Space analysis

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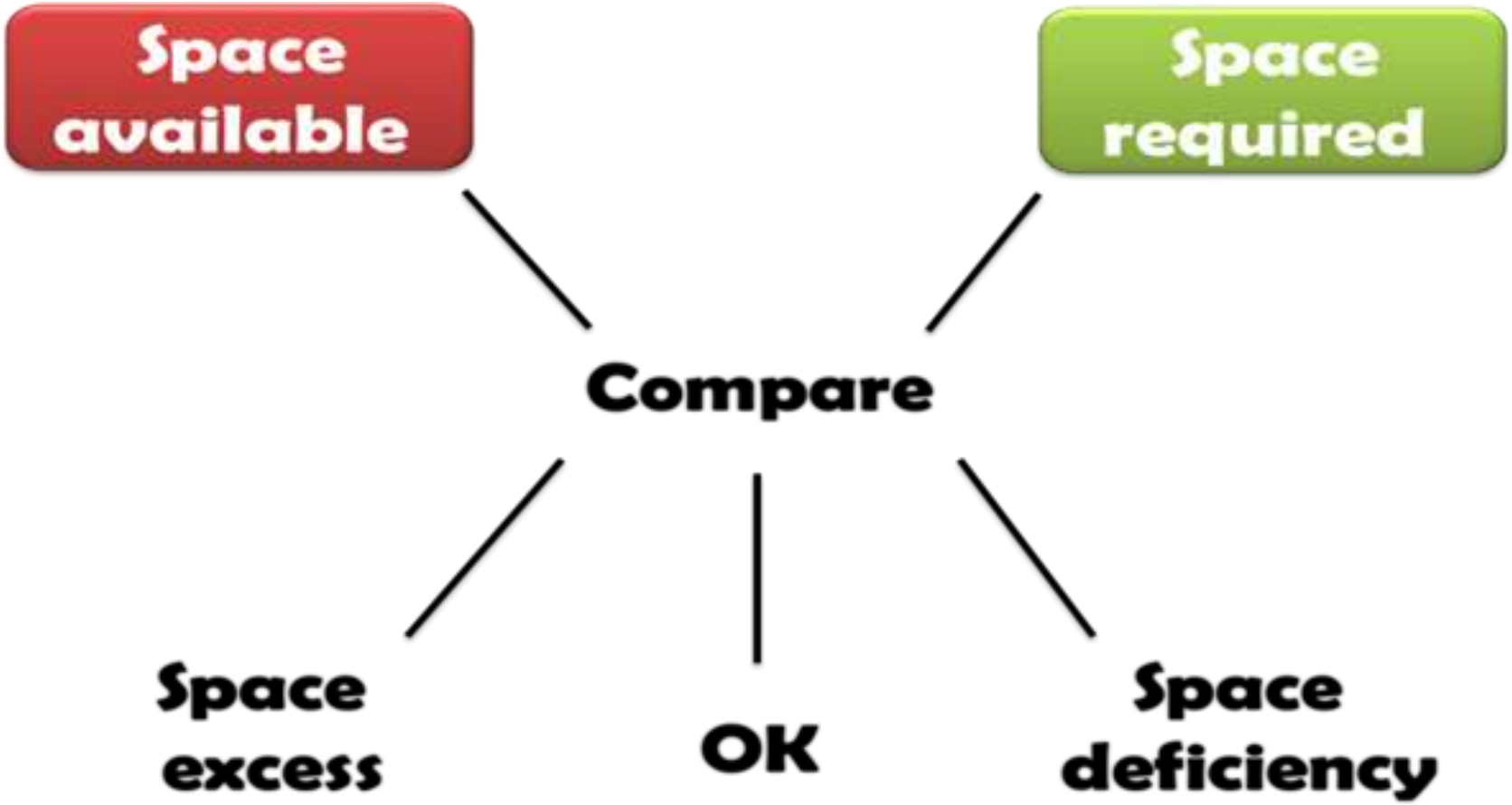
Definition :

procedure of quantifying the space required in each arch, which aids in diagnosis, assessment of need for extraction, treatment planning and anchorage planning.

- Space Analysis requires a comparison between the amount of space available for the alignment of the teeth and the amount of space required to align them properly.
- Space Analysis can be done either directly on the dental casts or by a computer method after appropriate digitization of the arch and tooth dimensions.

Crowding in the arch is denoted as a **negative number (-)** while excess spacing in the arch is denoted as a **positive number (+)**.

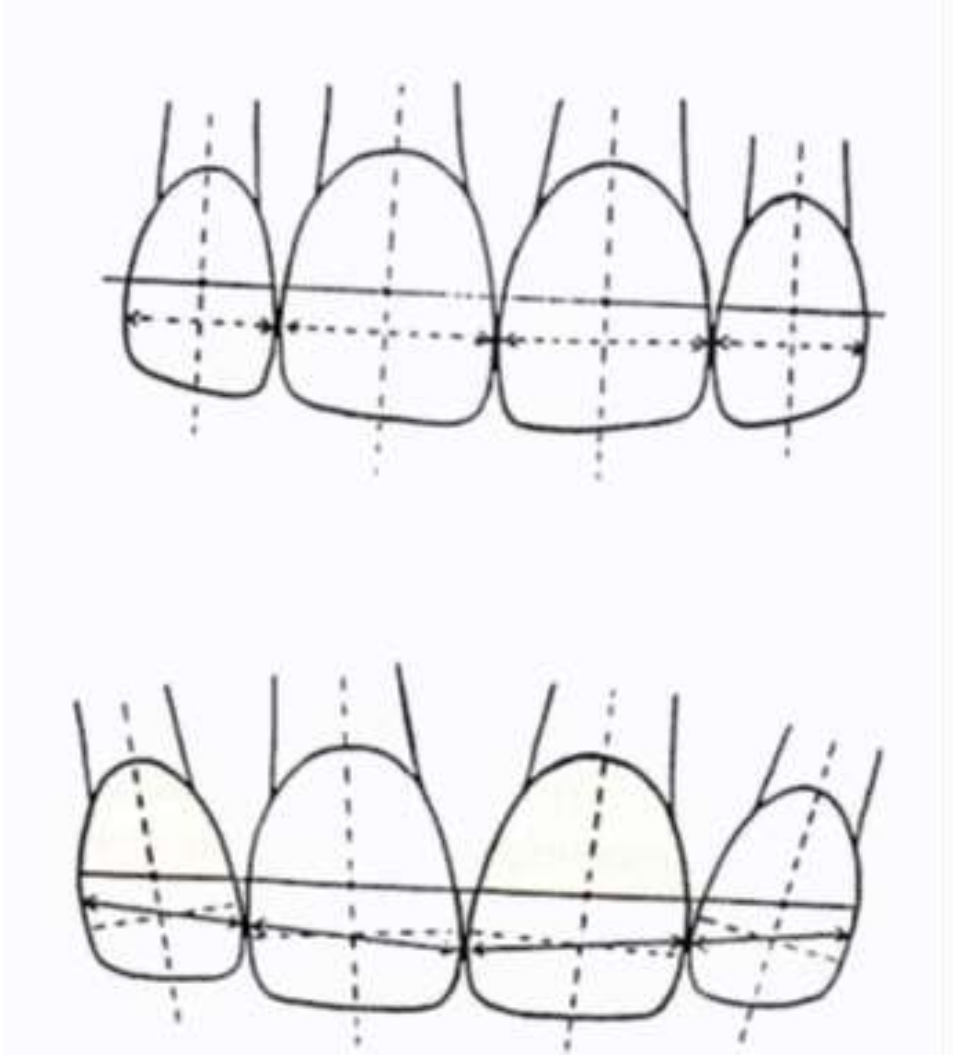


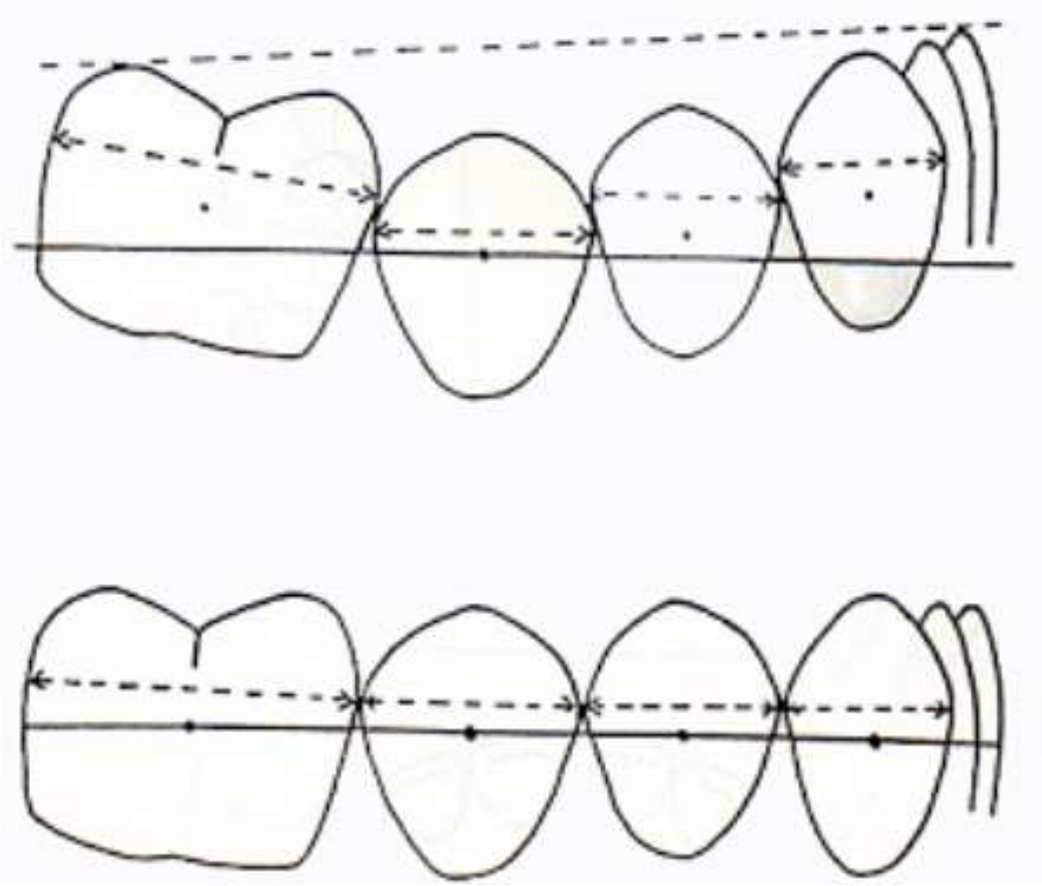
Benefits of Comprehensive Space Planning

- A disciplined approach to treatment planning.
- Defining whether the objectives are attainable.
- Anticipating shortage of anchorage or excess of space.
- Identifying whether extractions are necessary.
- Planning the mechanics of anchorage.
- Planning the mechanics of arch relationship correction.
- Improving pretreatment patient information.
- Obtaining valid informed consent.

Space is required to correct the following:

- Crowding and spacing .
- Incisor anteroposterior change (usually aiming to achieve a normal overjet of 2 mm).
- Levelling of occlusal curves (flattening the curve of Spee).
- Arch contraction (expansion will create space).
- Correction of upper incisor angulation (mesiodistal tip).
- Correction of upper incisor inclination (torque)





Mesiodistal tip

Flattening the curve of Spee

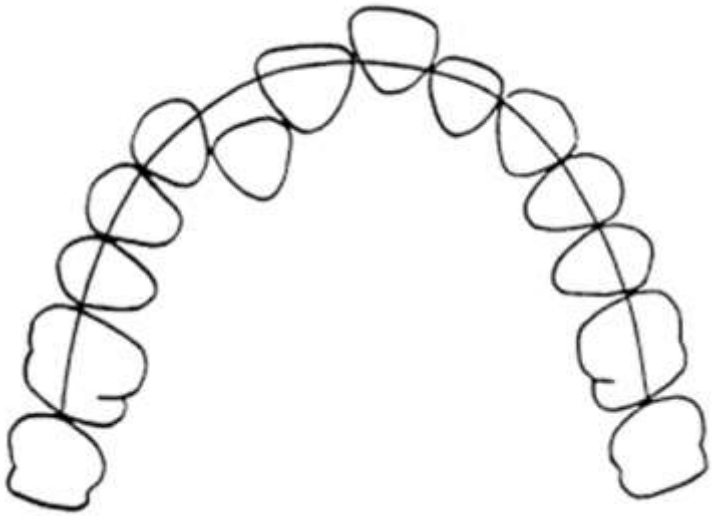
Space Analysis of Permanent Dentition

The **first step** is calculation of space available. This is accomplished by measuring arch perimeter from the mesial of one first molar to the other, over the contact points of posterior teeth and incisal edge of anteriors. There are two basic ways to accomplish this manually:

- ✓ *By dividing the dental arch into segments that can be measured as straight line approximations of the arch.*
- ✓ *By contouring a piece of wire (or a curved line on the computer screen) to the line of occlusion and then straightening it out for measurement.*

The first method is preferred for manual calculation because of its greater reliability. Either method can be used with an appropriate computer program.

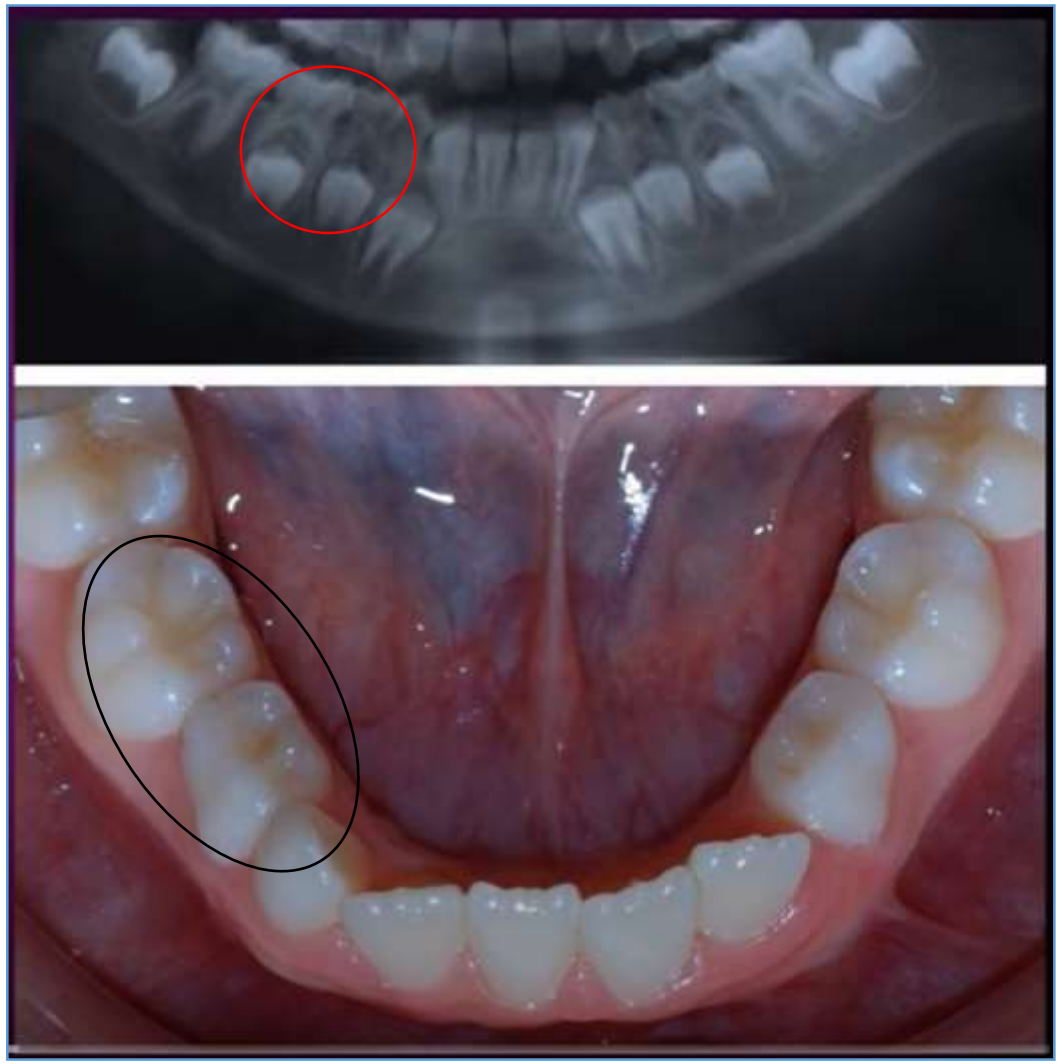
The **second step** is to calculate the a mount of space required for alignment of the teeth. This is done by measuring the mesiodistal width of each erupted tooth from contact point to contact point (from its highest contour) and then summing the widths of the individual teeth.



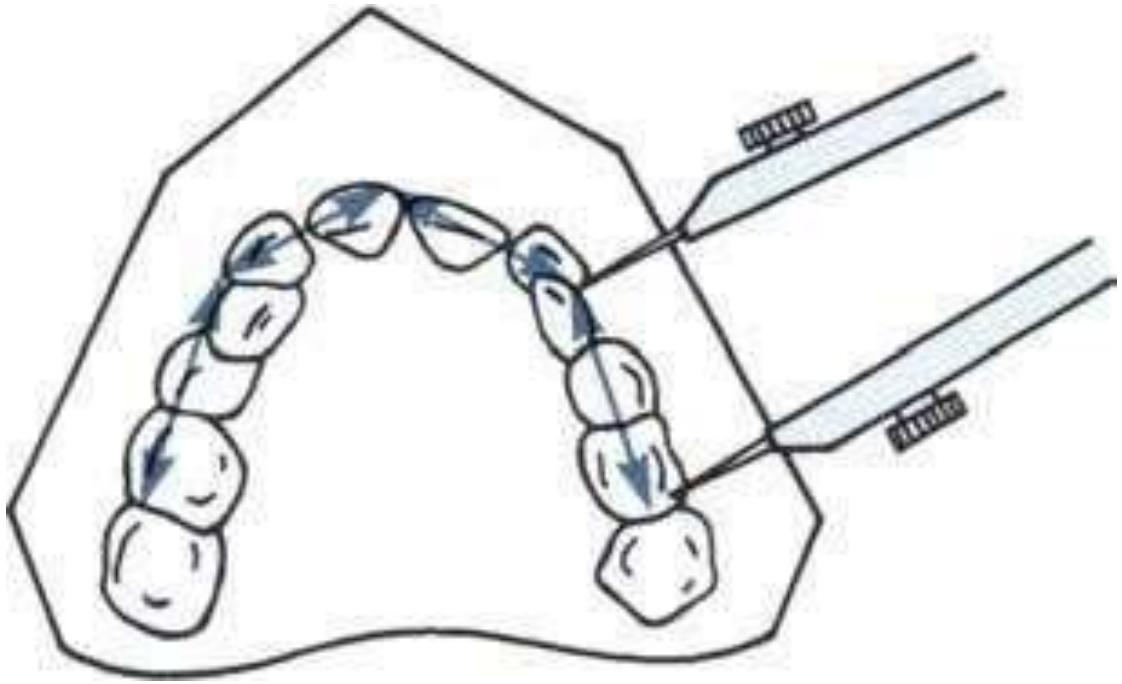
The subtraction of the space required from space available will give ***space analysis***

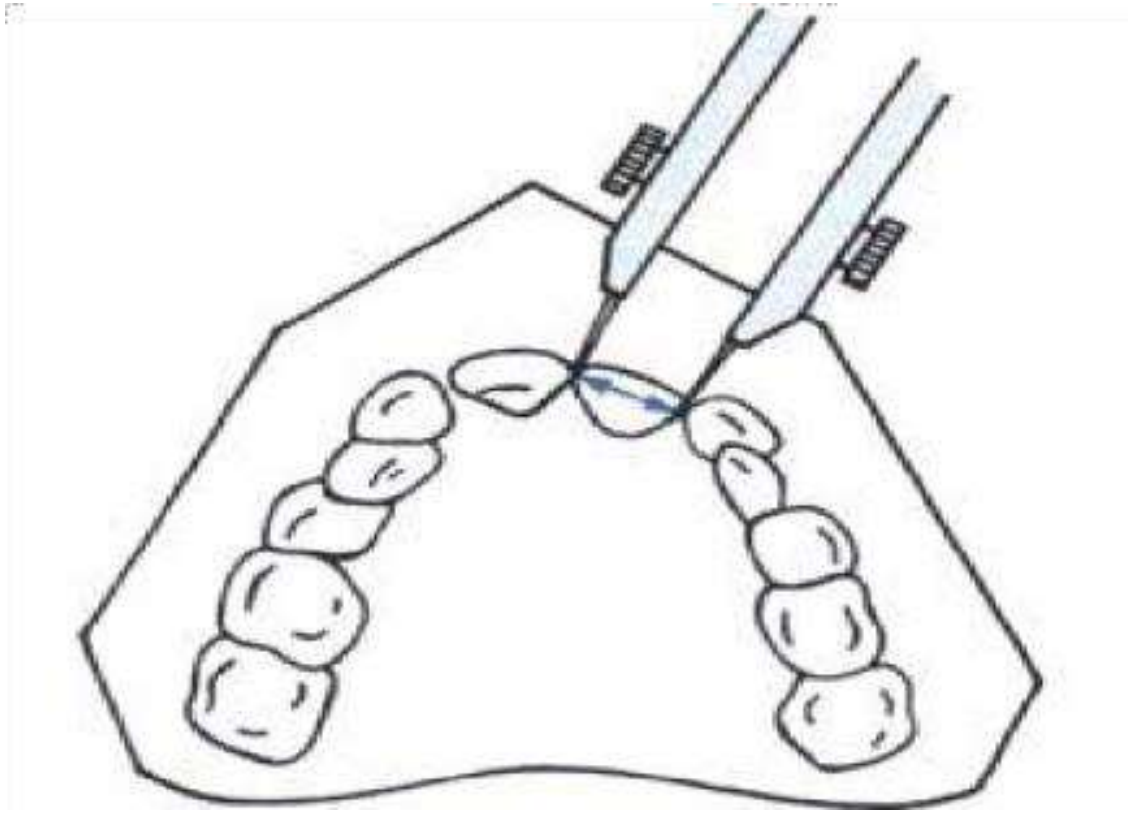
Space Analysis of Mixed Dentition

The purpose of mixed dentition analysis is to evaluate the mount of space available in the arch for erupting **permanent canines and premolars**. A meaningful mixed dentition analysis depends on an accurate prediction of the mesiodistal widths of the unerupted permanent canines and premolars which is essential part of this analysis.



The approach in measuring arch length in the mixed dentition is essentially the same as that described for the permanent dentition. The only difference is the need to predict the mesiodistal widths of the unerupted permanent canines and premolars in mixed dentition.

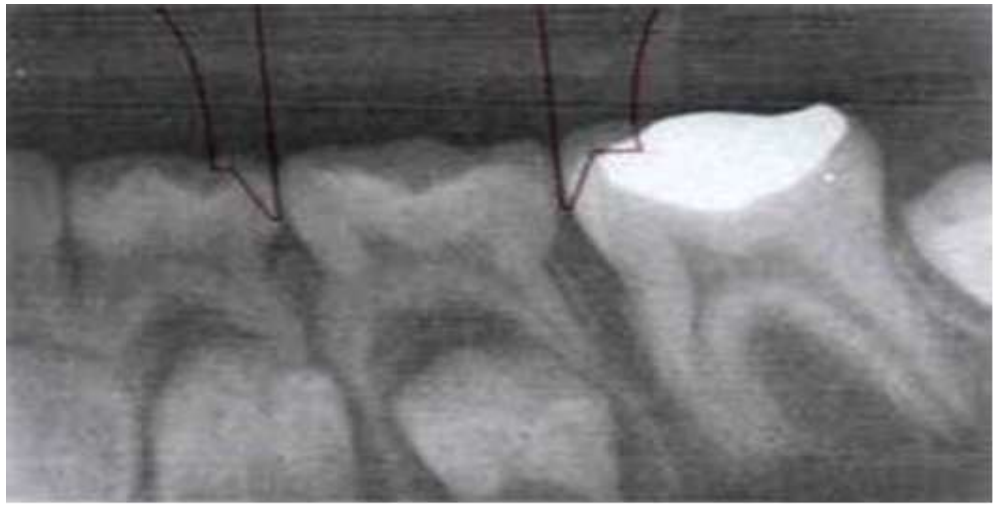


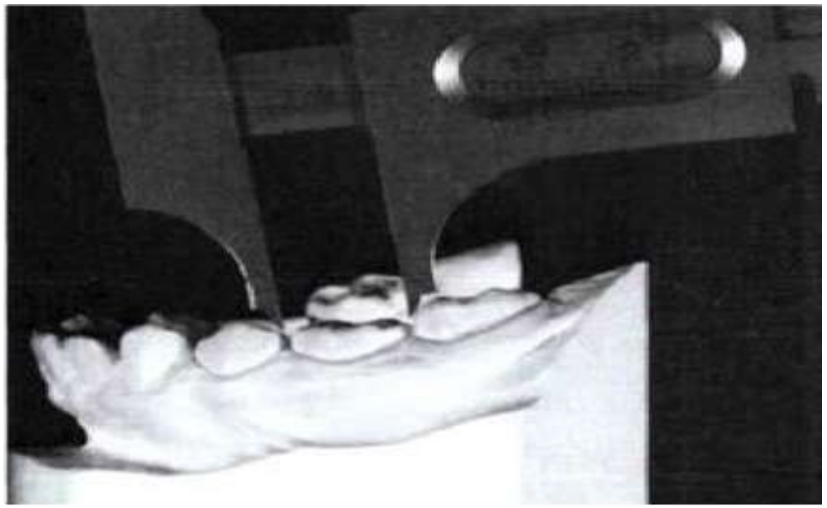


There are three different approaches to estimate the size of unerupted permanent teeth:

1. **Measurement of the teeth on radiographs :** this requires an undistorted radiographic image, which is more easily achieved with individual periapical radiographs than with panoramic radiographs. With any type of radiograph, it is necessary to compensate for enlargement of the radiographic image by measuring an object that can be seen both in the radiograph and on the cast, usually a primary molar tooth. A simple proportional relationship can then be set up:

$$\frac{\text{True width of primary molar}}{\text{Apparent width of primary molar}} = \frac{\text{True width of unerupted premolar}}{\text{Apparent width of unerupted premolar}}$$





2. Estimation from proportionality tables: there is good correlation between the size of the erupted permanent incisors and the unerupted canines and premolars. These data have been tabulated by **Moyers** for white American children. The mesiodistal width of lower incisors is measured and this number is used to predict the size of both the lower and upper unerupted canine and premolars. The size of the lower incisors correlates better with the size of the upper canines and premolars than does the size of the upper incisors, because upper lateral incisors are extremely variable teeth.

Moyers Prediction Values (75% level)

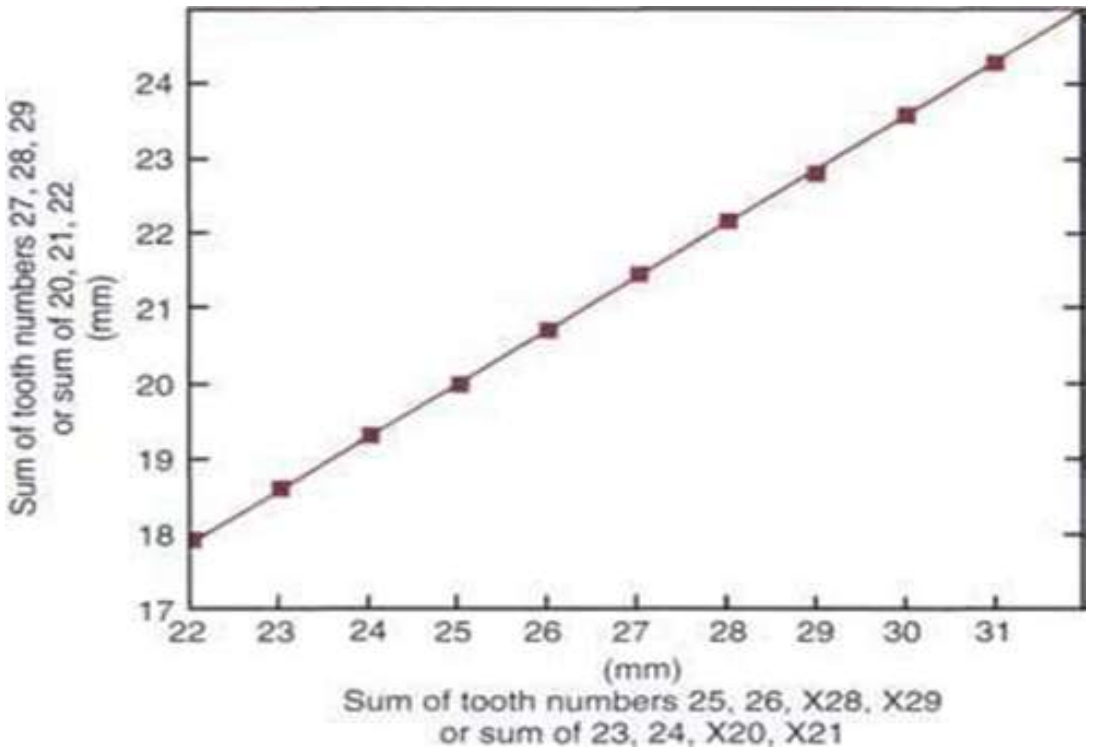
Total mandibular incisor width		**19.5**	**20.0**	**20.5**	**21.0**	**21.5**	**22.0**	**22.5**	**23.0**
Predicted width of canine and premolars	Maxilla	20.6	20.9	21.2	21.3	21.8	22.0	22.3	22.6

Tanaka and Johnston developed another way to use the width of the lower incisors to predict the size of unerupted canine and premolars. For children from a European population group, it not requires radiographs or reference tables (once the simple equation is memorized), which makes it very convenient. The method, however, is less accurate for other population groups.

TANAKA AND JOHNSTON PREDICTION VALUES		
One half of the mesiodistal width of the four lower incisors	**+10.5 mm =**	**estimated width of mandibular canine and premolars in one quadrant**
	+11.0mm =	**estimated width of maxillary canine and premolars in one quadrant**

3. Combination of radiographic and prediction table methods: since the major problem with using radiographic images comes in evaluating the canine teeth, it would seem reasonable to use the size of permanent incisors measured from the dental casts and the size of unerupted premolars measured from the radiographs to predict the size of unerupted canine. graph developed by **Staley and Kerber** from Iowa growth data allows canine width to be read directly from the sum of incisor and premolar widths. This method can be used only for the mandibular arch and, of course, requires periapical radiographs. For children of European ancestry, it is quite accurate.

Graph showing relationship between size of lower incisors measured from cast plus lower first and second premolars measured from radiographs (x-axis) and size of canine plus premolars (y-axis).



For Asian and African child, direct measurement from the radiographs is the best since the Moyers, Tanaka-Johnston, and Staley-Kerber predictions are all based on data from white school children of northern European descent.

Leeway Space

The combined mesiodistal widths of deciduous canine, first and second molars is more than that of the combined mesiodistal widths of permanent canine first and second premolars. The difference between the two is called Leeway Space.

Maxilla = 0.9 mm segment 1.8 mm total Mandible 31.7

mm segment 33.4 mm total

If space analysis is done in the mixed dentition, it is necessary to adjust the space available measurement to reflect the shift in molar position that can be anticipated


Thank You