

The mixed dentition pantomogram: A valuable dental development assessment tool for the dentist

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ABSTRACT

The mixed dentition pantomogram is routinely used in paediatric patients. This paper discusses the value of the pantomogram for early identification of problems in dental development during the mixed dentition stage. Aspects regarding dental maturity, leeway space, the sequence of eruption of the permanent teeth, anomalies and the development of the canines will be reviewed.

Keywords: Pantomogram, mixed dentition, dental development

INTRODUCTION

The mixed dentition spans a period of approximately 6 years, and recognizing what is 'normal' or favourable and what is unfavourable during this phase of life allows one to identify developing problems early.¹ Fleming *et al*^{1,2} describe this skill as one of six keys to success in managing malocclusion in the mixed dentition stage. Potential problems in the mixed dentition can be corrected or improved in up to 60% of cases, if identified early.¹ When a mixed dentition case is analysed, the pantomogram provides the clinician with most of the information needed at a single glance.³ In addition, panoramic radiology has the advantage of reduced radiation dosage. The radiation dosage of one pantomogram is equivalent to approximately four bitewing films.⁴ The pantomogram is therefore a recommended and frequently used diagnostic aid in the mixed dentition stage and is valuable to the clinician in:

- The detection of pathosis of bone and/or teeth⁵
- The detection of developmental aberrations, i.e.
- Establishing the dental age of patients^{5,6,7}
- Assessing incipient eruption problems^{5,8,9}
- Estimating the presence, size and shape of unerupted teeth^{5,7,9}
- Identification of dental anomalies^{7,9}

The film plays a minor role as a diagnostic tool for caries. Early periapical pathosis and interproximal caries are in fact more accurately diagnosed on bitewing radiographs and periapicals.¹⁰⁻¹² The overlapping of contact areas on the pantomogram makes the diagnosis of these lesions more difficult¹². However, some authors have found no significant difference between the accuracy of caries detection on a pantomogram as compared to bite-

wings.¹³ The projection of the newer pantomographic machines eliminates much of the interproximal overlapping.¹³

This article serves to suggest a systematic approach to interpreting the various developmental patterns that are seen on pantomograms of the mixed dentition. The following details should be taken into consideration, observed and noted:

- The dental age of the patient
- The leeway space situation
- The sequence of eruption of the permanent teeth
- The developmental status of the permanent maxillary canines
- Developmental anomalies of the teeth

THE DENTAL AGE OF THE PATIENT

Dental and chronological ages are poorly correlated⁶. According to Duterloo¹⁴, 'the dental age is a measure of biologic maturation and very relevant when monitoring development or planning orthodontic treatment.'⁷ There are three considerations when estimating the dental age:⁶

- The clinical picture
- The stage of root development of the permanent teeth
- The amount of root resorption of the primary predecessors.

The permanent teeth tend to erupt in groups.⁶ The incisors and the first molars should all have erupted by the age of 8 years.^{14,6} This phase is referred to as the first transitional period of the mixed dentition.¹⁵ This is followed by an apparent delay of approximately 12 to 24 months, the so-called intertransitional stage of the mixed dentition.¹⁶ During this stage, there are no visible clinical changes with the exception of the development of the canine bulges and the so-called 'ugly duckling' stage. The latter presents as a maxillary central diastema with distal inclination of the lateral incisors. There may also be flaring and labial tipping of these teeth.¹⁶ Resorption of roots of primary teeth, together with changes in the developing teeth and alveolar remodeling are ongoing and are visible on the panoramic radiograph.¹⁴ The subsequent stage, the second transitional period,¹⁷ is heralded by the eruption of the group which includes the mandibular canines and the first maxillary and mandibular premolars (dental age of approximately 11 years).⁶ This is followed by the group which

includes the second premolars and the maxillary canines at approximately 12 years of age⁶ and are then followed by the second permanent molars.⁶

From a pantomogram one may assess the dental age and by comparing it to the chronologic age of the child, one may possibly identify:

- Any tooth or teeth that may be erupting outside the normal sequence of groups. The cause of this delay is often visible on the pantomogram.¹⁸
- A generalized acceleration of the eruption process.¹⁸
- A generalized delay in the eruption process which, according to Becker,¹⁹ may be regarded as a warning sign for potential palatal canine impaction and associated lateral incisor size variations or agenesis. This may also be an indicator of nutritional deficiencies or certain systemic conditions.¹⁸

THE LEEWAY SPACE SITUATION

Crowding of the mandibular incisors in the early mixed dentition is a common occurrence.⁷ The extent of the potential crowding in the permanent dentition can be predicted by utilising good quality dental casts in combination with prediction tables or formulae.^{3,20} Crowding in the mixed dentition stage has been classified according to its aetiology. Primary crowding has hereditary origins⁹ whilst secondary crowding has environmental origins such as habits, early loss of primary teeth or interproximal dental caries.²¹ The leeway space may be assessed on a pantomogram to check whether it is intact or has been compromised in any way. Compromised leeway space can be recognised on a pantomograph as:

- A prematurely missing primary tooth or teeth in the buccal segments²¹
- Interproximal caries of the primary molars or canines²¹
- Excessive mesial tipping of the first permanent molars associated with early loss or interproximal caries of the primary molars or canines.²¹ Clinically a mesio-lingual rotation is visible.
- Distal inclination of the incisors as a result of early loss of the primary canines.²¹
- Tilting of the first permanent molars and permanent incisors towards each other associated with early loss of teeth²¹ or cases of infraocclusion.²²

Compromised leeway space would constitute secondary crowding. Such crowding may be successfully intercepted if identified.^{2,9} Should the treatment entail distalizing a first molar that has tipped mesially, it should be treated before the erupting second molar reaches the cervico-enamel junction of the first molar.²³ If the leeway space is intact, it may be utilized to resolve minor crowding, if required.²⁴

THE SEQUENCE OF ERUPTION OF THE PERMANENT TEETH

This may be viewed as favourable or unfavourable as far as the space for alignment of permanent teeth is concerned. The

sequence of eruption should be viewed as follows:

- Sequence of eruption in the mandible
- Sequence of eruption in the maxilla
- Asymmetries in eruption between the left and right sides
- Eruption of mandibular teeth prior to their maxillary counterparts.

The sequence of eruption of the permanent teeth, particularly in the mandible, is of utmost importance especially when the space situation is marginal.⁶ The most favourable sequence of eruption from a space management point of view is 6, 1, 2, 3, 4, 5 followed by the 7.²¹ This sequence of eruption is the key to the stability of the mandibular arch form which in turn supports the maxillary arch and prevents it from collapsing.²¹ Any other sequence of eruption in the buccal segments may lead to a loss of more than the leeway space, resulting in the crowding of teeth even in cases where sufficient space may have been predicted originally.⁶

Eruption of the mandibular canine following the mandibular lateral incisor and prior to the first premolar is considered favourable. The incisors are supported by the canines, thereby preventing lingual and distal tipping and eventual over-eruption.²¹ Should this sequence be reversed and the first premolar erupt before the canine (which is common with the early loss of the first primary molar), the premolar would erupt and make contact with the distal aspect of the primary mandibular canine. In this situation, there would not be sufficient space for the permanent canine to align itself in the arch.²⁵ It would therefore be either labially or lingually positioned.¹⁷ Simultaneous eruption of the mandibular canines and first premolars is not uncommon.¹⁷ The mandibular first premolar frequently appears to be closer to the occlusal plane than the permanent canine as seen on a pantomogram. In these cases, one should estimate the eruption time by assessing the maturation of the roots of the canine and the premolar. Generally, the tooth showing the greatest development of the root will erupt first.^{25,26} It is quite normal for the mandibular canine to lag behind the first premolar during early development,

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but in the later stages of the mixed dentition, it is normal for the canine to overtake the first premolar and to erupt before the latter.²⁶ The eruption time of the first premolar is also dependant on the root resorption of the first primary molar. Asymmetrical root resorption tends to indicate a delay in eruption time of the succedaneous tooth.²⁵

The mandibular second premolar has three different paths of eruption,^{25, 27} namely: a mesial, an occlusal or a distal path and these can be easily detected on the pantomogram. It is estimated that unerupted second premolars display a mesial inclination in 25% of cases and a distal inclination in 56.5% of cases.²⁷ The eruption of the second permanent molar prior to the second premolar in cases with a marginal space situation tends to decrease the space available for the second premolar. The premolar may therefore be partially blocked out of the arch.⁶ This unfavourable sequence may be an indication for intervention,⁶ particularly in cases where the second premolars exhibit a mesial or an occlusal path of eruption. Second premolars that erupt with a distal inclination tend to hold the first permanent molars back, thus keeping the space open.²⁵ Peck *et al*²⁸ stated that pantomographic images do not accurately show the mesio-distal inclinations of mandibular premolars. The panoramic radiographic technique exaggerates the angle of these inclinations, particularly when the premolars are also lingually tipped.²⁹ Should the inclinations of the second premolars appear unfavourable on the pantomogram, other radiographic views may be considered to confirm these angulations prior to space management procedures being instituted in cases where marginal space situations exist. On a mixed dentition pantomogram it is common to see more overlapping or 'stacking' of the developing buccal maxillary permanent teeth than their mandibular counterparts. This is due to the root angulations, in that the maxillary roots converge while their mandibular counterparts diverge, together with the fact that the leeway space in the mandible is larger than that in the maxilla.³⁰

The sequence of eruption in the maxilla is normally 6, 1, 2, 4, 5, 3, (or 4,3,5) 7.²¹ Should the canines, however, erupt ahead of the premolars, they may be displaced as a result of this unfavourable sequence.⁶ It is important that the maxillary canines and second premolars erupt in quick succession in order to prevent unnecessary space loss. This closeness in development should be visible on the pantomogram during the late mixed dentition phase.²¹ Should the second permanent molar erupt prior to the second premolar, an excessive space loss with exfoliation of the second primary molar will occur which may result in crowding out of the second premolar.^{6, 21}

Small variations in eruption times of teeth between the left and right sides are sufficiently common to be considered normal.⁶ However, the greater the variation, the more likely the probability that the problem is of a localized nature.¹⁸

According to work done by Savara and Steen,³¹ it is common for mandibular teeth to erupt prior to their maxillary counterparts. Should such a disruption occur, overeruption of the opposing maxillary tooth or teeth can be expected and identified on a pantomogram.

THE DEVELOPMENTAL STATUS OF THE PERMANENT CANINES

Impaction and ectopic eruption of maxillary canines in particular is a problem of considerable proportion.³² Early treatment of canine ectopia is viewed positively.³² Radiographic diagnosis is used in conjunction with clinical palpation of the buccal canine bulges.³² An understanding of normal development is of the utmost impor-

tance in identifying potentially problematic canines.³² The developing canines should be assessed in a number of ways:

- The first point to be noted is whether the crown of the maxillary canine is lying occlusal to the root apex of the lateral incisor. According to the guidance theory of eruption, the canine is thought to use the root of the lateral incisor to guide it into position.³³ This indicates whether interceptive treatment in the case of a problem may be instituted or not.³⁴
- The angulation of the permanent canine may present as mesially inclined, upright or distally inclined. The mesial inclination should be no more than 30 degrees to the mid-sagittal plane.³⁵ This would indicate a favourable inclination for the normal positioning of the canine in the arch.
- Resorption of the roots of the primary canines should be visible, starting in the inter-transitional stage¹⁶ (8 to 10 years of age). Non-resorption may be associated with mesial, distal, palatal or buccal deflection of the permanent canine. This is often seen as overlapping of the crown of the permanent canine and the unresorbed root of the primary canine. In all of these cases, canine ectopia may be anticipated.³⁶
- With a visible overlap of the crown of the permanent canine over the root of the lateral incisor, the lateral may or may not display a rotation. The rotation would indicate contact between the crown and the root. This rotation of the lateral incisor may lead to root resorption of the lateral incisor.³⁴ The amount of overlap between the crown of the canine and the root of the lateral incisor is a good indicator of whether interceptive treatment will be successful or not.⁸ If more than half of the root of the lateral incisor is overlapped by the erupting canine the chances of normalization as a result of interceptive treatment decreases significantly.⁸
- In all cases where the canine is palatally positioned, it will appear enlarged on the pantomogram. A generalized unilateral enlargement of all teeth indicates improper positioning of the patient relative to the focal trough.³⁷

The abovementioned criteria may also be broadly applied to the mandibular canines.

DEVELOPMENTAL ANOMALIES OF THE TEETH

Numerous developmental dental anomalies may be detected on the pantomogram. It is not uncommon for more than one anomaly to be present.³⁸

- Radiology is the only means of diagnosing early disturbances in the number of teeth, thereby enabling interceptive treatment to be instituted timeously.⁷
- The presence of supernumerary teeth often results in deviations of eruption and positions of permanent teeth. In order to more accurately locate these supernumerary teeth, a second radiograph, usually an occlusal view, is necessary.³⁹ Supernumerary teeth, particularly in the anterior region of the mouth, may be difficult to see on a pantomogram because of their relationship to the focal trough.³⁹
- In the case of congenitally missing permanent teeth, the pantomogram affords an opportunity to monitor the path of eruption of the surrounding teeth. When maxillary lateral incisors are missing, the developing permanent canines need to be carefully monitored as the root of the primary lateral incisor may not be large enough to guide the canine, thus resulting in ectopia.⁴⁰ Mandibular second premolars display a great variation in the timing of their development.²¹ Due to this variability, determination of congenital absence must be exercised with care.

Accurate diagnosis of a congenitally missing second premolar or a second premolar with hypodontia may be made with any degree of safety only at the age of 9 to 10 years and older.²²

Micro- or macrodontia or teeth with structural defects such as Amelogenesis Imperfecta and Dentinogenesis Imperfecta may need a periapical radiograph in order to make a positive diagnosis.⁷ Maxillary canine ectopia has been shown to be relatively commonplace in cases where peg lateral incisors are present.⁴⁰

Other dental anomalies visible on a pantomogram during the mixed dentition stage are:

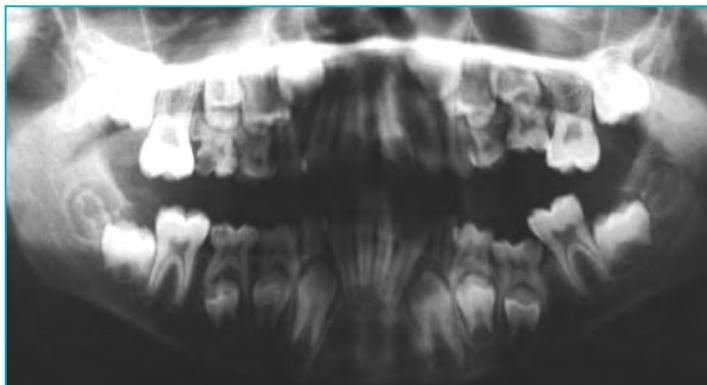


Figure 1

- Localized disturbances in eruption such as ectopic eruption of the first molars. On the pantomogram, the permanent molar will be seen to have a strong mesial inclination and to be impacted under the distal part of the second primary molar. Self-correction may occur between the ages of 6 and 7 years. In these cases, the distal root of the second primary molar may appear to be partially or completely resorbed on the pantomogram.³²
- Infraocclusion can be diagnosed by a “step” in the occlusal plane. It is important to establish the radiographic presence of a permanent successor as this is crucial to the management of the case.²²

There are many different pantomographic machines available. However, the technique of taking pantomograms is basically similar. Some technical tips for successful pantomograms⁴¹ include:

- Stand the patient upright.
- Position the chin in the chin rest.
- Incisors must bite in the groove of the mouthpiece.
- Close the side guides with the mid-sagittal plane centred in the machine.
- Patient should place the tongue against the roof of the mouth, swallow and hold still until the exposure is taken.

CONCLUSION

The general dental practitioner is well-positioned to assess and manage the development of the occlusion. The routine use of the pantomogram during the inter-transitional stage (age 8 to 10 years) of the mixed dentition is recommended as a valuable aid to clinical examination so that unfavourable as well as abnormal patterns of development can be identified. This enabling the dentist to act timeously and to co-ordinate further treatment.

Figure 1 illustrates certain of the concepts referred to in the text

Dental age: 9 years

- Approximately 1/3 of the roots of the mandibular canines and first premolars have formed.

- Mandibular second premolar - root development just beginning.

Leeway space:

Compromised R maxilla

- Distal caries of 55.

Compromised L maxilla and mandible

- Infraocclusion 65, 75, 85.

Sequence of eruption: Unfavourable

- The mandibular second permanent molars appear set to erupt before the second premolars.

Maxillary canines:

- Thus far no resorption of the roots of the primary canines.
- Canines are in contact with the roots of the lateral incisors.
- No overlap between the crown of the 3 and the root of the 2.
- Permanent canines appear enlarged indicating palatal positioning.
- Angulation favourable.

Mandibular canines:

- Angulation favourable.
- Resorption of the roots of the primary canines is occurring.

Anomalies:

- Advanced infraocclusion of 65 and 75.
- Early infraocclusion 85.

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