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To Access Malocclusion using Anterior Mesiodistal Width of Teeth using Different Methods: A Review Article

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Abstract

The evaluation of study models is a fundamental procedure in orthodontics for diagnosing and planning treatment for malocclusion. This process involves assessing the upper and lower dental arches, focusing on arch length, arch form dimensions, and mesiodistal tooth sizes. Malocclusion is identified through discrepancies in tooth material within the maxillary or mandibular arches, which can indicate the need for orthodontic correction. Significant tooth size discrepancies are commonly observed in Class II Division 1 and Class III malocclusions. The advent of digital 3D scanning technology has revolutionized orthodontic analysis by facilitating more efficient and accurate measurements, thus potentially replacing plaster casts. This study aims to assess tooth sizes across malocclusion groups using digital models and 3Shape 3D measurement software.

Keywords: Malocclusion, Mesiodistal, Mandibular Teeth

Introduction

Analysis of Study Models in Orthodontics

The analysis of study models is an essential procedure in orthodontics for diagnosing and treatment planning for patients with various types of malocclusion. This analysis involves a three-dimensional evaluation of the upper and lower dental arches and their occlusal relationships. Key aspects of this evaluation include arch length, arch form dimensions, and mesiodistal tooth sizes [1, 2].

Malocclusion is diagnosed by identifying discrepancies or excesses in tooth material within the maxillary or mandibular arch forms. Such discrepancies can indicate the need for orthodontic intervention to correct misalignments and achieve proper occlusion [3, 4].

Significant tooth size discrepancies are more prevalent in Class II Division 1 and Class III malocclusions. Jabri *et al.* conducted a study comparing tooth-size ratios among Class I, II, and III malocclusion groups and found no significant differences. However, their study had limitations, especially in the analysis of subgroups within Angle's classification of malocclusions.

Mullen *et al.*[6] assessed Bolton ratios with both dental casts and digital models, discovering no significant differences between the two approaches. They found that digital measurements were 65% quicker than manual measurements. The researchers concluded that digital models are not only as accurate as plaster models but also more efficient, making them a suitable alternative to traditional plaster models.

Cast models have traditionally been essential diagnostic tools in orthodontics. With the advent of three-dimensional (3D) scanning technology, it is now possible to scan and store intraoral models digitally, streamlining the management of casts. Digital orthodontic analysis not only simplifies data access but also eliminates the need for manual measurement tools. As intraoral digital modeling becomes more prevalent, it could potentially replace plaster casts, revolutionizing analysis procedures. This study, therefore, sought to assess tooth sizes across various malocclusion groups using digital models and 3Shape 3D measurement software.

To measure tooth size, either manual or digital methods can be used. Plaster models are commonly utilized to examine the shape and structure of the dental arches, measure tooth sizes, and create a three-dimensional representation of the patient's occlusion.[7]

Various methods which we are discuss to evaluate the malocclusion through which we can measure Class I malocclusion, Class II malocclusion & Class III malocclusion.

Various methods use for mesio distal dimension of teeth

1. Moyers Mixed Dentition Analysis

Robert moyers in 1971.Materials Dental cast, Boley's gaug, Probability chart

Procedure to Measure the sum of m-d width of lower permanent incisors. place 1 tip of gauge in midline & other at distal surface of mandibular lateral incisor. mark this point & repeat this on other side. 2nd mark will be on deciduous canine in case of crowding. distance from mesial surface of mandibular 1st Molar to marked point is space available for eruption of mandibular canine & pms predict the size of canine & pms from probability chart.

if space available is greater than the predicted space the excess space can be used for late mesial shift of molars.

if space available less than predicted space is indication of future crowding.

2. Tanaka & Johnston

They combined the sexes in the study whereas have separate index for both sexes. This analysis takes three measurements into account: Space available after the incisors are correctly aligned. Predicted size of permanent canines and premolars. M-D width of mandibular incisors.

Analysis

mandibular incisors + 10.5/ 2 (for mand. canine & sum of maxillary incisors + 11/ 2 (for max. canine & pm)

Space available = total arch length – [sum of lower incisors + 2 x

(calculated width of canine and premolars).

3. Hixon and Old Father & Staley and Kerber's Analysis

Original equation measurements was primarily obtained from the measurements of the teeth on the left side. Whereas new one on both sides. IOWA facial growth studies.

Arnamentarium Boley's gauge, Study cast, IOPA. Helios double caliper (staley and Kerber analysis)

Premolars that were rotated were not used in staley and Kerber analysis.

From the casts, on one side, measure the m-d widths of the permanent mandibular central and lateral incisor.

From the periapical radiographs, measure the m-d width of unerupted first and second premolars

Total the m-d widths of four(4) teeth. Compare the measured value to estimated tooth size from the Hixon-Oldfather chart.

Repeat steps 1 to 3 for the other side of the arch.

4. Ballard and Wylie's

Ballard and Wylie were so concerned about the distortions of the X- ray films that they devised a scheme for estimating the widths of the mandibular canine and the premolars on the basis of the combined widths of the four lower incisors

Using the plaster models of 441 cases, they measured and recorded the widths of all the mandibular teeth including the first molars.

On the average, the sum of the four permanent lower incisors were 23.84 +/- 0.08 mm

The average sum of the canine,first and the second premolars turned out to be 21.97 +/- 0.06mm.

This analysis makes use of a radiograph and study cast to determine the width of unerupted teeth.

Armamentarium

Dental cast, Boley gauge, millimeter ruler,Periapical radiograph

5. Ashley Howe's Analysis

Relationship exists between the sum of m-d width of the teeth ant. to 2nd molar & width of the dental arch in the 1st pm region. He considered tooth crowding to be due to deficiency in arch width rather than arch length.

Determination of total tooth material (TTM)

Determination of premolar diameter (PMD)

Determination of premolar basal arch width (PMBAW)

Determination of basal arch length(BAL)

P.M.B.A.W.%=P.M.B.A.W X 100 T.T.M

The PMBAW &PMD are compared

If PMBAW > PMD then it indicates that arch expansion is possible.

If PMBAW < PMD it indicates that arch expansion is not possible.

6. Pont's Analysis

In 1909 Pont presented a system whereby the mere measurement of 4 maxillary incisors automatically established the width of the arch in the premolar and molar region.

This Index is a maxillary Expansion index The distance between 14 - 24 (i.e. the distal end of the occlusal groove) is recorded and called as measured premolar value (MPV).

The distance between 16 - 26 (i.e. the mesial position of the occlusal surface) is recorded and is termed as measured molar value (MMV). Whereas on the mandibular teeth the points used are the distobuccal cusps of the first permanent molar.

Sum of incisors (SI)

The distance between 14 - 24 is recorded and called as (MPV)

The distance between 16 - 26 is recorded and is termed as (MMV).

The difference between the measured and calculated values determines the need for expansion.

If measured value is less, expansion is required.

7. Linderharth Analysis

This analysis is very similar to Pont's analysis except that a new formula has been proposed to determine the calculated premolar and molar value

The calculated premolar value is determined using the formula: S.I.x100/ 85

The calculated molar value is determined using the formula: S.I.x100/ 64

Korkhav's Analysis

This analysis is also similar to Pont's analysis. In addition, this analysis utilizes a measurement made from the midpoint of the inter-premolar line to a point in between the two maxillary incisors.

For upper anterior arch length -:

Maxillary arch length (Lu) = SuI x100/ 160

SuI=Sum of upper incisors

Correlation between maxillary and mandibular arch length
The anterior arch length of the mandible (Ll) is shorter than the maxillary arch length (Lu) by labio lingual width of the incisal edge of the upper central incisor
Standard value Ll= standard value of Lu-2mm
Increased measurements Proclined upper anterior teeth
Decreased measurements – retroclined upper anterior teeth.

9. Upper / Lower Tooth Size Discrepancy / Boltons Tooth Ratio Analysis

In 1958, Bolton published his work on interpreting m-d tooth size dimensions and their effect on occlusion. The m-d widths of the 12 maxillary teeth (1st molar to 1st molar) were summed up & compared with the sum derived by the same procedure carried out on the 12 mandibular teeth.
The ratio derived between the two is the percentage relationship of mandibular arch length to maxillary arch length.
If the overall ratio is > 91.3% = mandibular tooth material excess
If the overall ratio is < 91.3% = maxillary tooth material excess
If ant. ratio is > 77.2% = mandibular tooth material excess
If ant ratio is < 77.2% maxillary tooth material excess

10 Tooth Shape Disharmony / Peck And Peck Index

It is done in lower arch Peck and Peck suggested Persons with ideal incisal arrangement had smaller mesio- distal width and comparatively larger labio-lingual width than in persons with incisal crowding.
Procedure m-d widths mandibular incisors = (M.D.).
l-l width of mandibular incisors = (L.L.).
Calculate proportion of the M.D of each tooth to the
L.L of the tooth by using the formula: M.D/LL X 100.
Mean value for central incisor 88-92%
Mean value for lateral incisor 90-95%
Inference
If the value for a given case is more than the mean value then, mesio-distal width of the tooth is more than the labio-lingual width, proximal stripping is indicated in such cases.

11. Tooth Size Arch Length Discrepancy/ Carey's Analysis /Arch Perimeter Analysis

Carey's Analysis helps in determining the extent of discrepancy b/n arch length & tooth material discrepency. It is performed in lower cast & same on upper is called arch – perimeter analysis.
The arch anterior to the first permanent molar is measured using soft brass wire touching mesial surface of 1 st molar of one side and passed over buccal cusps of the premolar & along anteriors & is continued opposite side first molar.
Determination of tooth material: m-d width of teeth anteriorto 1st molar is determined and summed up. The discrepancy is the difference b/n arch length & tooth material
Discrepancy
2.5 mm –In this proximal stripping can be carried out.
2.5-5mm-Extraction of second premolar is indicated.
>5mm-Extrction of first premolar is indicated.

12. Sanin & Savara Analysis

This makes use of precise mesio distal measurements of the crown size of each tooth. Appropriate tables of tooth size distributions in the population & charts for plotting the patients measurements. Commonly used is a boley's gauge to measure the teeth.

13. Kesling Diagnostic Setup

HD Kesling introduced the diagnostic set-up. it helps the clinician in t/t planning as it simulates various tooth movements, which are to be carried out in the patient. The individual teeth along with their alveolar process are sectioned off from the model using a saw and replaced back in the desired final position.
Procedure - Dental cast arranged at 65`to FH plane
Mandibular Incisors are arranged at same angle
Canine and Premolars are placed in correct contact relationship
The maxillary teeth are set according to the mandibular teeth.
If the remaining space on each side is adequate to receive the permanent first molar, then extraction is not required.
If space is inadequate then some teeth must be removed usually the first premolar.
Uses of Diagnostic Set-up
Aids treatment planning as it helps to visualize tooth size-arch length discrepancies and determine whether extraction is required or not.
The effect of extraction and tooth movement following it on occlusion can be visualized.
It also acts as a motivational tool as the improvements in tooth positions can be shown to the patient.

14. Ree's analysis

Given by Denton J. Rees.
All the measurements are made on study models which should be essentially accurate.
Special attention given to the extension into the mucobuccal fold in order to approximate basal bone to at least the distal of first permanent molar.

Method
A ruler is placed against the side of the cast, at right angles to the occlusal surface, and a line is drawn at the mesial contact point of each first permanent molar.
The third line is drawn through the midline contact of upper and lower central incisor.
This line is extended to a point 8-10mm from the gingival margin in the apical direction.
A piece of scotch tape 5 inches long is cut into strips approximately 1/8th inch wide and a thin strip of tape is then placed so that one end is superimposed on the molar mark.
The tape is pressed firmly to the cast to pass through the incisor point, and then trough the opposite molar point.
The teeth on each cast from second premolar to second premolar are recorded at their greatest mesio distal diameter.
Calculations
Following chart permits a quick analysis on any sets of casts.
UB to UT =1.5 to 5 - mean 3.5 - range 3.5
LB to LT =2 to 7 - mean 4.5 - range 5
UB to LB =3 to 9.5 - mean 6.5 - range 6.5
UT to LT =5 to 10 - mean 7.5 - range 5
Where U = MAXILLA; L= MANDIBLE; B= APICAL BASE; T= TOOTH CROWN

Inference
By comparing the average normals to the measurements

taken on the set up casts, following points of diagnostic importance can be derived.
UB to UT or LB to LT.
If discrepancy exists, in borderline cases, internal and external muscular forces, facial esthetics, and other factors will determine the treatment plan.

UB to .LB. If discrepancy exists, reduction of teeth and base may be necessary in one arch, or if not indicated, expansion of other arch is the only alternative.
UT to LT. If discrepancy beyond normal range are present, tooth mass is reduced in one arch or increased in the other by judicious placement of crown or inlays.

15. Irregular Index
Given by Robert M. Little. Anterior dental crowding is perhaps the most frequently occurring characteristics of malocclusion. Adjectives such as mild, moderate and severe etc. are descriptively helpful but still allow a wide range of interpretation.
Method The proposed scoring method involves measuring the linear displacement of anatomic contact points, of each mandibular incisors from the adjacent tooth anatomic points. The sum of these five displacements represent the degree of anterior irregularity.
Each of five measurements represents, in horizontal linear distance between the vertical projection of the anatomic contact points of adjacent teeth.
Calculations/ Inferenence: The results of the irregularity index can be correlated with the scale ranging from 0 to 10 formed by the subjective ranking.
0 – Perfect Alignment.
1,2,3 - Minimum irregularity.
4,5,6 - Moderate irregularity
7,8,9 – Severe irregularity
10 to 20 – Very severe irregularity.

Conclusion
There are numerous model analysis based on different criterias. Now it is left to the orthodontist to accept which ever analysis he feels best suits his group of patients and his diagnosis and treatment planning.

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