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## Panoramic radiologic appraisal of anomalies of dentition: Chapter #2

**By Dr. Allan G. Farman**

The previous chapter higlighted the sequential nature of developmental anomalies of the dentition in general missing teeth in particular. This chapter provides discussion supernumerary teeth and anomalies in tooth size.

**Supernumeraries:** Supernumeraries are present when there is a greater than normal complement of teeth or tooth follicles. This condition is also termed hyperodontia. The frequency of supernumerary teeth in a normal population is around 3 % (1). Most supernumeraries are found in the anterior maxilla (mesiodens) or occur as para- and distomolars in that jaw (see Fig. 1). These are followed in frequency by premolars in both jaws (Fig. 2, 3). Pre-, post- or para-dentition supernumeraries are possible depending on the timing of development of the supernumerary teeth in relation to that of the regular teeth. Most supernumeraries are rudimentary or conical in shape; however, some are regular in shape and are then termed supplemental teeth. Supernumerary premolars are frequently supplemental. Complications from supernumerary teeth include impactions and displacement or delayed eruption of regular teeth. Most individual supernumerary teeth are sporadic in occurance; however, multiple supernumeraries can occur in association with cleidocranial dysplasia or Gardner's syndrome. Multiple supernumeraries should be differentiated from compound odontomas. Compound odontomas are encapsulated discrete hamartomatous collections of denticles.

Recognition of supernumerary teeth is essential to determining appropriate treatment (2). Diagnosis and assessment of the mesiodens is critical in avoiding complications such as impedence in eruption of the maxillary central incisors, cyst formation, and dilaceration of the permanent incisors. Collecting data for diagnostic criteria, utilizing diagnostic radiographs, and determining when to refer to a specialist are important steps in the treatment of mesiodens (2). Early diagnosis and timely surgical intervention can reduce or eliminate the need for orthodontic treatment and reduce complications to the regular dentition in such cases. As a good rule of thumb, if a permanent tooth is erupted to half its crown height and the contralateral equivalent tooth in the same arch is not seen clinically, a radiograph should be made to investigate the cause.

In a series of 10 cases of supernumerary premolars treated in Barcelona only one case altered the normal eruption of the regular premolars; two evidenced follicular cyst development (3).

This is consistent with the supernumerary premolars commonly being post-dentition in onset and being impeded from eruption by the regular teeth. Panoramic radiography is an important step toward the identi-

*"Cleidocranial dysplasia is an autosomally dominant condition characterized by defective ossification of cranial bones and clavicles."*

fication, localization and surgical removal of these supernumerary teeth (4).

**(a) Cleidocranial dysplasia:** Cleidocranial dysplasia is an autosomally dominant condition characterized by defective ossification of cranial bones and clavicles. It is associated with multiple supernumerary teeth, especially anterior to the first permanent molars, retained primary teeth and unerupted permanent teeth (Fig. 4). There is also delayed fontanelle closure, and hypolasia or aplasia of the clavicles (5).

McNamara et al. (1999) reported the effectiveness of dental panoramic radiography in identifying features pathognomonic for cleidocranial dysplasia (6). In addition to the established dental complications of failure of eruption of the permanent dentition and multiple supernumerary teeth, morphological abnormalities of the maxilla and mandible, particularly in the ascending ramus and coronoid process are present. While there often are numerous supernumerary teeth present in cleidocranial dysplasia this might not be apparent clinically. Failures in tooth eruption often results in apparent hypodontia. It is often necessary to fabricate overdentures for the prosthodontic treatment of such patients.

Dentigerous cysts may form around the crowns of unerupted regular and supernumerary teeth weakening the structure of the jaw and predisposing it to pathologic fracture. Dental panoramic radiography is a valuable adjunct in confirming the diagnosis of

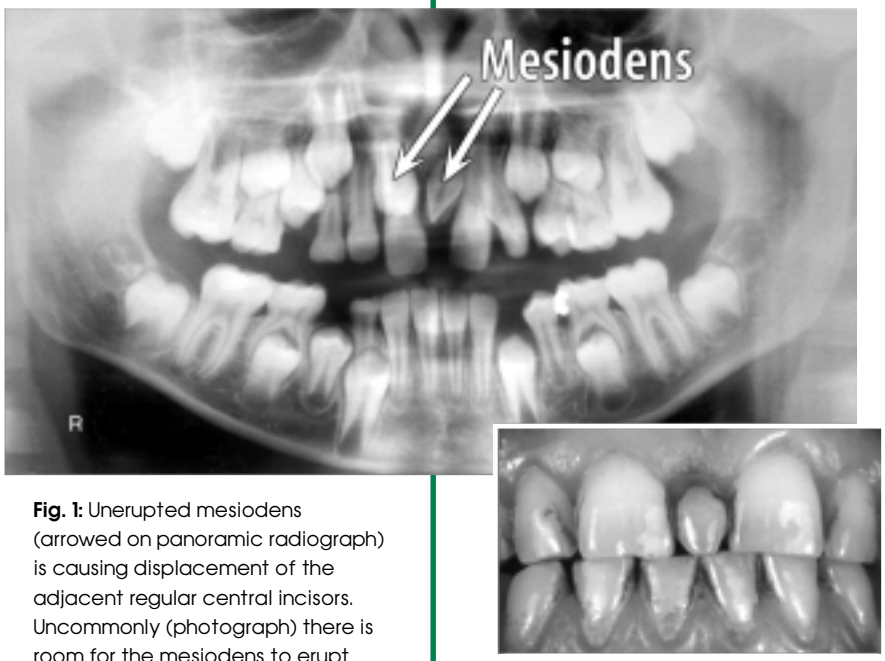



**Fig. 1:** Unerupted mesiodens (arrowed on panoramic radiograph) is causing displacement of the adjacent regular central incisors. Uncommonly (photograph) there is room for the mesiodens to erupt and "function".

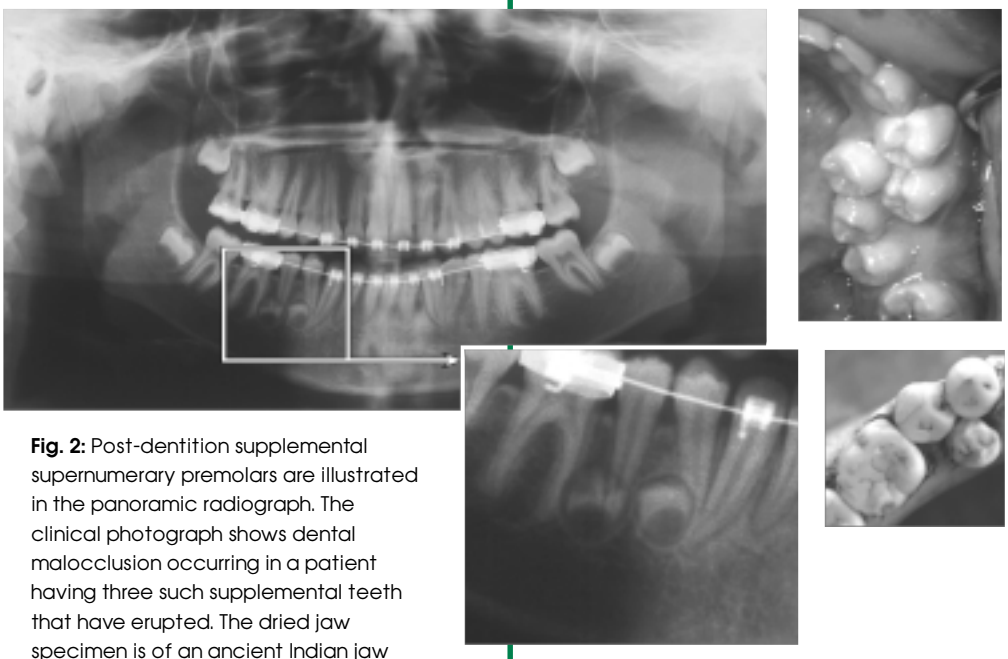


**Fig. 2:** Post-dentition supplemental supernumerary premolars are illustrated in the panoramic radiograph. The clinical photograph shows dental malocclusion occurring in a patient having three such supplemental teeth that have erupted. The dried jaw specimen is of an ancient Indian jaw more than 1000 year old (Mississippian) showing an erupted supplemental premolar tooth.

**Fig. 3:** Multiple unerupted supernumerary teeth in the mandible that are not interfering with the regular dentition. In such cases a syndrome such as cleidocranial dysplasia should be ruled out.

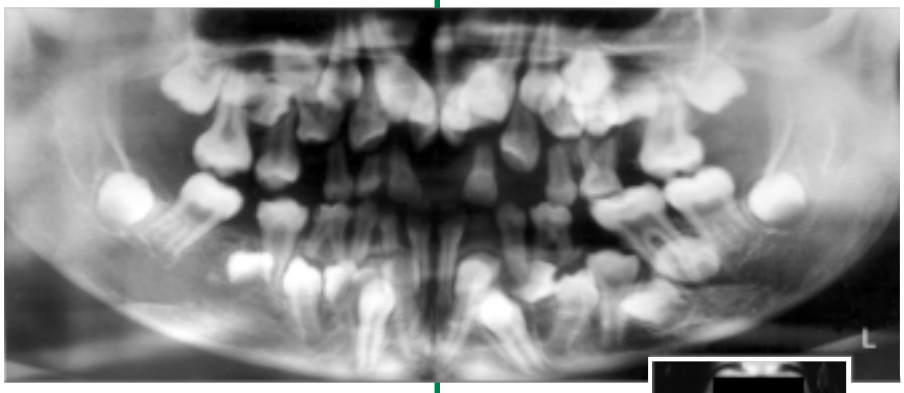


**Fig. 4:** Cleidocranial dysplasia is associated with multiple supernumerary teeth (panoramic radiograph). Affected patients often have hypoplastic or absent clavicles and have the flexibility to bring their shoulders close together in the midline (e.g. photograph).

cleidocranial dysplasia and in subsequently checking for dentigerous cyst formation.

**(b) Gardner's syndrome:** Gardner's syndrome (famial adenomatosis coli; intestinal polyposis type II ) is characterized by the occurrence of multiple impacted supernumerary teeth, osteomas of the long bones, skull and jaws, multiple polyposis of the large intestines and multiple epidermoid or dermoid cysts Significantly, the intestinal polyps are premalignant. Detection of osteomas in the jaws and multiple supernumerary teeth (Fig. 5) on panoramic radiology may lead to the early determination of the syndrome and preventive management of a potentially fatal malignancy (7). In a matched study 82 % of patients having this syndrome showed osteomatous changes compared to 10 % of controls. Supernumerary teeth, compound odontomas and impacted teeth were found in 30 % of patients having Gardner's syndrome compared to 4 % of controls.

**Anomalies in Tooth Size**

**(a) Macrodontia**

Macrodontia involves a tooth or teeth being larger than normal in size with proportional enlargement of pulp chamber, crown and root (Fig 6). This condition may be general or localized. General true macrodontia can be associated with pituitary giantism. Unilateral relative macrodontia can occur in hemifacial hypertrophy. Macrodontia is often sporadic, but can also be a feature of Ekman-Westborg-Julin syndrome (8, 9). There is usually a normal

complement of teeth. Macrodontia needs to be differentiated from connation (gemination or fusion) and concrescence. In germination there is division of a tooth with an attempt to make an additional tooth. In fusion there is combination of two or more teeth with a reduction in number. For fusion, this number count presupposes that the combination does not involve a supernumerary tooth or teeth. Concrescence is the joining of adjacent teeth through cementum.

Early detection of macrodontia is of importance for orthodontic planning of space and cosmetic intervention. Certainly if space is not available for eruption of all of the teeth due to macrodontia, impaction or malocclusion is likely to ensue. Panoramic radiology can help in early diagnosis. Caution needs to be applied; however, as the crown of a tooth that is lingually or palatally displaced will appear magnified horizontally on standard panoramic views. Moreover care needs to be made to ensure the patient was positioned symmetrically in the cephalostat. Rotation or lateral displacement of the head during panoramic radiology can cause one side of the jaws and teeth to be minified, while the other side is magnified.

**(b) Microdontia**

Microdontia implies the abnormal smallness of a single or multiple teeth. This is most commonly an isolated anomaly such as a peg lateral or diminutive third molar tooth (Fig. 7). The

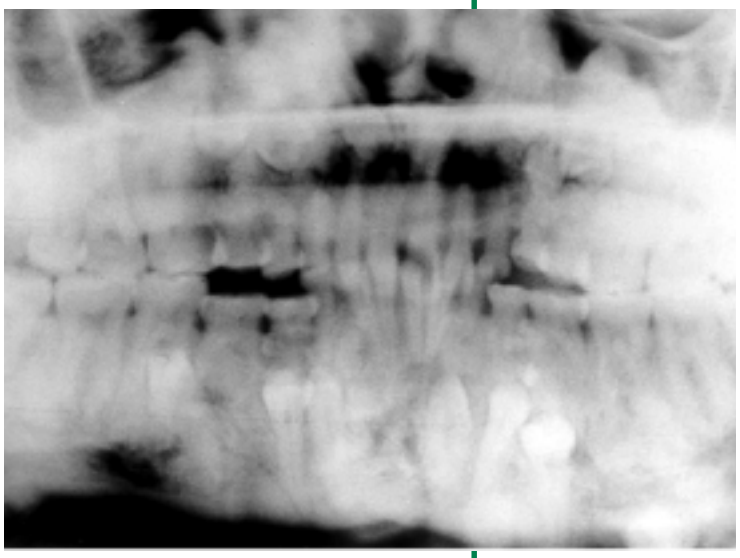
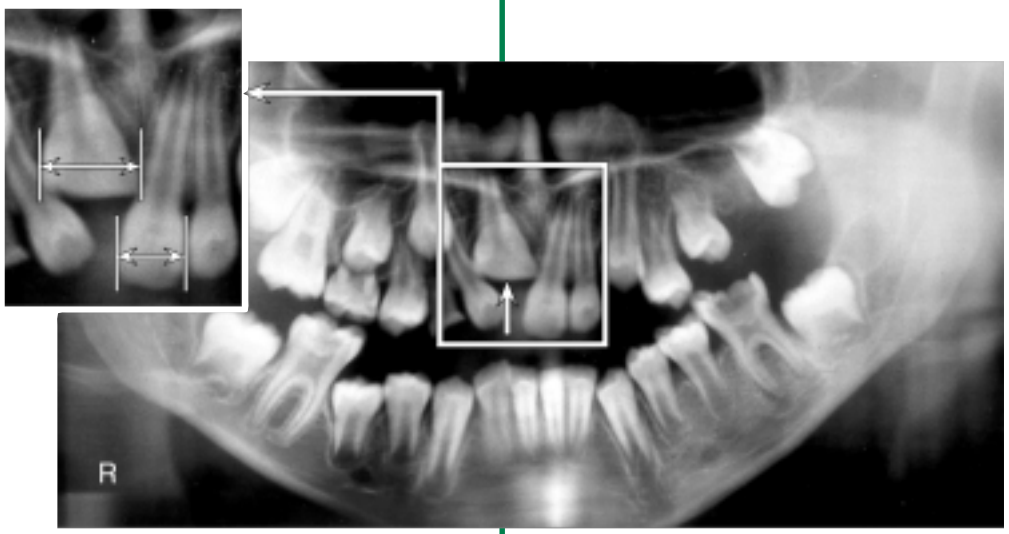


**Fig. 5:** Gardner's syndrome: multiple osteomas are present in both jaws and there are also retained primary teeth and multiple impacted permanent teeth. Such patients are also prone to develop intestinal cancer.



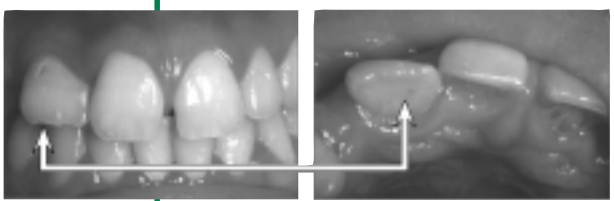
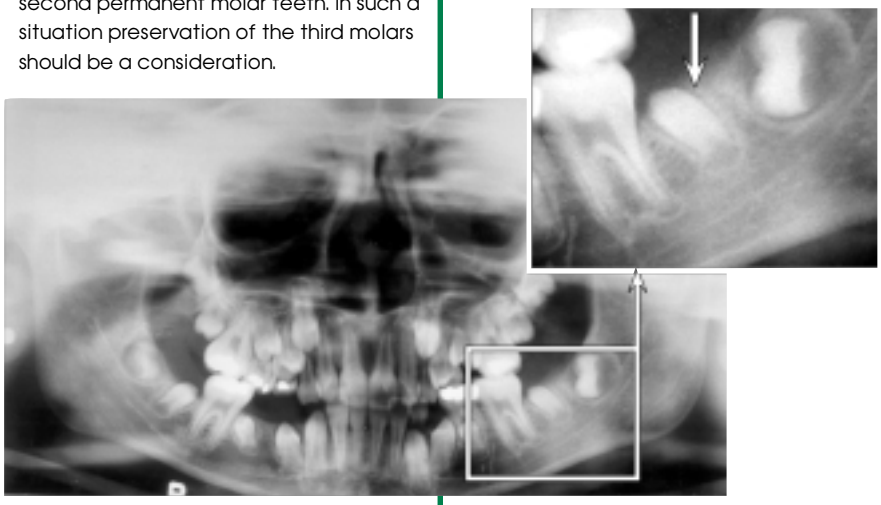



**Fig. 6:** Sporadic macrodontia results in a disproportionately large tooth crown in comparison with the contralateral counterpart tooth (radiograph). The photograph illustrates a case of macrodont lateral incisior in which the tooth was similar in size to a maxillary central incisor tooth.

***"Microdontia implies the abnormal smallness of a single or multiple teeth. This is most commonly an isolated anomaly such as a peg lateral or diminutive third molar tooth."***

**Fig. 7:** Bilateral microdont mandibular second permanent molar teeth. In such a situation preservation of the third molars should be a consideration.



diminutive tooth tends to be somewhat conical in shape. Such teeth need to be differentiated from rudimentary supernumerary teeth, and abnormally shaped teeth due to ectodermal dysplasia or radiation in childhood. Early detection of microdontia can be effected by use of panoramic radiology for evaluation of growth and development.

Baccetti (1998) examined patterns of association among five types of dental anomalies (aplasia of second premolars, small size of maxillary lateral incisors, infraocclusion of primary molars, ectopic eruption of first molars, and palatal displacement of maxillary canines) in an untreated orthodontic population, aged 7-14 years (10). The prevalence of associated tooth anomalies in five groups of 100 subjects each and characterized by the constant presence of one primarily diagnosed dental anomaly was compared to the prevalence for the examined dental anomalies in a control group of 1,000 subjects, deriving from a common initial sample of 4,850 subjects. Significant reciprocal associations ($p < 0.008$) were found among the dental anomalies studied. The statistically demonstrated existence of associations among different tooth anomalies was felt to be clinically relevant, since the diagnosis of a dental anomoly may indicate an increased chance for later developmental tooth and eruption disturbances.

**Panoramic Radiology: an important adjunct in the assessment of dental anomalies**

This and the previous chapter reviewed anomalies in the number and size of teeth. These conditions are of importance for patient esthetics – and consequently may affect perceptions of self-worth. Early detection of dental anomalies isof importance for planning timely orthodontic intervention to assure optimal function dental occlusion and stomatognathic function. The panoramic radiograph is an important adjunct in the assessment of normal growth and development. In the future, Panoramic Imaging News will cover anomalies in tooth morphology and dental structure.

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*" Panoramic radiographs can be used to assess eruption patterns and space availability for posterior teeth."*

# In The Recent Literature:

***Impacted canines: Panoramic radiography combined with a lateral cephalometric image is useful in treatment planning impacted maxillary canines.***

**Stivaros N, Mandall NA. Radiographic factors affecting the management of impacted upper permanent canines. J Orthod 2000 Jun;27(2):169-73. (From the Orthodontic Department, University Dental Hospital, Manchester, UK.)**

The investigators used a retrospective, cross-sectional design to evaluate radiographic factors influencing the orthodontists' decision whether to expose or remove an impacted upper permanent canine. Panoramic and lateral cephalometric radiographic records of patients referred between 1994 and 1998 to the Orthodontic Department at Manchester University Dental Hospital having impacted upper permanent canines ($n = 44$) were evaluated. Canine position measurements made from the panoramic radiograph were angulation to the midline, vertical height, antero-posterior position of the root, overlap of the adjacent incisor, and presence of root resorption of adjacent incisor(s). The labio-palatal position of the impacted canine was assessed from the lateral skull radiograph. Whether the impacted canine had been exposed and orthodontically aligned or removed was also recorded. Stepwise logistic regression analysis showed that the labio-palatal position of the crown influenced the treatment decision, with palatally positioned impacted canines more likely to be surgically exposed and those in the line of the arch, or labially situated, removed ($p < 0.05$). Additionally, as the canine angulation to the midline increased, the canine was more likely to be removed ($p < 0.05$). The orthodontists' decision to expose or remove an impacted upper permanent canine, based on radiographic information, seems to be primarily guided by two factors: labio-palatal crown position and angulation to the midline. These can be readily assessed using a combination of panoramic radiography and a lateral cephalometric image.

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***Space assessment: Panoramic radiographs can be used to assess eruption patterns and space availability for posterior teeth.***

**Tsai HH. 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.

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***Age determination: Standard criteria have been developed using panoramic radiographs for the assess-***

***ment of biologic age in Swedish children and adolescents.***
**Nystrom M, Aine L, Peck L, Haavikko K, Kataja M. Dental maturity in Finns and the problem of missing teeth. Acta Odontol Scand 2000 Apr;58(2):49-56. (From the Department of Pedodontics and Orthodontics, University of Helsinki, Finland.)**

Development of teeth was studied from 2483 dental panoramic radiographs of 1651 healthy patients ranging in age from 2 to 25 years. Dental maturity was assessed using a method based on developmental stages of seven left mandibular teeth. Sex-specific tables were developed of maturity as a function of chronological age and of ages as a function of maturity scores. Percentile graphs for visual evaluations of dental maturity in children and adolescents were also developed. Since maturity scales do not tolerate any missing data, the authors developed linear regression models for predicting the formation stages of each of the seven mandibular teeth. It was easiest to predict the formation stage of the mandibular first molars (correct in 87% within the study material) and most difficult to predict the formation stage of second molars and second premolars (correct in 69% and 70%, respectively.

***Apical root resorption: Panoramic radiographs made before and following orthodontic treatment has been used to assess apical root resorption.***
**McNab S, Battistutta D, Taverne A, Symons AL. External apical root resorption following orthodontic treatment. Angle Orthod 2000 Jun;70(3):227-32. (From the Faculty of Health, Queensland University of Technology, Brisbane, Australia.)**

The association of appliance type and tooth extraction with the incidence of external apical root resorption of posterior teeth following orthodontic treatment was investigated using pre- and post-treatment panoramic radiographs. The study comprised 97 patients. A 4-level ordinal scale was used to rate external apical root resorption. The analysis was mutually adjusted for the effects of age at the start of treatment, pre-treatment overbite and overjet, use of headgear, tooth extraction, and type of appliance. The incidence of such resorption was positively associated with tooth position ($p < .001$), appliance type ($p = .038$), and extractions ($p = .001$). The incidence of resorption was 2.3 times higher for Begg appliance treatment compared with edgewise, and it was 3.7 times higher where extractions had been performed than when they were not.

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***Hypodontia: Panoramic radiographs showed that hypodontia is more frequent in patients having hemifacial microsomia than in matched individuals without this condition.***
**Maruko E, Hayes C, Evans CA, Padwa B, Mulliken JB. Hypodontia in hemifacial microsomia. Cleft Palate Craniofac J 2001 Jan;38(1):15-9. (From the Department of Oral Health Policy and Epidemiology, Harvard School of Dental Medicine, Boston, USA.)**

This study described the patterns of missing teeth in patients having hemifacial microsomia (HFM) and compared the prevalence of missing teeth in subjects with HFM with a group of unaffected subjects. Missing teeth were determined by evaluation of panoramic radiographs. Records of 125 patients with HFM were available from the Craniofacial Center at Boston's Children's Hospital. Seventy-six met inclusion criteria for radiographic analysis of hypodontia. Fifty-two patients met inclusion criteria for comparing the prevalence of hypodontia with a group of patients from the Department of Orthodontics at Harvard School of Dental Medicine. A Fisher's exact test was conducted to test the hypothesis that HFM patients have a greater prevalence of missing teeth than individuals without the anomaly. A $chi^2$ test for trend was conducted to determine whether hypodontia was more prevalent with increasing severity of the mandibular deformity in HFM. Hypodontia was more prevalent among HFM patients (26.9%) versus the comparison group ($p < .0001$). Additionally, the degree of hypodontia was correlated with the grade of

mandibular hypoplasia ($p$ = .024). Hypodontia was found to be more prevalent in patients with HFM than in comparison subjects.

***Third molar eruption assessment: Sequential panoramic radiographs can be used to evaluate eruption of third molars following extraction of second molar teeth.***
**Orton-Gibbs S, Crow V, Orton HS. Eruption of third permanent molars after the extraction of second permanent molars. Part 1: Assessment of third molar position and size. Am J Orthod Dentofacial Orthop 2001 Mar;119(3):226-38. (From the St Helier Hospital, Surrey, UK.)**

The eruptive path of third molars after extraction of second molars was examined in 63 patients. Panoramic radiographs from the start and the end of active treatment and three or more years after treatment were assessed. Study models were used to compare the size of the second and third molar teeth and to assess the final position of the third molars following eruption. All third molars erupted; none became impacted. During eruption, maxillary third molar crowns uprighted and maintained their angulation as they came into occlusion. Mandibular third molar crowns continued to upright significantly mesiodistally after active treatment, with space closure being the result of horizontal translation rather than mesial tipping. Further uprighting occurred once occlusion was established although few became as upright as the second molars they replaced. Mandibular third molar roots were frequently curved distally, thus the third molar crown position was invariably better than the overall tooth angulation would suggest by 16.5° on average. Model analysis (Richardsons' scoring system) showed 96 % of mandibular and 99 % of maxillary third molars erupted into an acceptable position. The mesiodistal size of third molars was suitable to replace second molars. On average, mandibular third molars were 0.55 mm larger and maxillary third molars were 0.70 mm smaller than second molars.

# Frequently Asked Questions:

**Q: What infection control precautions or practices should be applied to the use of a Panoramic Corporation PC-1000 X-ray machine?**

A: Universal precautions as recommended by the CDC, OSHA, ADA and OSAP should be applied. Wearing of exam gloves is recommended. The hand grips, chin rest, forehead support, temple supports, and any surface that may potentially come in contact with the patient, either directly or secondary from the operator, should be disinfected with a hard surface disinfectant such as BIREXse or should be draped. The bite-guide used to position the patient is designed to be disposable and is not autoclavable. Discard and replace after each use. When using the cephalometric attachment, disposable rubber covers should be placed over the ear rods. Surface disinfectants should be used on any direct or secondary contact surfaces.

**Q: Is there a method for reading panoramic radiograms to assure a thorough review of everything being shown?**

A: One approach was suggested by Dr. Allan Farman, our editor, in the initial Panoramic Imaging News Vol 1. #1. "I approach the radiograph roughly in the numerical sequence shown, namely starting with the bony landmarks from the midline of the upper jaw and nasal cavity, then working back in the maxilla and zygomatic complex on each side. The soft tissue shadows of the tongue and soft palate are incorporated at this stage. This is followed by evaluation of the cervical spine and associated structure. I then evaluate the contents of the mandible starting from the midline and then progressing posteriorly on each side. Any examination would be incomplete without a thorough evaluation of the soft tissues anterior to the spine and inferior to the mandible. The last part of the evaluation should be the area of chief complaint and the dental arches. You can sequence your evaluation in many ways; however, it is very important to develop a consistent approach that ensures that all diagnostic information in the radiograph is indeed read."

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