University of Babylon
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5th stage

Orthodontics

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Lec.4 Space discrepancy & Space Analysis

Methods of Mixed Dentition Analysis

If analysis is being undertaken in mixed dentition, it is necessary to estimate the size of the un-erupted permanent teeth (canines &premolars) to calculate the space required. The difference between the permanent and mixed dentition space analyses is the need to predict the mesiodistal width of the un-erupted canines and premolars in mixed dentition. There are three main approaches to mixed dentition space analysis:-

1. *Measurement of the teeth on radiographs. (Nance mixed dentition analysis, Hukaba mixed dentition analysis)*

This requires an undistorted radiographic image, which is more easily achieved with individual periapical radiographs than with panoramic radiographs. Even with individual radiographs, it is often difficult to obtain an undistorted view of the canines, and this inevitably reduces the accuracy. With any type of radiograph, it is necessary to compensate for enlargement of the radiographic image. This can be done by measuring a tooth that can be seen both in the radiograph and on the casts, usually a primary molar tooth .A simple proportional relationship can then be set up:

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

Accuracy is fair to good depending on the quality of the radiographs and their position in the arch. The technique can be used in maxillary and mandibular arches for all ethnic groups.

2- Prediction tables or equation (Non-radiographic method):-

They are based on the direct measurement of the mesiodistal width of already erupted permanent teeth especially mandibular incisors to estimate the size of unerupted canine and premolars. The most commonly used are Moyer's Mixed Dentition Analysis and Tanaka and Johnson Analysis.

Keep in mind that The size of the lower incisors correlates better with the size of the upper and lower canines and premolars than does the size of the upper incisors, therefore The mandibular incisors were chosen instead of maxillary incisors ***because of their early eruption onset and size stability ,while The maxillary incisors are not used since they show a lot variability in size specially the upper lateral incisors***.

a- Moyers mixed dentition analysis (Estimation from proportionality tables):

Estimation the size of un-erupted permanent teeth in Moyer analysis is done by using ***Prediction table or Proportionality table*** which is currently used worldwide. There is a reasonably good correlation between the size of the erupted permanent incisors and the unerupted canines and premolars.

To utilize the Moyers prediction tables, the space required for alignment of teeth can be calculated by measuring the greatest mesiodistal width of the erupted teeth (permanent central &lateral incisors) either from patient mouth or from study model. While, mesiodistal width of un-erupted permanent teeth (canine & premolars) in upper and lower arch is determined from probability tables ***depending upon the collected mesiodistal width of the erupted permanent mandibular anterior teeth (centrals &laterals).***

In the tables used in Moyers Mixed dentition analysis, 75% level of probability is used as it is the most practical from a clinical standpoint.

The Moyer's space analysis depends upon probability tables, no radiographs are required, can be used for the upper or lower arch, and the accuracy of it is fairly good if applied on children on whom data was tabulated.



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**	**23.5**	**24.0**	**24.5**	**25.0**	**25.5**	**26.0**
Predicted width of canine and premolars in Maxilla	**20.6**	**20.9**	**21.2**	**21.3**	**21.8**	**22.0**	**22.3**	**22.6**	**22.9**	**23.1**	**23.4**	**23.7**	**24.0**	**24.2**
Predicted width of canine and premolars in Mandible	**20.1**	**20.4**	**20.7**	**21.0**	**21.3**	**21.6**	**21.9**	**22.2**	**22.5**	**22.8**	**23.1**	**23.4**	**23.7**	**24.0**

b- Tanaka and Johnston mixed dentition analysis:-

Tanaka and Johnston developed another way to use the width of the lower incisors to predict the size of unerupted canines and premolars and simplified Moyers 75% level of prediction table into a formula ***(certain equation)*** to predicted the width of maxillary canine and premolars (in one quadrant):

The space required for alignment of teeth can be calculated by measuring the greatest mesiodistal width of the erupted teeth (permanent central &lateral incisors) either from patient mouth or from study model. While, mesiodistal width of un-erupted permanent teeth (canine & premolars) in upper and lower arch is determined by using the equation (formula) below:-

TANAKA AND JOHNSTON PREDICTION VALUES

One half of the mesiodistal width of the four lower incisor	**+ 10.5 = estimated width of mandibular canine and premolars in one quadrant**
	+11.0mm = estimated width of maxillary canine and premolars in one quadrant

The method has good accuracy ,it requires neither radiographs nor reference tables (once the simple equation is memorized), which makes it very convenient.

For example :- if the mesiodestal width of lower four incisors are equal to 22mm and the upper four incisors are equal to 28mm.

According to **Tanaka and Johnston method of space analysis,** what are the amount of space required in the upper and lower arch?

Upper arch :-

(M-D width of L4 incisors/2)+11= width of unerupted U3,4,5 one quadrant

22/2=11mm

11+11=22mm (width of unerupted U3,4,5 in one quadrant)

22*2=44mm (width of unerupted U3,4,5 in both quadrant Lf& Rt)

Space required in upper arch= Summation of the M-D width of permanent teeth from ULf 6 to URt 6

= Sum of M-D width of U4incisors+ Sum of M-D with of U Lf &U Rt unerupted 3,4,5

=28+44

=72mm the amount of space required in the upper arch.

Lower arch:-

(M-D width of L4 incisors/2)+10.5= width of unerupted L3,4,5 one quadrant

22/2=11mm

11+10.5=21.5 mm (width of unerupted L3,4,5 in one quadrant)

21.5*2=43mm (width of unerupted L3,4,5 in both quadrant Lf& Rt)

Space required in lower arch= Summation of the M-D width of permanent teeth from LLf 6 to LRt 6

= Sum of M-D width of L4incisors+ Sum of M-D with of L Lf & L Rt unerupted 3,4,5

=22+43

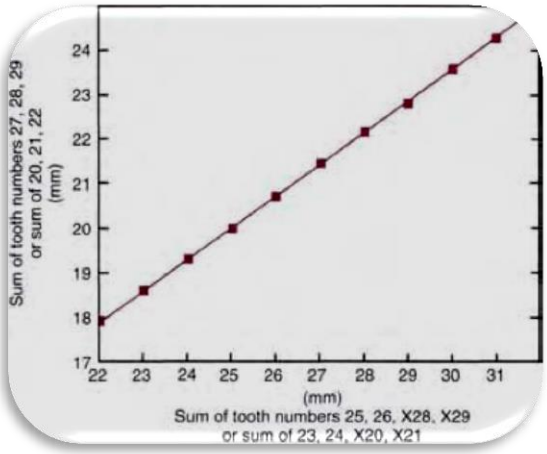
=65mm the amount of space required in the lower arch.

c- Combination of radiograph and prediction equation:Stanley & kerber mixed dentition analysis

Estimation the size of un-erupted permanent teeth in this analysis is done by using ***prediction graph*** by using direct measurement of the mandibular incisors and proportionate measurement of the premolars from radiographs.

The mesiodistal width of the permanent erupted central and lateral incisors is measured from the dental cast. The mesiodistal width of un-erupted premolars is measured from the periapical radiograph. Then summation of the mesiodistal width of central, lateral & premolars of that particular side. The collected mesiodistal width of un-erupted canine&premolars can be read directly from the graph.

This method is used only for mandibular arch and require radiographic image.



In mixed dentition space analyses, after predicting the width of the unerupted teeth:

1- Determine the amount of space needed for alignment of the incisors.

2- Measure the amount of space available of canine and premolars from the mesial surface of the first permanent molar to the distal surface of the lateral incisor.

3- Subtract the space needed for incisor alignment, any necessary molar adjustment(like late mesial shift in lee way space ,which is 0.9mm per quadrant in the upper arch and 1.7mm per quadrant in the lower arch) and overjet correction. This is the actual space available.

4- Finally compare the space available with the predicted canine and premolar widths to estimate space need.

Space deficiency could occur in mixed dentition period for two main reasons:

- ❖ Arch length is too small to accommodate the teeth, arch length- tooth size discrepancy (true, hereditary crowding).
- ❖ Arch length is lost due to local factors as in ectopic eruption of the permanent 1st molar or mesial migration of the permanent 1st molar due to premature loss of primary molars, proximal caries of primary molars, restoration that doesn't restore the ideal contour of primary molar mesio-distally. (secondary crowding).

- If the mixed dentition space analysis predict no or very mild crowding problem, routine care and periodic observation of the child.
- If the mixed dentition space analysis predict mild to moderate crowding, utilization (holding) Leeway space by using holding arches (Nance holding arch in upper &lingual arch in lower), using space maintainer in case of early loss of primary molars, space regainer in case of mesial shift of permanent 1st molar had already occurred, disking of primary teeth (the mesial &distal side of deciduous canines) used to resolve mild anterior crowding.
- If the mixed dentition space analysis predict severe crowding, comprehensive diagnosis & evaluation of the malocclusion should be undertaken. Serial extraction or fixed orthodontic appliance in mixed dentition period may be required.

Example

if the mesiodestal width of upper four incisors (U4incisors) are equal to 28mm, space available for U4 incisors =25mm, over jet =5mm, and space available from mesial side of U6 to distal side of U2 =24mm per quadrant; and

the mesiodestal width of lower four incisors(L4incisors) are equal to 22mm, space available for L4 incisors =19mm , space available from mesial side of L6 to distal side of L2 =24mm per quadrant; and depth of curve of spee =2mm per quadrant.

1- According to **Tanaka and Johnston method of space analysis,** what are the amount of space required in the upper and lower arch?
2- What are the Amount and type of space discrepancy in the U&L incisor region?
3- What are the Amount of space discrepancy (space requirement) in the U&L posterior regions?
4- What are the Amount of space discrepancy(space requirement) in the U&L arches as a whole?

The solution

1- Previously solved in page no. 4

2- **Upper arch**

Space discrepancy = SA-SR

25-28= -3mm (mild crowding)

Lower arch

Space discrepancy = SA-SR

19-22= -3mm (mild crowding)

3- **Upper arch**

SA/Q=24mm (24*2=48mm SA in both Q.)

Amount of SR for correction :-

Ant. Crowding = **+3mm**

OJ: 5mm -2mm=3mm (excess proclination) , 3*2= **+ 6mm** SR for OJ correction

Molar adjustment (late mesial shift) = 0.9mm/Q *2= **+1.8mm** both Q for M shift .

Sum of SR for correction = (3+6+1.8)=10.8mm

SA-SR(correction)=

48mm-10.8mm=37.2mm the amount of actual available space for U post. Both side.

Space discrepancy = actual SA-SR(M-D with of U Lf & Rt 3,4,5)

37.2mm -44mm= **-6.8mm** amount of space requirement in the U post. In both Q. ; **3.4mm per Q**. there will be crowding in the upper posterior regions.

Lower arch

SA/Q=24mm (24*2=48mm SA in both Q.)

Amount of SR for correction :-

Ant. Crowding = **+3mm**

Correction of C of S

Depth of curve of spee(DCS) =2mm/Q

DCS in both Q /2 +0.5= amount of SR for correction of CS

4/2+0.5= **+2.5 mm** (amount of SR for correction of CS)

Molar adjustment (late mesial shift) = 1.7 mm/Q *2= **+3.4mm** both Q for M shift .

Sum of SR for correction = (3+2.5+3.4)=8.9mm

SA-SR(correction)=

48mm-8.9mm=**39.1** the amount of actual available space for L post. Both side.

Space discrepancy = actual SA-SR(M-D with of L Lf & Rt 3,4,5)

39.1mm - 43mm= **-3.9mm** amount of space requirement in the L post. In both Q. ; **1.95mm per Q.** there will be crowding in the lower posterior regions.

4- upper arch

SA = ant. SA + post. SA(both side)

= 25mm+48mm

=73mm (upper arch length)

Total SR= sum M-D width of U Lf & Rt 1,2 & unerupted U Lf&Rt 3,4,5 + SR for correction of crowding, Oj and Late M shift

SR=sum M-D width of U Lf & Rt 1,2 & U Lf&Rt 3,4,5

=28mm+44mm

=72mm

SR for correction of crowding, Oj and Late M shift

3+6mm+1.8mm

=10.8mm

Total SR= 72mm +10.8mm

=82.8mm (amount of SR)

Space discrepancy = SA-SR

73mm -82.8mm

= **-9.8 mm (amount of space descripancy in the upper arch – sever crowding)**

Lower arch

SA = ant. SA + post. SA(both side)

= 19mm+48mm

=67mm (lower arch length)

Total SR= sum M-D width of U Lf & Rt 1,2 & unerupted U Lf&Rt 3,4,5 + SR for correction of crowding, CS and Late M shift .

SR=sum M-D width of L Lf & Rt 1,2 & unerupted L Lf&Rt 3,4,5

=22mm+43mm

=65mm

SR for correction of crowding ,CS and Late M shift

3+2.5mm+3.4mm

= 8.9mm

Total SR= 65mm +8.9mm

=73.9mm (amount of SR)

Space discrepancy = SA-SR

67mm -73.9mm

= **-6.9 mm (amount of space descripancy in the lower arch – sever crowding).**