Space Analysis

Dental cast analysis is an essential diagnostic tool, which can aid in planning the orthodontic treatment, and aid in making up important decision for arch expansion or extraction in a given case.

The analysis can be done either directly on the dental casts or by a computer algorithm after appropriate digitization of the arch and tooth dimensions by scanning the casts.

Space analysis:

It's the comparison between the amount of *space available* for the alignment of the teeth and the amount of *space required* to align them properly. It is determined by a simple subtraction of the required space from the available space.

Permanent Dentition Analyses:

Two measurements are required for space analysis:

1.Calculation of space available.

2.Calculation of space required.

3.The space available – space required = the space adequacy or inadequacy to accommodate the teeth.

If (+ ve) then a spacing is the result but if (-ve) then crowding is the end result.

The Space available:

The space available means the arch length available to accommodate the present teeth.

Arch length measurement is an estimate of the length of the true line of arch from mesial side of one first molars to the other. There are two basic ways:

It can be measured by using a soft brass wire. The wire is placed touching the mesial aspect of first permanent molar, then passed along the buccal cusps of premolars, incisal edges of the anterior teeth and finally continued the same way up to the mesial of the first molar of the contralateral side. The wire is then straightened to measure the space available.

Notes:

✓ In case of proclined incisors the brass wire should be passed along the cingula of anterior teeth.

✓ In case of retroclined incisors the brass wire should be passed along the labial surfaces if they are retroclined.

✓ In case of well-aligned anterior teeth, the wire is passed over the incisal edges of the anterior teeth.

By dividing the dental arch into segments (4-6) straight line segments. Each segment is measured individually with a sharp pointed caliper. The sum of all these segments on both sides represents the available arch length.

Space required:

Tooth material is determined by measuring the mesiodistal width of the teeth anterior to the first permanent molars including (incisors, canines and premolars) at the maximum contour using bow divider and summing them all together. It represents the space required.

Calculating the space requirements

Space is required to correct the following:

- **Crowding: as mentioned above.**
- **Incisor anteroposterior change**

It is often necessary to alter the anteroposterior position of the upper incisors, particularly when reducing an overjet. The aim is to create an overjet of 2mm at the end of treatment.

-If incisors are retracted, this requires space; every millimeter of incisor retraction require 2mm of space in the dental arch.

-If incisors are proclined then space is created: for every millimeter of incisor proclination 2mm of space are created in the arch

For example, if a patient presented with an overjet of 7mm and the incisors needed to be retracted to create a normal overjet of 2 mm so to reduce the overjet by 5mm would require 10 mm of space.

- **Levelling occlusal curves:**

Where there is no occlusal stop the lower incisors may over-erupt resulting in an occlusal curve which runs from the molars to the incisors (Curve of Spee). Levelling an increased curve of Spee requires 1 to 2mm of space depending on the depth of the curve, which is measured from the premolar cusps to a flat plane joining the distal cusps of first permanent molars and incisors. It is generally accepted that 1 mm space is required for 3mm depth

- **Arch contraction and arch expansion:**

Arch contraction requires space while arch expansion creates space**.**

- **Correction of upper incisor angulation (mesiodistal) and inclination (Torque):**

The space requirement to correct incisor angulation or inclination are usually minimal

Note: space occupied by a tipped tooth is greater than an upright tooth.

Mixed dentition analysis:

If analysis is being undertaken in the mixed dentition, it is necessary to estimate the size of the unerupted permanent teeth (canine and premolars) to calcluate the space required. The approach in measuring the space available (arch length) in the mixed dentition is essentially the same as that described for the permanent dentition.   The only difference between the permanent and mixed dentition space analyses is the need to predict the mesiodistal widths of the unerupted permanent canines and premolars in the mixed dentition.

Estimating the size of unerupted permanent teeth to determine the required space:

There are three basic approaches to doing this:

A. *Radiographic methods (Nance's mixed dentition analysis):*

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. This can be done by measuring an object that can be seen both in the radiograph and on the casts, usually a primary molar tooth. A simple proportional relationship/equation can then be set up, this requires the use of the following formula:

$$\frac{\text{True MD width of erupted primary molar}}{\text{MD width of erupted primary molar on X-ray}} = \frac{\text{True MD width of unerupted tooth}}{\text{MD width of unerupted tooth on X-ray}}$$

B. *Non radiographic method:* Estimation from proportionality tables by utilizing the Moyers prediction tables, the mesiodistal width of the lower incisors is measured and this number is used to predict the size of both the lower and upper unerupted

canines and premolars.