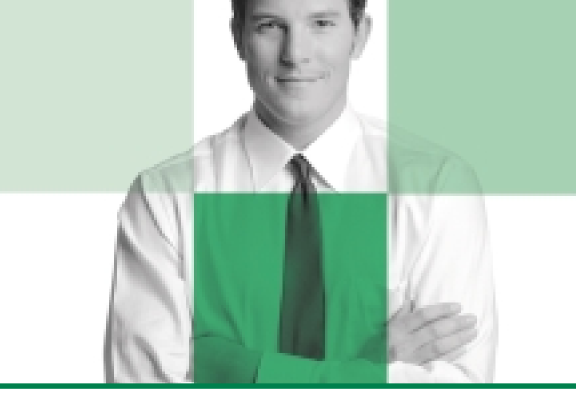

PANORAMIC Imaging News

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Featured Article:

In The Recent Literature:

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In order to provide more extensive coverage to our clinical topics, Panoramic Imaging News has been expanded to eight pages. With this issue, we begin a multiple part series focusing on developmental anomalies of the dentition.

Panoramic radiologic appraisal of anomalies of dentition: Chapter #1

By Dr. Allan G. Farman

Following FDA guidelines for radiographic examinations, the American Academy of Pediatric Dentistry in 1997 reaffirmed its recommendation for radiographic assessments of the dentition, growth and development during the transitional dentition and in adolescence.(1) This recommendation can be followed by making panoramic radiographs of your patients when they are approximately 5-7, 9-12 and 16-18 years old.

Whittington and Durward (1996) used panoramic radiographs to survey anomalies in primary teeth and their correlation with the permanent dentition of 1,680 5-year-old children. Anomalies of the primary teeth were detected in 23 children (1.4 %). Six children (3 boys and 3 girls) had hypodontia, 3 children (2 boys and 1 girl) had a supernumerary tooth, and 14 children (9 boys and 5 girls) had connated teeth. Six of the affected teeth (in 4 boys and 2 girls) were diagnosed as fusion, and 8 (5 boys and 3 girls) as gemination. The panoramic radiographs of the 23 children with anomalies of the primary teeth revealed that 14 (61 %) also had anomalies of the succedaneous permanent teeth. Children with hypodontia in the primary dentition all had corresponding permanent teeth missing. The results of the study confirm that, when there is hypodontia, hyperdontia, gemination, or fusion of teeth in the primary dentition, there is an increased likelihood of anomalies of the succedaneous permanent teeth. Because of this close relationship between the dentitions, early identification of anomalies of the primary teeth can allow the dentist to investigate further and plan for treatment at the appropriate time.

Locht (1980) evaluated panoramic radiographs of 704 Danish children aged 9-10 years and found 631 malpositioned teeth, caries in 224 primary and 32 permanent teeth, 60 malformed permanent teeth, 53 periapical inflammatory radiolucencies, and 42 dentigerous cysts. Hypodontia was present in 7.7 % and supernumeraries in 1.7 % of the studied population. These radiographic findings were certainly important for dental treatment planning.(3) Neal and Bowden (1988) also examine the diagnostic value obtained from panoramic radiographs taken at 9-10 years of age.(4) Radiographs from 982 patients were examined and 261 (26.5 %) showed findings of significance in orthodontic diagnosis and treatment planning.

Cholitgul and Drummond (2000) examined panoramic

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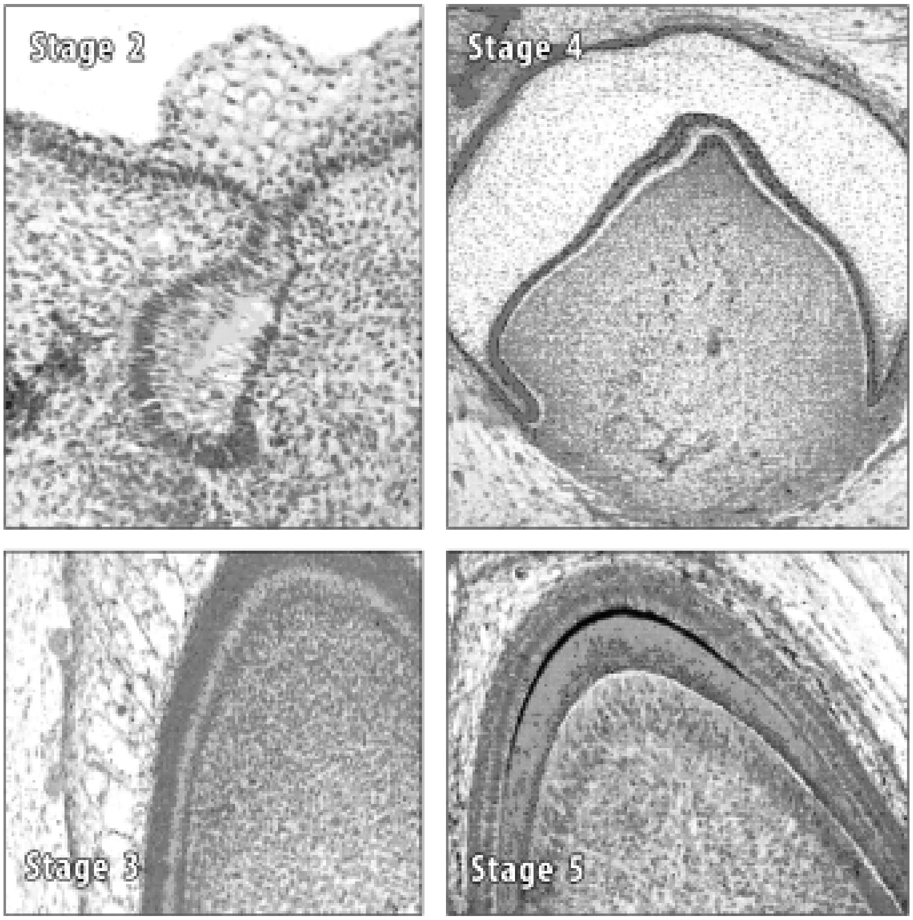

Fig. 1. Stages of development in tooth development. The type of developmental anomaly is largely dictated by the stage at which it is initiated.

1. Initiation
↓
2. Proliferation
↓
3. Histodifferentiation
↓
4. Morphdifferentiation
↓
5. Mineralization
↓
6. Eruption
↓
7. Maturation

radiographs of 1,608 children and adolescents aged 10 to 15 years (797 males and 811 females) to determine the prevalence of tooth and jaw abnormalities. Abnormalities were detected in 21 % of the radiographs (23 % of females and 17 % of males); 879 teeth were diagnosed with abnormalities on 331 radiographs. The most common abnormalities were malpositioned teeth, missing teeth, misshaped teeth, and teeth appearing hypoplastic. Bony abnormalities and growth problems were also detected. This study demonstrated the value of panoramic radiography in detecting or confirming dental abnormalities, and supports the use of panoramic radiography to aid in the assessment of dental development.

Early detection of dental anomalies allows for timely intervention. Failure to achieve timely detection often results in more extensive treatment combined with a poorer outcome prognosis. Making a panoramic radiograph at the appropriate time is a matter of professionalism. Failure to do so might well constitute professional negligence.

Teeth develop in utero and during the first two decades after birth, with maturation and regressive changes occurring throughout life. It is important to understand the biological sequence and range in tooth development if one is to adequately assess anomalous dental developments and their clinical consequences. The reader's knowledge of normal developmental stages will be assumed for the purpose of this article.

Development anomalies of the dentition can de divided according to the stage of tooth formation when the abnormality is initiated. Stages of tooth development (Fig. 1) start with initiation of tooth formation by ectomesenchymal stimulation and subsequent proliferation of the overlying epithelium to form first the dental lamina and subsequently the tooth bud.

Abnormalities in the number of teeth can be caused by a failure in tooth bud formation (too few teeth) or formation of an excess number of tooth buds (too many teeth). This is followed by stages of histodifferentiation and morphodifferentiation. Anomalies in tooth shape likely occur during one or both of these stages. The developing tooth next moves to the stage of mineralization. Anomalies in structure of the mineralized tissues can occur at this stage. Mineralization of the crown is followed by tooth eruption that can also be aberrant causing dental impaction, malocclusion, transposition or ectopia. Maturation includes the completion of the tooth root(s) (normally three years following eruption for permanent teeth), and subsequent increasing thickness of the dentin surrounding the pulp. Mild attrition such as the wearing down of enamel mamelons on the incisive edges of incisors can also be considered a process of maturation. More severe attrition, abrasion, erosion, dental caries, and exodontias can be considered regressive changes beyond the scope of this article.

A detailed review of all dental anomalies is too wide a topic for a single issue of this newsletter. This issue will begin to review abnormalities resulting in a reduction of the number of teeth. Variations in dental morphology and structure, impaction and abnormal eruption will be subjects for subsequent issues.

Anomalies in tooth number

The full human dentition is composed of 20 primary teeth (8 incisors; 4 canines; 8 molars) followed by transition to 32 adult teeth (8 incisors; 4 canines; 8 premolars; 12 molars) with equal numbers of teeth in each jaw. If less than the normal complement of teeth develops, the patient is said to have hypodontia. If a patient develops an excessive number of teeth, the extra teeth are termed supernumeraries. Panoramic radiographs are of particular importance for evaluating the number of teeth present as they provide the whole picture rather than just small segments of coverage. Furthermore, both regular and supernumerary teeth may be displaced to positions still within the panoramic view but beyond the bounds of a periapical radiograph.

Hypodontia

For hypodontia to be diagnosed, the missing tooth or teeth must not be accounted for by extraction. Dental extractions result in "pseudohypodontia." Pseudonyms for hypodontia are oligodontia and "partial anodontia". The latter term, while still used in several texts, is a misuse of the English language as it conditions an absolute. Anodontia, the complete absence of teeth, can rarely occur in consequence of the several ectodermal dysplasia syndromes, but is extremely rare. Large numbers of missing teeth, and teeth with stunted root formation, can also be a complication of radiation therapy applied to treat childhood cancers.

The most frequently missing permanent teeth are the third molars and maxillary lateral incisors, followed by the premolars in either jaw. While missing third molars rarely if ever cause clinical problems, missing maxillary lateral incisors have cosmetic consequences that require working with the child's parents or legal guardians to establish a treatment strategy of space maintenance plus prosthetic replacement versus canine substitution. Similarly, missing premolars require consideration of orthodontic consequences, planning space maintenance or closure (Fig. 2). Where permanent teeth are absent there is often an associated reduction in alveolar bone height and width, and drifting of adjacent teeth. If the primary tooth is retained, there are several possible outcomes. In the case of the maxillary lateral incisor, the crown size is small and short and its retention rarely provides a good cosmetic result. Crowning the primary tooth is not usually an option as the neck of the tooth is too narrow, and the root has frequently been resorbed to a greater or lesser extent. In the case of the missing premolar, the retained primary molar has a crown height that is much shorter than that of the adjacent permanent molar. The resulting malocclusion can predispose to periodontal disease and compromise the survival of the adjacent tooth or teeth. Alternatively, the primary molar may be ankylosed (fused) for the underlying bone. In such cases, normal growth and devel-

Fig. 2. Hypodontia with missing second mandibular premolar teeth and retained primary second molars. Each example shows a different clinical outcome. From upper left to lower right the cases show: (a) slight root resorption of retained primary and some tilting of adjacent permanent teeth; (b) marked root resorption of primary molar; (c) root resorption with bony ankylosis of retained primary molar; (d) re-submergence of retained primary tooth; (e) severe periodontal disease affecting adjacent regular teeth.

opment can cause resubmergence of the retained primary tooth. One can only surmise the difficulty that an orthodontist would have if an attempt were made to move a permanent tooth through such a submerged primary.

Ith-Hansen and Kjaer investigated persistent primary second molars in a group of young people in their late twenties with agenesis of one or two second premolars (6). In 1982-83 it had been decided, in connection with the orthodontic evaluation of 25 patients, to allow 35 primary molars (one or two in each patient) to remain in situ. All patients had mixed dentitions and agenesis of one or two premolars. The primary teeth were generally in good condition, although root resorption and infraocclusion (compensated by occlusal composite onlays) occurred. In 1997, 18 of the 25 patients with a total of 26 retained primary molars were re-examined, comprising a clinical examination for exfoliation, extraction, loosening, and ankylosis, and

"This study's findings suggest a higher than normal risk of hypodontia in subjects with Down's syndrome."

a radiographic examination for root resorption, tooth morphology (crown and root), and alveolar bone contour. The examination showed that the degree of root resorption was unaltered in 20 of the 26 primary molars. Three of the 6 remaining primary molars had been extracted and 3 showed extensive resorption. In 3 of the 26 primary molars the infra-occlusion had worsened. Hence, it was concluded that persistence of primary second molars in subjects with agenesis of one or two premolars can be an acceptable, semi-permanent solution. It was emphasized that further studies would be needed to establish whether this could also be an acceptable long-term solution. Obviously, if it is decided to retain a primary molar when there is premolar agenesis, the patient should be followed carefully. Periodic radiographs would be needed.

Yanagida and Mori (1990) researched congenital hypodontia using 4009 panoramic radiographs of pedodontic patients (1036 boys aged 2-5 years, 905 boys aged 6-11 years, and 22 boys aged 12 years or older; 1032 girls aged 2-5 years, 985 girls aged 6-11 years 985, and 29 girls aged 12 years or older) (7). Congenital hypodontia of primary teeth was found in 62 children (78 teeth). Congenital hypodontia of permanent teeth was found in 314 patients (566 teeth). Obviously, the majority of cases were unilateral further complicating the treatment interventions by lack of symmetry. No significant differences were found between the right and left sides of the jaw or in relation to the patient's gender. Further, in view of the age of the patients studies, it was not possible to assess the agenesis of third permanent molars; hence, the numbers are lower than would otherwise be the case. Peltrola et al (1997) examined panoramic radiographs of 392 Estonian schoolchildren aged 14-17 years and found that, excluding third molars, 14 % had missing teeth; 17 % had missing third molars (8).

Comprehensive dental examinations and panoramic radiographs were used to determine the prevalence of hypodontia in 662 Australian military recruits (9). Of the sampled population, 6.3 % exhibited some degree of hypodontia (third molar agenesis excluded). Third molar agenesis occurred in 22.7 % of the sample. There was no statistical difference between the sexes in third molar agenesis; however, women exhibited an extremely low incidence of absence of maxillary lateral incisors.

Hypodontia and clefts

Shapira et al (1999) studied panoramic and periapical radiographs of 278 patients with cleft lip, cleft palate, or both (158 males and 120 females), age 5 to 18 years, to determine the frequency of missing second premolars and the possible association between the cleft side and the side from which the premolar was absent (10). The prevalence (18 %) of missing premolars found in this study was thought to be significantly higher than that found in the general population. A considerably higher incidence of missing second premolars was found in the maxilla compared with the mandible both for unilateral and bilateral missing teeth. The second premolar was absent more frequently on the left than on the right side, both in males and females and in both jaws, corresponding to the side where clefts occurred more often.

Hypodontia and Down's Syndrome

Kumasaka et al (1979) used panoramic radiographs and clinical records to investigate developmentally absent permanent teeth in 98 subjects with Down's syndrome (trisomy-21) (11). This retrospective study was made using the records and panoramic radiographs of subjects from approximately five years of age through to their most recent records. The time period covered by records ranged from 6 to 28 years. The majority of subjects with Down's syndrome (63 %) exhibited hypodontia, and many subjects were missing two or more teeth (53 %). Unlike in the general population, the most frequently absent teeth were the lower lateral incisors (23.3 %). The next most frequent agenesis was the upper second premolars (18.2 %), the upper lateral incisors (16.5 %), and the lower second premolars (15.3 %). This study's findings suggest a higher than normal risk of hypodontia in subjects with Down's syndrome. Shapira et al. (2000) showed a notably high prevalence of third molar agenes is in Down's syndrome patients (74 % of individuals older than 14 years) (12).

"Teeth are essentially ectodermal appendages so dysplasia of ectoderm can affect tooth development."

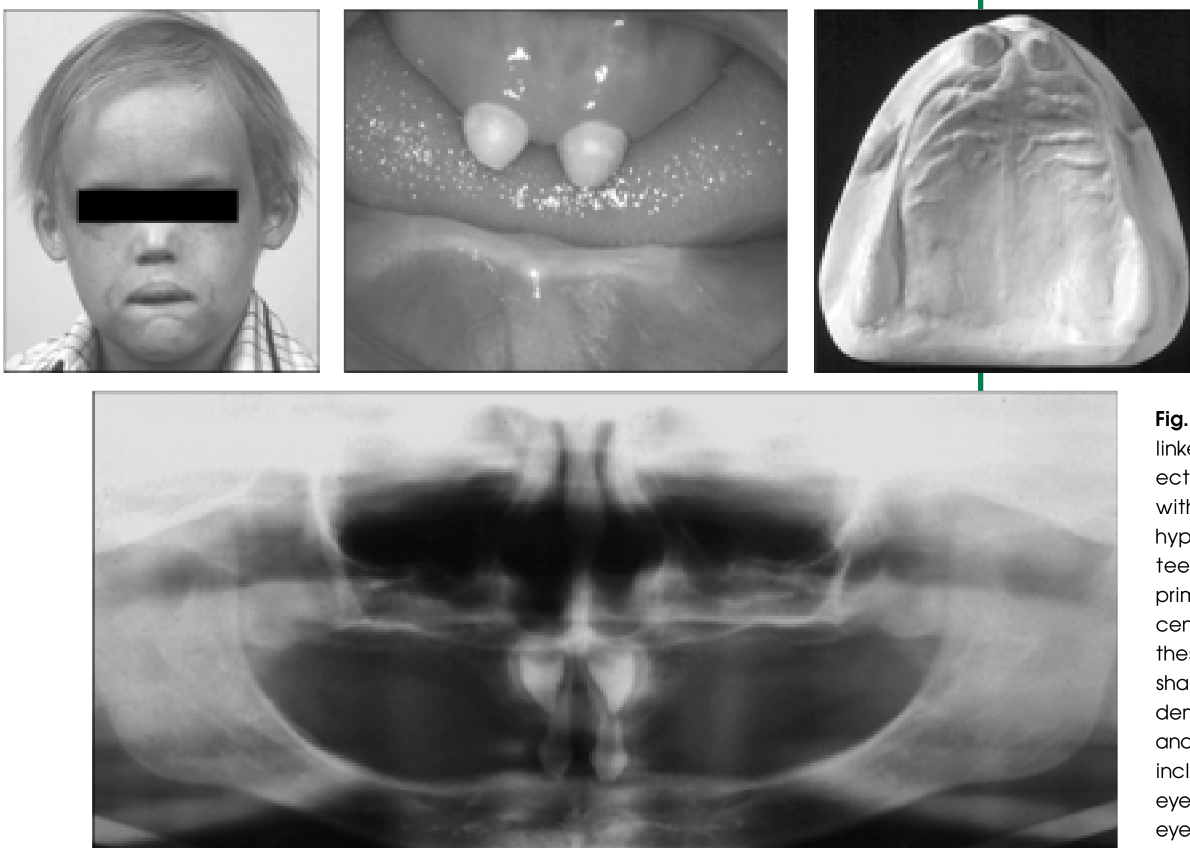

Fig. 3. Case of sex-linked hypohidrotic ectodermal dysplasia with severe hypodontia. The only teeth present are the primary and adult central incisors – and these are conical in shape. The child also demonstrates dry skin, and sparse hair including absence of eyebrows and eyelashes.

Hypodontia and Ectodermal Dysplasias

There are a variety of syndromes in which there can be severe hypodontia – or even anadontia – in view of abnormalities in ectoderm (Fig. 3). Teeth are essentially ectodermal appendages so dysplasia of ectoderm can affect tooth development.

Guckes et al (1998) assessed the pattern of permanent teeth present in a self-selected sample of 17 female and 35 male patients with ectodermal dysplasia presenting for treatment with dental implants (13). The mean age of the sample was 18.7 years (age range: 5.9 to 60.9 years). Panoramic radiographs were examined independently by two investigators to determine the permanent teeth present. None of the sample reported extractions of permanent teeth prior to presenting for implants. The permanent teeth most likely to be present, reported as a percentage of the patient sample with that tooth, were: maxillary central incisors (42 %), maxillary first molars (41 %), mandibular first molars (39 %), maxillary canines (22 %) mandibular second molars (17 %), maxillary second premolars (15 %), and mandibular premolars (12 %). Comparing dentition by quadrants, mandibular anterior teeth (canines and incisors) were the teeth least likely to be present. The maxillary central incisors, maxillary first molars, mandibular first molars, and maxillary canines are the most conserved teeth in hypodontia associated with ectodermal dysplasias. Successful use of osseointegrated implants in the anterior mandibles of most of these patients suggests that habilitation of the mandible with dental implant-supported prostheses is a reasonable option. This does not negate the need for the patient to receive instructions from a physician regarding such issues as thermal regulation and genetic consultation.

(Continued Next Issue.)

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In The Recent Literature:

Canine ectopia: Using panoramic radiographs, approximately half the subjects with palatal ectopia of canines also have other dental anomalies. Buccal ectopia of the canine was not associated with such additional dental anomalies.

Becker A, Chaushu S. Dental age in maxillary canine ectopia. Am J Orthod Dentofacial Orthop 2000 Jun; 117(6):657-62. (From the Department of Orthodontics, the Hebrew University-Hadassah School of Dental Medicine, Jerusalem, Israel.)

An etiologic connection between palatally ectopic canines and small and missing teeth is well established in the literature. Additionally, it has been observed that patients with palatally ectopic canines have delayed dental development. This report examined the validity of this latter observation. The authors assessed radiographically the subjects' dental ages using criteria of tooth calcification, rather than tooth eruption pattern. A similar determination was made in relation to subjects in whom buccally ectopic canines were present. The experimental group consisted of panoramic radiographs of 55 consecutively treated patients with palatally displaced maxillary canines and of 47 consecutively treated patients with buccally displaced canines. The panoramic radiographs were compared with those from a control group of 57 consecutively treated patients with normally placed canines. Approximately half the subjects with palatal displacement exhibited a late-developing dentition, whereas the timing of dentition in the remaining subjects appeared to be normal. Buccal displacement was not associated with a retarded dental development, and the ranges of the dental age values were similar to those seen in the control group. The results support the idea that there are different etiologies for the occurrence of buccal versus palatal ectopia of maxillary canines. They also suggest that dentitions with a palatal canine may be of two distinct varieties, with different dental characteristics and, perhaps, different etiologies.

Dental age assessment: Panoramic radiography provides an excellent means of assessing the dental age of patients; however, there is a need to develop separate assessment standards for different population groups.

Davidson LE, Rodd IID. Interrelationship between dental age and chronological age in Somali children. Community Dent Health 2001 Mar; 18(1):27-30. (From the Department of Child Dental Health, School of Clinical Dentistry, University of Sheffield, UK).

This cross-sectional study compared dental age with chronological age in Somali children under 16 years of age and age- and gender-matched white Caucasian children, all resident in Sheffield, England. The sample group comprised 162 subjects: 84 Somali and Caucasian boys (mean age 10.6 y) and 78 Somali and Caucasian girls (mean age 11.2 y). The dental age was assessed for each subject using existing panoramic radiographs.

“Radiographic changes in the position of impacted third molar teeth can be considerable even after the usual age for eruption of such teeth.”

Comparisons of the difference between dental age and chronological age were made for each gender and both ethnic groups. Independent sample t tests were employed for statistical analysis. The level of significance was set at p ˜ 0.05. The mean difference between dental age and chronological age was found to be 1.0 years for Somali boys, 0.2 years for Caucasian boys, 1.2 years for Somali girls, and 0.5 years for Caucasian girls. The difference between dental and chronological age was significantly greater in Somali subjects than in Caucasian children. The authors conclude that Somali children are more dentally advanced than their Caucasian peers. This finding underlines the need for population-specific dental development standards for accurate dental age assessment.

Impacted third molars: Radiographic changes in the position of impacted third molar teeth can be considerable even after the usual age for eruption of such teeth.

Venta I, Turtola L, Ylipaavalniemi P. Radiographic follow-up of impacted third molars from age 20 to 32 years. Int J Oral Maxillofacial Surg 2001 Feb; 30(1):54- 7. (From the Department of Oral Medicine, University of Helsinki, Finland.)

Nineteen patients (13 male, six female) with 34 impacted third molars (21 in the mandible and 13 in the maxilla) were followed using panoramic radiographs from age 20 to 32 years. All were examined clinically and panoramic radiographs were taken at baseline and at the end of the study. Radiographic criteria included tooth resorption, follicular enlargement, root development, change in inclination of the third molar, state of impaction, and the relative depth of the third molar in bone and its relation both to the ramus of the mandible and to the second molar tooth. In the mandible, the mean change in inclination was 19° with 76 % of teeth changing in angulation. In the maxilla, only 23 % of the teeth changed in inclination. The state of impaction (soft tissue, partially in bone, completely in bone) had changed for 44 % of the teeth. According to a questionnaire, no pain or other symptoms in the region of the third molars were reported by 74 % of the patients during the 12-year study period. The authors conclude that considerable radiographic changes, without notable symptoms, can occur in terms of tooth inclination and the state of impaction of third molars after the usual age for their eruption.

Second molar eruption patterns: Panoramic radiographs can be used to assess the eruption patterns and space availability for second permanent molars.

Tsai IIli. Eruption process of the second molar. ASDC J Dent Child 2000 Jul; 67(4):275- 81. (From the Department of Pedodontics, School of Dentistry, China Medical College, Taichung, Taiwan, Republic of China.)

This study observed the eruption process of maxillary and mandibular second molars by evaluating 238 panoramic radiographs. The developmental of the second molars was divided into four stages: completion of crown calcified = stage 1; initial root formation = stage 2; initial formation of the radicular bifurcation = stage 3; and root length equal to crown height = stage 4. The mesiodistal crown width of the first and second molars, axial inclination and eruption rate of these teeth, and the space available for their emergence was measured at each stage. Statistical analysis was performed to assess changes in development. Mandibular second molars began to erupt at stage 3 and maxillary second molars at stage 2. The axial inclination of the mandibular second molars was essentially unchanged from stages 1 to 4 but maxillary second molars uprighted gradually from stage 1 to 4. The available space increased significantly from stage 1 to 2 in both jaws. It is suggested that the space available for emergence of the second molar is prepared before stage 2, and then the tooth begins to erupt. For the maxillary second molars, there was a further increase in the available space after stage 3. A negative correlation was determined between the mesiodistal crown width of the mandibular second molar and the available jaw space at stage 2. A positive correlation was seen between the mesiodistal crown width of maxillary second molars and the available jaw space at stage 3.

PANORAMIC Imaging News
Volume 3, Issue 1

CE TEST: Panoramic radiologic appraisal of anomalies of dentition: Chapter #1

NOTE: *These questions are based* ***both*** *on the lead article and the abstracts from the recent literature.*

1. Oligodontia is synonymous with:
   ______ a) Hyperodontia
   ______ b) Macrodontia
   ______ c) Cleidocranial dysplasia
   ______ d) None of the above

2. Ectodermal dysplasias are frequently associated with all BUT one of the following. What is the one EXCEPTION?
   ______ a) Absence of eyebrows and eyelashes
   ______ b) Difficulty in thermal regulation
   ______ c) Hypoplasia of the clavicles
   ______ d) Multiple missing teeth

3. Significant movement in the positioning of impacted third molar teeth can be observed late into the third decade of life.
   ______ True ______ False

4. The most common congenitally missing teeth are:
   ______ a) Maxillary and mandibular premolars
   ______ b) Maxillary lateral incisors and third molars in both jaws
   ______ c) Primary canines and incisors
   ______ d) Mandibular first molars

5. In the study by Kumasaka what percentage of Down's syndrome patients experienced hypodontia?
   ______ a) 15 ______ b) 47
   ______ c) 63 ______ d) 92

6. The permanent teeth most likely to be present in ectodermal dysplasia are:
   ______ a) Maxillary central incisors
   ______ b) Maxillary canines
   ______ c) Mandibular premolars
   ______ d) Mandibular first permanent molars

7. According to the work of Shapiro et al, what percentage of patients with clefts also had one or more missing premolars?
   ______ a) 7.7 ______ b) 18
   ______ c) 34 ______ d) 54

8. Hypodontia in the primary dentition is unlikely to be followed by hypodontia in the permanent dentition.
   ______ True ______ False

9. In the use of panoramic radiology for the assessment of patient age, there is a need to develop population specific dental development standards.
   ______ True ______ False

10. The correct sequence for tooth development is: (1) Proliferation; (2) Morphodifferentiation; (3) Initiation; (4) Histodifferentiation; (5) Mineralization.
   ______ True ______ False

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