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Debates in Orthodontics

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ABSTRACT: Orthodontics, like other fields of medicine and dentistry has its fair share of controversies. Some of these controversies have haunted the profession since its inception and some individuals may be reluctant to change their treatment philosophies in the light of new clinical evidence. New research often highlights inadequacies in these fundamental teachings, eventually leading to a change in clinical practice. A trend is emerging towards evidence-based rather than opinion based decisions as more and more structured research is published.
Such science can neither validate the superiority of a technique nor help to make rational choices among alternatives. Hence, clinical experience and common sense assume a more commanding role in decision making.
KEYWORDS: Controversies,reliability,esthetic need,treatment planning

I.INTRODUCTION

"Our basic controversies in orthodontics tend to be immortal. They never get solved because there is very limited interest in solutions."- Many clinicians feel that it is better not knowing the answers because it allows them to practice in a way that feels comfortable, regardless of the evidence. "The bad, but 'saleable' science drives the good, academic-based, science out of business. As a result, our meetings sometimes are a series of infomercials for appliances and manufacturers." - Dr. Lysle Johnston.

Dr. Johnston's relentless cynicism is born of his 50 years as an academic orthodontist and the changes he has witnessed in the specialty. The specialty has to decide if a dialogue is important on such issues such as mandibular growth effects from functional appliances. Too many orthodontists don't seem to let the evidence direct their treatment decisions. The two most common explanations for the effects of functional appliances, that it's all growth or that it's all dentoalveolar, are both wrong and are substitutes for careful thinking. The preponderance of the evidence, Johnston feels, shows that the early effect of a functional appliance is mandibular displacement and that the final result shows no more mandibular growth than traditional edgewise orthodontic treatment in a growing individual. Results of a small, unpublished study actually show the best mandibular growth effect with a headgear and bite plane. Dr. Johnston's contention is that functionals add nothing to the outcome of a case except adding to cost and treatment time.

From the beginning of the orthodontic specialty, attention has been given to facial growth prediction. Hand-wrist films, stature measurements, and vertebral shape have all been promoted as accurate predictors of facial growth velocity. In a recent study, chronological age turned out to be as accurate in predicting the facial growth peak as any of the other seemingly more sophisticated methods. Ten to 12 years in girls and 12 to 14 years in boys is the time to treat, when growth is important for the treatment outcome. There has been a change in frequency of premolar extraction from 70% extraction cases 30 to 40 years ago to 20% in the latest survey. In the face of no new evidence on the subject, this is a troubling development in a "profession looking for its soul."

Much of the decline is due to the fact that extraction is controversial and bad for business. In fact, a study that looked at adults who were borderline extraction cases as adolescents and treated with four premolar extractions showed a 2mm flatter soft tissue profile than comparable patients treated non-extraction. Not exactly the dramatic difference that would have been anticipated. Long-term stability was enhanced in patients who did not have the mandibular inter-canine dimension expanded. This finding has been reported numerous times during the history of the specialty, but is conveniently ignored when making the decision to expand rather than extract.

Are there any effective substitutes for extraction? Are there any appliances that can do this? Let alone any orthodontists willing to try

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it? What value do people place on orthodontic treatment?

Dr. Johnston studied the assessment of treatment needs from a patient's perspective as well as from orthodontists. He found that patients' opinions of their problems have no correlation to the severity of the problems as measured by standard orthodontic indices. The take-home message is, **"Who needs orthodontics? The person who wants it needs it."**

I.Esthetic Need for orthodontic Treatment

In countries where orthodontic treatment widely available many clinicians accept esthetic impairment as sufficient cause for orthodontic treatment.The rationale underlying such recommendations appears to based on the belief that impaired appearance resulting from malocclusion will negatively influence self-esteem, and that low self-esteem will lead to poor social adjustment and possibly to affective disorders, such as depression. Others insist that orthothontic treatment should be provided only when physical health or functioning is at risk, arguing that the real cause of debilitating responses to dentofacial disfigurement is not the individual's appearance per se.

On the one hand, we run the risk of denying treatment and possibly denying social and psychological well-being along with it to many individuals whose occlusal problems are primarily esthetic. On the other hand, we run the risk of overtreating and ultimately forcing upon society standards for dentofacial appearance that are both unrealistic and, for many, unattainable. The links between esthetic impairment, perceptions of appearance, and social behavior generally have been treated quite casually when they have been considered at all. Yet it is only through understanding these variables and the links between them that we can determine the appropriateness of treatment for conditions in which the impact is primarily on appearance rather than on physical health or functioning

II.CONTROVERSIES IN CLASSIFICATION OF MALOCCLUSION

In 1900, Edward H. Angle wrote that all teeth should be considered when classifying cases.In 1907, he emphasized using the maxillary first molars as reference teeth.Arguments are presented to illustrate the confusion in relying solely on Angle's system of classification.The changes in Angle's thinking and writings between 1900 and 1907 have created a dilemma:should the orthodontist use only the permanent first molars to determine the classification of an Malocclusion?Or, should the canines be included?If so, which teeth, the molars or canines, should be given priority when determining the classification of an occlusion? Or, should the orthodontist use all the teeth to assign a case to one of Angle's Classifications?

Some orthodontists believe that it refers to an asymmetrical occlusion, with a Class II molar relationship on the patient's left side and a Class I molar relationship on the right side. Other orthodontists perceive just the opposite.As a result, orthodontists in the United States cannot agree on the meaning of a Class II Division 1 subdivision malocclusion.A survey was sent to the chairperson of each orthodontic department in teaching facilities in the United States. Fifty-seven surveys were mailed. The survey consisted of a 1-page questionnaire that asked whether, in the orthodontic residency program's philosophy, subdivision refers to the Class I side or the Class II side.

Thirty-four surveys were returned (return rate about 60%) with mixed results. Twenty-two respondents believe that subdivision refers to the Class II side, 8 believe it refers to the Class I side, and 3 teach their students neither meaning for subdivision.

Canine classification

Maxillary canines are among the most stable of dental units because they are the longest rooted of all teeth and therefore very well anchored to the alveolar bone. The canine is the "keystone" tooth in the dental arch, and like the keystone of a stone archway, it provides a buttressing support for the incisors, as well as the posterior teeth. Also, canines provide a vital protective function in lateral excursive movements. Classification was based on the sagittal relation of the maxillary canine to the mandibular canine.

Premolar classification

The premolar classification was put forth by Morton Katz as a modification to the Angle's classification.From the negative perspective, orthodontists traditionally have not had high regard for premolars as functional dental units and have selected premolars most often of all tooth types for sacrifice in an extraction treatment. Also, premolars may have anomalous tooth size or shape.premolars usually present a sharply defined cusp tip, which is centered on the central axis of the premolar crown and which fits precisely into the opposing embrasure. Also, the cuspal inclines are

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steeper and deeper than molar cusps, which makes a more positive fit.

From the above discussion it is clear that the system of classification we use today is inadequate in describing a dental anomaly in it's entirety, aid in treatment planning or be easy to use. A universal classification system will be necessary which will be accepted by all orthodontists around the world. This would help us in standardizing malocclusion rather than disagreeing on the very nature of problem the patient has.

III.CONTROVERSIES IN ETIOLOGY OF MALOCCLUSION

GENETIC VS ENVIRONMENTAL FACTORS

A strong influence of inheritance on facial features is obvious to recognize.It is also apparent that certain types of malocclusion run in families.e.g. Hapsburg jaw. There is considerable anthropological evidence that population groups that are genetically homogenous tend to have a normal occlusion e.g: Melanesians of Philippine islands, this is the result of genetic isolation and uniformity.

Based on this evidence, workers of the yesteryears were tempted to conclude that the great increase in population and its mobilization was the primary explanation for the increase in malocclusion in modern man.The earlier part of the 20th century.

■ The view was that malocclusion is primarily the result of inherited dento-facial disproportions strengthened by the breeding experiments carried out by Prof. Stockhard (1930). Later part of 20th century,A revival and a swing back to the earlier concept that jaw function is related to malocclusion.A number of familial and twin studies in the latter part of the century by workers like Lundstrom (1984), Corrucini (1980), Potter (1986), Bolton and Brush, Harris and Johnson (1991) gave a more balanced view showing that there is no single explanation for malocclusion in terms of function, heredity or environment, but is a result of a complex interplay of these elements.

Brook (1984) and Rule (1995) concluded that Supernumerary teeth follow a familial trait, but they do not follow a simple Mendelian pattern. Jasmine's (1993) work on twins also supports this.Osborne(1958) in twin studies concluded that tooth crown dimensions are strongly determined by heredity.Alversalo and Portin (1969) missing and malformed lateral incisors are due to common gene effect. Their association with familial trends, other dental anomalies like missing teeth, ectopic canines, etc. suggests a polygenic etiology.

Harris and Smith (1982) concluded that crowding, rotations and occlusal relations are entirely nongenetic in nature. If seen in Siblings due to intra familial environment.Bone based direction and proportions are based on moderately strong genetic control syndrome than a malocclusion. In Skeletal malocclusions(Class II Div I), Class.II Div 2, Class.III Twin studies indicate the presence of high familial correlation, showing polygenic inheritance.Among these,Class III is the most heavily influenced malocclusion by genetics."The pertinent question for the etiologic process of malocclusions not whether there are inherited influences on the jaws and teeth, because obviously there are, but whether malocclusion is often caused by inherited characteristics"

RESPIRATORY PATTERN

Respiration is the Primary determinant of jaw and tongue posture.When there is altered respiratory pattern,there will be change in posture of head, jaw, and tongue that alters equilibrium results in jaw growth and tooth position.Harvold,Tomer and Vargevik (1981) observed total nasal obstruction in monkeys, for a prolonged time led to the development of malocclusion by placing a block on the roof of the mouth, forcing the tongue to a more downward position, producing a variety of malocclusion. Because total nasal obstruction in humans is so rare, the important question is whether partial nasal-obstruction is a risk factor in causing malocclusion ?

Ballard and Gwynne-Evans (1958) concluded that Nose breathers, who have a lip - apart posture, usually have post seal with tongue against soft palate as an adaptive mechanism.Woodside,(1991) Concluded that change from mouth-open to mouth-closed breathing after adenoidectomy for severe nasopharyngeal obstruction. Bushey found no relationship between nasal respiration and linear measurements of adenoids in lateral cephalogram before and after adenoidectomy.

Fields et al (1991)Compared respiratory mode in normal and long-faced subjects. Long-faced → significantly smaller component of nasal air flow (40%) but total volume and nasal cross-sectional area were similar.Significant difference in airway impairment does not have direct effect on breathing mode → behaviorally determined than structurally dependent.

Rapid maxillary expansion for transverse maxillary deficiency correction also increases nasal airflow. Hartgerick et al (1987) found no increase of nasal breathing,Can decrease in nasal resistance and did not change respiratory mode of the

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patient.Bell(1977) and Spalding et al (1991) found no decreased nasal resistance and no increased % of nasal airflow.Provides another example why clinicians and researchers should not assume that because one of the parameters of nasal respiraton is affected, others like cross-sectional area, peak nasal flow rate and respiratory mode will all be similarly affected".

Contemporary view

2 opposing principles, leaving large gray area between them:

1. Total nasal obstruction likely to alter pattern of growth and lead to malocclusion. – High percentage of oral respiratory is over represented in long-face population.
2. Majority of individuals with long-face deformity have no evidence of nasal obstruction because some other etiological factor as principal cause.

Tongue-thrust as etiologic factor

Definition- placement of tongue-tip forward between incisors during swallowing. The term tongue-thrust is a misnomer, since it implies that the tongue is forcefully thrust forward. Laboratory studies indicate that individuals who place the tongue tip forward when they swallow do not have more tongue force against teeth than those who keep tongue tip back- in fact, tongue force may be lower.

Tempting to blame tongue-thrust as a cause for open bite, since these individuals keep their tongue between the anterior teeth when they swallow.

The mature/ adult swallow pattern appears in some normal children as early as age 3, but not present in majority until about age 6 & is never achieved in 10 - 15% of a typical population. Some times children & adults who place their tongue between anterior teeth are spoken of as having a retained infantile swallow- this is clearly incorrect, since only brain damaged children retain a truly infantile swallow in which posterior part of the tongue has little or no role. (Proffit)

Equilibrium theory: Light but sustained pressure by tongue against the teeth would be expected to have significant effect. Tongue-thrust swallowing simply has too short a duration to have an impact on tooth position.Tongue pressure against the teeth during a typical swallow is < 1 seconds. A typical individual swallows about 800 times in a day, while awake, but has only a few swallows / hour while asleep. Hence – total/ day is < 1000 times, & thus 1000 seconds of pressure has little/no effect.

Current view point:

Tongue –thrust is primarily seen in 2 circumstances:

- In young children with normal occlusion – transitional stage in normal physiologic maturation.
- In individuals of any age with displaced anterior teeth – adaptive.Hence it is more a "Result" than a "cause"

However tongue posture is more important.

- Light pressure for more duration → change in tooth position.

THIRD MOLARS – A DILEMMA! OR IS IT?

Third molars are usually considered as Vestigial organs which may be reserves for mutilated dentition.The role that mandibular third molars play in lower anterior crowding has provoked much speculation in the dental literature.In a survey of more than 600 orthodontists and 700 oral surgeons, Laskin found, that 65% were of the opinion that third molars sometimes produce crowding of the mandibular anterior teeth.As a result of such opinions, the removal versus the preservation of third molars became the subject of contention in dental circles.

The differing views are third molars should be removed even on a prophylactic basis, because they are frequently associated with future orthodontic and periodontal complications as well as other pathologic conditions.There is no scientific evidence of a cause and effect relationship between the presence of third molars and orthodontic and periodontal problems.

"**Pressure from behind**" theory:

The late lower arch crowding is caused by pressure from the back of the arch. But whether this pressure results from Dev. 3rd molar, Physiologic mesial movement / drift or anterior component of force derived from forces of occlusion on mesially inclined teeth is not sure

Relationship between 3rd molars and incisor crowding

Bishara et al (1989 and 1996) reviewed changes in Lower incisor that occur with time in **untreated** populations between 12 and 25 years and again at 45 years Increase in tooth size arch length discrepancy with age – consistent decrease in arch length. These changes were attributed to a consistent decrease in arch length that occurred with age.

Fastlicht (1970) found that in orthodontically treated subjects had crowding.**Little et al (1981)** observed that 90% of extraction cases that were well treated orthodontically ended up with an unacceptable lower incisor crowding.These long term studies indicated that the incidence as well as the severity of mandibular incisor crowding increased during adolescents and adulthood in both the normal

untreated individuals as well as orthodontic treated patients, after all retention is discontinued.

Bergstrom and Jensen (1961) Cross-sectional study examined dental students of whom had unilateral agenesis of upper and lower 3rd molar, More crowding in the quadrant with 3rd molar present than in the quadrant with the third molar missing.Mesial displacement of lateral dental segments on the side with 3rd molar present in the mandibular arch not in the maxillary arch.The unilateral presence of a third molar did not have an effect on the midline.

Schwarze (1975) compared a group of 56 patients with third molar germectomy to 49 subjects with third molars. He found significantly greater forward movement of first molars associated with increased lower arch crowding in the non extraction group. Lindquist and Thilander (1982) concluded that extracted third molar unilaterally found more stable space conditions (less increase in crowding) on the extraction side compared with the control . Studies indicating lack of correlation between mandibular 3rd molar and post retention crowding **.**

Retrospective studies

Presence of 3rd molar does not produce a greater degree of lower anterior crowding or rotational relapse after cessation of retention. **Kaplan (1974)**.In a cephalometric study found no significant differences in mandibular growth patterns between various 3rd molar groups – erupted, impacted or agenesis.Majority of cases have incisal crowding, but no correlation with 3rd molars. Ades et al (1990)

Although the mandibular third molar probably does exert an insignificant force on the dental arch during its eruption, an objective review of the existing information regarding this topic must conclude that the third molars do not significantly influence the lower anterior crowding.

IV.CONTROVERSIES IN DIAGNOSIS

Diagnostic value of plaster models in Contemporary Orthodontics

Models are the only three dimensional records available to represent dentition in a functional occlusion.Callahan et al(2005) conducted a study in which Orthodontic patients(11 Class I, 7 Class II, 2 Class III) were selected.Four Orthodontists participated with a experience of 8 to 30 years. Initially extra oral photographs, Radiographs are provided.Following which a questionnare is given consisting of 20 diagnostic criteria including Molar relationship, Canine relationship, Arch form, Overbite, Overjet, Crowding etc.Plaster models were later provided and the Diagnosis and treatment plan were revisited to evaluate whether models added any value to the diagnosis.Results was that Diagnostic values remain unchanged.

Rheude B, Sadowsky Pl compared Digital models to plaster models. They concluded this variation as clinically insignificant.**Han U,**In contrast to previous studies, Diagnostic models could provide adequate amount of information for treatment planning in 55% of cases

Current view point is that diagnostic changes made following the addition of study models to the other records proved not to be clinically significant.

CONTROVERSIES IN CEPHALOMETRICS

Orientation of the head in space when one is focusing at a distant point at eye level. German anthropological society in 1884 – Frankfort Agreement. The plane which passes through the left and right porion landmarks and the left orbitale achieved uniformity in craniometric research.Downs – timely warning. It was he who had shown that discrepancies between cephalometric facial typing and photographic facial typing disappear when the Frankfort plane is not horizontal but tilted up or down.

Bjorks studies of facial prognathism also illustrates the unreliability of intra cranial reference lines on cephalograms. Two adult men were selected to represent maximum and minimum facial prognathism relative to the S-N plane.Bjork illustrates the greatest variation in the inclination of the cranial base rather than the greatest differences in prognathism.

The simplest procedure to obtain facial photographs and head radiographs is to instruct patients to sit upright and look straight ahead to a point at eye level on the wall in front of them. The conventional use of two ear rods to stabilize the head in radiographic cephalometry is based on the assumption that the transmeatal axis of humans is perpendicular to the mid sagittal plane. The relationship of the left and right ears in their vertical and horizontal relation is frequently asymmetric.

The insertion of ear rods will obviously result in vertical and/or horizontal rotation of the head ,which introduces a deficient and misleading image. Thereby,the attempt to determine facial asymmetry of a patient generally results in a compromise rather than as an exact definition. Only the left ear rod should be used in radiographic cephalometry both for the lateral and frontal projection. The right ear rod should merely be inserted against any part of the ear.

Reliability of Landmark identification and Head Film Measurement.

The porion, condylion , orbitale and basion were less readily identified than some of the other landmarks. Condylion was less readily identified and Gnathion more accurately identified. Baumrind and Frantz demonstrated marked differences in magnitude and configuration of envelope of error found among different landmarks.Other factors that can influence landmark identification are film density and sharpness.

Limitations of traditional superimposition methods: No points or planes in the craniofacial complex are stable and all move relative to each other during growth. Orthodontic analyses, in effect , relates relatively stable areas as depicted by arbitrarily selected points or planes to more remote but less stable landmarks.

While the primary errors are biologically induced , the secondary errors are entirely mathematically defined, since they are related to the primary errors. Errors in tracing superimposition can be compounded by the method of superimposition used in interpreting the findings. A study conducted by Ghafari et al demonstrated differences in interpretation of facial changes by comparing four traditional cephalometric methods of superimposition.Best fit on anterior cranial base anatomy,sella-nasion,registration point with bolton nasion planes parallel and basion- nasion

The results of their study showed differences among all paired methods to be statistically significant. Growth behavior of an individual as recorded on a sequential set of roentgenograms has been shown to differ greatly when studied using different superimposition methods. Nothing is known of the growth behavior of the individual parts in the continuum of the discrete points studied. Because of the inability of conventional cephalometry to apprehend curved forms, it is limited to landmark indices.

Reference planes: The various reference lines still compete with each other.One system is more or less as good or poor as any other and none is completely reliable because each is subject to large individual variability. What can be done to diminish this problem? The answer is to choose measurements that are based on different reference planes, in this way it is hoped to compensate for pronounced variations in one or the other reference lines.

True vertical plane: The problem of a constant reference plane can be solved if the true vertical plane is used. The true vertical is a constant and is perpendicular to the true horizontal. Some clinicians have acknowledged this fact and developed a cephalometric assessment based on this reference plane. (Michielis and Tourne,1990;Viazis,1991) Viazis analysis was based on Bolton standards in which natural head positionwas never a serious consideration.Thus there was a shortcoming of lack of equivalent norm data. A criticism could be that readers do not agree with some of the abbreviations selected. (SN – SGn instead of Y axis etc).

Cross evaluation with different reference planes is important and can be demonstrated with the ANB angle. If one takes only the ANB angle to measure the relative position of maxilla and mandible to each other ,one must realize that any different horizontal or vertical position of point N and the location of the points A and B in the vertical plane will have an influence on the size of this angle and not on the actual sagittal relation of the two jaws. (Hussels and Nanda ,1984).

The same holds true for a rotation of the occlusal plane: backward rotation of the occlusal plane has a decreasing effect on the ANB angle, though sagittal basal relationships remain constant.

Shortcomings of ANB angle:

Taylor in 1969 pointed out that ANB angle did not always indicate true apical base relationship. Varied horizontal discrepancies of points A and B could give the same ANB measurement because variation in the vertical distance from nasion could compensate for other variation. Beatty in 1975 reported that ANB angle is not always an accurate method of establishing the actual amount of apical base divergence.As an alternative to ANB angle for measuring apical base discrepancy , he devised the AXD angle,where point x is located by projecting point A on to a perpendicular to SN line.Point D is located in the bony symphysis as described by Steiner.

Frankfort horizontal basis for cephalometric analysis Lundström and Lundström-AJO 1995 No difference was found between the variability of the Frankfort horizontal and the sella-nasion line with regard to the horizontal plane. The large variation of both intracranial reference lines, related to NHP, as well as to NHO, confirms their relative unsuitability as cephalometric references for clinical purposes. Findings indicate that a horizontal line, related to natural head position, adjusted to natural head orientation when indicated, presents the most reliable basis for cephalometric analysis.

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Variability between the optic plane and Frankfort horizontal – Tremont Frankfort horizontal is commonly constructed on a lateral cephalogram from the top of the ear rod to orbitale. Ear rod positioning and identification of orbitale present obvious variables with such a reference plane. The optic plane has been proposed as a more accurate representation of Frankfort horizontal.
The optic plane, was significantly different from anthropologic Frankfort horizontal. Also, the optic plane did not vary significantly less from anthropologic Frankfort horizontal than from ear rod to orbitale Frankfort horizontal.

The optic plane was constructed, as defined by Sassouni, by drawing the supraorbitale plane (a line tangent to anterior clenoid and the roof of the orbit), drawing the infraorbital plane (line tangent to the inferior of sella turcica and the floor of the orbit), and then bisecting the angle formed by their intersection to obtain the optic plane.

Steiner – 1953 AJO,Porion and Orbitale are not accurate for use as we are not dealing with dry skulls. Points S and N are clearly visible in the X ray pictures and can be located easily and accurately. Emphasizes that points S and N are located in the mid sagittal plane of the head and therefore they are moved a minimum amount whenever the head deviates from the true profile position and that the points are located on hard non yielding tissue.

Point A revisited – Jacobson- AJO 1980 Point A cannot be accurately identified in all cephalometric radiographs. In instances where this landmark is not clearly discernible, an alternative means of estimating the anterior extremity of the maxillary base is shown. A point plotted 3.0 mm. labial to a point between the upper third and lower two thirds of the long axis of the root of the maxillary central incisor was found to be a suitable point - (estimated point A) through which to draw the NAE line and one which most closely approximates the true NA plane.
Steiners analyses:

Acceptable compromises: Steiner clearly recognized that cephalometric standards are merely gauges by which to determine more favorable compromises as a treatment goal.He developed a chart that reflects a number of average measurements of normal dentofacial relationships. Steiner recognized variations in antero posterior jaw relations to each other. The compromise describes the anticipated axial inclinations of the maxillary and mandibular incisors to the NA and NB lines at various ANB relationships.

The Steiner compromises are geometric resultants of morphogenetic variations and their resulting treatment possibilities. Method of appraisal of jaw disharmony Witts The Witts appraisal is the extent to which the jaws are related to each other. The occlusal plane is drawn through the region of the overlapping cusps of the first premolars and first molars.The point of contact on the occlusal plane from points A and B are labeled AO and BO respectively. The average jaw relationship according to Witts is – minus 1 mm for men and 0 mm for women.

Schudy described the occlusomandibular plane angle (OM angle)as another method of evaluating skeletal divergency and thus an indication of skeletal pattern.A variation in the range of OM angles is from 7 to 21 degrees. As the OM angle approaches 21 degrees,hyperdivergency of skeletal pattern is more likely. Smaller OM angles indicate hypodivergency.

A-Po line and cephalometric correction-Ricketts.The A-Po line is another method used in cephalometric analyses to assess the position of mandibular incisor tooth. A range of –2mm to +3mm is considered a satisfactory incisor position,with + 0.5 mm lower incisor tip to APo line being an idealized position. Downs credits Ricketts for suggesting relating the lower incisor to the profile,specifically the lower face using A-Po.

Cephalometric correction describes a method to determine mandibular dental arch crowding or spacing by assessing mandibular incisor position on a cephalometric radiograph in concert with mesiodistal dimensions of mandibular teeth and mandibular arch circumference. The rationale is that by advancing or retracting the mandibular incisor 1mm will result in a 2mm gain or a 2 mm reduction in the available space for mandibular arch.

Calculations have indicated that tipping the lower incisor tooth forward by 3 degrees results in total dental arch length increase of 2.5mm. Conversely, retracting the mandibular incisor 3 degrees will encroach on the lower arch length by 2.5mm. Ricketts stresses the significance of utilizing linear as well as angular measurements in these assessments. All cephalometric measurements must be evaluated in concert with other measurements and must include clinical and diagnostic judgement.

Mc Namara analyses: For determining the anteroposterior relationship to maxilla and mandible , mid facial length is measured from condylion to point A. The effective length of the mandible is measured from condylion to gnathion. Birte Melsen suggests that there are displacements

of condyle,pogonion,menton and point B relative to superimposition on implants at a study done on annual intervals between 8.5 yrs and 15.5 yrs of age.

Soft tissue analyses- Holdaway Legan and Burstone suggest using a constructed horizontal.This is a line drawn through nasion at an angle of 7 degrees to the SN line. A vertical reference line can be traced passing through sub nasale (SnV) or glabella. Naso labial angle – formed by two lines namely the columella tangent and an upper lip tangent.Arbitrary value is 90 to 110 degrees. Legan and Burstone report a mean value of 102 +/- 4 degrees.

Scheidman et al drew a postural horizontal line through subnasale and further divided the naso labial angle into columella tangent to postural horizontal (-25 degrees)and upper lip tangent to postural horizontal (-85 degrees). They argue that each of these angles must be assessed individually in as much as they vary independently.

E line: Drawn from tip of nose to soft tissue pogonion.Normally the upper lip is about 4 mm behind this reference line while the lower lip lies about 2 mm behind it. Ricketts admits that considerable variation exists in terms of age and sex.He therefore advises that adult lips should be contained with nose – chin lip line. S line:- Steiner line is a line drawn from soft tissue pogonion to the mid point of the S shaped curve between sub nasale and tip.

H line: The harmony line is tangent to the chin point and the upper lip. The H line angle formed between this line and the soft tissue nasion – pogonion line.The H line angle measures either the degree of upper lip prominence or the amount of retrognathism of the soft tissue chin.

Reliability of Digital vs Conventional cephalometric Radiology

Scott R. Mclure compared accuracy of landmark identification utilizing these two different image acquisition methods 19 commonly used cephalometric landmarks are used in the analysis.The landmarks location on the digital images and transparent acetate films could then be described by using X and Y co-ordinates with the aid of computerized program.The average position for each landmark was also used to facilitate accurate superimposition in the creation of scatterograms for each landmark.Three of the 19 landmarks indicated statistically significantly higher landmark identification error for film based identification methods than for digital image based identification.But the error is less than 1 mm indicating unlikely clinical significance.

Trpkova etal conducted similar study in 15 skeletal landmarks and concluded landmark identification using digital images had more precision in both x and y dimensions than conventional film based landmark identification.

Current view point is that the advantages of digital cephalometry coupled with proven clinical performance equal to that of film may lead to shift in what is considered the standard for cephalometric radiography in future.

V.CONTROVERSIES IN TREATMENT PLANNING

EXTRACTION vs NON-EXTRACTION

■ "To extract or not to extract" was one of the early debates that clouded orthodontic world ever since its beginning.

■ In 1911 ANGLE declared: Angle had an uncompromising position against extraction. It was his credo that "the best balance, the best harmony, the best proportions of the mouth in its relation to the other features require that there shall be a full complement of teeth, and that each tooth shall be made to occupy its normal position—i.e., normal occlusion.".Angle developed a classification of malocclusion based on this principle, which is still used today. Another distinguished orthodontist was Calvin S. Case (1847-1923. Case was recognized for his skill and artistry in the esthetic aspects of the practice.. Case continued his interest in orthodontics, devising original appliances and the use of intermaxillary elastics (a technique for which both he and Baker were to claim originality). His special attention to the cleft palate patient was a pioneering work, and he developed a classification of malocclusion that included 26 divisions. It was his reintroduction of the concept that the removal of certain teeth will enable the correction of malocclusion and improve general health and comfort that proved to be a "bombshell." It met with great opposition from many practitioners, especially those influenced by Angle. In 1921 Case published his major work, A Practical Treatise on the Technics and Principle of Dental Orthopedia and Prosthetic Correction of the Cleft Palate. Case was a strong advocate of the relationship of malocclusion to facial improvement. Facial improvement was a guide to treatment. Case/angle controversy TOP Originally, Case was a genuine admirer of Angle. He advocated the Angle system at every turn and hoped to place this system before the dental profession. In fact, he gave up the general practice of dentistry because of Angle's influence. The discord started over the claim that Angle attributed the origin of the use of intermaxillary elastics to Baker, while Case thought

that he should have received that credit. In fact, when Angle described this procedure, he never mentioned Case. This led to charges and countercharges between them in 1903. Case's claim was that in 1890 he started this procedure and reported it at the Chicago Dental Society and also at the Columbian Dental Congress in 1893. The second point of contention was—and is the one usually remembered—the question of the extraction of certain teeth as a means of treatment. Angle's thesis was that "there shall be a full complement of teeth, and that each tooth shall be made to occupy its normal position." Case defended the discreet use of extraction as a practical procedure, while Angle believed in nonextraction. However, the unexpected result of this controversy was that it convinced general practitioners that they should not attempt orthodontic treatment but should refer patients to the specialist.The extraction story was continued into 1911 with Martin Dewey (1881-1933) an ardent champion of nonextraction. The climax of this conflict was a debate in 1911 at the annual meeting of the National Dental Association (former name of the ADA). Bitterness and animosity were rampant. It took many years after this episode for the problem to become a matter of calm and objective evaluation and respectful appreciation of various points of view, each of which has made its contribution to orthodontics. The first decade of the twentieth century was an era of the manufacture of standardized appliances. These appliances were made as sets of various kinds mounted on cards and sold by dental supply companies. By the use of a few simple soldering techniques, the dentist could make a required "fitting," as it was called. George C. Ainsworth patented a regulating appliance that used vertical tubes and the principle of the loop wire in 1904.Varney Barnes patented the so-called Barnes posterior tube consisting of a soldered band that held several teeth together, with vertical tubing applying root pressure to individual teeth.Many innovative ideas and procedures were introduced. Victor H. Jackson (1850-1929) was experienced in mechanics and devised a specially designed appliance known as the Jackson crib, which incorporated the use of an auxiliary spring (finger) as an aid in tooth movement.His appliance was one of the first "systems" of treatment to influence the development of modern orthodontics. Jackson published Orthodontia and Orthopaedia of the Face in 1904. In it he claimed that with his method a large number of patients could be cared for as contrasted to the highly sophisticated techniques in vogue at the time that limited the number of patients. Another contribution was reintroduction of the maxillary suture opening by Herbert A. Pullen (1874-1938) in 1902.Charles A. Hawley (1861-1929) used a celluloid sheet containing a geometric figure that, when adapted to a model, determined the extent of proposed tooth movement (1905) and introduced the retainer appliance that bears his name (1908).Scientific studies included research in dental histology, particularly by Frederick B. Noyes (1904); the influence of heredity and environment on dental structures (1905); emphasis on rhinology, which brought the medical fraternity into cooperation (1907); the study of the deciduous dentition vis-a-vis nasodental growth, especially by Edward A. Bogue (1838-1921);and the diagnosis of "mouth breathing," which took on special meaning (1907). In 1907 Benno Lischer (1876-1959), dean and professor of dental orthopedics at Washington University Dental School in St. Louis, founded the International School of Orthodontia, and in 1912 he published Principles and Methods of Orthodontia. He was an advocate of early treatment. Lischer wrote: "It is my firm belief that irreparable damage is done by oft repeated advice to wait until the permanent teeth are all erupted before beginning operations for correction of malocclusion."Other publications included the first separate journal entitled American Orthodontist, which started in 1907 and ceased publication in 1912. In 1909 C. N. Johnson (Chicago) edited a work entitled A Textbook of Operative Dentistry, which contained a chapter, "Orthodontia," written by Herbert A. Pullen covering over 275 pages of text. It contained not only etiology, diagnosis, and treatment modalities but also instruction in laboratory procedures.

Between 1930-1970

Charles Tweed re-treated the relapse cases with extraction; previously treated with non-extraction methodology, & found occlusion to be much more stable.He supported his theory by Cephalometrics.In late 1940's Extraction reintroduced widely .**Raymond Begg** popularized "Begg" appliance for extraction treatment.This was further strengthened by Prof. Stockard's experiments which showed that malocclusion could be inherited.So why the total change in philosophy?Instability of non extraction results due to Arch length collapse in particulary

1. Lower anterior crowding
2. Reversion to original class II malocclusions and procumbencies.

Between 1970-1990's:

■ **Saw the revival of non-extraction philosophy.**

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Premolar extraction does not guarantee stability of tooth alignment.(Little, Wallen and Riedel – 1981) Lower anterior crowding recurred post retention and deep bites recurred more readily in all 4 extraction cases

- Argument resurfaces

"If result not stable either way, why sacrifice teeth at all".

vs

"If extraction cases are unstable, non-extraction would be worse"

- **Between 1970-1990's**:

Changing views of esthetic.Fuller profile than orthodontic profile.Change from banding to bonding and introduction of functional appliances.

- **Between 1970-1990's**:

The ill-famous litigation – Witzig and Spahl (1980),Premolar extraction causes distalization of mandible posteriorly, displacement of condyle resulted in perforation of articular disc results in TMD.

What happened? Why this shift back to an approach to treatment which was discarded 50 years ago?

Management of Non extraction treatment has improved

1. Issue of growth and our ability to influence it
2. Reduction of caries maintaining arch length(Mixed dentition treatment)
3. Reduced camouflage treatment

Treatment modalities converting borderline cases into non –extraction cases:

Early intervention:

- Use of 'E' space.
- Proximal stripping of primary teeth.
- Space regainers with space maintainers.
- Arch expansion.
- Use of functional appliances.
- Molar distalization.
- Bonded attachments rather than banded ones.

Adult:

- Molar distalization.
- Inter-proximal reduction.
- Arch expansion.
- Surgery for skeletal discrepancies.

Expansion vs Extraction

- Expansion is possible when acceptable range of protrusion in biologic limits. extraction control space closure by combination of retraction (anteriors) and protraction (posteriors).
- Importance of soft tissue
- Lip separation – increases with tooth prominence.
- Thick, full lips – can afford prominent incisors.
- Cephalometric readings can serve as guidelines.
- Size of nose and chin.
- Lip strain i.e. lack of well defined labiomental sulcus.

Stability considerations

- Limiting forces from cheeks
- Fenestrations in buccal cortical plate (> 3mm)

Witzig and Spahl 1987 and Dierkes 1987 have asked

"What are the spaces at the corners of smile from extraction treatment?"

- In Washington university the smile photographs of post treatment extraction and non extraction patients found no predictable relationship between extraction of premolars and Esthetics of smile.If the inter canine width or arch form is maintained during treatment, whether extraction or non extraction, the width of the smile would be the same post treatment.

The claim that the negative spaces in the buccal corridor are a routine result of extraction treatment appears to be false.

Contemporary Extraction Guidelines:

For Class I crowding / protrusion:

- Arch length discrepancy < 4mm with no vertical discrepancy: non-extraction.
- Arch length discrepancy = 5-9mm

Non-extraction : Transverse expansion of premolar segment.

Extraction : Any pattern of extraction depending on hard and soft tissues.

- Arch length discrepancy > 10mm :Extraction

Current view point find that the history completed the circle and rather than anterior crowding being the principal reason for extraction treatment, facial cosmetics should assume the major diagnostic role in border line cases.

CONTROVERSIES IN TIMING OF TREATMENT

Saltzman, Moores in agreement with Tweed said

Mixed dentition can be the most efficient orthodontic care for a specific patient if warranted by carefully oriented analytical diagnosis.

- why do orthodontist wait until the permanent dentition has developed to begin corrective orthodontic t/t.

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■ The optimal timing of treatment of children with malocclusion remains controversial.Determining the relative merits of alternative treatments is complex, not only because of variability in initial conditions and treatment response, also because of differences between orthodontists in treatment beliefs, goals techniques and even skills.

When skeletal change is a goal of Class II malocclusion treatment by growth modification or surgery, dental compensation is a key component to the success of treatment. Melsen (AJO-2003)She did a long term study on intermaxillary molar displacement. A strong tendency of the molars to return to the class II relationship was demonstrated.No evidence that a Class I relationship obtained by extraoral traction was more stable that that obtained by functional or intermaxillary appliances.

VI.CONTROVERSIES IN TREATMENT MODALITIES

CONTROVERSIES IN MYOFUNCTIONAL THERAPY

The use and mode of action of functional appliance is shrouded in controversy. The reason behind this is because of the different philosophies and basis on which each designer constructed his appliance. There may not be a specific modus operandi behind all functional appliances.

Quote from Brite Melson's The controversies herein relates to the Growth changes with functional appliances. as the occurrence of more growth during a given period than would have been expected without treatment. as the attainment of a final size larger than would have occurred without treatment or By 1980's though clinical success with functional appliances was witnessed by practitioners, questions whether they could really stimulate mandibular growth remained. Growth stimulation can be defined in two ways: Functional appliances evolved from different concepts of the interrelationship between the orofacial musculature , dentition and plasticity of growth. Each led to a working hypothesis expressed as an appliance design.

Does early treatment really make any difference in the long run, compared with treatment during adolescence? Advantage of early treatment: reduction in number of patients requiring extractions or surgery.**Does it really modify growth?**he randomized clinical trials of the 1990's: the data showed that, on average, children treated with either headgear or a functional appliance had a small but significant improvement in their jaw relationship, while the untreated children did not.

While Angle strongly believed that the mandible could be made to grow Case disagreed. As **Case states.. "Malrelations of this character point directly to heredity**. **The claim and recently repeated inference that the mandible can be made to grow by artificial stimuli beyond its inherent size is not in accord with any law of organic development."** Baring future chemical or genetic manipulation, this still appears to be a valid principle, although there are others who strongly believe otherwise.The answer seems to be elusive. As is shown by the use of the Milwakee braces. However the Milwaukee braces phenomenon also shows us the remarkable rebound capacity of the hard tissue system and the dominance of inherent growth potential.**Can mandibular growth be modified beyond it's true genetic potential?**

Gianelly through various studies has shown that the mean growth modification of 2mm can be achieved by functional appliance treatment.Thus when compared to a 6mm correction of class II relation to a class I the effects of functional appliances may not be clinically significant. Harvold found significantly higher increments in mandibular length during treatment than after treatment. But however when he compared the results with untreated controls matched for age and growth status he found that the changes can only be ascribed to normal age related changes.Studies by McNamara on the Frankel appliance and Herbst appliance effects on the mandible and the dentition have shown both appliances had influenced the growth of the craniofacial complex in treated persons. Significant skeletal changes were noted in both treatment groups,with both groups showing an increase in mandibular length and in lower facial height,as compared with controls.

McNamara and Bryan studied the Long-term mandibular adaptations to protrusive function on 11 experimental animals.. At the end of the 14-week experimental period, the mandibles of the treated animals were 5 to 6 mm longer than those of the control animals. They concluded that the results of this study do not support the hypothesis that the mandible has a genetically predetermined length

Limitations of current clinical and animal research:A double blind study is not possible in testing functional appliances and thus bias cannot be eliminated. The orthodontist is well aware of the type of appliance he is using and probable treatment effects it can produce. Growth versus treatment changes should always be compared with

untreated controls matched for age, sex and growth status. Even though so much criteria may be taken the experimental samples and control samples may not be totally matched because the growth potential of two people may not be the same unless they are monozygotic twins. And if monozygotic twins were even used it would be unethical to treat one sibling while leaving the other untreated.

Functional appliances and two phase treatment

A multicenter, randomized controlled trial of 174 children to study the dental, skeletal and psychosocial effects of Twin Block have shown that all changes produced were purely dentoalveolar and skeletal changes were actually so minimal as to be considered clinically significant. However results did show that early Twin Block use did result in an increase in self concept and a reduction of negative social experiences.

For 30 years, investigators have noted facial skeletal changes in monkeys as a result of altered oral function.The potential for changes both as a result of increased mandibular length and also effective mandibular position by means of temporo-mandibular joint remodeling was proposed.

Florida study (AJO DO-1998) Keeling, Children aged 9 years at the start of treatment were randomly assigned to control, Bionator and Headgear with Biteplate There was no significant differences in the final PAR scores when patients who wore their headgear or bionator as a retention appliance between phase 1 and phase 2 treatment were compared with patients who did not wear any appliance during this period

University of NorthCarolina(1997) It was a prospective long term study.It had an almost ideal research design.Conducted by Drs. Camilla Tulloch and William Proffit.All subjects were children with overjet of 7mm

University of North Carolina(1997-2004) There was no difference between the groups with regard to ANB angle either at the start or after phase II of treatment.No difference in the quality of dental occlusion between the children who had early treatment and those who did not.There was approximately the same distribution of success and failure with and without early treatment.

Early treatment did not reduce the number of children needing extraction of premolars or other teeth during phase II of treatment.Early treatment did not reduce the eventual need for orthognathic surgery.There was little influence on the time duration that both groups spent wearing fixed appliances.Early treatment did reduce severity of class II malocclusion.Overjet did decrease in the treated groups whether the appliance was a headgear restricting the maxilla or a functional one positioning the mandible forward.

Still doubt whether early treatment is better or not as long as treatment is provided at some point in time.

Studies on Arch length discrepancy (Little AJO 2002).

Without treatment a short arch length will only get worse.Cases that underwent expansion showed the poorest long-term results.Serial extraction followed by routine treatment yields no greater long-term improvement over premolar extraction in the full dentition.

Gianelly A.A. Neither self-concept nor the ability to modify growth is improved by stage-one treatment,There are no skeletodental differences between the results obtained by one-stage and two-stage treatments. Accordingly, two-stage treatment cannot be endorsed on the basis of providing unique and characteristic psychological or skeletodental benefits.

Current view point showed there is very little evidence in the literature to suggest the two phase treatment can significantly modify growth or eliminate the need for protracted phase two treatment nor can it be justified to result is fewer extractions or avoidance of orthognathic surgery. Early phase one treatment is beneficial in reducing the incidence of incisors trauma and may be useful in correction of eruption disturbances.

- **Duterloo** defines orthopedic effect in orthodontics as a change in the position of bones in the skull in relation to each other induced by therapy
- According to **Isaacson**, orthopedic appliances provide a new muscular and functional environment for the facial bones that encourages growth changes of either the mandible or the maxilla.
- **Class III Orthopedic changes**
- Stimulation of maxillary growth in all cases, inhibition of mandibular growth as a result of class III therapy was reported in 67% of the studies.Few studies report on long-term effects of chincup therapy. The findings of Sugawara et al. indicate that chincup therapy did not necessarily guarantee positive correction of the skeletal profile after complete growth.

Maxillary Expansion

- Therapeutic maxillary expansion happens ranging from 0.9 to 3.2mm in 12 weeks to 6 months (short treatment period).Wertz R, Dreskin (1977). The Normal Maxillary growth according to Bolton studies the yearly increase in interjugular width is approximately 1mm, which coincides with Rocky Mountain Standards.Savara claims that the

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maxillary width, expressed as distance between both pterygomaxillary fissures, increased with 0.18mm between 12 and 16 years, because of normal growth.

- Therapeutically induced maxillary expansion is larger than the increase expected because of normal growth, within a short observation period. As stated by Sarnäs, the net increase out of retention is only 1.6 mm being within anticipated normal growth.

Current view point in Maxillary Expansion is that no scientific evidence exists so far to indicate that an orthodontist can induce a stable enlargement of maxillary basal bone that exceeds normal growth.

Bite Opening controversy

Although the sagittal construction bite advancement concept generally was accepted by clinicians in Europe (it varied from 3 to 6 mm) depending on the severity of anteroposterior dysplasia and resultant abnormal buccal segment interdigitation, the theory pertaining to the amount of vertical opening and its effects on the muscles produced considerable controversy.**Anderson and Haupl's** interpretation presupposed freedom for the mandible to assume the physiologic rest position.**Slagsvold**, later professor of orthodontia at Oslo, reported that his own observations did not substantiate this premise completely. Nevertheless he concurred that forward posturing should not exceed the rest position vertical opening of 2 – 4 mm.

Too wide on opening made compliance more difficult and could produce a depressing force on the teeth, hardly desirable in deep bite, class II malocclusions. Grude and Frankel strongly support this construction bite limit

The philosophy of **Harvold & Woodside** has been to exceed the free way space limits, if for no other reasons than to keep the appliance in place at night during sleep or as to maintain a corrective stimulus.

- Incremental vs one step advancement

Frankel recommends incremental small advancements of 2 to 3 mm for his appliances rather than the great leap forward of 5 to 7mm. Reactivation of optimal tissue response as well as enhanced patient compliance are factors. This concept encourages daytime wear. The frequency of deglutition is increased and phasic muscle activity is enhanced.

Frankel R: Clinical relevance of step by step mandibular advancement in the treatment of mandibular retrusion using the frankel appliance AJO 1996

Sander and Schmuth also have studied the effect of large protrusion construction bites with tendency to disclude the appliance both during the day and at night reducing the desired effect and jiggling selective teeth. Also histological evidence support periodic incremental advancement because of the periodically enhanced condylar and fossa response with each adjustment.With single 6 to 7 mm the condylar and fossa growth stimulus is of shorter duration, daytime wear becomes more difficult and adverse labial proclination of mandibular incisors may be greater.

- Day time vs Night time wear

Selmer Olsen believed that the muscles could not actually be stimulated during sleep. Nature had designed them to rest at night and swallowing occurred only 4 to 8 times any hour.**Harvold and Woodside, Ricketts** recommend nighttime wear of appliance for maximum effect.

- Effect of head posture during sleep

Mandibular rest position depends on the head and body posture, thereby the restriction of muscle movement required to create the desired mandibular position change, without the activator in place, varies constantly involving different muscle groups and creating different force vectors on the activator.Variation in head posture during sleep alters the magnitude and direction of force.

The phase of sleep, intraoral air pressure, dream cycle, state of mind are additional conditioning factors all uncontrolled by clinician.Only the mandibular position and the potential effect on glenoid fossa are controlled.

What happens with the use of functional appliances?

In spite of considerable research and debate the precise mode of action of functional appliance remains obscure

Dentoalveolar changes: Harvold and others have stressed the importance of a vertical manipulation of the functional occlusal plane in achieving class II corrections with removable functional appliances. Prevention of the eruption of maxillary buccal segments which is normally in downward and mesial direction

Removable functional appliance do not distalize the upper dentition unless Headgear is used

What happens with the use of functional appliances?

- **Midface restriction**
- **Effect on Mandibular growth:** is again a controversy
- Can we grow smaller Mandibles?
- Much of the work demonstrating the ability of functional appliances to stimulate mandibular, growth as based on animal experimentation.

In animal studies,cartilage proliferation by increased mitotic activity in pre-chondroblastic

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zone shows growth increments of condyle.Petrovic A, (1975) found significant Increase in effective length of mandible.McNamara 1987 found therapeutic remodeling of glenoid fossa.Woodside DG 1987,Catch-up growth after treatment independent of direction of therapeutic force.Several investigators showed dramatic changes in mid-face of monkeys after headgear treatment.Joho JP 1973,the same story holds true for maxillary protraction studies on monkeys.Experiments on mandibular retrusion in rats show histological and some macroscopic decrease of mandibular length.

Whether these findings on animal models are applicable to human beings during routine clinical treatment is debatable.

- Discrepancies between animal and human studies are expected since animal experimentation frequently involves the use of continuous forces.
- These types of forces usually are impractical and often undesirable in most clinical situations therefore treatment results can be expected to be less dramatic and more variable

Long-term Effect After Activator, Headgear-Activator, Herbst Appliance and Headgear Treatment

- The orthopedic effect induced by an appliance is one point of interest, but more interesting is long-term behaviour
- **Panchez et al** published many reports on long-term effects on Herbst appliance.
- Only temporary effect on existing skeleto-facial growth pattern.
- After orthopedic intervention – maxillary and mandibular growth seemed to strive to catch up with early pattern.

Basal maxillary changes are relatively stable 6 years after retention. The growth pattern of the maxilla was changed in a more posterior-inferior direction Recently, DeVincenzo investigated changes in mandibular length before, during, and after successful orthopedic correction of Class II malocclusions. The increase in mandibular length during the functional appliance phase was pronounced and the rate of increase is dramatic.

CONTROVERSIES IN PREADJUSTED APPLIANCE

Torque in the Base vs Torque in the Face

By 1988, about 30 % of all American orthodontists were using the straight wire appliance, another 50% were using Partly programmed edgewise appliances.Patent restrictions allowed them to reproduce no more than four of the eight vital features that appear in fully programmed brackets (David webb, "A" company)The Torque In the base allows the slot of the fully programmed bracket target correctly on the crown's mid transverse plane,Torque in the face causes occlusogingival variation in the placement of slot point over mid transverse plane

Hence the Torque in base was an important issue with the first and second generation PEA brackets because Level slot line up was not possible with brackets designed for Torque in Face. Modern Bracket systems like MBT system, have been developed using CAD-CAM system.The computer is first able to locate the precise location for the bracket slot, relative to in – out distance and torque position for each teeth. Once this position is established, it can be build up the in – fill areas to optimize all requirements of the brackets

018 vs 022 Slot:

BRACKET DESIGN

Brackets are of basically two types

- ribbon arch brackets
- edgewise brackets.

The ribbon arch brackets were first designed by Angle for his Ribbon arch appliance. The bracket was modified by inverting it by 180 degree and used by Raymond Begg for his light arch wire appliance.

Angle- single wing bracket
Swain – twin brackets
Ivan Lee – preangulated
Jarabak – preangulated and pretorqued
Andrews – fully programmed

E.H. Angle was the first to design the Edgewise type of bracket for his edgewise appliance. He used the 0.022 slot for his appliance .As the edgewise appliance originated before the discovery of stainless steel, Angle was forced to use gold alloy wires for making arch wires.Gold alloy wires had a low modulus of elasticity and therefore to increase the stiffness of the wire in bending and torsion and to increase the rigidity, Angle had no other choice but to increase the dimensions of the wire and therefore had to use the 0.022 slot.

Steiner who first proposed the 0.018 slot (0.018 x 0.028) and used it for the 'Steiner' brackets which were single width brackets with rotation wings. Swain later adopted the 0.018 slot for his Siamese brackets to improve wire characteristics due to the decreased inter bracket span.With the advent of stainless steel which is 50% stiffer than spring tempered gold it became essential to decrease wire dimensions to reduce force levels. The 0.022 slot today prevails over the 0.018 slot because of the development of newer orthodontic alloys such as TMA and NiTi. It was the discovery of TMA with it's stiffness

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characteristics similar to gold that brought back the 0.022 slot back into the market.

ADVANTAGES OF 0.018 SLOT

- Decreased wire inventory
- Decreased treatment time
- Increased wire flexibility due to smaller dimension of wires.

DISADVANTAGES OF 0.018 SLOT

- Desired third order M/F ratios may not be produced by newer orthodontic alloys.

ADVANTAGES OF 0.022 SLOT

- Recommended for Orthognathic cases
- Can use newer orthodontic alloys with minimum patient discomfort

DISADVANTAGES OF 0.022 SLOT

- Increased treatment time.
- Inability to attain third order control until last stages of treatment
- Increased wire inventory

Though both the 0.018 and 0.022 slot may still be used based on personal preferences, a uniform slot size and tooling units may be necessary for standardization and to know that we really use the slot size we wanted irrespective of where the manufacturer is based.

Bracket prescription

■ In Andrew's Original System:

➢ Concerning the 3rd order information:

➢ On the upper arch:

➢ -The upper incisor only has a 7° torque

➢ - The upper canine has a negative torque of –7, equal to the torque of the biscuspids.

➢ - The torque if slightly greater on molars.

➢ On the Lower arch:

➢ - The torque on the buccal segments is progressive from the canines to the 2nd molars.

A torque of 7° on central incisors was soon found to be insufficient, since the play between archwire and bracket slot, which wasn't taken into account, creates important loss of information during retraction stages and hence the amount torque necessary to compensate for the unwanted lingual tipping was clearly greater than 7°

Andrew's system soon got the reputation of being an "anchorage burning appliance"

Vari Simplex Discipline Dr.ALEXANDER 1974

■ The most important angulation of the is the -6 degrees angulation of the lower 1st molars.

■ The mandibular first molars have this tip back built in to promote leveling and to gain arch length.

■ The preservation of anchorage achieved using this technique is in keeping with the original Tweed principles

In other systems, torque was developed based on averages obtained by measuring the dentition of untreated ideal occlusions.The Vari-Simplex approach, however, was to measure torque found in rectangular archwires used to finish well treated orthodontic cases.The 5º torque in mandibular incisor brackets helps to move the incisal edge of the mandibular incisors lingually (less than 0.5 mm) and the root apices of these tooth labially (approximately 1mm).

Hilgers prescription

Upper incisors have a considerably increased torque. 22° for the central incisor, 14 ° for the lateral incisor.Upper canine has a 7 ° torque, this creates a transverse differential of 14 ° between canine and biscuspid.

Ricketts Bioprogressive therapy

Bioprogressive therapy started initially with placing torque in the upper anteriors only.This so called automatic torquing of the upper incisor was a graduation of multiples of 7 degrees with the

■ cuspid at 7º,

■ lateral at 14º and

■ central at 22º (may be it should have been 21º).

The "Full Torque Bioprogressive appliance" had built in torque for the lower posterior brackets too.The same graduation for 7º, 14º and 22º was incorporated here, too.

Ricketts finally developed the "Triple Control Bioprogressive appliance" which also had second molar tubes with 32º of torque.

MBT prescription

Combination of Andrew's and Roth with few changes.Anti rotation system was removed, all the excessive mesial tip has been removed.Upper incisors have markedly increased torque of 17 ° and 10 ° and upper canine -7 ° torque.The torque on the lower incisors increase to - 6 °

VII. CONTROVERSIES IN ORTHOGNATHIC SURGERY

THE USE OF RIGID INTERNAL FIXATION

Controversies in the use of Rigid internal fixation include:

■ Does RIF improve bony healing and post operative osteotomy strength?

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- Does it improve long term stability?
- Is there a greater chance of developing TMD post operatively with RIF?

It was Spiessl who first described the use of bone screws for fixation of a sagittal osteotomy in 1974. Kundert compared condylar displacement in patients treated with sagittal osteotomies of the mandible with screw fixation and wire fixation. The authors noted condylar distraction in both groups with the magnitude slightly greater in the screw fixation group. A computed tomography study showed some medial rotation of the condylar segment. Varying inter condylar distances were also seen. However, screw fixation apparently caused no major positioning problems of the condylar bearing segments.

VIII. ROOT RESORPTION related to ORTHODONTIC TREATMENT

- **Controversies in factors influencing root resorption**

Alveolar bone density

Becks,Tager,Reitan found Root resorption is greater in dense bone Wainwright – Density affects tooth movement rate, but no relation to extent of root resorption.

Fixed vs removable

- The use of fixed appliances is more damaging to the roots.Ketcham claimed that normal function is disturbed by the splinting effect of orthodontic fixed appliances over a long period that can cause root resorption.

-

Begg V/s edgewise

It is often stated that the light wire Begg technique causes less root resorption than edgewise. Although maxillary incisor root resorption during the Begg third stage has been documented. There is no difference between these techniques, but found that the frequency of root resorption was significantly higher in traumatized maxillary incisors when intruded by the Begg technique compared with edgewise technique .

Type of Orthodontic movement

The stress distribution along the roots during bodily movement is less than the stress concentration at the apex resulting from tipping. Therefore risk of root resorption that is due to bodily movement should be less than that of tipping.

Degree of Orthodontic force

Harry and Sims found the distribution of resorbed lacunae was directly related to the amount of stress on the root surface. They concluded that higher stress causes more root resorption. According to Schwartz, applied force exceeding the optimal level of 20 to 26 gm/cm2 causes periodontal ischemia, which can lead to root resorption.

Continuous vs intermittent forces

The pause in treatment with intermittent forces allows the resorbed cementum to heal and prevents further resorption. On the other hand, intermittent forces have been linked in their damaging effects to jiggling forces.

Orthodontic treatment timing

Orthodontic treatment should begin as early as possible since there is less root resorption in developing roots and young patients show better muscular adaptation to occlusal changes. Rosenberg HN evaluation of the incidence and amount of apical root resorption and dilaceration occurring in orthodontically treated teeth, having incompletely formed roots at the beginning of Begg treatment.

IX.ORTHODONTIC TREATMENT AND TEMPOROMANDIBULAR DISORDERS

The attention of the orthodontic community regarding TMD however was heightened in the late 1980s after litigation involving the allegations that **orthodontic treatment was the proximal cause of TMD in orthodontic patients.**In the 1980's articles in various journals and trade magazines suggested that orthodontic treatment might play a role in initiating temporomandibular disorder. On the other hand it was also claimed that orthodontic treatment might be effective in alleviating the signs and symptoms of TMD.

Effect of headgear and/or class II elastics in correction of Class II malocclusions withdeepinterlockingcusps & Effect of Reverse Headgear or Class III Elastics for Correction of Class III malocclusion;a compensating movement by the mandible can put distal pressure on the condyles and conceivably cause an anterior dislocation of the disk. The cross elastics have a little effect on TMJ. As the jaw is pulled to one side, distal pressure is put only on one condyle and chances of anterior dislocation of disc.

Effect of Lower Expansion and Upper Contraction :

If a orthodontist tries to close down the anterior (upper) spaces without opening the bite, it may create a premature contact with the lower anterior teeth and exert distal pressure on the mandible that may result in TMJ pain. The majority of orthodontically treated cases mostly have dental deep bite at the beginning.. As the bite deepens

post treatment four possible adverse effects can be seen.

- ✓ Spacing in upper anterior teeth.
- ✓ Crowding in lower anterior teeth.
- ✓ Tends to move maxillary dentition forward.
- ✓ Drives the mandible distally

Since most of the orthodontists give a 3 to 3 fixed retainer on both upper and lower anterior teeth after the active treatment. These retainers prevent

- ➢ Firstly, lower anterior teeth from crowding or collapsing.
- ➢ Secondly, prevent the upper anterior teeth from rotating, separating or moving forward.

But at the same time the retainer cannot prevent other two adverse effects i.e. **forward movement of maxillary dentition and distal movement of mandible**, which can again lead to TMJ problems.

National Institute of Health revealed no statistically significant differences between the treated and untreated groups & the assumption made by some authors that orthodontic treatment can prevent symptoms of mandibular dysfunction is disproven.

- ✓ Another study of the long term effects of orthodontic treatment stated that comprehensive orthodontic treatment can be under taken without fear of creating TMD problems.
- ✓ In the major longitudinal study conducted by **Dibbets et al** treated by Begg mechanotherapy, activator and with chin cups, revealed that at the end of treatment, fixed appliance group had a higher percentage of objective symptoms than did the functional group, but no differences existed at the 20 year follow up evaluation.

Does the removal of teeth as part of an orthodontic protocol lead to a greater incidence of TMD ?

- ✓ View point articles and tests have strongly associated the extraction of premolars with the occurrence of TMD in orthodontic patients.
- ✓ But clinical studies that have dealt with this issue have not shown relationship between premolar extraction and TMD.
- ✓ Sadowsky etal reported that joint sounds were evident before and after treatment.in extraction and non extraction cases.They reported there is no increase in the risk of development of joint sounds regardless of whether teeth were removed .

Can orthodontic treatment lead to a posterior displacement of the mandibular condyle?

- ✓ A number of viewpoint articles have asserted that a wide variety of traditional orthodontic procedures e.g. premolar extraction, extraoral traction, retraction of maxillary anterior teeth cause TMD signs and symptoms by producing a distal displacement of condyle .
- ✓ **Gianelly et al** did the study collecting the tomograms to evaluate condylar position. They took the tomograms before orthodontic treatment and compared them with tomograms from treated patients with fixed mechanotherapy and removal of four premolars. No differences in condylar position were noted between groups .
- ✓ Another study conducted by **Luecke and Johnston** evaluated the pretreatment and post treatment cephalograms of patients treated with fixed appliances in conjunction with the removal of two upper premolars and concluded that posterior condyle position was not a result of orthodontic treatment.

Should the occlusion of orthodontic patients be treated to specific gnathologic standards ?

- ✓ Several view point articles including those by **Roth et al** and **Williamson** have maintained that TMDs may result from a failure to treat orthodontic patients to gnathologic standards that include the establishment of a “mutually protected occlusion” and proper seating of the mandibular condyle within the glenoid fossa.
- ✓ In contrast Pullinger et al reported that small occlusal slides less then 1 mm are common in asymptomatic subjects as well as patients with TMD.
- ✓ The establishment of an occlusion that meets gnathologic ideals probably is unnecessary particularly in adolescent patients and sometimes impossible to attain in some adult patients .A trend toward decreased prevalence of TMD signs and symptoms in treated patients also was noted by Sadowsky , Polson and Dahl et al.

CONCLUSION

Orthodontics may be the only speciality which has “philosophies”.It was based on these philosophies that most work in orthodontics was done.However treatment philosophies may not be enough in todays world.We need more scientific basis to back our treatment protocols.The only way to resolve these controversies is by moving on from traditional “Opinion based Orthodontics” to “**Evidence based** Orthodontics”

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