of water fluoridation. In the unfluoridated areas all the children, and in the fluoridated areas only selected children, had received regular topical fluoride treatments. In both areas the use of fluoride toothpastes and oral hygiene had been encouraged. When the socioeconomic variable is allowed for, child dental health appears to be better in the unfluoridated areas.

Child dental health; Epidemiology, oral; Fluoridation; Social class

Goldberg, P.; Matsson, L.; Anderson, H.: Partial recording of gingivitis and dental plaque in children of different ages and in young adults. *Community Dent Oral Epidemiol*, 13:44-46, February, 1985.

In epidemiologic studies, total recordings of the amount of dental plaque and the degree of gingival inflammation tend to be too time-consuming. Various partial recording methods have accordingly been suggested. However, the validity of these methods when applied to different age-groups has not been investigated sufficiently. The aim of the present study was to test whether different systems for partial recording of plaque

and gingivitis can take the place of a full-mouth recording in children of different ages and in young adults. Ninety children, divided into three age groups (4-6, 7-9, 14-16 years), and 30 adults (20-22 years) were examined. The degree of gingival inflammation was recorded using the Gingival Index and the amount of dental plaque using the Plaque Index. Two partial recording methods were tested. One of these covered the teeth suggested by Ramfjord, modified for children with a primary dentition, and the other the front segment of the maxilla. The results were compared with those from an examination of all tooth surfaces. In all age-groups excellent agreement was found between the partial recording method suggested by Ramfjord and a full-mouth recording of both the gingival state and the amount of dental plaque. Examination of the maxillary front segment was less accurate and resulted in a systematic underestimate.

Dental plaque; Epidemiology, oral; Gingivitis

Noren, J. G. et al: SIMS analysis of deciduous enamel from normal full-term infants, low birth weight infants and from infants with congenital hypothyroidism. *Caries Res*, 18:242-249, May-June, 1984.

Secondary ion mass spectrometry (SIMS) was used for determining the concentrations of Na, K, Mg, Sr, F and Cl in human deciduous enamel from three groups of children. From infants with a birth weight less than 2,000g, 11 teeth were analyzed. Four teeth from infants with congenital hypothyroidism were analyzed and as references 16 teeth from normal healthy full-term infants were used. It was shown that normal deciduous enamel displayed differences in ele-

mental distribution between pre- and postnatal enamel, differences between the inner and outer parts of the enamel and certain correlations between the recorded elements. In the enamel from infants with perinatal disorders the low birth weight groups appeared more similar to the normals than the hypothyroid group, which differed from the other groups.

Apatite, Enamel, Ion probe

Retief, D. H. et al: Enamel and cementum fluoride uptake from a glass ionomer cement. *Caries Res*, 18:250-257, May-June, 1984.

Class V cavities were prepared at the cemento-enamel junction on the facial surfaces of 45 extracted human central maxillary incisors. Enamel samples for analysis were obtained by means of perchloric acid etching from circular areas, 1 mm in diameter, positioned 1.5, 3.5, 5.5, and 7.5 mm from the incisal and apical margins of the restorations, respectively. The preparations were filled with Fuji Ionomer Restorative, Type II. The restored teeth were individually suspended in synthetic saliva at 37°C and the saliva changed at regular intervals. Fifteen teeth were removed after 1, 3, and 6 months, respectively. Enamel and cementum samples were again obtained from the teeth from sites parallel and adjacent to the previous biopsy sites. The fluoride content of the etching solutions was determined by gas chromatography and the calcium content by atomic absorption spectrophotometry. Fluoride acquired by enamel after 1 month ($\pm 2,500$ ppm F) was retained after 3 and 6 months. Fluoride acquired by cementum after 1 month ($\pm 15,000$ ppm F) was significantly reduced after 3 months ($\pm 6,000$ ppm F) and maintained at this level after 6 months.

Cementum, Enamel, Fluoride, Glass ionomer cement