ASDC
AMERICAN SOCIETY OF DENTISTRY FOR CHILDREN
JOURNAL OF DENTISTRY FOR CHILDREN
SEPTEMBER—OCTOBER 1995

There are few things we claim to value more than our children. They are our most cherished resource; they represent the future; they justify the hardships of everyday life. "I am doing this for my children," says the exhausted bank executive or the immigrant dry-cleaning operator, and by this attribution, their grinding routine is transformed into a meaningful struggle. It is difficult to

imagine how impoverished our prospects would be, how hopeless the future would look, if we could not dream of a better existence for our children. To an extent we rarely realize, it is children that give meaning to adult life. No community could survive without this link to the future, which gives stability and purpose to the energies of its members.

—Mihaly Csikszentmihalyi

PUT SIMPLY, CHARACTER IS FORMED BY PLACING EXAMPLES OF VIRTUE IN FRONT OF YOUNG PEOPLE. IRONICALLY, THE RECENT RESURGENCE OF INTEREST IN TEACHING VALUES AND ETHICS HAS TOO OFTEN IGNORED THIS BASIC PRINCIPLE.

—Charles J. Sykes

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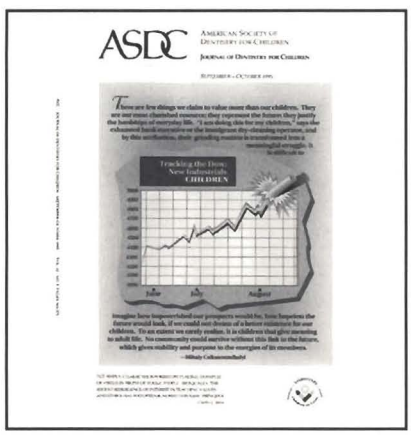

Society is of one voice, when it comes to exclaiming the importance of children. When the time arrives for corporate and personal sacrifices, however, the voice wavers.

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A total of 1,035 children were examined. One hundred and sixty (15.4 percent) had a dental injury.

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Calendar

1995

ASDC Annual Meeting, Palm Springs, CA, October 11-15

1996

3rd Congress of the European Academy of Paediatric Dentistry, June 8-11—Bruges, Belgium—Pre-Congress June 7-8, 1996

ASDC Annual Meeting, Westin Canal Place, New Orleans, LA, October 23-27

1997

ASDC Annual Meeting, site to be determined, late October

For The Busy Reader

The impacted maxillary canine: I. Review of concepts—page 317

In part I, the authors review various circumstances that may be associated with an impacted maxillary canine. The latter rarely occurs as a single isolated dental anomaly. Often it is accompanied by either a peg-shaped or missing lateral incisor. A premaxillary skeletal deficiency is routinely found in association with the impacted canine, but not always. On occasion the impacted canine will show maxillary excess, generalized dental spacing, and more than adequate arch-length for the impacted tooth.

The final position of the canine is largely dependent on the proper location and alignment of the lateral incisor. The maxillary canine has the longest period of development, forms in the highest area of the face, and has the longest eruption path from the point of its origin below the orbit to its completely erupted position in the oral cavity.

Requests for reprints should be directed to Dr. M. M. Kuftinec, Department of Orthodontics, College of Dentistry, New York University, New York, NY 10010.

The impacted maxillary canine: II. Clinical approaches and solutions—page 325

In part II, the authors describe the orthodontic management, surgical approaches, and periodontal considerations in the treatment of impacted canines. Challenging cases where functionally and esthetically satisfactory results were obtained are described. The orthodontic movement of an impacted canine should be approached as if one were assisting the tooth's natural eruptive process. The forces applied should be low, so a force of approximately 20 to 30 grams is recommended. Factors that may complicate treatment are discussed.

Requests for reprints should be directed to Dr. M. M. Kuftinec, Department of Orthodontics, College of Dentistry, New York University, New York , NY 10010.

Sealant status and factors associated with sealant presence among children in Milwaukee, WI—page 335

Sealants are safe, cost-effective, and easy to apply. This description of dental sealants is virtually universally approved; nevertheless their use remains low. The most recent national survey on caries prevalence (1986-87) showed that 7.6 percent of school-children in the United States have sealants. Gift and Newman, in 1992, reported results from the National Health Interview Survey. The results indicated that only 14.5 percent of schoolchildren, ages five to seventeen, had at least one sealant.

In this study, the authors survey Milwaukee school-children (six to fourteen years) for sealants; describe factors associated with the presence of sealants; describe differences among ethnic and minority groups.

Requests for reprints should be directed to Dr. Cesar D. Gonzalez, Assistant Professor, Marquette University, School of Dentistry, Department of Developmental Sciences and Community Health, Division of Pediatric Dentistry, 604 N. 16th Street, Milwaukee, WI 53233.

Partial pulpotomy: Another treatment option for cariously exposed permanent molars—page 242

The most important and difficult aspect of pulp treatment is determining the health of the pulp, or its stage of inflammation, so a decision can be made regarding the desired form of treatment. Because of their rich blood supply, young permanent teeth are excellent candidates for several pulp-healing procedures. Because of its success in the management of traumatized incisors with pulp exposure, partial pulpotomy or pulp curettage is recommended as an alternative treatment for molars with a pulp exposed by caries.

Requests for reprints should be directed to Dr. Eliyahu Mass, Department of Pediatric Dentistry, The Maurice and Gabriela Goldschleger, School of Dental Medicine, Tel Aviv University, Tel Aviv 69978, Israel.

Toothbrushing ability is related to age in children—page 346

Parents frequently fail to realize that their children are not old enough to brush their own teeth properly. Removal of plaque by brushing is dependent on coordinated muscular movements, innate skills, and the ability to understand instruction. The authors report on an in-

vestigation in which they wished to determine whether age could be a predictor of the level of toothbrushing ability in children. They concluded that chronologic age is a reasonable predictor of toothbrushing ability, and that children younger than ten years of age may not have the physical dexterity for effective toothbrushing.

Requests for reprints should be directed to Dr. John H. Unkel, Assistant Professor and Acting Director, Pediatric Dentistry, West Virginia University, School of Dentistry, Health Sciences Center, North, Morgantown, WV 26506-6305.

Incidence of dental caries in children with acute lymphoblastic leukemia is related to the therapy used—page 349

The authors' studies show that children with cancer have more dental caries during treatment than age-and-sex-matched controls. The authors compared dental caries scores in children who had been treated for acute lymphoblastic leukemia with those of healthy controls; and, furthermore, to compare the risk for dental caries in patients with chemotherapy, patients with chemotherapy and central nervous system irradiation, and patients who received bone marrow transplants with whole body irradiation.

Requests for reprints should be directed to Dr. Ulla Pajari, Institute of Dentistry, Aapistie 3, 90220 Oulu, Finland.

Anterior tooth trauma in eleven-year-old South African children—page 353

A study of the prevalence of dental trauma in South African children was included in a major study on dental health and disease in South African children for the period 1985-1990. The trauma study targeted permanent anterior teeth of eleven-year-old children in the main ethnic groups of South Africa. A total of 1,035 children were examined. One hundred and sixty (15.4 percent) of the children were victims of dental trauma. According to type of tooth, 91.8 percent involved the maxillary anterior teeth; 84.2 percent, the central incisor; 7.6 percent, the lateral incisor; and 8.1 percent, the mandibular anterior teeth.

Requests for reprints should be directed to Dr. J. Anthony Hargreaves, Faculty of Dentistry, University of Alberta, Edmonton, Alberta, T6G 2N8, Canada.

Pediatric dental practice: The number of your employees is increasing—page 356

In the past decade, the total number of employees in dental offices increased by almost two-thirds (64.6 percent) from 342 thousand to 563 thousand individuals. The total number of production workers (dental hygienists, dental assistants, and dental technicians) increased from approximately 300,000 to a half million workers. The average number of employees per dental facility increased from four to more than five persons.

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

Accessory jaw and mouth: Report of case—page 360

The author describes a patient with an accessory bony segment attached to the mandible with accessory teeth. The differential diagnosis is discussed.

Requests for reprints should be directed to Dr. E.M.H. Al-Waheidi, Faculty of Dentistry, Jordan University of Science & Technology, P.O. Box 3030, Irbid, Jordan.

Mercury hypersensitivity from amalgam: Report of case—page 363

Occupational exposure to mercury is known to cause contact dermatitis, which is extremely rare. The author describes the case of an eight-year-old boy who developed an erythematous area on the labial commissura, the cheek, and the neck, following the placement of an amalgam restoration.

Requests for reprints should be directed to Dr. Işin Ulukapi, °Istanbul Üniversitesi, Dişhekimliği Fakültesi, Pedodonti Anabilim Dali, 34390 Çapa-°Istanbul/Turkey.

Clinic

The impacted maxillary canine: I. Review of concepts

M.M. Kuftinec, D Stom, DMD, ScD
Y. Shapira, DMD

Impacting is the process or condition of being impacted. An impacted tooth is a condition in which a tooth is embedded in the alveolus so that its eruption is prevented or the tooth is locked in position by bone or by the adjacent teeth.[1]

Impaction of teeth, particularly that of permanent maxillary canines, is not a very rare dental anomaly, yet its treatment is usually a challenge to orthodontists.[2,3]

Any tooth in the dental arch can be impacted, but the teeth most frequently involved in a descending order are the mandibular and maxillary third molars, the maxillary canines, the mandibular and maxillary second premolars, and the maxillary central incisors.[4]

The maxillary canines are the second most frequently impacted teeth, (second to the mandibular third molars). The incidence of maxillary canine impaction is approximately 2 percent of the patients who seek orthodontic treatment, and about 1 percent in the general population.[5,6] Canine impaction is ten to twenty times more common in the maxilla than in the mandible.[7,8] Palatal impaction of canines is two to twenty times more prevalent than labial impaction. In the mandible, the opposite is true, where labial impactions are more common.[5,9] Unilateral canine impactions are more common than bilateral (about 5:1), and the left side is slightly more frequently affected than the right.[10] When impacted palatally, the tooth is usually rotated and assumes an oblique or semihorizontal position. Displacement toward a horizontal position, observed in 32 percent of impactions, might be a result of continued growth of the root.[11] When impacted labially, the canines are most often found in a vertical position.

Impactions occur more frequently in females than in males, with the ratio of 2.5:1, for palatally impacted canines.[7] This higher frequency in females is related to the higher frequency of missing, small, and peg-shaped lateral incisors, observed together with impaction of palatally displaced canines found in females.[12] Canine impaction in the primary dentition is extremely rare.

Of additional interest is the fact that canine impactions rarely occur as a single isolated dental anomaly. They are frequently accompanied by either peg-shaped or missing lateral incisors.[12] Retained primary teeth are quite common and so are various supernumerary permanent teeth. A premaxillary skeletal deficiency is routinely encountered with canine impactions, and it can be intuitively explained. Yet, this deficiency is not always present and in fact, on occasion the maxillary canine impactions will show maxillary excess, generalized dental spacing, and more than adequate arch-length for the impacted tooth.[13]

While secular changes in human dentition suggest a decrease in overall size of permanent teeth of about 4 percent over the last 150-200 years, more recent reports

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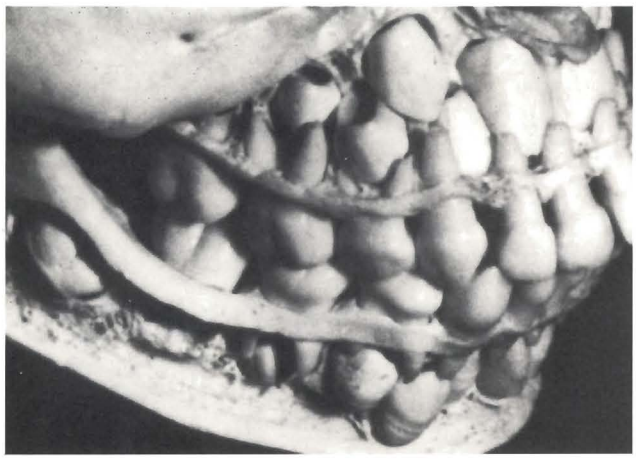

Figure 1. Position of the developing maxillary permanent canine at approximately three years of age. From Frans P.G.M. van der Linden: Transition of the human dentition, *by permission.*

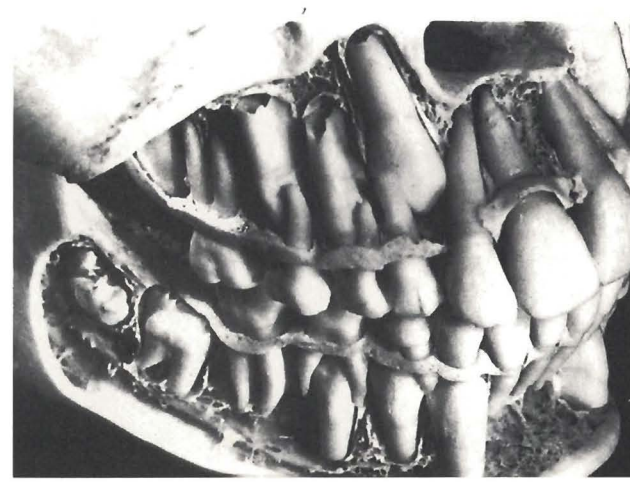

Figure 2. Position of the developing maxillary permanent canine during the early mixed dentition. From Frans P.G.M. van der Linden: Transition of the human dentition, *by permission.*

on the incidence of impactions would indicate an increase in the number of impacted teeth. Clearly one would need to allow for a possible shrinkage of alveolar bone as a plausible contributing factor, but it would appear that there is not a causative correlation between the arch-space deficiency and impactions of canines.[14]

Why do these impactions seem to occur more often than they did formerly? The answer may be rather complex, if indeed the original premise is correct. Several factors could contribute to this phenomenon. Orthodontists probably now see a larger segment of the population; fewer teeth are lost to caries, periodontal disease, trauma, and similar causes, thus increasing the likelihood of impaction due to the space deficiency; general dentists are better educated to recognize developmental problems and thus more likely to refer their patients with impactions to orthodontists for treatment.

In our esthetic-conscious society, it is increasingly important to preserve the natural dentition. This certainly includes keeping or "saving" the impacted teeth. Replacing or "substituting" canines that may be lost because of impaction just is not an appealing treatment option.

NORMAL DEVELOPMENT

The tooth germ of the maxillary permanent canine starts to develop at the age of four to five months, very high in the anterior wall of the maxillary sinus, under the floor of the orbit. At about three years of age, the intrabony position of the developing maxillary permanent canine is below the orbit, above the floor of the nose, and between the nasal cavity and the maxillary sinus. Its crown is directed mesially and lingually to the primary canine and to the developing first premolar; and is close to the mesial roots of the maxillary first primary molar. With the development of the first premolar, the canine, the first premolar, and the first primary molar are positioned one above another (Figure 1).

At about the age of six years, the canine crown tip is at the level of the nasal floor. It is positioned lingually to the apex of the primary canine root and directed mesially. During the course of pre-eruptive migration, the canine is changing its position relative to the adjacent teeth. It follows a mesial path until it reaches the distal aspect of the lateral incisor root. The erupting canine is gradually uprighting to a more vertical position, and is guided by the lateral incisor root until it is fully erupted adjacent to the root (Figure 2).

The final position of the canine is largely dependent upon the proper location and alignment of the lateral incisor. If the lateral incisor is malpositioned lingually or rotated, the canine will lose, therefore, the proper guidance from the lateral incisor and continue to move forward until it reaches the distal aspect of the central incisor. It may then erupt adjacent to the central incisor, occupying a part of the lateral incisor space. If the lateral incisor is congenitally missing, the canine erupts in a mesial direction until it comes into contact with the distal aspect of the central incisor root and erupts.[15]

The maxillary canine has the longest period of development, forms in the highest area of the face, and has the longest eruption path from its point of origin below

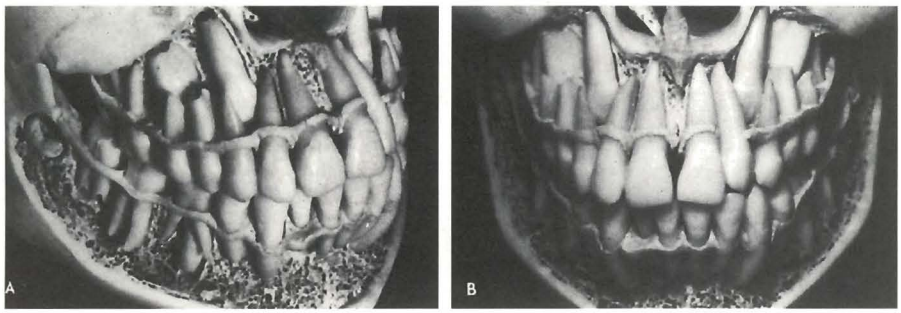

Figure 3. Position of the same tooth during the late mixed dentition stage. Note the intimate relation of the canine with the distal root surface of the lateral incisor. From Frans P.G.M. van der Linden: Transition of the human dentition, *by permission.*

the orbit to its completely erupted position in the oral cavity.[4]

Although the maxillary permanent canine initiates its calcification very early (four to five months postpartum), soon after the first permanent molar and the permanent central incisor (at partum and three to four months postpartum, respectively), its eruption begins several years after the eruption of the first molar. For the canine, it takes almost twice as long to erupt completely (twelve years) as it does for the first permanent molar (six years). These characteristics of eruption make the canine more susceptible to various unfavorable environmental influences.

The maxillary canine, usually the last tooth to erupt anterior to the first molar, has to prepare its own way between all teeth in the dental arch by wedging action (Figure 3). Unlike premolars, which replace teeth equal to or greater than their own mesiodistal diameters, the canine is preceded by a primary tooth that is narrower; it has to compete, therefore, for space with the concurrently erupting second molar. If the space is not adequate, the tooth will be high labially in the arch, or becomes impacted.

ETIOLOGY

The etiology of maxillary canine impaction remains obscure. Several theories have been offered as explanations for the proneness of these teeth to impaction. These include:

- ☐ Failure of the primary canine root to resorb.
- ☐ Prolonged retention of the primary teeth.
- ☐ Crowding and shortening of the arch-length.
- ☐ Localized pathologic lesions, such as dentigerous cyst.
- ☐ Ankylosis, odontoma, or supernumerary tooth.
- ☐ Small or congenitally missing lateral incisors.
- ☐ Other hereditary patterns.[16]

Environmental factors may contribute to or even cause this anomaly during the long, tortuous eruption path of a canine from its high point of origin to its final functional occlusal plane.[17]

Another possible explanation is that a disturbance associated with the follicle of the unerupted tooth may influence significantly the direction of eruption and contribute to severe displacement of the maxillary canine.[18]

Bass and Miller suggested that a local disturbance of the dental lamina may be responsible for setting the canine on the wrong path of eruption.[17,19] Takahama and Aiyama suggested that impaction of the canine may be a manifestation of a microform of cleft lip and palate.[20]

Crowding was ruled out as the major cause for palatal impaction by Jacoby, who reported that impaction was found in arches with no arch-length deficiency.[13] Moreover, he stated that, excluding the possibility that the tooth bud may have formed palatally, the explanation for palatal impaction could be excessive space in the canine area. This excessive space would allow the canine to move palatally in the bone and find a place behind the buds of the other teeth. Several cases reported by Reddy would support this theory.[14]

Some reports have shown that palatally displaced canines are not related to crowding in the maxillary dental arch, and do not seem to be the primary cause in the cases presented with impaction of mandibular canines or with ectopically erupted mandibular lateral incisors.[12,21-23]

The majority of canines are impacted palatally among Caucasians and buccally among Asians. Over 50 percent of Asians present a tapered arch form, resulting in more severe crowding in the anterior segment.[24] This observation supports the Jacoby theory that the buccal displacement of the canine is associated with crowding, and excessive space leads to palatal impaction. Another factor may be the higher incidence of Class III malocclusion with its associated reduction in the size of the maxilla, combined with increased tooth size found in Asians.[24]

Other reports have shown an exceptionally high inci-

dence of palatally displaced maxillary canines in the presence of small, peg-shaped lateral incisors or in cases where lateral incisors are missing.[12,17,19] Moreover, a definite link was found between small crown size and shortening of the roots of the lateral incisors adjacent to palatally displaced canines. The suggested explanation was the lack of guidance from the roots of the lateral incisors during the early stages of canine eruption.[25] Cases with missing or small lateral incisors, or palatally displaced canines experience late development of their dentitions.[21,22,25]

Traumatic injury to the maxillary anterior region at an early stage of dental development has also been suggested as a possible etiologic factor in canine impaction.[26]

Palatal bone is more dense than alveolar bone, and the soft tissue covering the anterior part of the hard palate is very dense, thick, and resistant. This may retard the eruption of the palatally displaced canine.[27]

The maxillary lateral incisor presents its oval shaped root to the migrating canine crown. Rotation of the lateral incisor, therefore, would guide the canine palatally or buccally. Palatally displaced canines tend to be associated with a mesiolabially rotated lateral incisor, whereas the buccally displaced canines tend to associate with a distolabially rotated lateral incisor.[24] Whether this phenomenon is a cause or an effect of canine displacement and possible impaction is still speculative.

Interestingly, one of the authors has a familial occurrence of impaction of a maxillary canine, present in four consecutive generations. Canine impactions indeed were found to occur in families, suggesting a genetic or familial pattern of inheritance.[28-30] In a recent article, Peck and Peck suggest a multifactorial genetic pattern of inheritance for the anomaly.[31]

Although genetics is an attractive hypothesis, we cannot subscribe to the Peck and Peck suggestion, because they attempt to justify circumstantial and epidemiologic evidence as genetic.[32]

DIFFERENTIAL DIAGNOSIS

The diagnosis and localization of the impacted canine are usually made on the basis of clinical and radiographic examinations. Normally, a maxillary canine can be clinically palpated high in the labial sulcus above the primary canine as early as eight to nine years of age.

It has been shown that canines that can be palpated positively, erupt normally.[33,34] Retention of the primary canines beyond age thirteen years, with no sign of labial canine bulge, may suggest canine impaction and should be confirmed by a radiographic investigation.

The position of the lateral incisor should be carefully checked. Distal or labial flaring of a lateral incisor can be caused by pressure from the mesially and ectopically erupting canine (Figure 4). A labially flared lateral incisor may indicate a buccally displaced canine, whereas a distally tipped and rotated lateral incisor suggests a palatal, ectopic canine (Figures 5, 6).

Maxillary lateral incisors adjacent to impacted canines face the danger of root resorption, and should be carefully observed, therefore, clinically and radiographi-

Figure 4. Labially flared maxillary lateral incisor caused by the pressure of the mesially displaced canine. A. Frontal B. Panoramic view.

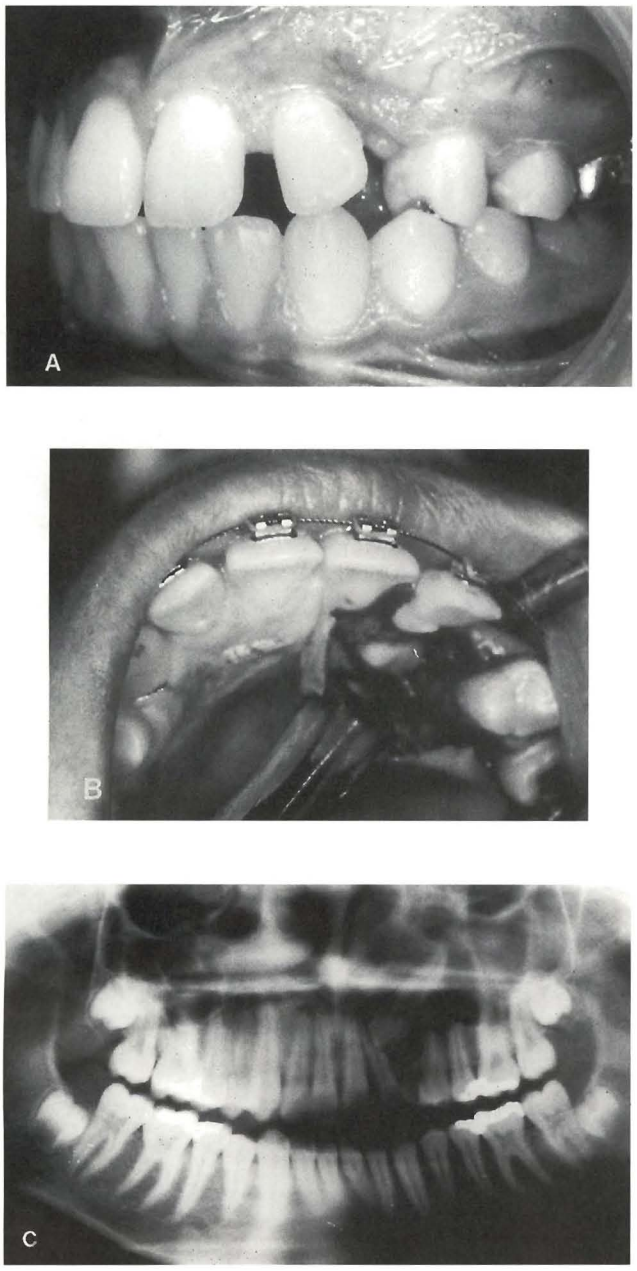

Figure 5. Distally tipped maxillary lateral incisor caused by palatally ectopic canine. A. Lateral. B. Surgically exposed palatal impacted canine. C. Panoramic view prior to the removal of the primary canine.

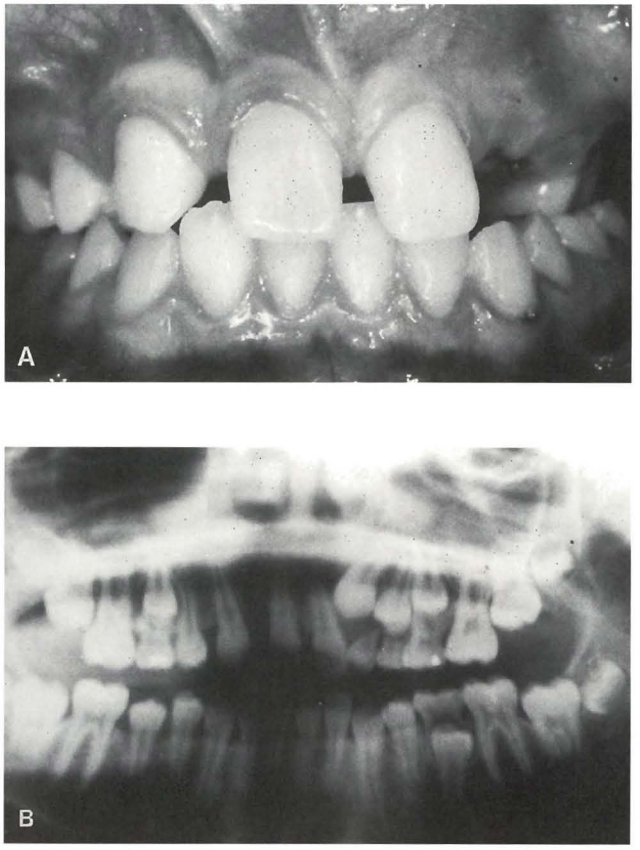

Figure 6. Distally tipped maxillary central incisor caused by the mesially displaced canine in the congenital absence of the lateral incisors. A. Frontal. B. Panoramic radiograph.

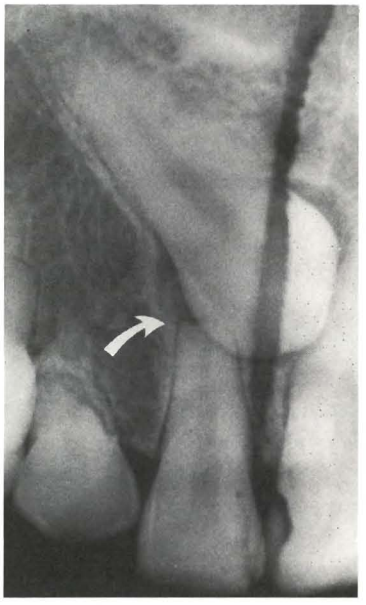

Figure 7. Apical root resorption caused by the impacted canine.

cally.[35] Excessive mobility of the lateral incisor may be the result of apical root resorption caused by the ectopic canine (Figure 7).

In the diagnostic procedure for potentially impacted canines, occlusal, oriented lateral and frontal, along with oblique radiographs are very useful in locating the rel-

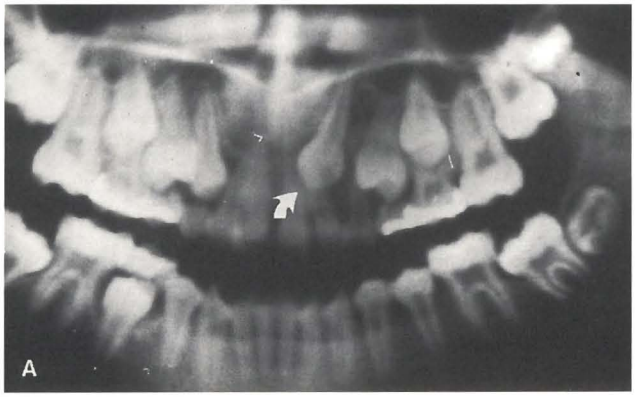

Figure 8. Distally tipped maxillary lateral incisor caused by the mesially ectopic canine. A. Note the enlarged follicle of the unerupted canine with no evidence of resorption of the primary canine. B. The primary canine was extracted to provide a more favorable eruption path.

ative position of the maxillary canines.[36] In the lateral radiogram, the crown should be near the apex of the primary canine root and inclined mesially. The long axis of the canine should be somewhat parallel to the long axis of the incisors.

In the frontal radiogram, the canine should be inclined only slightly medially with the crown below the apex of the lateral incisor and well below the lateral border of the nasal cavity. The canine root should lie laterally to the lateral border of the nasal cavity.[36]

If there is no evidence of canine bulge high in the alveolar process and the tooth appears to be tipped mesially in the frontal radiogram with the crown medial to the lateral border of the nasal cavity, a future impaction of the maxillary canine can be expected. Lack of resorption of the primary canine root, or uneven resorption of the apex of the primary canine seem to be the result of an ectopically erupting canine, rather than the primary

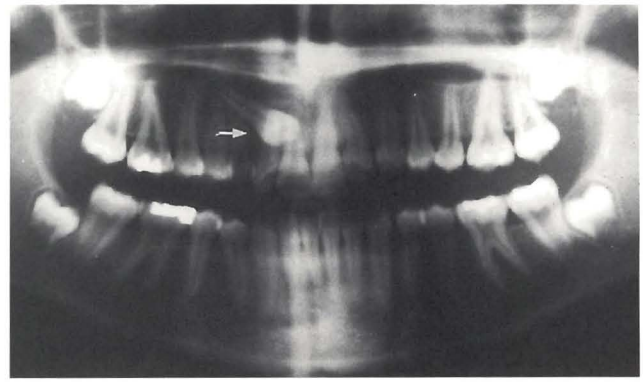

Figure 9. Panoramic view of a semihorizontal impacted canine with the retained primary tooth.

cause for the ectopic eruption (Figures 8, 9).

To determine whether the impacted canine is positioned palatally or labially, utilizing Clark's rule, two periapical radiograms are taken in the same horizontal plane at different cone angles (one film taken at a more distal position than the other). If the canine moves in the same direction as the tube head, then the canine is in a palatal position. If the canine moves in the opposite direction, it is on the buccal side. If there is very little movement, then the canine is in a relatively normal (central) position in the alveolar ridge.

The routine panoramic radiograph of a mixed dentition patient can also be used to identify a potential canine impaction. When the cuspal tip of the canine is located mesially to the long axis of the erupted lateral incisor root, canine palatal impaction occurred. When it overlaid the distal half of the lateral incisor root, the canine will usually (not always) be palatally impacted. (Figure 8).[37]

Computed tomography (CT) has recently been introduced as a standard method used in medical radiology to detect bone pathology. Computed tomography has been suggested as a very useful method for three dimensional diagnosis of ectopic maxillary canines, especially where a potential canine root ankylosis or lateral root resorption is suspected. The transverse orientation of the cuts detects the labiolingual localization of the impacted maxillary canine and the extent of lateral root resorption, which would not be detected in any other radiographic techniques.[38,39]

After the proper location of the impacted canine has been determined, the timing of the surgical exposure relative to the orthodontic treatment plan sequence has to be determined.

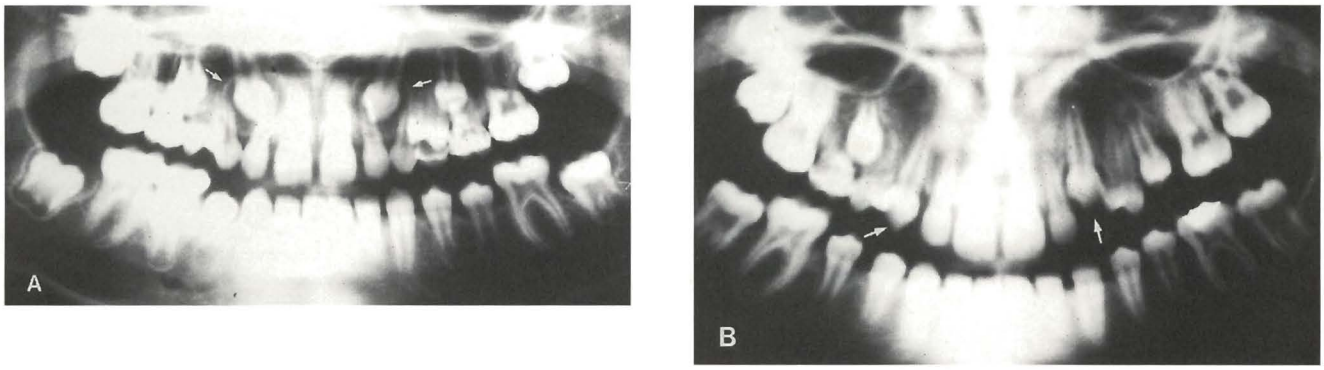

Figure 10. Mesially displaced maxillary canines. A. Note the enlarged follicle of the unerupted canines with no evidence of resorption of the primary canines. B. Eruption of the permanent canines 1.5 years following the extractions of the primary canines.

PREVENTION

The best time to begin observation of potential maxillary canine impaction is the dental age of eight to nine years. At that time, the canine begins its long intrabony migration. It seems to migrate buccally from a position lingual to the root apex of the primary precursor.

If a canine-bulge cannot be clinically palpated high above the primary canine, while a medial tilt of the long axis of the canine in relation to the lateral wall of the nasal cavity is visible on the frontal radiograph, and a lingual position of the canine in relation to the incisors is present on the lateral radiograph, then early removal of the primary canines is recommended.[36]

When the periapical view shows that the canine is not resorbing the primary canine root vertically, is excessively angulated mesially, or has slipped past the guiding influence of the lateral incisor, the correct procedure is to extract the primary canine immediately in order to allow the permanent canine to become upright (Figure 8).[40-42] If there is not sufficient space to allow eruption, then placement of cervical traction to move the buccal segments distally may be indicated, particularly in an edge-to-edge or distoclusal molar relationship, if extraction of permanent teeth were to be avoided. When the canine axial inclination is more horizontal and its eruption path more abnormal, the interceptive methods may not provide spontaneous correction; additional treatment solutions then should be explored (Figure 9).

If the lateral incisor is inclined distally due to mesial pressure of the erupting canine on its root, untimely alignment of the lateral incisor may end up in root resorption, as its root is moved into the canine crown.

When an enlarged follicle of an unerupted canine, in association with the retained primary tooth, is seen radiographically, the direction of eruption may often result in an impacted tooth. Intervention consists of removal of the primary predecessor together with a follow-up observation of the developmental follicle. These measures can provide a more favorable path of eruption (Figure 10).

Prevention of impacted canines provides the best long-term results. Early interceptive methods should be undertaken, therefore, wherever possible, after adequate observation and evaluation of selected cases are completed.

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THE STABILITY OF FACIAL OSTEOTOMIES

The Le Fort I osteotomy of the maxilla, the bilateral sagittal split osteotomy of the mandibular ramus and the horizontal osteotomy of the anterior mandible have been used increasingly as the surgical procedures to correct mid- and lower-third dentofacial deformity. This has been true, especially during the last two decades.

However, with the recent increased utilization of these procedures in reconstructive jaw surgery it should not be forgotten that sectioning and repositioning of the maxilla and mandible was first described more than 130 years ago.

Skeletal instability continues to be a major problem in the postoperative period following corrective jaw surgery. The conflicting data in the literature regarding 'stability' ensure that further studies are still necessary to clarify the clinical implications of these findings.

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The impacted maxillary canine: II. Clinical approaches and solutions

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Y. Shapira, DMD

The first part of this paper reviewed normal canine development and discussed the etiology and differential diagnosis of canine impactions. The second part describes the orthodontic management, surgical approaches, and periodontal considerations in the treatment of impacted canines. Illustrations of these concepts are given by presenting several challenging cases where functionally and esthetically satisfactory results were obtained.

CLINICAL MANAGEMENT

As there are many forms of canine impactions, there are equally as many theories of how best to approach the treatment of these conditions. The authors of this paper have either treated or supervised treatments of literally hundreds of impactions.

With accumulated clinical experience, which included a humbling number of failures, to solve the problem of impaction optimally, certain rules of management are offered to the reader.

Orthodontic and surgical intervention should not be delayed, to avoid unnecessary difficulties in aligning the tooth in the arch. In the most difficult cases of horizontally located canines with the cusp edge in close contact with the roots of the incisors, managing the impacted canine may endanger the incisor roots and failure may be expected (Figure 1).

While it is difficult to adopt blanket rules regarding the biomechanics of impaction management, several common-sense precautions are in order. It is prudent to approach the treatment of canine impaction with the "safe play" attitude: irreversible decisions should be postponed for as long as practical. This is particularly true of extracting teeth in order to make room in the arch for the impacted teeth. It is recommended that whenever possible, one wait for some evidence of response by the impacted tooth before extracting the

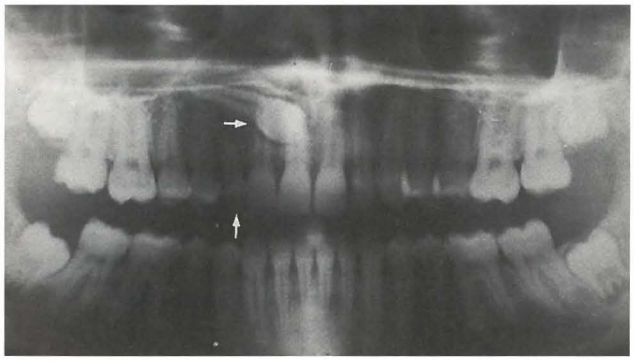

Figure 1. Panoramic radiograph of a horizontally impacted maxillary canine and retained primary canine.

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tooth. It could prove singularly disheartening and frustrating if, for example, the first premolar is extracted and the canine fails to "erupt" as a result of our intervention.

Similarly, it can be generally stated that the impacted canine should be erupted to a site in the mouth that is closest to its impacted position, but consistent with the previous rule of safe play. That means that the labially impacted teeth should be encouraged to erupt labially, and those palatally impacted to move through the palatal tissues. If the impacted canine is in the middle of the alveolus, that is to say it is neither clearly palatally nor labially impacted, then the palatal approach is recommended. The palatal mucosa is keratinized and makes, therefore, a much better host site for the tooth to erupt. Consequently, the labially treated impactions end up with insufficient collar of keratinized gingival tissue, which causes both an esthetic and a functional problem. An additional factor that favors a palatal approach is the availability of the relatively easy-to-use palatal arch, which leaves facial surfaces of the teeth available for needed treatment.[1-3]

BIOMECHANICS

For the many anatomical variations of shape and position of impacted teeth, there are as many different biomechanical approaches to their treatment.

In light of what is generally known about eruptive tooth movements, it is prudent to review the basic physiologic concepts. This should be done to avoid predictable mishaps during movement of impacted teeth into the arch.

One should approach the orthodontic movement of an impacted tooth as if one were assisting the tooth's natural eruptive process. Only very light forces should be applied to such a tooth throughout the assisted eruptive movements of the tooth.[2] Because the tooth will frequently need to resorb some of the surrounding bone, the applied force should exceed the blood pressure of the capillary network within the tissue surrounding the tooth (eruptive sac or forming periodontal ligament). The force of approximately 20 to 30 grams is usually sufficient and thus recommended.

As a practical consideration, it is somewhat difficult to gauge accurately these low level forces. Also, the high rate of decrease of force may be of practical importance, first due to fairly rapid changes in relation to the respective components, and secondly because the commonly used force-producing devices (elastic or power threads) tend to lose their activation rather rapidly and unpredictably. The relative constancy of needed force, together with implied superiority of the highly keratinized palatal mucosa, makes the palatal arch a most desirable approach to the correction of many cases of impacted maxillary canines.[2,3] The palatal arch provides a spring with a relatively low decrease-of-force rate and a useful moment-to-force ratio. The system is particularly suitable for treatment of bilateral impactions; one-sided impactions, however, can be easily handled.[3,4] Care must be taken that the palatal arch is not excessively active, because the impacted teeth may be moved in an uncontrolled way and distal tipping of maxillary molars could occur. A typical mechanical setup in the case of bilateral canine impaction is shown in Figure 2. It is a common occurrence that one canine is brought into the arch before the other. If this happens, it is of the utmost importance that the levels of force, applied to a single tooth, are properly adjusted. This usually means reducing activation of the palatal arch by a half.

The biomechanical rules applicable to palatal impactions and a simulated analysis of moments and forces in respect to a single canine activation is shown in Figures 3A and 3B. From even cursory analysis of these illustrations, it will be evident that the anchor teeth, usually the maxillary first permanent molars, will react in the opposite way from the intended and desired movement of the impacted maxillary canines. Usually these side effects are not detrimental, particularly when the forces applied to the canines are kept low. When an unusual resistance to movement of canines exists, the molar anchorage needs to be supplemented by including labial

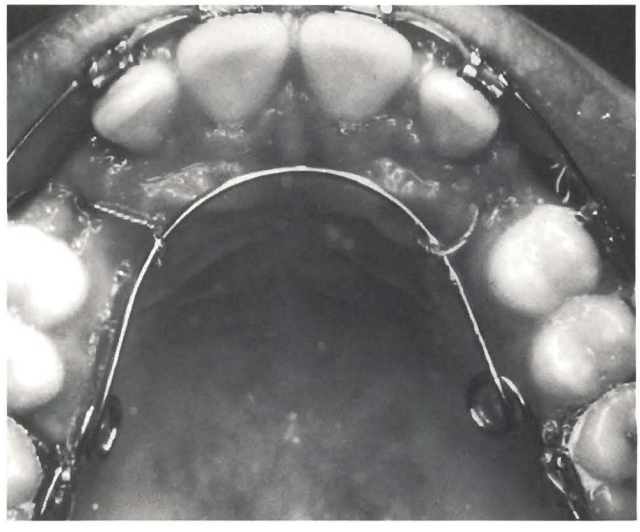
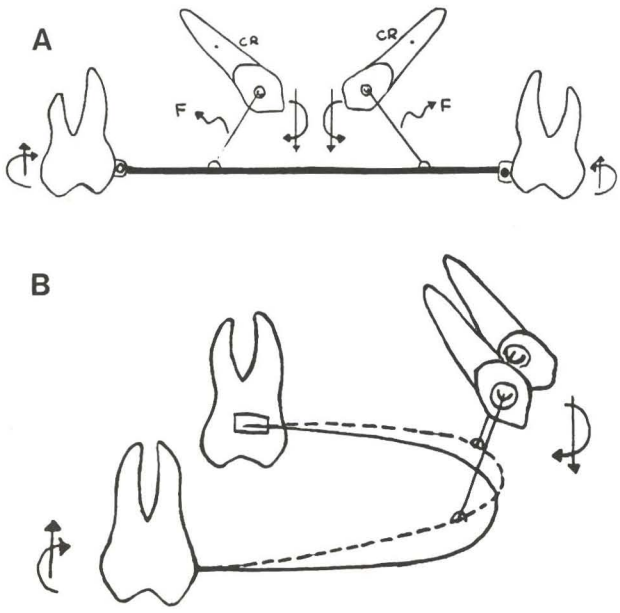


Figure 2. Activated palatal archwire applying force to the impacted canine through the twisted ligature wire.



Figures 3A and 3B. Biomechanical principles involved in using palatal archwire in the treatment of canine impaction.

appliances on additional posterior and occasionally anterior teeth. It should also be noted that the force applied to the canines comes typically from two sources: the activation of the palatal arch and a power chain or thread, tied to an attachment bonded on the tooth. It would be easy to prove that the decrease-to-force rate of the palatal arch has more favorable characteristics than that of an elastic tie. For that reason we advocate the use of a precious metal (usually silver) chain, directly attached to an exposed tooth with the subsequent activations of such a set-up by manipulating the palatal arch, while reducing the number of links in the attached chain (Figures 4A and 4B).

If the impacted tooth does not respond and show some evidence of movement from its original impacted position within six to eight weeks, one needs to reevaluate the condition, trying to determine the reasons for the apparent lack of response. Clearly, a radiographic evaluation is of paramount importance in this respect and thus should be done with the utmost attention to detail. Usually, one can detect small differences in the relative positions of the impacted teeth to adjacent teeth, taking proper care that the radiograms are obtained in a comparable way (orientation, magnification, and angulation) and that the adjacent teeth are not the ones that moved, thereby creating an impression that the impacted tooth moved. In Figures 5A, 5B, and 5C, a case

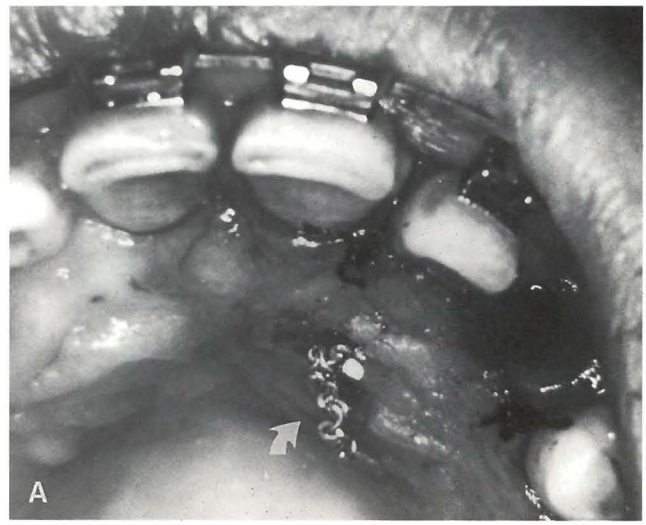


Figure 4A. A section of silver chain attached to the exposed maxillary canine.

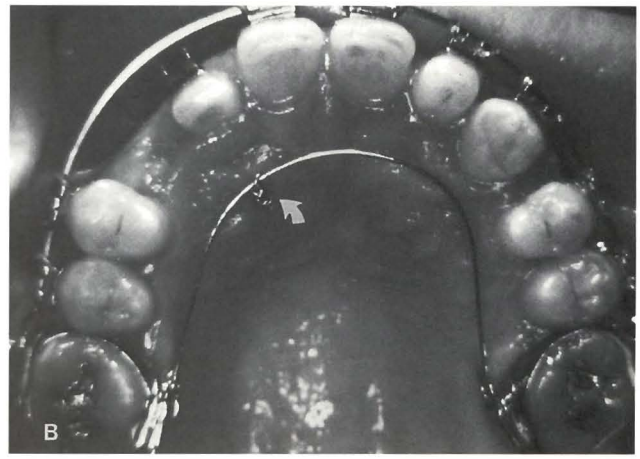


Figure 4B. Chain tied to the activated palatal archwire.

is shown where what appeared to be a routine labial impaction of the maxillary canine, after about five to six months of treatment, failed. Closer radiographic examination indicated a presence of a mesially directed dilaceration of the root's apex. That tooth was extracted (Figure 5C), and the first-premolar-for-canine substitution was undertaken.

SURGICAL APPROACH

Treatment of impacted canines has been advocated for occlusal, functional, and esthetic reasons and because of

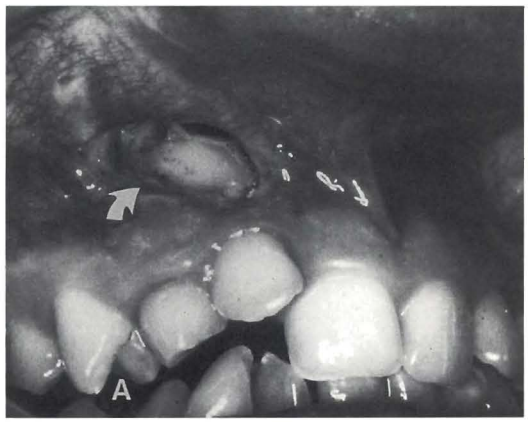


Figure 5A. Exposed maxillary canine, shown before bonding an attachment to it.

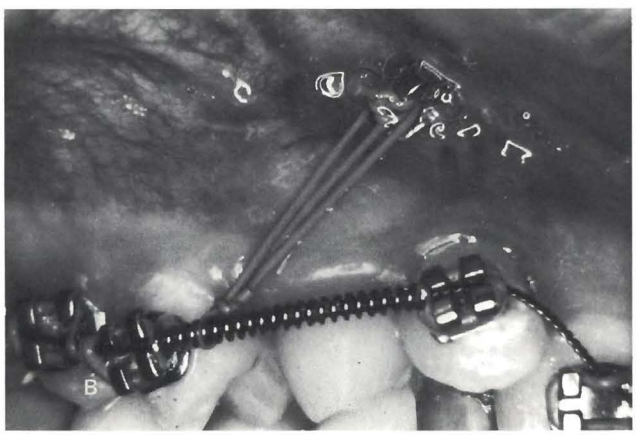


Figure 5B. Mechanics used in attempting to bring the impacted tooth into alignment. A power head is attached between an eyelet on the canine and a labial archwire. Note that no extractions have been made to this point in the treatment.

Figure 5C. After the tooth failed to move, it was extracted. A mesial dilaceration of the root's apex is noted.

Figure 6. Resorption of teeth adjacent to the impacted canine.

the possible harm impacted canines may cause if left untreated. Root resorption of the adjacent teeth (Figure 6), cyst formation, infections, periodontal defects, and referred pain have been reported.[5,6]

Many surgical techniques for the exposure of the impacted canines have been described in the literature over the years. Traditionally, most surgical techniques to make access to impacted teeth involved exposure of the entire crown.[7] Some clinicians have recommended exposure even beyond the limits of the crown.[8] The extent of surgery was dictated by the access needed for the particular ligation technique.

Extensive surgical exposure of the crown was advocated by some, with removal of bone and the dental follicle, followed by channeling the bone to the alveolar process to encourage spontaneous eruption of the tooth, if root development was incomplete.[9] Others used celluloid crown, cast gold cap, guttapercha, surgical, or periodontal packing to force the tooth to erupt with no orthodontic devices or assistance.[10-12]

An extensive surgical procedure was used for the placement of a lasso loop wire ligature around the neck of the tooth, which often required removal of bone beyond the cementoenamel junction. This procedure was reported to cause the most serious damage to the impacted tooth, such as external root resorption, ankylosis, and loss of bone support. The mechanism involved was related to the induced inflammatory processes that bring connective tissue into direct contact with the tooth enamel.[13-16]

A common method for exposing impacted canines was to cement an orthodontic band at the time of surgical exposure. This procedure also required extensive removal of bone around the crown for cementation of a band. With the advent of the direct bonding techniques, there is no longer a need for extensive surgical procedures.

Two basic surgical techniques are widely used for the exposure of palatally impacted canines. A "closed eruption" in which the crown is surgically exposed, an attachment is bonded during the exposure, and the flap sutured back over the crown, leaving a twisted soft ligature wire passing through the mucosa to apply the orthodontic traction (Figures 7A-7D). A direct bonding of the impacted canine at the time of surgery may cause soft tissue injury from the acid etching used in an open wound. Moreover, bleeding control to avoid blood and saliva contamination and maintain a dry field is quite difficult for the successful bonding of an orthodontic attachment, especially when impaction is deep. If during treatment the bond fails to hold, or the twisted ligature wire brakes subgingivally, a second surgical procedure is necessary for exposing and bonding the tooth. In addi-

Figure 7A. The unilateral "closed eruption" technique; surgically exposed and etched canine.

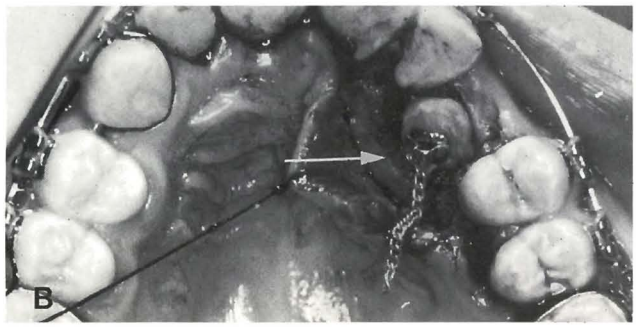


Figure 7B. A bonded eyelet with attached chain.

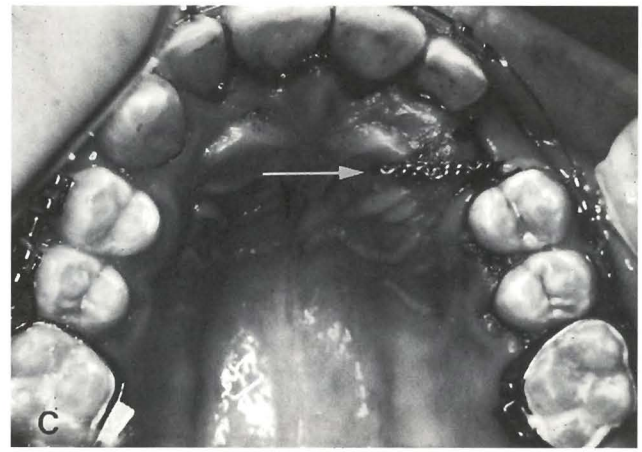


Figure 7C. Chain passing through the mucosa to attach to the palatal archwire.

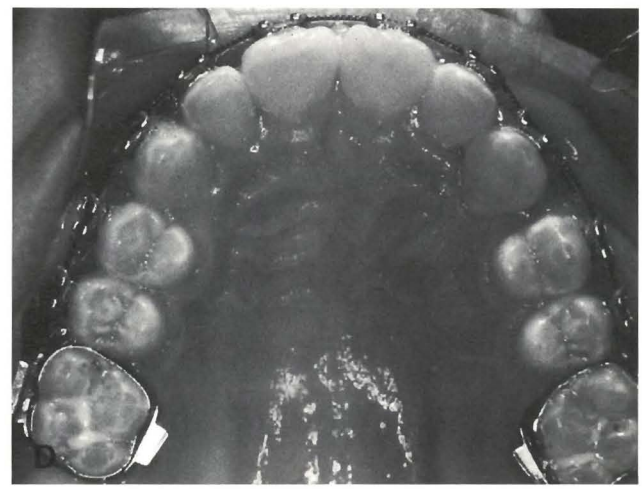


Figure 7D. Canine aligned in the arch.

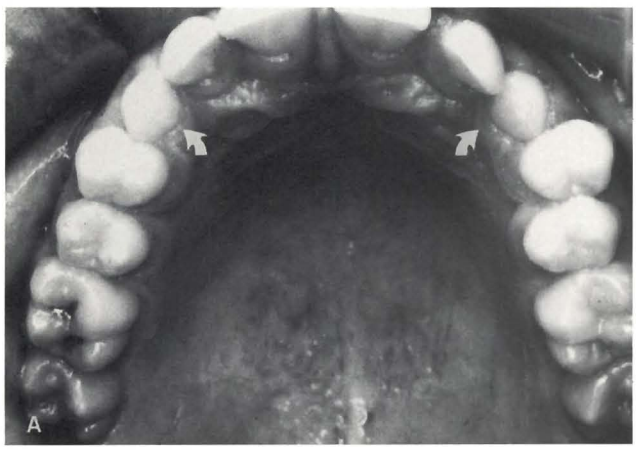


Figure 8A. The bilateral "closed eruption" technique, with the retained primary canines.

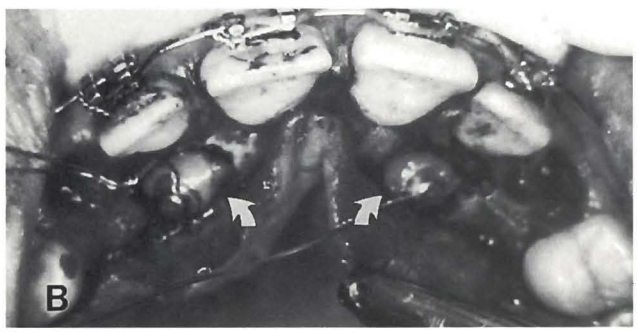


Figure 8B. Surgically exposed canines with bonded attachments following removal of the primary canines.

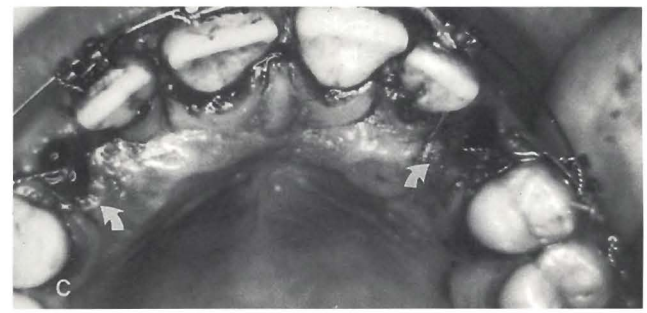


Figure 8C. Flap is sutured over the canines with the twisted ligature wires passing through the mucosa.

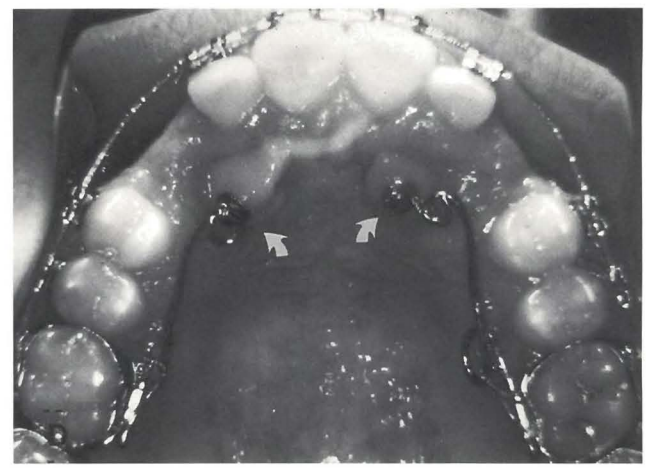


Figure 8D. The activated palatal sectional springs.

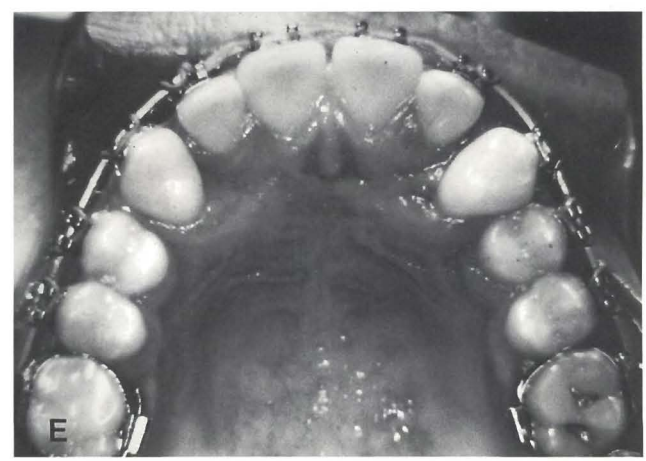


Figure 8E. Canines aligned in the arch.

tion, canine eruption may be delayed as it has to overcome the resistance of a dense and thick soft palatal tissue (Figures 8A-8E).

In the "open window" eruption technique, a flap is raised and a minimal amount of bone is removed, enough to expose the tip of the impacted crown to be bonded. The flap is then returned and sutured with a small "window" cut into the flap of the palatal soft tissue, covering the embedded crown packed with surgical dressing for one week (Figure 9A). This allows for wound healing and epithelialization and prevents growth of tissue over the exposed crown. The major advantage of this technique is that when the pack is removed, a dry field is easily attained for the placement of a small direct bond attachment, and eruption appears to be ac-

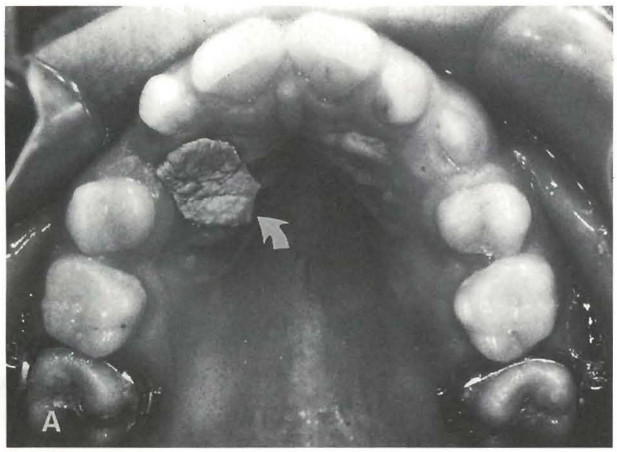


Figure 9A. The "open window" eruption technique showing the surgical dressing.

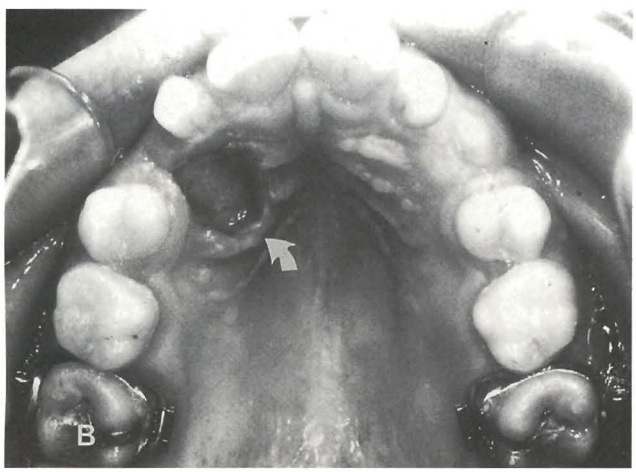


Figure 9B. The exposed canine one week later ready for bonding.

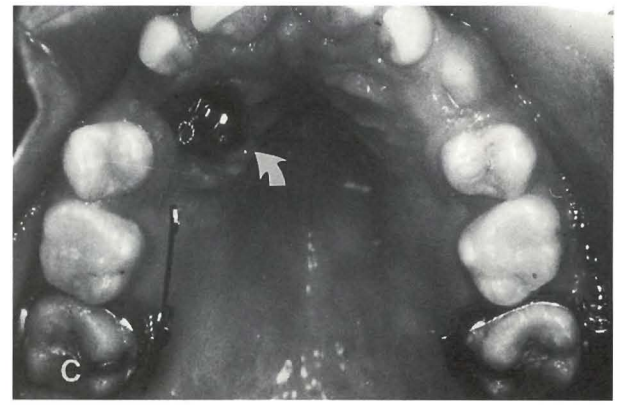


Figure 9C. Bonded attachment with sectional spring not activated yet.

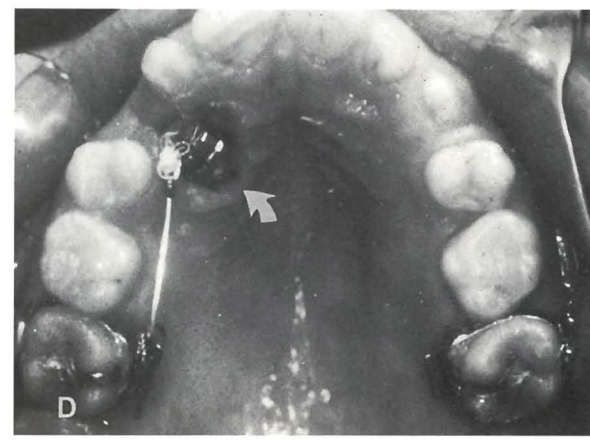


Figure 9D. Spring activated traction force to the canine.

celerated (Figures 9B-9D). No loss of attachment, ankylosis, or root resorption were reported for impacted canines treated with this technique.[14]

When the tip of the canine is located outside the palatal bone presurgically, only 3 to 4 mm of palatal mucosa is sectioned, and no bone has to be removed to gain access for bonding. Frequently after the tooth is mechanically extruded through the palatal soft tissue, a more precise bracket placement is required for final positioning of the tooth in the arch.

Many papers have been published to describe surgical techniques with various modifications of flap design to expose the palatally impacted canines for orthodontic traction. In the flap design frequently used, a sulcular incision along the neck of the teeth is performed, and the mucoperiosteal flap raised included the gingival margins and the lingual aspects of the interdental papillae.

Modified flaps have been suggested where the incision is made 4 to 5 mm away from the free gingival margin to maintain the marginal gingival contour and the interdental papillae upon elevation of the flap without compromising the integrity of the periodontal attachment of the adjacent teeth.[17,18]

Other surgical approaches included autotransplantation of maxillary canines without endodontic therapy; transalveolar transplantation of the impacted maxillary canine, followed by endodontic treatment; and posterior segmental maxillary osteotomy, after removal of the palatally impacted canine, with simultaneous advancement of the posterior segment to close the extraction site.[19-21]

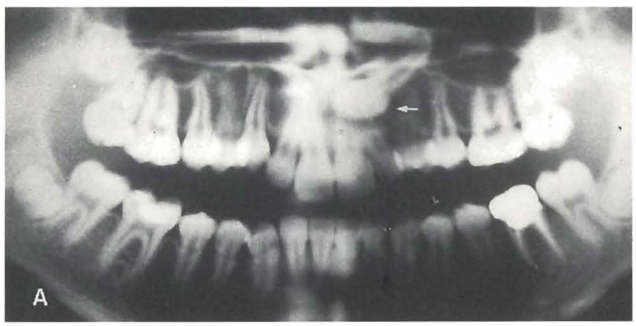


Figure 10A. Panoramic view of the horizontally impacted canine. Note the complete absence of space for the canine.

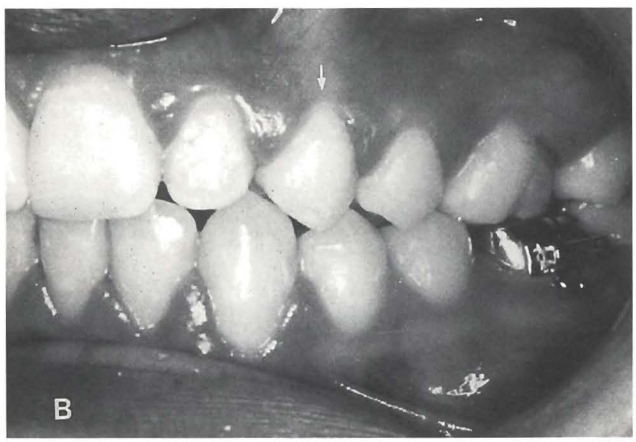


Figure 10B. Canine was surgically extracted and substituted with the first premolar.

Figure 10C. Periapical radiograph after canine removal showing apical root resorption of the lateral incisor caused by the impacted canine. It could not be detected in the panoramic radiograph.

These were presented as an alternative only for selected adult patients unwilling to undergo prolonged orthodontic therapy or prosthesis because of esthetic, social, or financial reasons. The prognosis of these treatments is uncertain or poor because of frequent root resorption and ankylosis.

Ferric and rare-earth magnets, producing a desirable light continuous force, have been advocated as a modern alternative approach to the traditional force-producing gadgets. They are arranged in a configuration that produces a magnetic field, reportedly capable of encouraging eruption of impacted canines.[22]

A magnetic attraction system was recently reported by Vardimon and coworkers, in which a vertical magnet containing bracket is bonded to the impacted canine, while an opposite pole magnet is incorporated in a removable maxillary appliance. It is suggested that this system reduces the treatment time, requires less aggressive surgical procedures and decreases the hazards of bone loss and root resorption.[23]

An alternative of extraction of the impacted canine and substitution of it with the first premolar (which is moved forward) is contraindicated, unless the canine is ankylosed or impacted in a full horizontal or even in an apical direction, or if a large cystic formation exists around the impacted canine crown (Figures 10A-10C).

Alveolar mucosa not capable of withstanding functional stresses of mastication and brushing will frequently deteriorate, resulting in a pocket formation or a gingival recession. The labially impacted maxillary canines are frequently positioned above the mucogingival junction.

In any surgical procedure to expose labially impacted teeth, preservation of the keratinized attached gingiva is a major consideration. The treatment of choice is usually a more conservative technique of an apically positioned flap that includes the keratinized tissue. Two vertical incisions are made on the mesial and distal aspects of the impacted tooth, and a horizontal incision is made in the incisal edge of the impacted tooth that includes at least

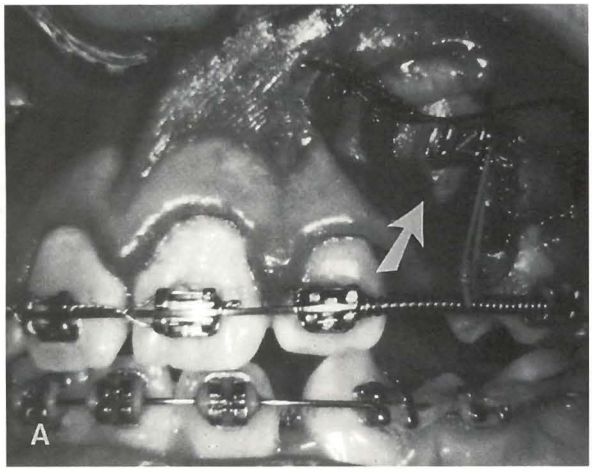


Figure 11A. Apically positioned flap to expose the labially impacted canine.

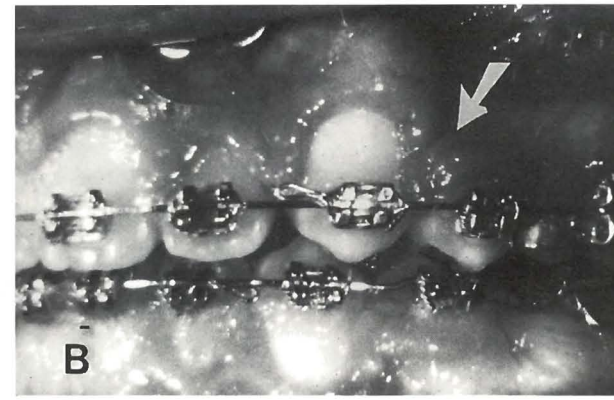


Figure 11B. Keratinized tissue carried down with the eruptive tooth.

3 mm of attached gingiva in the flap. The flap is raised through blunt dissection, sliding it apically and suturing it into position at the cervical line of the impacted tooth. A border of keratinized gingiva will be carried with the erupting tooth to its final position in the arch (Figures 11A, 11B). This will prevent the sequelae of recession and pocket formation often accompanying the lack of attached gingiva.[6, 24-26]

Gingival recession during orthodontic treatment is more likely to occur in patients with no attached gingiva, or as a result of removal of the enamel epithelium during surgery.

Comparing periodontal status following the alignment of palatally and labially impacted maxillary canines, which were surgically exposed and completed orthodontic treatment, shows bone loss in the palatally impacted and loss of attached gingiva in the labially impacted canines.[27-29] Thus, posttreatment, periodontal evaluation was recommended in cases where the integrity of the periodontium was at risk, and treated as necessary.

COMPLICATIONS

Complicating factors that the clinician must be aware of and actively look for because they will modify the treatment plan and strategy include evidence of root resorption of the lateral and central incisors.[30,31] Figure 10C depicts such an occurrence. While most of the time this resorption will prove to be a preexisting condition, it could be iatrogenic and a direct result of our efforts to erupt the impacted teeth. From the practical standpoint, it is very important to inform and alert the patient of the existing resorption, regardless of how it occurred or "who is to blame." An important treatment consideration is to make an attempt to move the impacted tooth away from the resorbing roots if at all possible and practical.

Rare cases of coronary resorption or idiopathic internal resorption of the maxillary impacted canine have also been reported.[32,33]

Ankylosis has been shown to occur in only 2 percent of patients with an impacted canine without having any surgical intervention.[32] Ankylosis cannot be easily observed and diagnosed from two-dimensional periapical or panoramic radiographs. CT is a very useful method for three dimensional diagnosis of impacted canines particularly when they are suspected to be ankylosed.[34,35] CT findings may "save" the failure of a surgical exposure and the lack of response to orthodontic traction of an ankylosed tooth, together with a possible risk to the adjacent teeth.

It has been reported that surgical luxation did not reverse the process of ankylosis once it had occurred.[14,26] Moreover, it has been suggested that the surgical luxation may indeed be the main cause of ankylosis and for that reason should be avoided.

When an impacted canine is diagnosed as ankylosed, its extraction and autotransplantation should be considered the treatment of choice.[36]

Other complications resulting from the surgical procedures and orthodontic techniques also may increase the risk of gingival recession, bone loss and detached gingiva around the treated canine.[14, 37]

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TRANSMUCOSAL FENTANYL CITRATE

The use of safe, non-noxiously administered sedation is a critical dimension of the humane care of children. Toward this end, we have presented data suggesting that oral transmucosal fentanyl citrate can provide rapid onset and safe analgesia and sedation for children undergoing painful procedures. The parents, nurses, and children in this study all reported a significant decrease in pain when compared to a placebo control group. There was a significant incidence of nausea and vomiting which may limit the clinical usefulness of this agent. Clearly, additional investigation of ways to prevent nausea and vomiting is warranted. Use of OTFC or similar agents administered transmucosally may eventually have relevance to other settings such as emergency rooms for laceration repair and fracture reduction but clearly these indications require more formal investigation.

Schechter, N.L. *et al*: The use of transmucosal fentanyl citrate for painful procedures in children. Pediatrics, 95:335-339, March 1995.

Sealant status and factors associated with sealant presence among children in Milwaukee, WI

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The relatively slow rate of adoption of pit and fissure sealants among dentists continues to be a problem in the application of research findings to improve the oral health of the public. The effectiveness of sealants in the prevention of caries in pits and fissures is widely documented.[1-5] Sealants are safe, cost-effective, and easy to apply.[6,7] Studies conducted between 1975 and 1983 reported on the underutilization of sealants by dentists and their reluctance to use this caries-preventive technique.[8,9] More recent evidence has suggested that the use of sealants by the dental profession has increased.[10-16] Frequency of use, however, when reported, remains low.[15,16]

As a result of the slow rate of adoption of sealants, oral health objectives for the year 2,000 specifically target an increase in sealant use: "Increase to at least 50 percent the proportion of children who have received protective sealants on the occlusal (chewing) surfaces of permanent molar teeth."[17]

The most recent national survey on caries prevalence (1986-87) showed that 7.6 percent of schoolchildren in the United States have sealants applied to their permanent molars.[18] Gift and Newman in 1992, reported results from the National Health Interview Survey, which provided information on oral health activities for US children ages two to seventeen years. The results indicated that only 14.5 percent of schoolchildren, ages five to seventeen, had at least one sealant present.[19] Gillcrist *et al* reported findings on the prevalence of dental sealants from the 1988 oral health survey of schoolchildren in Tennessee. The results indicated that only 10 percent of the sample had sealants present.[20] Perceived reasons for this low utilization of sealants from the perspective of the dental profession and insurance companies have been documented, including concern for sealing over caries, retention, and cost-effectiveness.[8,9,12,14-16,21-27]

A survey conducted by the U.S. Department of Commerce reported that the largest and fastest growing ethnic minority group in the U.S. is of Mexican descent.[28] Despite this fact, little information is available on the oral health status of Hispanics in the U.S.A.[29] Ismail *et al*, in a 1982-83 national survey, reported that dental caries in Mexican-American children, ages five to seventeen years, was predominantly a disease of occlusal surfaces.[30] Waldman, in 1990, reported minority children (African-Americans and all others) as having a higher rate of DMFS (Decayed; Missing; Filled Surfaces) and fewer number of dental visits with a smaller percent of the visits for prevention purposes than nonminority children.[31] Gift and Newman reported that Hispanic and

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African-American children, ages five to seventeen years, were less likely to have sealants than Caucasian and non-Hispanic children.[19]

Public information about caries preventive procedures is minimal. Studies have been conducted to determine the sources of information about dental sealants. Dental offices and news media were the most frequent sources mentioned.[32-36]

Kale and Nathanson, in 1987, reported on the knowledge and attitude of parents about pit and fissure sealants and changes in usage and attitude. They compared two surveys conducted during 1983 and 1986 among parents of school-children in the greater Boston area. Results indicated a significant increase in awareness and use of pit and fissure sealants between the two studies.[37]

Selwitz *et al*, in 1992, reported factors associated with the presence of sealants in first and second graders residing in Columbia, SC. Parents of the sealed children and of a random sample of the non-sealed children were interviewed by telephone. Factors associated with presence of sealant included: dentists or staff recommending sealant use, parents being knowledgeable about dental sealants, parents being highly educated, and parents having dental insurance coverage.[36]

The objectives of this study were:

- ☐ To determine sealant presence among schoolchildren ages six to fourteen years, in Milwaukee, WI.
- ☐ To describe factors associated with the presence of sealants among these children.
- ☐ To describe differences, if any, among ethnic majority and minority groups. Of special interest was sealant presence among Hispanic children.

METHODS

Child sample and clinical examination, sealant presence

The first stage of this study consisted of a dental examination of children to record the presence of dental sealants. During the spring of 1994, three trained and calibrated dentists performed dental examinations in children six to fourteen years of age. Since one of the objectives of this study was to find differences, if any, between Caucasian children and minority children, schools were selected based on a high proportion of minority children. Race and ethnicity were defined by respondent's self-perception as indicated in school admission papers and were mutually exclusive variables: for example, a child could be black and Hispanic. Information was obtained through the Milwaukee Public Schools (MPS) Central Administration. Approval to contact schools and principals was given by the MPS superintendent. Twelve schools agreed to participate in this project. Grades included in the survey were fifth to eighth. The number of children who qualified for participation in the study was 6,365. Consent forms were given to each child to take home for their parents to complete. Only children having one or more permanent molars were to be examined.

Portable dental chairs with examination lights were used in each school. Teeth were isolated and dried with cotton rolls. Examiners used gloves, masks, a dental mirror, and a 23 dental explorer per examination. Three undergraduate dental students assisted by recording the information. Every child was examined, using the same protocol. Presence of sealants was recorded, only for permanent molars. Sealant presence was recorded if any part of a dental sealant was visible. If the sealant material was used as part of a restorative technique rather than as a purely preventive procedure, it was not recorded as a sealant.

Survey instrument, parent knowledge and characteristics

The second stage of the study consisted of the collection of information, using a questionnaire. The 15-item questionnaire was designed to measure demographic information of parents and children, date of child's last dental examination, availability of a regular dentist, insurance coverage (Medicaid included), parents' knowledge about sealants, sources of information about sealants, parents' level of education, and the family's total annual income. Due to the large number of Hispanic children and the possibility that many Hispanic parents did not speak English, each questionnaire was double-sided, with English and Spanish versions.

The questionnaire was pretested with ten parents randomly selected from families that came to the pediatric dental clinic at Marquette University for their children's dental care. Revisions were made in accordance with the pretest results. The questionnaire, accompanied by a cover letter (also in English and Spanish), was given to each child after their dental examination. Every child was asked to take the questionnaire home for their parent(s) to complete. The cover letter instructed the parents to respond to the questionnaire either in English or Spanish, and then to give it back to their child to return the questionnaire to the principal's office. A second set of questionnaires was given to nonrespondents

one week later (also via children, at every school). This method of student delivery, instead of mail delivery, as suggested by Dillman, was chosen after it was strongly recommended by the schools' principals.[38]

Returned questionnaires were reviewed, edited, and data were entered into a statistics computer program at Marquette University Computer Center. Data were analyzed using frequencies and Chi-Square tests. A statistical significance was chosen at P-value < 0.05.

Human subjects

Procedures followed were in accordance with Marquette University's human subjects committee and the MPS Central Office.

RESULTS

Response, number of children with sealants and children's demographic characteristics

Of the 6,365 students enrolled in the twelve schools, 1,402 (22.0 percent) consent forms were returned and signed by the parents giving permission for the dental examination. Of these 1,402 children, 1,234 (88.0 percent) were examined. Nonparticipants were absent from school, due either to illness or field trips taken the day of the examination. Of these 1,234 children, 742 questionnaires were returned (60 percent response rate) by parents.

The ethnic breakdown was as follows: Caucasian children = 235 (19 percent); African American children = 304 (24.6 percent); Hispanic children = 625 (50.6 percent); and "other" children including American Indian, Asian and combinations of ethnic backgrounds = 70 (5.6 percent) (N = 1,234). Females accounted for 681 (55.2 percent) children, and males for 553 (44.8 percent) (N = 1,234). The age breakdown of the sample is shown in Table 1.

Of the 1,234 children examined, only 118 (9.6 percent) had at least one dental sealant in their permanent molars. Table 2 shows children's characteristics that were found associated with the presence of sealants. These included: gender (females more likely than males) (P-value = 0.02); ethnicity (Caucasian children more likely than Hispanics, African-American, and "other" children) (P-value = 0.01); and age (children in the older group, 10-14 years, more likely than children in the younger group, 6-9 years) (P-value = 0.00).

Table 1 ☐ Age distribution of children examined (N = 1234).

Age	Frequencies	Percent
6	21	1.7
7	224	18.2
8	228	18.5
9	234	19.0
10	205	16.6
11	154	12.5
12	109	8.8
13	44	3.6
14	15	1.2

Table 2 ☐ Childrens' characteristics associated with sealant presence (P-value < 0.05).

Characteristics	Sealant Presence Yes	No	P-value
Gender (N=1234)			0.02
Female	77(11%)	604(89%)	
Male	41(7%)	512(93%)	
Ethnicity (N=1234)			0.01
Whites	30(13%)	205(87%)	
Hispanics	67(11%)	558(89%)	
Blacks	16(5%)	288(95%)	
Other	5(7%)	65(93%)	
Age (N=1234)			0.00
Younger group (6-9 Yrs.)	48(7%)	659(93%)	
Older group (10-14 Yrs.)	70(13%)	457(87%)	
Time elapsed since last dental exam (n=719)			0.00
Less than 6 months ago	35(18%)	162(82%)	
Six months/1 year	31(15%)	176(85%)	
More than 1 year	14(4%)	301(96%)	
Availability of a regular dentist (n=741)			0.00
Yes	63(13%)	422(87%)	
No	17(7%)	239(93%)	

Children's dental characteristics

When asked about time of child's last dental examination, almost half of respondents (44 percent) reported that more than a year had elapsed since last dental examination. Twenty-nine percent indicated six months to one year, and only twenty-seven percent of the sample had a dental examination in the last six months (n = 719). Over two thirds (65 percent) reported having a dentist who served as a regular source of dental care for their child. Thirty-five percent indicated not having a dentist available for regular dental care (n = 741).

Children with a more recent dental examination (P-value = 0.00), and children with a regular dentist (P-value = 0.00) were more likely to have sealants present (Table 2).

Parents' demographic characteristics

Most respondents (87 percent) were females. Almost half of respondents (48 percent) were married. Twenty-five percent reported that they had never been married, while twenty-seven percent indicated that they had been married and were now either divorced, widowed or separated (n = 728). Forty-three percent of respondents reported an annual total family income of less than $10,000. Twenty-four percent indicated a total annual income of $10,000 to $15,000. Eighteen percent reported a total annual income between $15,000 to $25,000, while only 15 percent earned more than $25,000.

Children of parents with a total annual income of more than $25,000 were more likely to have sealants present (P-value = 0.00) (Table 3).

Table 3 ☐ Parents' characteristics associated with sealant presence (P-value = <0.05).

Characteristics	Sealant Presence Yes	No	P-value
Sealant exposure prior to study (n=739)			0.00
Yes	60(24%)	191(76%)	
No	20(4%)	468(96%)	
Sources of sealant exposure (n=219) (Multiple response item)			0.00
Family, friend	3(7%)	38(93%)	
News media	5(11%)	40(89%)	
Dentist	45(34%)	88(66%)	
Knowledge about purpose of sealants (n=667)			0.00
Incorrect	17(11%)	132(89%)	
Correct	54(20%)	222(80%)	
Do not know	7(3%)	235(97%)	
Parents' level of education (n=694)			0.00
Eighth grade or less	11(7%)	152(93%)	
Some high school	10(6%)	167(94%)	
High school graduate	19(11%)	155(89%)	
Some technical school	18(21%)	68(79%)	
Higher education	19(20%)	75(80%)	
Parents' total annual income (n=681)			0.00
Less than $10,000	17(6%)	276(94%)	
$10,000 to $15,000	18(11%)	144(89%)	
$15,000 to $25,000	15(12%)	109(88%)	
More than $25,000	26(25%)	76(75%)	

Parents' exposure, sources of information and knowledge about sealants

When participants were asked whether they had heard, seen or read about dental sealants before this study, only 34 percent indicated previous information. Sixty-six percent reported no previous exposure to sealants (n = 739). Parental responses to a multiple-choice question asking where they heard, saw, or read about dental sealants were also collected.

Table 3 shows the results for sources of information about sealants. Dentists were the most common source of information, with half of responses (53 percent). The news media category was second, with 18 percent of responses. Family, friends or neighbors were third, with 15 percent of responses. Physicians (7 percent), school programs (5 percent), and health departments (2 percent) accounted for the remaining sources of information about sealants (n = 282).

In regard to knowledge about the purpose of sealants, the results indicated that 41 percent of respondents were correct in answering this question. Twenty-two percent were incorrect, and 36 percent did not know (n = 667).

Parental knowledge and information variables found associated with presence of dental sealants were: parents having been exposed to dental sealants before this survey (P-value = 0.00), dentist recommending sealant use (P-value = 0.00), and parents being knowledgeable about the purpose of sealants (P-value = 0.00) (Table 3).

Parents' level of education

Twenty-three percent of parents reported having an eighth grade or less level of education. Twenty-six percent reported some high school education. Twenty-five percent graduated from high school. Only 12 percent had either some technical school experience or were actually technical school graduates, while 13 percent reported having a higher degree of education, i.e. college graduate or an advanced degree (n = 694).

Children of parents who had advanced their education beyond a high school level were more likely to have sealants than children of parents with a lower level of achieved education (P-value = 0.00) (Table 3).

Insurance coverage

Seventy-three percent of respondents indicated that their children were covered by dental insurance while 27 percent reported their children were not covered by dental insurance (n = 717).

No significant difference was found in the percent of children with sealants for the insured group (10.5 percent) when compared to the percent of children sealed in the noninsured group (12.4 percent).

DISCUSSION

With regard to the percent of schoolchildren with sealants, the results of this study (9.6 percent) are similar to those reported by others.[20,32] For example, the 1988 Oral Health Survey in Tennessee found only 10 percent of schoolchildren with sealants present in their permanent teeth, while Lang *et al* reported that only 6.4 percent of schoolchildren in southwestern Michigan had sealants in their permanent teeth.[32]

This study cannot be directly compared to the 1986-87 National Institute of Dental Research NIDR survey, the 1989 NHIS by Gift and Newman, and the Columbia, SC survey by Selwitz *et al*, because of differences in design (sealant presence recorded in primary and permanent teeth, as opposed to "only in permanent teeth," as in this study).[18,19,36] It is interesting that only 7.6 percent of schoolchildren in the NIDR study, 14.5 percent of children in the NHIS, 7.9 percent of schoolchildren in Columbia SC, and 9.6 percent of schoolchildren in our study had at least one sealant present.

Females were more likely than males to have sealants, although the difference was not large. This result is similar to the 1986-87 NIDR survey.[18]

One of the main objectives of the study was to observe differences, if any, among ethnic minority and majority groups. In this survey, Hispanics, African-Americans and "other" children were less likely to have sealants placed on their teeth than Caucasian children. Although the difference between Caucasian and Hispanic children was not large, the trend still existed. The same trend was observed in the 1989 NHIS where Caucasian and non-Hispanic children were more likely to have dental sealants than Hispanic children.[19] This becomes an even greater problem, if we consider that a decrease in the number of Caucasian children and an increase in the number of Hispanic, "other" races, and African-American children have been projected.[39] This change in population demographics will affect the dental profession and make the provision of dental services to Hispanic children an important part of pediatric dental practices and dental public health programs that target minority child populations.[40]

The finding that children in the older age-group (10 years of age to 14 years of age) were more likely to have dental sealants than children in the younger age-group (6 years of age to 9 years of age) is similar to previous reports.[19,20] Gift and Newman reported that only 10 percent of children 5 years of age to 8 years of age had at least one dental sealant, while 18 percent of those 9 years of age to 11 years of age, 15 percent of those 12 years of age to 14 years of age, and 15 percent of those 15 years of age to 17 years of age had dental sealants.[19] Also, in the 1988 Tennessee survey, children in the older age-group (9 years of age to 17 years of age) were more likely to have sealants than children in the younger age-group (6 years of age to 9 years of age).[20]

In this study, children with a more recent dental examination were more likely to have sealants applied to their permanent molars. A similar result was reported by Gift and Newman in 1992, where children with more dental visits in the previous twelve months were more likely to have sealants than their counterparts.[19]

Having a regular source of dental care was also positively associated with sealant presence. This result is similar to findings reported by Selwitz *et al* in 1992, where sealant presence was directly related to dental visit patterns.[36]

Previous exposure to sealant information proved to be an important factor for presence of sealants in our study. Parents were more likely to obtain dental sealants for their children, if they had been exposed to sealant information before this study. Dental offices and news-media were the most frequent sources of information about sealants in our survey. This result is similar to findings reported by others.[32-35] The way the news-media presents information to the public, however, can have either a positive or a negative influence in the way the public perceives the usefulness of any technique, in this case, dental sealants. For example Selwitz *et al* reported that parents were less likely to obtain dental sealants for their children, if they heard about them from the mass media.[36] The authors suggested that this finding was due to conflicting or negative opinions expressed by some dental practitioners through mass media news reports. Individual's perception then becomes an important factor in regards to media presentations.

Public knowledge, or lack of, about the purpose of dental sealants is another factor that has been associated with the presence or absence of sealants. Results from our study show that parental knowledge about dental sealants is limited. This finding is consistent with results from previous studies.[32-34,36] Even though the newsmedia have been frequently cited as a source of information about sealants, communication channels, specifically television, could have an even greater influence in informing and educating the public with regards to the benefits of sealants, because of the large audience that uses this communication tool.

In general, level of education, income, and insurance coverage are closely related factors. For example, someone with a higher degree of education is more likely to

have access to insurance coverage. These three factors also have been studied in relation to presence of sealants. Findings from previous studies report that parents with a higher level of education, higher income, and dental insurance coverage are more likely to obtain sealants for their children than their counterparts.[32,36] In regard to level of education and income, and their positive relationship to sealant presence, the results from our study are consistent with previous findings.[32,36] In our study, dental insurance coverage was not an important factor, however, in relation to sealant presence. Of the 524 respondents (73 percent) covered by insurance, the majority (87 percent) are in Medicaid or HMO groups. The authors suggest that the lack of difference in sealant presence between the insured group and the noninsured group may be that children under Medicaid or HMO groups are experiencing a problem of access to dental offices, and consequently, to preventive dental care, such as the application of dental sealants.

While this study deals only with sealant status of children in the City of Milwaukee, it appears that a greater effort is needed, if the oral health objectives of *Healthy People 2,000* are to be achieved.

Specifically, this research points out the need to measure progress toward the year 2,000 sealant objectives in minority populations.

In conclusion, the percent of school-children with sealants in their permanent molars in the City of Milwaukee is low (9.6 percent). Efforts are needed to increase the knowledge of the benefits of sealants by the general public, as well as to promote sealant use by dentists in both private practice and public health programs, especially for minority children.

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NICOTINE ADDICTION IN YOUNG PEOPLE

Although the epidemic of disease and death from smoking is played out in adulthood, it begins in childhood. Every day another 3000 young people become regular smokers. A person who has not started smoking as a teenager is unlikely ever to become a smoker. The tobacco industry has argued that the decision to smoke and to continue smoking is a free choice made by an adult, but nicotine addiction is really a condition that takes hold in young people.

Ask a smoker when he or she began to smoke, and chances are you will hear the tale of a child. The image of children sneaking away to experiment with tobacco is a familiar one, and people often consider smoking a rite of passage. But many young people progress steadily from experimentation to regular use, with addiction taking hold within a few years, making the image more disconcerting. Between one third and one half of adolescents who try smoking even just a few cigarettes soon become regular smokers.

With some 40 million smokers in this country addicted to nicotine, a ban on tobacco is not feasible. Abrupt removal of these products from the market could lead to serious adverse effects on those addicted to nicotine and possibly result in a black market as well. A more reasonable approach is to focus on the problem of smoking where it begins—in young people. A comprehensive and effective policy is needed to prevent future generations of young people from becoming addicted to nicotine in tobacco. Such an approach should have three objectives: to reduce access to tobacco products by children and teenagers; to convince young people that nicotine is addictive and that tobacco products pose serious health hazards for them, not just for other people; and to reduce the powerful imagery in tobacco advertising and promotion that encourages young people to begin using tobacco products.

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Partial pulpotomy: Another treatment option for cariously exposed permanent molars

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Despite modern advances in dental caries prevention and an increased understanding of the importance of maintaining the natural dentition, many teeth are still lost prematurely, leading to malocclusion and other problems. The primary objective of pulp treatment is to maintain the integrity and health of the oral tissues.[1] The most important and difficult aspect of pulp therapy is determining the health of the pulp, or its stage of inflammation, so that a decision can be made regarding the best form of treatment.

Young permanent teeth are good candidates for many pulp healing procedures (conservative treatments), due to their rich blood supply, which is believed to enhance the pulp's ability to react successfully to various insults.[2]

Several types of conservative pulp treatment have been recommended for young permanent teeth, including protective base or liner, indirect pulp treatment, direct pulp capping and pulpotomy (cervical). More recently, partial pulpotomy or pulp curettage, indicated mainly for handling traumatized incisors with pulp exposure, has been recommended as an alternative treatment for cariously exposed molars.[3-5]

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The objectives of this paper were to present a review of the indications for the several conservative treatments; to present a description of the procedure for accomplishing a partial pulpotomy in young permanent molars; and to present a report of a case in which a tooth was treated successfully by partial pulpotomy.

CONSERVATIVE TREATMENTS

Protective base or liner

A protective base or liner is a material that is placed over the pulpal and axial walls of a cavity preparation to act as a barrier between the restorative material and the tooth. Pashley and Pashley stated that "if dentin was impermeable, there would be less endodontic therapy and dental treatment would be less arduous".[6] Dentin is permeable, however, and allows movement of materials from the oral cavity to the pulp and vice-versa. Continuous marginal leakage with secondary recurrent caries is probably the most common cause of pulpal degeneration under restorations.

Pulpal irritation associated with microleakage is often related to dentinal permeability. In deep cavities the dentin covering the pulp is thin, the tubules are wider in diameter, and packed closer together. This dentin is extremely permeable and cannot be considered a barrier. It should, therefore, be covered with a material that seals dentin well.

Indirect pulp treatment

This treatment is recommended for teeth that have deep carious lesions, approximating the pulp, but without signs or symptoms of pulpal degeneration. In this procedure, the deepest layer of remaining carious dentin is covered with a biocompatible material to prevent pulp exposure and additional trauma to the tooth. Calcium hydroxide paste and zinc oxide-eugenol paste are two materials most commonly used in this treatment.[7] The rationale for indirect pulp treatment is that few viable bacteria remain in the deeper dentinal layers and after the cavity is sealed properly, they will be inactivated.

There is still no conclusive way of determining whether one is dealing with an infected carious lesion, or a bacteria-free demineralized zone. The decision, therefore, must be made by the clinician, who should be guided by the quality of the dentin: Soft, mushy dentin should be removed; hard discolored dentin can be indirectly capped. The ultimate objective is to maintain pulp vitality by arresting the carious process, promoting dentinal sclerosis (reducing permeability), stimulating the formation of tertiary dentin, and remineralizing the carious dentin.[8]

Direct pulp capping

Direct pulp capping is indicated when a healthy pulp has been inadvertently exposed during an operative procedure. This treatment also can be used for small carious exposures in young permanent teeth. The tooth has to be asymptomatic, and the exposure site must be pinpoint in diameter and free of oral contaminants. A calcium hydroxide preparation is placed over the exposure site to stimulate dentin formation and thus "heal" the wound and maintain the vitality of the pulp.[9] Langeland *et al* claim that an unbroken dentinal bridge can only be demonstrated with careful serial sectioning throughout the perforation area.[10] What appears to be an acceptable bridge on a radiograph will usually turn out to be perforated or doughnut-like histologically. A pulp under such a bridge can become infected by bacterial penetration, emphasizing the importance of a leakage-free restoration.

Cervical Pulpotomy

Cervical pulpotomy, also referred to as apexogenesis, is indicated for iatrogenic or carious exposures larger than 1 mm in diameter, in asymptomatic teeth. It implies removing infected and inflamed coronal pulp tissue at the level of the entrance of the root canals and has been used in exposed carious or traumatized teeth with incomplete root formation.

This procedure was recommended to be followed by root canal treatment, because of a concern that pulp obliteration, frequently observed after cervical pulpotomy, would make endodontic procedures difficult.[11]

Partial Pulpotomy

Partial pulpotomy, also referred to as pulp curettage, is a conservative treatment modality in which only superficial pulp tissue is removed at the exposure site. This technique was suggested by Massler in 1959, but practitioners were reluctant to use it.[12] Today, partial pulpotomy is indicated for treatment of pulp exposures in permanent incisors with fractured crowns.13 This indication is based on the histologic appearance of the exposed pulps, where penetration of microorganisms and inflammatory reactions are limited to a superficial area, even as long as a week following the exposure.[14,15] The hypothesis that, by extrapolation, partial pulpotomy may also be applied successfully as a treatment modality in cases of cariously exposed pulps in young permanent molars has been raised.[3-5,16]

Mass and Zilberman recommend partial pulpotomy for treating cariously exposed young permanent molars that fulfill the following criteria:

- ☐ No/or recent pain complaint of short duration that subsided with analgesics.
- ☐ No reaction to percussion, no vestibular swelling and no mobility.
- ☐ No internal or external resorption and no pathological changes in PDL or surrounding bone in the radiographic examination.
- ☐ Pulp exposure during caries removal not exceeding 1-2 mm in diameter, with bleeding that stopped within 1-2 min.[3]

Clinical and radiographic success of partial pulpotomy has been reported by several investigators.[3-5,16] This technique may also be applied in cariously exposed mature permanent molars (with closed apices), since a complete endodontic treatment in young permanent molars prevents the physiologic apposition of dentin, leaving the tooth fragile and prone to fractures.

TREATMENT PROCEDURE

A typical example of partial pulpotomy in a seven-year-nine-month-old girl is demonstrated. After local anesthesia was achieved and a rubber dam was placed, the

Figure 1: Periapical radiograph of a mandibular right first permanent molar immediately after being treated by partial pulpotomy.

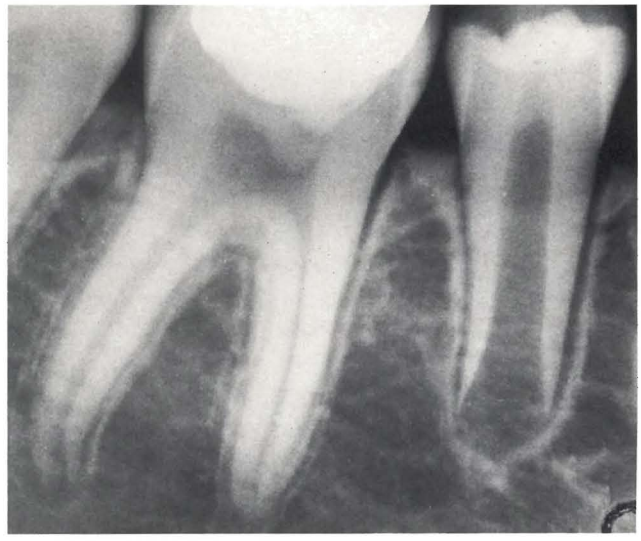

Figure 2: The same tooth after forty-one months follow-up. Notice the dentinal bridge formation, physiological apexogenesis and narrowing of the pulp chamber and root canals.

caries was removed from a mandibular right first permanent molar; the pulp was exposed at the site of the mesial horn. The exposed pulp tissue was removed with a high speed abrasive diamond bur under a rich water spray to a depth of approximately 2-3 mm. The excised pulp was irrigated with saline until bleeding stopped. A calcium hydroxide paste (Calxyl™-Otto & Co., Dirmstein, Germany) was placed gently over the wound, covered by quick setting zinc oxide eugenol paste (IRM™ - The LD Caulk Co. Milford, DE). The remaining dentin was covered with a quick setting calcium hydroxide base (Dycal™ -Caulk Dentsply Ltd., Weybridge, Surrey, England) and the tooth was restored with amalgam.

A radiographic follow-up of the treated tooth is shown in Figures 1 and 2, forty-one months after treatment. The successful outcome of the treatment can be observed by the presence of the dentinal bridge, the physiological apexogenesis and narrowing of the pulp chamber and canals.

DISCUSSION

A cariously exposed pulp, specially in asymptomatic teeth, often shows, histologically, a microabscess beneath the penetrating caries. Evidence of continued defense efforts, however, against the decalcifying process and bacterial aggression were noticed underneath.[17] Thus, Baume and Holz claim that direct pulp capping with calcium hydroxide, in cases of pulp exposure as a result of penetrating caries, is contraindicated.[18] In contrast to direct pulp capping, the superficially infected and inflamed parts of the pulp are surgically removed in partial pulpotomy. Tronstad and Mjor have shown that calcium hydroxide, the most appropriate and commonly used pulp dressing, has no beneficial effect on inflamed pulps.[19] A calcium hydroxide paste, which accelerates the deposition of a dentinal bridge and maintains antibacterial properties, is the preferred pulp capping agent.[20] Pure calcium hydroxide powder mixed with sterile isotonic solution, or a commercial preparation may also be used as an immediate pulp dressing. In partial pulpotomy, a thick layer of therapeutic paste is in direct contact with a healthier pulp tissue and the sealing against offending bacterial invasion is enhanced.

Another element that determines the outcome of a conservative pulp treatment is the surgical technique used. Cutting the pulp tissue, using a high speed diamond or tungsten bur, has been shown to cause minimal injury to the underlying tissue.[21]

Preventing bacterial contamination during treatment by avoiding exposure to saliva, or after treatment by preventing microleakage at the tooth/restoration interface, improves treatment prognosis.

The success demonstrated in various clinical studies justifies recommending partial pulpotomy as a treatment option for asymptomatic, cariously exposed, young permanent molars.

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ALKALINE PHOSPHATASE ACTIVITY AND CEMENTUM FORMATION

Alkaline phosphatase (ALP) is a glycoprotein thought to be involved in processes leading to mineral formation in tissues like bone and cementum. In the rat molar periodontium, several regions are associated with the formation of cementum (periodontal ligament, inner part of the gingiva), whereas other areas are not (*e.g.*, the outer part of the gingiva just beneath the outer oral epithelium). In an attempt to establish how the spatial distribution of ALP activity relates to cementum formation, we assessed the activity of the enzyme quantitatively in the periodontium of the rat maxillary molars, by using the indoxyl-tetrazolium salt method. It appeared that the distribution of enzyme activity in the ligament was heterogeneous, indicating local variations in the phosphate household. Highest activity was found in areas related to mineralization, adjacent to the alveolar bone and cementum. Enzyme activity was higher adjacent to cellular cementum than to acellular cementum. With respect to acellular cementum, a highly significant positive correlation was found between ALP activity and cementum thickness, which indicates a close relationship between local phosphate production and cementum formation rate. An interesting observation in the connective tissue of the gingiva mesial to the first molar was a sharp demarcation between an ALP-positive inner part, adjacent to the tooth, and an ALP-negative outer part, underneath the outer oral epithelium. In the interdental gingiva, the entire connective tissue proved positive for the enzyme, suggesting that this region consists of the combined inner gingival parts of two adjacent teeth.

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Toothbrushing ability is related to age in children

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Dental plaque has been demonstrated to increase the risk of dental caries and periodontal inflammation.[1-5] Toothbrushing has been advocated to reduce plaque accumulation on the surfaces of the dentition. Removal of plaque by toothbrushing is dependent on coordinated muscular movements, innate skills, and the ability to understand instruction.[6]

Various designs of toothbrushes and toothbrushing durations have been recommended to enhance the mechanical removal of dental plaque.[3,7]

Van der Weijden *et al* suggested that electric rather than manual toothbrushes may be more effective in plaque removal.[3] Kimmelman and Tassman suggested that the number and type of bristle affect the cleaning efficiency of the brush. Pinkham stated the duration of brushing did not increase cleaning effectiveness in children.[1] Hawkins and Honkala *et al*, on the other hand, determined that duration positively made an impact on toothbrushing effectiveness in teens and adults.[1,2,8]

Toothbrushing is considered effective when plaque accumulations are found on 10 percent or less of available tooth surfaces.[11] Toothbrushing effectiveness has been related to psychomotor skills and hand-function ability.[9,10] Few studies, however, have been undertaken to assess the age at which children acquire the ability to engage in effective toothbrushing. The purpose of the present investigation was to determine whether or not age could be a predictor of the level of toothbrushing ability in children.

METHODS AND MATERIALS

Twelve adult college students and 210 children from four city elementary schools were asked to enroll in the study. All students with signed consent/assent forms were permitted to participate. The adults served as the control population, seven were female and five were male. Of the 210 children, 122 were selected; fifty-eight were males and sixty-four, females. The selected children ranged from age six to age eleven (Table 1). The remaining ninety-eight children were excluded from the study for one or more of the following reasons: Neuromuscular, hearing, sight, or mental impairment; visible carious lesions; missing or exfoliating teeth; or orthodontic appliances.

Each participant was presented to a pediatric dentist and dental hygienist in random order. Each participant was given a No. 211 Butler toothbrush™ and received oral hygiene instruction in the horizontal scrub technique by the same dental hygienist. The maxillary quadrant opposite the participant's brushing hand was selected for study in order to minimize lingual interfer-

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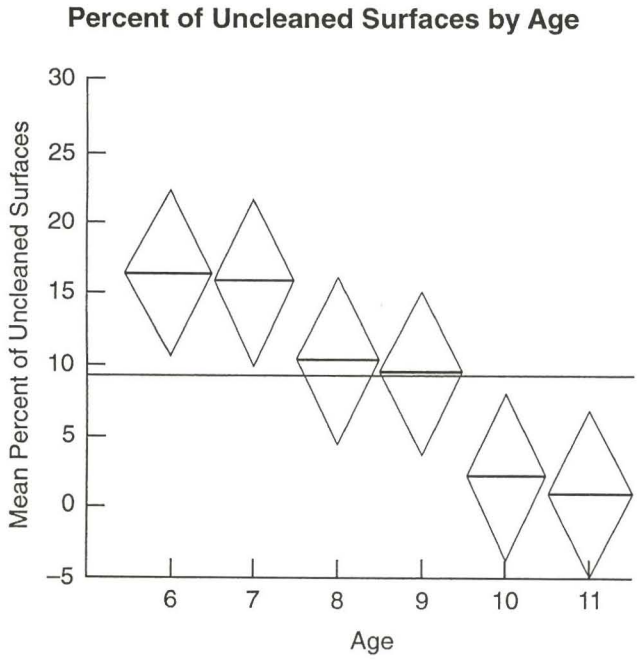

Figure 1. Superior and inferior points of diamonds signify upper and lower limits for a 95 percent confidence interval for the mean percentage of unbrushed surfaces at each age.

Table 1 ☐ Mean percentages of unbrushed tooth surfaces.

Age	Subjects	Percentages
6	21	16.4683
7	18	15.9722
8	19	10.5263
9	20	9.5833
10	21	2.1825
11	23	0.9058

Table 2 ☐ Mean percentages of unbrushed tooth surfaces.

	Buccal	Lingual
Male and female	3.34657	6.07188
Male	3.72798	6.09165
Female	2.94516	6.05211

ence. The quadrant studied consisted of six teeth in the primary, mixed, or permanent dentition stage.

Plaque was removed from this quadrant by the dentist before the participant brushed his teeth. The adjacent buccal and palatal tissues were dried. A consistent mixture of a commercially available disclosing solution and pumice (one milliliter of pumice to six drops of erythrosine dye) was applied to the quadrant's dentition. The participants were provided a mirror, and offered an incentive for removing the mixture from their teeth. Without their knowledge children and adults alike were allotted thirty seconds to remove the mixture from the dentition by toothbrushing.

All unbrushed primary and permanent teeth in the quadrant were recorded. Unbrushed was classified as a lingual or buccal surface from which the mixture was not completely removed by brushing.

The data were analyzed using an analysis of variance (ANOVA). When the ANOVA was significant, a follow-up Fisher's Significant Difference test was used to determine which age-groups were statistically different.

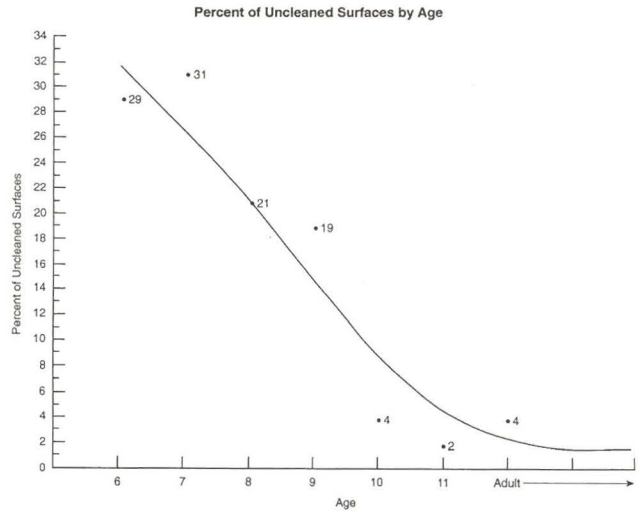

Figure 2. Total percentage of uncleaned buccal and lingual tooth surfaces by age.

RESULTS

The children were divided into six groups by chronologic age (Table 1). An analysis of variance comparing the means of the six age-groups indicated a statistical difference in the means at a P-value of 0.0031. A follow-up Fisher's Significance Difference test determined this difference to be significant only when comparing the scores of the eleven-year-old children to the means of the six, seven, eight, and nine-year-old groups. The brushing ability of the eleven-year-olds, however, did not differ significantly (alpha at 0.05) from that of the ten-year-olds (Figure 1).

Figure 2 shows an age-related trend in toothbrushing ability. As expected, this ability improved with increasing age and by ten years of age approached that of adults. Approximately 4 percent of the tooth surfaces remained unbrushed in the ten-year-olds and the adults.

Brushing ability for males and females appears to be similar (Table 2). The mean percentage of unbrushed tooth surfaces was not found to be significant for males versus females, at the 0.05 alpha level.

Buccal surfaces were left unbrushed almost twice as often as lingual surfaces (Table 2). The mean unbrushed buccal surfaces were 3.33657 versus 6.07188 for unbrushed lingual surfaces, significant at 0.05 alpha level.

DISCUSSION

The intent of the present investigation was not to evaluate plaque removal, but to determine toothbrushing ability according to age. Toothbrushing ability is defined as achieving a level of manual dexterity to manipulate a toothbrush, employ a toothbrushing technique, and brush a buccal or lingual surface in its entirety. The horizontal scrub technique, education, and incentives were incorporated into the study as they standardized and

positively affected children's brushing ability.[8,14]

Few studies have attempted to relate chronologic age and toothbrushing skills. Pinkham, with the aid of nine dental assistants and thirty-four dental hygiene students, was one of the first investigators to explore age and its possible relationship to oral hygiene.[1] The study utilized the Greene Vermillion OHI-S recording technique for smooth surfaces. No statistically significant difference between age and mean oral hygiene effectiveness before and after toothbrushing was found. Also, time spent brushing had little effect on degree of cleanliness.

Others have suggested that the duration of the toothbrushing exercise affects the child's ability to remove plaque effectively.[2,3,8] Van der Weijden *et al* and O'Leary *et al* recommended brushing a minimum of thirty seconds per quadrant to remove about 90 percent of dental plaque in adults.[3,11] Removing at least 90 percent of the plaque is considered a clinically acceptable goal.[2,11] Standardizing the brushing time allowed children of different ages to be evaluated, while employing the same brushing method.

The brushing method utilized was the horizontal scrub technique as described by Sangness.[13] The horizontal scrub has been suggested as the most effective means of physically removing plaque in children.[4,5,12-14]

Previous studies have concluded that oral hygiene instruction, before children brush is not by itself a particularly strong predictor of future oral hygiene effectiveness or ability.[12] Innate brushing ability, visual motor and hand function skills may be predictive of toothbrushing skills.[6,8,10] The present investigation suggests that chronologic age is a reasonable predictor of toothbrushing ability. The percentage of unbrushed tooth surfaces in our study population declined from 29 percent in six-year-olds to less than 2 percent in eleven-year-olds (Figure 2); and the mean scores for unbrushed surfaces declined by a factor of 16 as age increased from six to eleven years (Table 1, Figure 1).

Of significance is the age at which the toothbrushing of a child can compare favorably with the adult population, i.e. 90 percent of tooth surfaces are brushed completely. Figure 2 illustrates that ten- and eleven-year-olds are similar in toothbrushing ability to adults. The eleven-year-old group had an *unbrushed surface* mean of 0.9058 percent, which is significantly different from the six, seven, eight, nine-year-old means, but not from the ten-year-old mean (Figure 1, Table 1).

Our results are similar to those of Mescher, who found that eleven-year-olds were capable of brushing their teeth effectively.[10] Apparently, children begin to attain a toothbrushing ability similar to that of adults, at ten years of age.

Differences in toothbrushing skills by gender were not significant in our investigation. Significant differences did exist, however, between buccal and lingual surfaces. In fact, almost twice as many lingual as buccal surfaces were left unbrushed (Table 2). This is consistent with Korins *et al*, who reported that buccal surfaces were cleaned more than lingual surfaces and that gender differences were not apparent.[4]

Children younger than six years of age were not addressed in the study. Pinkham and Simmons *et al* suggested that young children (younger than four years) did not comprehend the language necessary for effective toothbrushing.[1,6] McClure stated that three-to-five-year-old children were completely unable to wield the toothbrush.[12] Apparently language required to understand toothbrushing may be acquired at the entry into elementary education. Manual toothbrushing skills are acquired approximately four to five years afterward.

Parents should be advised to monitor, as well as actively participate in, their children's oral hygiene program. Parental monitoring should be particularly vigilant during periods when the child undergoes orthodontic treatment, especially if the child is younger than ten years of age. Children often require orthodontic care before acquiring adequate toothbrushing skills. Children with inadequate manual dexterity may be required, therefore, to seek professional dental care more than twice per year.

CONCLUSION

Chronologic age is a reasonable predictor of toothbrushing ability. Children younger than ten years of age may not have the physical dexterity required for toothbrushing. Children's toothbrushing skills approach those of adults by ten years of age. Buccal surfaces are brushed more often than lingual surfaces. There appears to be no difference in brushing ability between males and females.

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Incidence of dental caries in children with acute lymphoblastic leukemia is related to the therapy used

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The prognosis of childhood leukemia has improved considerably during recent years. Infection may be a serious complication, however, during treatment.[1] Life-threatening infections of dental origin are possible, as described by Marques and Walker.[2] Children with cancer who have dental caries may be at higher risk of serious infection than children with healthy teeth.

There are a few reports concerning childhood cancer and dental caries. On long-term evaluation after chemotherapy, Purdell-Lewis and co-workers found that children who had received chemotherapy had more filled or diseased permanent teeth than a control group, derived from national data.[3] Nunn *et al* could not show, however, any significant difference in the incidence of dental caries between children in remission and their siblings.[4] Our studies have shown that children with cancer have more dental caries during treatment than age-and-sex-matched controls.[5]

The aim of the present study is to compare dental caries scores in children who had been treated for acute lymphoblastic leukemia (ALL) with those of healthy controls, and to compare the risk for dental caries in patients with chemotherapy, patients with chemotherapy and central nervous system (CNS) irradiation, and patients who have received bone marrow transplants (BMT) with whole body irradiation.

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PATIENTS AND METHODS

Forty-five children (twenty boys and twenty-five girls) ages four to twenty years, (mean 12.5 years), who were treated for acute lymphoblastic leukemia in the department of pediatrics, University of Oulu, and forty-five age-and-sex-matched controls were included. The mean age of the patients at the initial cancer diagnosis was 5.4 years, ranging from seven months to fifteen years and the time lapse from termination of cancer therapy to the present dental examination ranged from one to eleven years (mean 3.8 years).

Twenty-two patients (CT group) were treated with combination chemotherapy, following the Nordic regimen in which remission was induced with prednisolone, vincristine and doxorubicin; consolidation and CNS-therapy consisted of L-asparaginase and three pulses of intravenous methotrexate infusions with concomitant intrathecal doses of methotrexate, at three-week intervals.[6,7] The continuation therapy included daily 6-mercaptopurine and weekly methotrexate up to thirty-six months.

Nineteen patients (CNS group) were treated with combination chemotherapy and CNS irradiation (24 GY). The chemotherapy in patients with irradiation consisted of prednisolone, doxorubicin and vincristine as induction treatment; and 6-mercaptopurine and methotrexate as maintenance therapy up to three years. Reinductions with vincristine, doxorubicin and prednisolone for one week were given monthly. Treatment of the central nervous system included cranial irradiation

of 24 GY in twelve fractions and six to eight intrathecal injections of methotrexate. Radiation therapy was started five to six weeks after diagnosis, when the patient was in remission. The total scattered irradiation in children with CNS irradiation to the molar teeth was 1.44 GY, to premolars and canines 0.82 GY, and to the anterior teeth 0.72 GY.[8]

Four patients (BMT group) received combination chemotherapy and radiotherapy of 10 GY to the whole body (also to the dental arches and salivary glands) in connection with bone marrow transplants.

Dental examination after cessation of cancer therapy was performed by a dental specialist (U.P.) at the Institute of Dentistry, University of Oulu, of forty-five children with ALL and of forty-five age-and-sex-matched children from Oulu who acted as controls. *Decayed* (D), *Missing* (M) and *Filled* (F) *Teeth* (T) and *Tooth Surfaces* (S) were recorded, following the WHO criteria including *Decayed* values only for lesions extending to the dentin.[9] In caries diagnosis in Finland, fiber optics are used and bite-wing radiographs are taken in suspect cases. Since it is not possible to take radiographs routinely of healthy children for ethical reasons, radiographs were not available for the purpose of this investigation.

Lifelong caries incidence was determined from health center documents. As all children in Finland annually attend health centers, the lifelong caries incidence was available, also from the time before cancer was diagnosed. The children with cancer visited health centers annually before the diagnosis of the disease, during anticancer therapy and after cure, and the controls also attended regularly. To study the caries incidence, forty-five local controls from the patient's home region were included in the study. The same local dentist examined the children with cancer and the controls. Interexaminer errors and reproducibility ratios for methods used with respect to local dentists were calculated as described earlier and were found to be adequate for the present purposes.[5] The results of Heifetz *et al* also suggested that experienced clinicians can record dental caries without calibration at an acceptable level for scientific purposes.[10] All the children had lived in nonfluoridated areas in the north of Finland (F content in water < 1 ppm) and had received similar dental treatment under the Finnish local authority health center system. The caries scores were determined by analyzing the annual records of the health centers before diagnosis, during the course of the disease, and after cessation of cancer therapy. In dental examinations the WHO criteria were used.[9]

The differences between the mean values were tested using Student's t-test or Mann Whitney's U-test. An adaptation of the test for proportional frequencies was used for the percentage differences between the mean values.[11]

Informed consent was obtained from the children and/or their parents and the investigation was approved by the Ethics Committee of the Medical Faculty, of the University of Oulu, Finland and conducted according to the provisions of the Declaration of Helsinki.

RESULTS

Dental examination (by the author U.P) after cessation of cancer therapy showed that eleven of forty-two (26.2 percent) of children with leukemia and sixteen of forty-two (38.1 percent) controls had healthy permanent teeth. Three children of both groups had only primary teeth. All children with ALL had 5.9 DMF teeth and the controls, 1.7 DMF ($p < 0.001$). DMFT scores for the patients in different treatment groups are shown in

Table 1 ☐ Dental caries experience in the permanent teeth of children with ALL and of the controls.

	DMFT	DMFS
All children with ALL (N=42)	5.9±5.9	11.3±14.2
All controls (N=42)	1.7±2.3	3.9±9.7
Difference	p<0,001	p<0,01
Children with CT (N=19)	3.4±4.4	5.7±9.6
Controls (N=19)	1.9±2.4	2.7±4.1
Difference	ns	ns
Children with CNS (N=19)	7.1±4.6	13.5±10.9
Controls (N=19)	1.8±2.3	5.8±13.8
Difference	p<0.01	p<0.01
Children with BMT (N=4)	12.0±11.5	27.0±30.3
Controls (N=4)	0.5±0.6	0.5±0.6
Difference	ns	ns

CT=chemotherapy, CNS=chemotherapy and CNS irradiation, BMT=bone marrow transplantation
D=decayed, M=missing, F=filled, T=teeth, S=tooth surface

Table 2 ☐ Lifelong caries incidence (number of new caries lesions per year) in children with ALL and in the controls.

	Before ALL diagnosis Mean SD	During the therapy Mean SD	After cessation of therapy Mean SD
All children with ALL (N=45)	1.5±2.4	2.7±3.0	1.3±1.4
All controls (N=45)	0.5±0.8	1.1±1.2	0.7±1.4
Difference	ns	p<0.05	p<0.05

Table 3 ☐ Lifelong caries incidence (number of new caries lesions per year) in children with ALL in relation to cancer therapy.

	Before cancer diagnosis Mean SD	During the therapy Mean SD	After cure of cancer Mean SD
Children with CT (N=22)	1.6±2.2	2.0±2.7	1.0±1.4
Children with CNS (N=19)	0.8±1.4	3.3±2.9	1.3±1.1
Children with BMT (N=4)	3.3±4.7	3.9±4.6	2.2±2.8

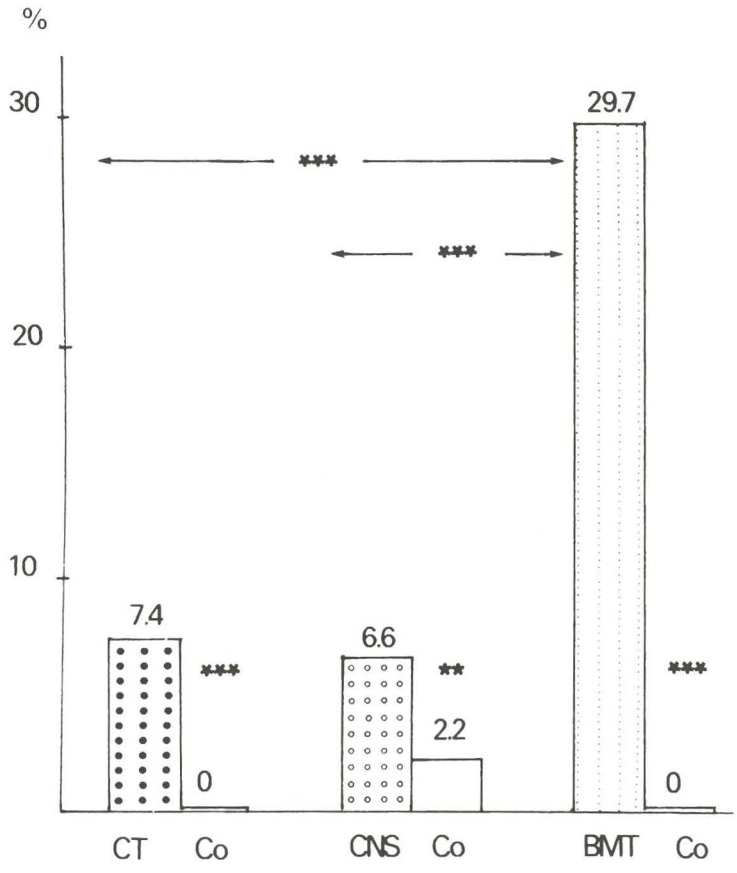

Figure. DMFS values (%) for the erupted approximal surfaces of anterior teeth at the age of twelve years in children with ALL.
+++ $p < 0.001$ ++ $p < 0.01$
CT = chemotherapy, CNS = chemotherapy and CNS irradiation
BMT = bone marrow transplantation, Co = control

Table 1. The CNS irradiation group had more caries than the controls ($p < 0.01$) and the chemotherapy group ($p < 0.01$).

The lifelong caries incidence analyzed from health center documents revealed that children with ALL developed 2.7 new caries lesions per year during the treatment of the disease compared to the controls 1.1 ($p < 0.05$). After cessation of cancer therapy children with ALL developed 1.3 caries lesions yearly compared to the controls 0.7 ($p < 0.05$). Children with ALL had 1.5 caries lesions yearly before cancer diagnosis compared to the controls 0.5 (Table 2) . The differences in the results between the different cancer therapy groups were insignificant (Table 3).

The analysis of affected permanent anterior teeth at the age of twelve years, analyzed from health center documents revealed that all the children with ALL had fifty-two of 544 (9.6 percent) approximal anterior tooth-surfaces filled, and the controls six of 464 (1.3 percent) ($p < 0,001$). The children with chemotherapy had thirteen of 176 (7.4 percent), children in the CNS irradiation group had twenty of 304 (6.6 percent) and children with BMT had nine of sixty-four (29.7 percent) of the approximal surfaces filled. All three therapy groups had anterior teeth filled significantly more often than their controls ($p < 0.001$). The differences between BMT and the other two cancer groups were significant (Figure). The differences between the two first cancer groups were not significant.

DISCUSSION

Our result that children surviving ALL had more caries than healthy controls is in line with the result of Purdell-Lewis and co-workers and in disagreement with the results of Nunn and co-workers.[3,4] The timetable for the development of caries was not known earlier. The risk for caries is increased not only during therapy, but after cessation of therapy as well.

It is worth noting that DMFT, DMFS indices are sometimes too imprecise to tell the differences in caries scores in countries with low caries scores. The mean DMFT at the age of twelve years is now below 2 in the whole of Finland.[12] The aim of WHO is to have DMFT below 2 by the year 2000; and we had achieved 1.5 in the north of Finland in 1991, where our patients live.[12] So a more sensitive index was needed to reveal that the chemotherapy group also had more dental caries than

the controls, and that there is a relation between caries incidence and cancer therapy. Since children today seldom have fillings in their anterior tooth-surfaces at the age of twelve years, the analysis of these teeth was one way to see the possible differences between the treatment groups.

The differences in the number of filled anterior teeth between children with BMT (who have received irradiation of 10 GY; also to the dental arches and salivary glands) and children with chemotherapy or children with chemotherapy and CNS irradiation (with scattered irradiation to the anterior teeth of 0.72 GY) showed that caries incidence is dependent on cancer therapy. Irradiation to the dental arches and salivary glands causes an increased risk of caries, partly due to the permanently reduced salivary flow.[13] Our results indicate that 10 GY whole body irradiation causes a considerably increased risk for caries. Patients with scattered irradiation of 0.72-1.44 GY in conjunction with chemotherapy may also have a higher risk of caries than patients with chemotherapy only. The high risk of caries seen in the anterior teeth in patients who received only chemotherapy may be caused by the disease itself or by the chemotherapy. Chemotherapy may cause transient xerostomia and impairment in many defense systems.[14]

Due to the increased risk of caries during and following treatment of leukemia, attention should be drawn to good dental care and prevention from the beginning of the cancer therapy. During new, more aggressive treatment-protocols, all efforts to avoid possible sources of infection should be made.

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THE IMPORTANCE OF EARLY DIAGNOSIS OF MEDULLARY THYROID CARCINOMA

Successful treatment of this potentially fatal syndrome requires early diagnosis. The dentist may be the first practitioner with the opportunity to identify the mucosal lesions and facial anomalies and refer the patient. Since these anomalies precede the development of MTC and pheochromocytomas, their early recognition can be life-saving.

Once recognized, the individual at risk for developing this syndrome should have annual screening tests for MTC and pheochromocytoma. These tests should be started as early as age 3 and continued annually until age 35. First-degree relatives of affected persons may also need to be screened. Genetic analysis has provided the means to diagnose gene carrier status for this syndrome with at least 90 percent accuracy.

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EPIDEMIOLOGY

Anterior tooth trauma in eleven-year-old South African children

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The prevalence of trauma to anterior teeth of children has been reported in several countries, usually with very general findings from a wide range of age-groups.

In respect to the different population groups in South Africa, the only major study was by Mogafe, who examined black children in an urban area in the Transvaal.[1]

A major study on dental health and disease in South African children was planned during the period 1985-1990, to look at their dental health status and to seek risk factors in predicting dental disease. As no other current information on tooth trauma in South Africans was available, other than Mogafe's findings, and because published international studies were not considered relevant to the mixture of ethnic, rural, and urban communities in South Africa, it was decided to include the prevalence of tooth trauma as an important component of the research protocol.

The tooth trauma information in this study was recorded to seek details on trauma frequency in permanent anterior teeth of a target group of eleven-year-old children in main ethnic groups in South Africa, for comparison with other world studies, and to establish information on the extent of the need for treatment of tooth-trauma, in South African children.

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MATERIALS AND METHODS

Before commencing the study, the protocol was approved in 1986 by the Committee for Research on Human Subjects at the University of the Witwatersrand.

The population samples selected were from children attending primary schools in the Gelukspan district of Bophuthatswana (350 km West of Johannesburg) comprising a black rural group; in Soweto, a black urban group; in Lenasia (30 km South West of Johannesburg), an urban group of children of Indian descent; and in Johannesburg, two groups, a "colored" (Eur-African Malay) urban group and a white urban group (Table 1). Consent was obtained from each child before examination. In all areas, cluster sampling of schools was used to obtain representative samples from the five communities. At each school, all children, age eleven years, were examined.

Clinical examination

Each child was examined for several dental and oral conditions using WHO criteria, some of which have been reported elsewhere.[2] Tooth trauma, to maxillary and mandibular permanent incisors, was graded according to

Table 1 ☐ Eleven year-old South African children examined in a cross sectional survey of tooth trauma

			Urban Black		Rural Black		Indian		Colored		White	
Total	M	F	M	F	M	F	M	F	M	F	M	F
1035	517	518	108	103	108	101	91	116	107	95	103	103
			211		209		207		202		206	

the previous classification of Hargreaves and Craig, modified to record different trauma conditions rather than specific treatment needs of the individual children (Figure).[3] Four experienced and calibrated clinicians completed the clinical examinations in good natural light, using a mouth mirror supplemented by palpation where necessary.

Data assessment

All recorded data were analyzed in an IBM 3083 J24 Main Frame Computer with VM/XA operating system at the University of the Witwatersrand. The software used was the Statistical Analysis System.[5] Categorical data were tested with the Chi-Square test. The critical level of statistical significance chosen was $p<0.05$.

RESULTS

A total of 1,035 children were examined (Table 1), numbers in each ethnic group and gender were similar. The prevalence of dental trauma, by ethnic group and gender is listed in Table 2. One hundred and sixty or 15.4 percent of children had received a tooth injury; the white children showed most evidence of trauma (21.4 percent); the black children, the least trauma: rural blacks 12.9 percent and urban blacks 13.7 percent. No statistically significant difference in trauma prevalence was seen among the ethnic groups.

Males showed more injuries than the females, with an overall ratio of 1.5:1, varying from 2.1:1 in the urban black children to 1:1 in the rural black children. The only group that confirmed a statistically significant gender difference was the urban black population, $x^2 = 4.25$ $p<0.05$.

The traumatized teeth can be categorized as follows:, injuries of 210 teeth (69.0 percent) in 160 of the children were predominantly of a minor nature, involving the enamel only. Of the other categories, 24.8 percent were grade 2 (dentine involvement); 3.3 percent, grade 3 (pulpal involvement); 2.4 percent, grade 9; or complete tooth loss (luxation); and less than 1 percent of total trauma was found in the other grades pooled together. No pulp testing was done or radiographs taken in this field study; thus vitality of the traumatized teeth was not determined beyond visual clinical examination.

The trauma to the individual tooth types (Table 3) showed 91.8 percent involved the maxillary anterior teeth; 84.2 percent, the central incisor teeth; 7.6 percent, the lateral incisor teeth; and only 8.1 percent to the mandibular anterior teeth. This distribution was similar for all ethnic groups.

Teeth recorded	12,11	21,22
	42,41	31,32

Classification		
	0	No sign of trauma
	1	Fracture of enamel only
	2	Fracture involving dentine
	3	Fracture involving dental pulp
	4	Displacement or excessive mobility, no fracture
	5	Displacement or excessive mobility and fracture of enamel
	6	Displacement or excessive mobility and fracture of dentine
	7	Displacement or excessive mobility and fracture to dental pulp
	8	Discoloration but no other sign of injury
	9	Tooth lost because of trauma (luxation)

Note: Fractured and displaced teeth could also show discoloration or sinus involvement. No vitality test or radiographs were taken for this classification.

Figure. Trauma categories for anterior teeth.

DISCUSSION

The trauma index used was based on the index introduced by Hargreaves and Craig for treatment of trauma, but modified to record different trauma conditions for large numbers of children, in a field survey situation.[3] This index was developed as an epidemiological tool, accepting the fact that observations of any traumatic involvement were being made months or years after the actual injury. Any residual looseness of a tooth normally would have resolved with only obvious fracture, displacement, discoloration, or tooth loss remaining apparent.

During the study an attempt was made to gain a detailed history of the injuries, but this was abandoned

Table 2 ☐ Trauma by ethnic group and sex.

	Number			Percentage			Ratio
	Total	M	F	Total	M	F	M to F
Urban Black	29	20	9	13.7	18.5	8.7	2.1 : 1*
Rural Black	27	14	13	12.9	13.0	12.9	1.0 : 1
Indian	29	15	14	14.0	16.4	12.1	1.4 : 1
Colored	31	21	10	15.0	19.6	10.5	1.9 : 1
White	44	26	18	21.4	25.2	17.5	1.4 : 1
	160	96	64	15.4	18.5	12.3	1.5 : 1

* $x^2 = 4.25$ $p<0.05$

Table 3 ☐ Trauma to individual teeth by ethnic group.

		Tooth type							
	n	11	12	21	22	31	32	41	42
Urban Black	37	16	3	14	1	1	0	2	0
Rural Black	30	11	0	16	2	0	1	0	0
Indian	44	19	4	19	0	0	2	0	0
Colored	40	19	1	14	2	2	2	0	0
White	39	26	0	23	3	0	2	4	1
	210	91	8	86	8	3	7	6	1
Percentage:		43.3	3.8	40.9	3.8	1.4	3.3	2.9	0.5
		47.1		44.7		4.7		3.4	
		91.8				8.1			

because few children could provide this information.

In the only other study on tooth trauma in South Africa, Mogafe using examinations of black children in the South African township of Springs, reported findings very similar to those given here for urban black children.[1] He used the index of Garcia Godoy *et al*, which is comparable to the index of Hargreaves and Craig, used in the present study.[3,6] His findings showed most trauma involved central incisor teeth (92 percent compared with 84 percent) and was of a mild nature with enamel fractures predominating (49 percent compared with 69 percent). Boys in both studies had statistically significant more injuries than girls (1.5 :1 and 2.1 :1, respectively). The majority of injuries involved single teeth, over 70 percent in both studies. Mogafe's findings pooled a wide range of age-groups (six to seventeen years of age), however, whereas the present study was restricted to eleven-year-old children. Mogafe attempted to identify the etiology of the injuries and suggested the major cause in his peri-urban South African group, was falls (48 percent) followed by collisions and bumps (30 percent) and pushing and fighting (20 percent). Injuries from vehicle accidents and injuries during organized sporting events were rare.

Kaba and Maréchaux reviewing injuries to the permanent teeth, in a well referenced paper, reported on twenty-four studies published between 1957 and 1988.[7] They noted considerable differences among the authors' total frequencies, which were attributed to environmental variations in the study areas and to variations in materials and methods used. Some studies looked at hospital admissions only; and for most studies statistical assessment was not used with findings of raw data given to express trends.

The present South African study, which was analyzed statistically, showed no significant differences between the ethnic groups in respect of frequency of trauma, although there was a tendency for more injuries to be found in the white children living in a typical city environment compared with the rural and peri-urban areas. The urban black children had a statistically significant gender difference, with more injuries to the boys than to the girls, which was reflected (although not significantly) in the other urban groups, but not in the rural black children.

Most of the trauma was treated by simple procedures, because the predominance of the injuries involved enamel fracture of the maxillary central incisor teeth. As radiographs were not used in the field during data collection, however, absence of periapical damage or infection could not be confirmed.

It is comforting to see that most injuries were of a mild nature and many children were not concerned or, in respect to enamel fractures, even aware of the injury. Nevertheless, 13 to 25 percent of boys and 9 to 17 percent of girls in the different ethnic groups were victims of dental trauma by eleven years of age. This illustrates the importance of recognizing tooth trauma as an important area of assessment and possible treatment need, when planning dental care of rural and urban populations in Africa.

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DEMOGRAPHICS

Pediatric dental practice: The number of your employees is increasing

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

Descriptions of the delivery of dental services for youngsters in the 1990s frequently emphasize 1) the ominous environment within which increasing numbers of children are being reared, and 2) the difficulties faced in attempting to provide needed services. For example:

"...6.3 million children, or 27 percent of all children under the age of 18, lived in 1993 with a single parent who had never married, up from 3.7 million in 1983."[1]

"...10.6 percent of children living in two-parent families were living below the poverty line. But 38.4 percent of children living with divorced mothers and 66.3 percent of those living with mothers who had never married were living below the poverty line."[2]

"Your next pediatric dental patient may have been physically or sexually abused."[2]

"Is your next pediatric patient an addict?"[3]

"(There are) differences in the health status of black and white children."[4]

"Only a small fraction of our health care dollar is spent on children."[5]

But just as the world of our youngsters is undergoing dramatic changes, so too is the setting for the delivery of dental services. While our concern generally is directed to the intrusion of the wide range of third party activities, limited attention has been directed to the evolving pattern of practice, in particular the increasing size of dental facilities.

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In only the last decade, the number of smaller dental establishments (less than five employees) which represented more than two-thirds of all dental facilities (69.1 percent) decreased to 54.5 percent. While the total number of dental establishments increased by 24 percent between 1980 and 1991, the actual number of smaller practices decreased by 2.2 percent. The increases in various sizes of practices with greater numbers of employees ranged from 68 percent to 154 percent (Table 1).

The probable increasing number of employees in your practice is part of the general trend in many (most?) dental offices.

SOLO PRACTICES

Although practices with a single dentist (and varying numbers of employees) remain the predominant model for the delivery of services, there have been dramatic decreases in their proportional representation. Between 1961 and 1992, solo practices as a percent of all private practices decreased from 85 percent to 68 percent.[7,8] In 1989, 58 percent of pediatric dentists in private practice were in solo practice arrangements (Table 2).

(Note: while specific data are not available by gender on solo vs nonsolo pediatric practice arrangements, there are some indications that the smaller representation of solo pediatric practices may be a reflection of the increasing number of women in pediatric dental practice.

- ☐ A smaller percent of female than male dentists are in solo practice, including practitioners of all ages and those less than forty-five years of age.

Table 1. ☐ Number of employees in dental establishments and percent change: 1980, 1991.[6]

Number of employees	Number of dental establishments		Percent change 1980-1991
	1980	1991	
1-4	59,207	58,013	−2.2%
5-9	21,877	36,744	67.9
10-19	4,000	10,155	153.9
20-49	548	1,317	140.3
50 +	59	133	125.4
Totals	85,691	106,362	24.1

Number of employees	Percent distribution 1980	1991
1-4	69.1%	54.5%
5-9	25.5	34.5
10-19	4.7	9.5
20-49	0.6	1.2
50 +	< 0.1	0.1
Total	100%	100%

Table 2 ☐ Pediatric dentist primary practice setting: 1989.[9]

	Percent
Private practice — individual	58%
Private practice — group	25
Educational institution	10
Hospital	1
Uniformed service	3
Other	1

Table 3 ☐ Number of dental employees, production employees in dental offices: selected years 1980–1993.[11]

Year	Total No. employees	Total No. production employees	Average No. of employees per dental facility
	(in 000s)	(in 000s)	
1980	341.9	297.9	3.98
1985	443.8	392.8	4.59
1990	522.6	458.5	5.09
1993	562.6	492.3	5.12

☐ Female dentists represent 9.1 percent of all dentists in general practice, 7.1 percent of all specialists and 15.3 percent of all pediatric dentists.[8,10])

INCREASING NUMBERS OF EMPLOYEES

In the past decade, the total number of employees in dental offices increased by almost two-thirds (64.6 percent) from 342 thousand to 563 thousand individuals. The total number of production workers (e.g. dental hygienists, dental assistants, and dental technicians) increased from approximately 300,000 to almost a half million workers. The average number of employees per dental facility increased from four to more than five persons (Table 3).

EMPLOYMENT PATTERN

Although there have been increases in the employment of dental hygienists and dental assistants in various practice modalities, the employment pattern of these auxiliaries by general practitioners and specialists has not been comparable.

Dental hygienists:

☐ Two-thirds of general practitioners compared to 29 percent of specialists employ dental hygienists.

☐ Ninety dental hygienists are employed per 100 general practitioners, compared to fifty dental hygienists per 100 specialists.

Dental assistants:

☐ Ninety-one percent of general practitioners and 95 percent of specialists employ dental assistants.

☐ One hundred and thirty dental assistants are employed per 100 general practitioners, compared to 210 dental assistants per 100 specialists (Tables 4 and 5).

SALARIES

By the 1990s, overhead costs for dental practices have reached between 60 and 70 percent.[12] Practitioners continuously are confronted by the dual constraints of third party and employee demands—the former to hold down charges and the latter for increases in salaries and benefits (the largest component of overhead costs). The resultant impact on auxiliary salaries has been mixed.

☐ Dental hygienist and dental assistants employed by specialists receive greater remuneration than their counterparts who are employed by general practitioners.

☐ Despite the increasing salaries paid to dental assistants, since the mid 1980s, these payments barely have kept pace with the rate of inflation.

☐ The salaries of dental hygienists, in terms of current and constant dollars (i.e. removing the effects of inflation) increased during the past decade, particularly for dental hygienists employed by specialists (Table 6).

Table 4 ☐ Percent of independent * general practitioners and specialists who employ dental hygienists and dental assistants: 1983, 1992.[8]

	Dental hygienists		Dental assistants	
	Gen. pract.	Spec.	Gen. pract.	Spec.
1983	58.7%	27.7%	87.6%	94.1%
1992	66.2	29.3	91.0	94.9**

* An independent dentist owns or shares in the ownership of a dental practice. This ownership status includes sole proprietors and partners, who own either incorporated or unincorporated practices.[8]
** 1990 datum

Table 5 ☐ Number of dental hygienists and dental assistants employed per 100 independent general practitioners and specialists: 1983, 1992.[8]

	Dental hygienists		Dental assistants	
	Gen. pract.	Spec.	Gen. pract.	Spec.
1983	67	40	118	187
1992	90	50	130	210

Table 6 ☐ Current and constant dollar weekly salary of full-time dental hygienists and dental assistants in independent general and specialist dental practices: selected years 1983–1992.[8,13]

Dental Assistants

	General practitioners		Consumer Price Index	Specialist practitioners	
Year	Current dollar	Constant dollar	(1982-84 = 100)	Current dollar	Constant dollar
1983	$224	$225	99.6	$240	$241
1987	278	245	113.6	313	275
1989	315	254	124.0	348	280
1992	352	251	140.3	395	281

Dental Hygienists

	General practitioners		Consumer Price Index	Specialist practitioners	
Year	Current dollar	Constant dollar	(1982-84 = 100)	Current dollar	Constant dollar
1983	$359	$360	99.6	$369	$370
1987	473	416	113.6	469	413
1989	578	466	124.0	600	484
1992	655	466	140.3	708	505

YOUR PRACTICE

There is no such thing as "average practice" or "average practitioner." Each practice responds to the desires and interests of the particular dentist(s), the community within which the practice has been established and the patients that are being served. But the chances are that you have increased the number of employees in your practice during the past years, whether they are chairside, front desk, or backroom personnel.

But while the increasing size of practice arrangements can increase practice productivity and facilitate the processing of the inevitable paperwork of third parties, the resultant number of employees places further management demands on you. If you are like most practitioners, you were attracted in your younger years to the profession based upon your experiences with your private dentist. Your experiences (and indeed your dental school training) provided limited, if any preparation for the management of a staff of five, ten, fifteen or more employees. Your staff "just sort of grew" in numbers.

No doubt increasing attention is directed to personnel decisions, fringe benefits, the continuing revolving door of recruitment, hiring and firing of a parade of employees (who often are responding to limited remuneration and the lack of opportunity for advancement within the confines of most practices).

You may be wondering, "what ever happened to that small comfortable practice that once attracted me to the profession?" Will your staff lose track of some of the youngsters in your practice in this ever changing flow of personnel? And speaking of patients and their parents, what are their reactions to such a changed environment, approaching a resemblance to the dreaded "C word", "the impersonal clinic"? The task will be to ensure that a sense of familiarity and concern, which seemed to pervade the traditional dental practice of past decades, will permeate the current enlarged arrangements.

But have you ever considered the thought that as you modify and increase the employment character of your practice, you are part of the long term changes affecting the profession? Originally you were attracted to the profession by a particular type of practice format. Increasing numbers of youngsters, currently being treated in greatly enlarged office arrangements comparable to yours, may someday be attracted to the profession because of the very nature of these particular "business" arrangements. Just try to imagine the next generation of dental practices (attempting to function with whatever form of national health insurance is enacted).

We know that the profession must evolve in response to the demands of the general public and the changing sources of finances. It is difficult to imagine with certainty the long term consequences of the continuing increasing sizes of practices and the impact on the care of our youngsters. For example, will it include the further delegation of duties to auxiliaries or impersonal clinic-style care with rows of dental operatories? But whatever the future will bring, your practice is the result of and the cause of these developments.

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POSSIBLE BIOLOGIC MECHANISMS OF FLUOROSIS

This hypothesis concerning possible alterations in the role of zone refinement during enamel maturation as a mechanism responsible for the fluorotic lesions is not exclusive of other hypotheses concerning mechanisms responsible for fluorosis. Indeed, it would appear to be compatible with the concept that partial inhibition of the proteinases responsible for cleavage of enamel matrix proteins and a delay in removal of the proteins during enamel maturation are involved in the development of fluorosis.

Further study will be required to confirm or refute the zone refinement hypothesis. Whatever modifications or replacement of the hypothesis may evolve, they must accommodate the observation that variations in ^{45}Ca uptake in developing enamel seem to be primarily the result of changes in the amount of isotopic exchange rather than variations in the degree of net Ca^{2+} deposition.

Bawden, J.W. *et al*: Consideration of possible biologic mechanisms of fluorosis. J Dent Res, 74:1349-1352, July 1995.

REPORTS

Accessory jaw and mouth: Report of case

E.M.H. Al-Waheidi, BDS, PhD

It is rare to find two mouths or an accessory jaw. The two mouths could be considered a teratoma, because of their adjunctive relationship.[1]

Rushton and Walker described a case with attached bony masses occurring bilaterally, in which the one on the right side contained teeth that were situated posteriorly to both tuberosities in the regions of the pterygoid processes.[2]

McLaughlin reported a case of duplication of mouth, tongue, and mandible.[3] There were teeth in the incisor area of the abnormal mandible.

Smylski reported a case with bilateral osseous structures situated within the cheeks, in which the left piece contained three teeth, one of which was erupted.[4] He concluded that these bony structures were probably parts of an accessory mandible.

Avery and Hayward reported a case of Klippel-Feil syndrome. An intraoral ridge containing teeth extended along the midline of the maxilla, and divided the roof of the mouth into two adjunctive palates.[5]

Chandra reported a case of duplication of the maxillary arch.[6]

Lawrence *et al* reported a case of congenital duplication of mandibular rami in a Klippel-Feil syndrome patient.[7] Each accessory ramus contained bone marrow and a small single rooted tooth.

Ball reported a case with bilateral accessory jaws containing teeth, in a patient with Klippel-Feil syndrome.[8]

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CASE REPORT

G.A. was a four-year-old female who had been referred for orthodontic opinion regarding the geminated lower primary tooth.

Extraoral examination revealed a cleft of 2.5 cm that occupied the left third of the lower lip and is surrounded by a well-developed vermilion border (Figure 1). This cleft was observed by the parents at birth. A clear, thin mucoid fluid drained from the cleft on palpation, and increased in volume during meal times. When the edges of the cleft were drawn apart, two teeth were seen within the cleft. This cavity was lined with a healthy mu-

Figure 1. A photograph showing two teeth erupting in the accessory mouth.

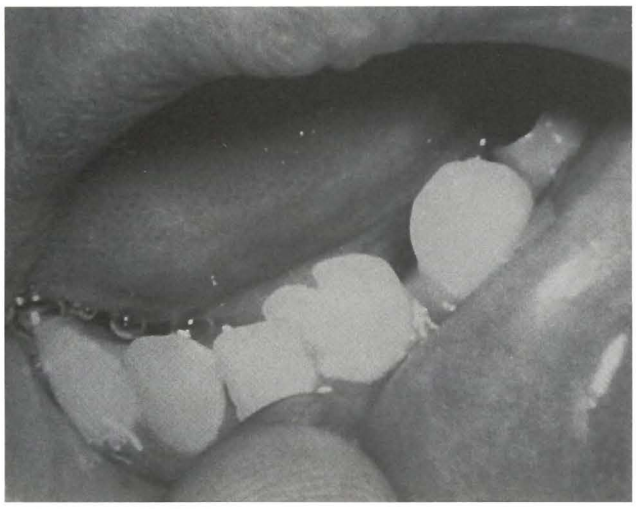

Figure 2. A photograph showing the geminated mandibular primary lateral incisor.

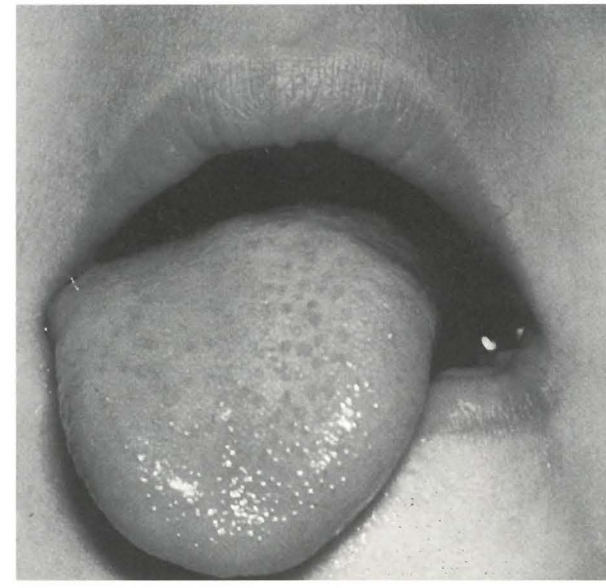

Figure 3. A photograph showing the enlarged left side of the tongue.

cous membrane covered with salivary secretion. The accessory teeth were firm and attached to a bony segment.

All primary teeth were present plus a geminated mandibular left primary lateral incisor; and a tongue, the left side of which was larger than the right side (Figures 2 and 3).

Radiological examinations showed an accessory bony segment attached to the left side of the mandible and protruding labially to accommodate the accessory teeth. Also there were five more supernumerary teeth contained in the body of the mandible (Figure 4). There is a history of a cleft palate, repaired a year earlier.

Other diagnostic procedures were conducted to exclude Klippel-Feil syndrome and any cervical vertebral involvement; and to reveal normal blood electrolytes and normal biochemical findings.

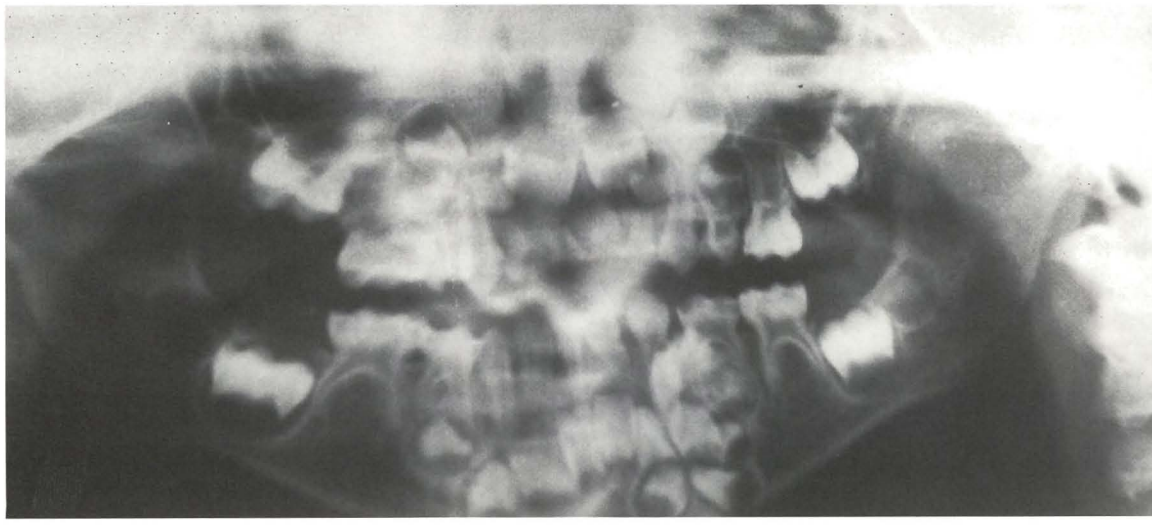

Figure 4. An orthopantomogram showing the supernumerary teeth and the accessory segment of bone.

TREATMENT

Accessory teeth and accessory bony attachments were removed and the accessory mouth was closed surgically. The patient remained under supervision for treatment of supernumerary teeth.

DISCUSSION

This case was considered as an anomaly that showed a duplication of the mouth, supernumerary teeth, accessory bone attached to the left side of the mandible, geminated primary teeth, unilaterally enlarged tongue, and history of a cleft palate.

Clefts affecting the lips and palate are components of syndromes, many of which exhibit single gene inheritance; and although environmental factors may evoke abnormalities in some cases, they result mainly from chromosomally induced deficiencies in both the mesoderm and ectomesenchyme.[9]

The basis of many facial congenital abnormalities begins with maldevelopment of the neural crest tissue that gives rise to much of the skeletal and connective tissue primordia of the face.[9]

CONCLUSION

The etiology of the cleft palate in this case could be attributed to the defect in the fusion of the embryonic components of the maxillary process. Also the proliferation of the mandibular process may have caused the formation of the accessory jaw and the proliferation of the dental lamina could be considered responsible for the large number of supernumerary teeth.

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DISCIPLINING YOUNG CHILDREN

Parents are often concerned about managing the oppositional behaviors of toddlers and preschool children and about the children's tendency to resist discipline. Several reviews on effective discipline strategies have been published. These articles emphasize the importance of the amount and quality of positive contact betwen parent and child (called time-in). Increasing the amount of parental attention the child receives and teaching parents strategies that encourage positive interactions (ie, active listening, physical nurturing, special time, etc) is often necessary before other disciplinary strategies are recommended. When parents have many concerns about their child's behavior, it may be necessary to help them identify their child's appropriate behaviors and have them provide the child attention and praise in response to these behaviors (catch them being good). Other commonly recommended strategies include using positive incentives for appropriate behavior, ignoring mildly inappropriate behavior, and using time-out from positive reinforcement to punish aggression, dangerous behaviors, and other inappropriate behaviors. There is a consensus that parents should avoid verbal nagging or repeated threats that are likely to lead to coercive parent-child interactions.

Blum, N.J. *et al*: Disciplining young children: The role of verbal instructions and reasoning. Pediatrics, 96:336-341, August 1995.

Mercury hypersensitivity from amalgam: Report of case

Işin Ulukapi, DDS, PhD

Amalgam is one of the widely used dental filling materials. Yet, the safety of dental amalgams for both the dental patient and the dental professional has been questioned intermittently since the inception of the use of this material.[1]

Several studies reporting mercury release from amalgam, have focused increased attention on the incidence and effects of mercury hypersensitivity.[1-5] Mercury hypersensitivity is an allergic response mediated by the immune system. It is usually delayed because of the time required for effector cells to accumulate and produce symptoms at the site of the reactions.

Occupational exposure to mercury is known to cause contact dermatitis, which is extremely rare.[1]

Reviews from 1905 to 1986 cite forty-one published clinical cases of allergy to dental amalgam restorations.[1,2] The method for confirming an allergy to mercury involves the proper use and interpretation of a patch test.[1,2,6-8] A patch test is judged positive on the basis of the evaluation of cutaneous signs such as erythema, edema, vesicles and papules and not on systemic changes, such as pulse rate and blood pressure, as suggested by some opponents of amalgam usage.[1]

CASE REPORT

The patient, an eight-year-old boy, presented in the Pedodontics Department of the Faculty of Dentistry, University of Istanbul, for the treatment of his decayed teeth. The patient had blue eyes and blond hair and considered to be in good health.

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Figure 1. Erythematous area on the buccal mucosa near to the amalgam filling.

His decayed left mandibular primary molar was restored with an amalgam filling (Degussa Standalloy F, Germany). Two days later at the second recall for polishing, the patient had an erythematous area on the labial commissura and on cheek and neck. During the intraoral examination an erythematous area (approximately 1 cm in diameter) on the buccal mucosa near the amalgam filling was observed (Figure 1). Because of these reactions the amalgam filling was replaced with a composite filling material (Prisma-Caulk USA) and the patient was recalled for observation in three days. The lesion disappeared during this time period.

For confirming an allergy to mercury or to amalgam, the patch test as described by von Mayenburg *et al*

Figure 2. Severe reactions to mercury and amalgam on the forearm of the patient.

(1991) was used by applying hypoallergenic plasters to a forearm.

Next day there appeared on the forearm of the patient edema, erythema, itching, and vesicles. These reactions were severest to mercury, but also occurred when exposure was to amalgam (Figure 2). Under the test plaster only edema clearly resulted from the test materials. Allergic erythema was also prominent from his underarm to his upper torso (Figure 3). These severe allergic reactions disappeared after using dermatologic ointments containing corticosteriods.

DISCUSSION

In allergic reactions the release of lymphokines result in an inflammatory response and localized tissue damage. As in other allergic reactions, previous sensitization by an antigen (mercury) is necessary before a secondary response can occur.[1,3]

In this case the patient had allergic reactions to an infant feeding formula. In addition, an infant moisturizing cream, which may have contained mercury, was used for a long time. It is known that there is a much lower rate of sensitization to most compounds when exposure is through mucous membranes rather than through the skin; this appears to be true for mercury and probably for this case.[1]

Exposure to mercury compounds can occur from manufactured mercurials and a wide variety of other sources, including environmental, dietary and occupational.[1,5] Allergic reactions to amalgam restorations are extremely rare and women seem to be affected more often than men.[2] The present case is a male child and because of its greater rarity, much more interesting. In the published cases the most common symptoms are dermatitis, eczema, urticaria, erythema, edema, and

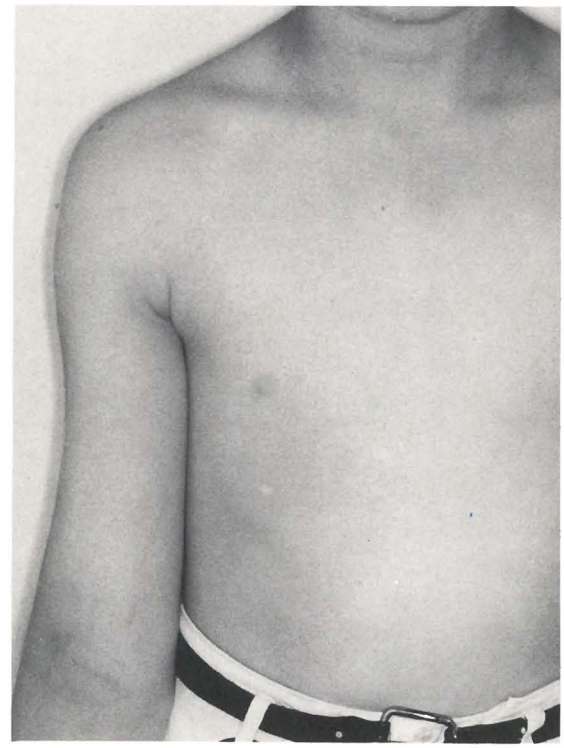

Figure 3. Erythema from underarm to upper torso of the patient.

itching, occurring primarily on the face, neck, limbs and upper torso. All these reactions were present in this case. The symptoms usually appear twenty-four to forty-eight hours after the placement of an amalgam restoration.[1] In most cases the symptoms disappear after removal of the amalgam restorations as they did in this case.

The incidence of allergic reactions to the mercury in dental amalgam appears to be small and idiosyncratic.

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ABSTRACTS

Kuftinec, M.M.; Shapira, Y.: The impacted maxillary canine: I. Review of concepts. J Dent Child, 62: 317-324, September-October 1995.
This first of the two papers dealing with impaction of the maxillary canines explores the etiology of the most frequently encountered and treated dental impactions. Developmental events believed to play a significant role in the etiology of impactions, together with diagnostic methods of localization, as well as the available preventive measures are reviewed. Our second paper deals with the clinical management of the maxillary impacted canines.
Canine impaction; Developmental anomalies; Tooth eruption; Development of maxillary canines

Gonzalez, Cesar D.; Frazier, Pearl J.; LeMay, Warren *et al*: Sealant status and factors associated with sealant presence among children in Milwaukee, WI. J Dent Child, 62: 335-341, September-October 1995.
Objectives: 1) To determine the percent of school-children aged 6-14 years with sealants placed in their permanent molars in the City of Milwaukee. 2) To describe factors associated with sealant presence among these children. 3) To describe differences, if any, among ethnic majority and minority groups. Twelve public schools agreed to participate in this project. After consent forms were obtained, 1,234 dental exams were performed. A 15-item pretested questionnaire was given to each child to take home for the parent(s) to complete. Response rate was 60 percent (N = 742). Data were analyzed using frequencies and Chi-Square tests (P-value < 0.05). Only 9.6 percent of the sample had sealants on their permanent molars. Variables that were found associated with children more likely to have sealants included: gender (female children more likely than males); children with a recent dental exam; children having a regular dentist; parents having heard about sealants before this study; parents' correct knowledge regarding the purpose of sealants; higher level of parents' education; higher parents' total annual income; ethnicity (Caucasian children more likely than Hispanic, African American, American Indian, or Asian children); and age (children in the older group, 10-14 years, more likely than children in the younger group, 6-9 years). Percent of school-children with sealants on their permanent molars in the city of Milwaukee is low. Efforts are needed to increase the knowledge of sealants by the general public as well as to promote sealant use by dentists in both private practice and public health programs, especially for minority children.
Sealants; School children; Parental questionnaire

Unkel, J.H.; Fenton, S.J.; Hobbs, Jr., G. *et al*: Toothbrushing ability is related to age in children. J Dent Child, 62:346-348, September-October 1995.
Methods to assess toothbrushing ability vary. The purpose of this study was to determine whether age could be a predictor for toothbrushing ability in children. This study evaluated the brushing patterns of 122 children utilizing the horizontal scrub technique. The results obtained suggest that a child's age is a reasonable predictor for toothbrushing ability.
Toothbrushing; Manual dexterity; Child's age

Pajari, U.; Ollila, Päivi; Lanning, Marjatta: Incidence of dental caries in children with acute lymphoblastic leukemia is related to the therapy used. J Dent Child, 62:349-352, September-October 1995.
Dental caries is an infectious disease and it may be harmful for children suffering from leukemia. DMFS, DMFT scores of forty-five children with acute lymphoblastic leukemia (ALL) were significantly higher than in healthy age-and-sex-matched controls after cessation of therapy. The children with CNS irradiation had higher DMFT (7.13 than children with only chemotherapy (3.4) and the controls (1.8). Lifelong caries incidence showed that children with ALL had 2.7 new caries lesions per year during the therapy compared to the 1.1 ($p<0.05$) new lesions in controls. More detailed analysis of permanent anterior teeth at the age of twelve years showed that all patient groups had more filled anterior teeth than controls ($p< 0.001$); and children with bone marrow transplantation had significantly more fillings than the other two groups.
Acute lymphoblastic leukemia; Dental caries; Chemotherapy; CNS irradiation; Bone marrow transplant

Hargreaves, J. A.; Matejka, J.M.; Cleaton-Jones, P.E. *et al*: Anterior tooth trauma in eleven-year-old South African children. J Dent Child, 62:353-355, September-October 1995.
Little new evidence on the prevalence of injury to the anterior teeth of children has been reported in the past five years and, in South Africa, trauma to the teeth of children in different ethnic groups has not been compared respectively. The purpose of this investigation was to determine the prevalence of dental trauma using well-defined criteria and to sample a specific age-group. Five regions were chosen and 1035 children in the eleven-year age-group were examined.
No statistical significance was found between the ethnic groups related to the amount of injury sustained. For all groups, boys received more injuries than girls. The most common injury was fracture of the enamel of the maxillary central incisor. With 15 percent of the children receiving some level of trauma by age eleven years, this is one of the

main dental treatment needs for South African children.
Traumatized anterior teeth; South African children; Eleven-year age-group

Waldman, H. Barry: Pediatric dental practice: The number of your employees is increasing. J Dent Child, 62:356-359, September-October 1995.
Dental practice arrangements are changing. There are proportionately fewer solo practices and increasing numbers of practices with many more employees. A review is provided of this evolving world of dentistry--including pediatric dental practice.
Practice modalities; Employees

Al-Waheidi, E.M.H.: Accessory jaw and mouth: Report of case. J Dent Child, 62:360-362, September-October 1995.
A rare case of teratoma, presented with a double mandible and double mouth, mucous secretions and two teeth erupting in the accessory mouth. There are numerous supernumerary teeth in the main body of the mandible, and geminated primary teeth in the mandibular arch. There was a history of cleft palate.
Jaw anomalies; Accessory mouth; Supernumerary teeth

Ulukapi, Işin: Mercury hypersensitivity from amalgam: Report of case. J Dent Child, 62:363-364, September-October 1995.
Mercury hypersensitivity is an allergic response mediated by the immune system. allergic reactions to mercury and other constituents of amalgam have been documented, but are very rare. The common symptoms are dermatitis, eczema, urticaria, erythema, edema and itching, occurring primarily on the face, neck, limbs and upper torso.
In this paper an interesting case of mercury hypersensitivity is investigated and discussed.
Mercury hypersensitivity; Dental amalgams

SMOKING CESSATION EDUCATION BY PEDIATRIC RESIDENTS

Relatively few training programs teach smoking cessation counseling, despite the fact that most program directors support the implementation of effective training programs at their institutions. It is not possible to say from our data what the ideal schedule or curriculum should be for teaching smoking cessation and prevention in residency curricula. Nonetheless, our results suggest that using curricular time may be effective in training residents in smoking cessation. Small group sessions are most effective at reaching residents, perhaps because that is when they are in ambulatory, teachable settings. Using surveys to key self-assessment and to create teachable moments for residents also may be an underused device for enhancing the performance of smoking cessation counseling behaviors by resident trainees.

Klein, J.D. *et al*: Training pediatric residents to prevent tobacco use. Pediatrics, 96:326-330, August 1995.
