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ORTHODONTIC TREATMENT IN THE GROWING PATIENT

(Early Treatment)

VOLUME TWO

MECHANICS FOR DECIDUOUS AND MIXED DENTITIONS – ORTHODONTIC AND ORTHOPEDIC TREATMENT

ORTHODONTIC TREATMENT IN THE GROWING PATIENT

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VOLUME II

MECHANICS FOR DECIDUOUS AND MIXED DENTITIONS – ORTHODONTIC AND ORTHOPEDIC TREATMENT

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LECTURE SEVEN - MODALITIES EMPLOYED FOR THE JUVENILE PATIENT

I INTRODUCTION

A. Phasing

Semantic problems always exist. In young patients communication pertains to the developmental phases during the child's progress to maturation. Growth becomes a major consideration.

The term "timing", as employed, denotes the age or time frame in which treatment is started. The "juvenile" in the present parlance refers to the child before adolescence and after babyhood. For orthodontic purposes the child started with the deciduous dentition present at age 3 years is called the "Preventive Phase". This usually includes age 3 to 6 years. If the mixed dentition is available, the traditional term is the "Interceptive Phase". This pertains to children in the 7 to 10 year old bracket. Both stages of development may be considered "juvenile".

The "adolescent", for orthodontic reference, is the patient with the permanent canines and premolars erupted. In the past, orthodontic therapy for any age of patient after the permanent dentition was accessible, was called "corrective". The "proper time" was thought to be when the premolars were obtainable to attachment. This was perhaps thought to be the most advantageous time by those who developed techniques to "correct" the full permanent dentition. They advocated treatment as soon as the permanent teeth were erupted with the exception of second permanent molars. Angle used the term early for the mixed dentition patients and very early for full deciduous dentition treatment.

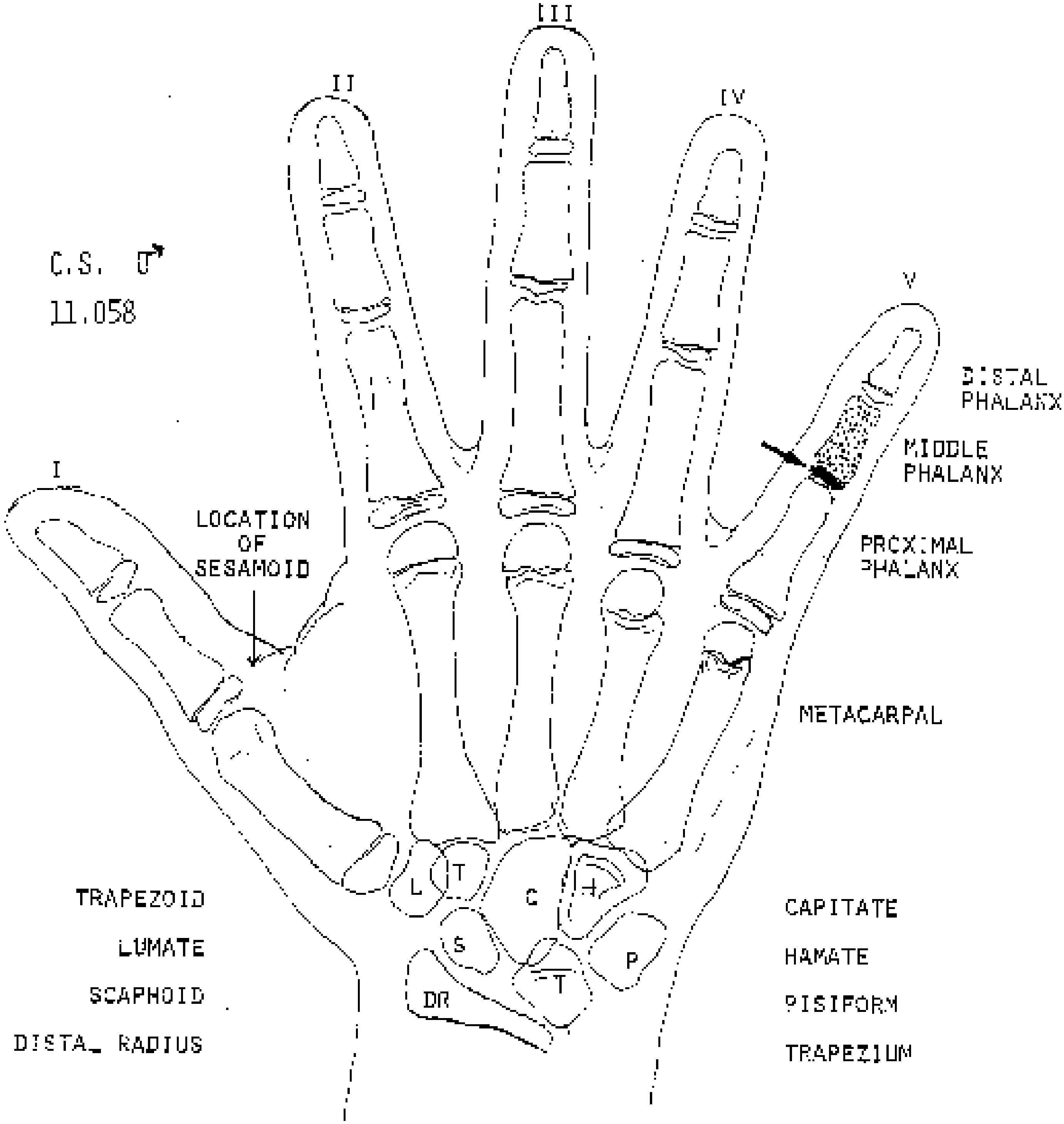
It was assumed that adequate growth would always be present in the ten or eleven year old patient. However, this is not always the case in females. Several girls have been noted to have epiphysical plates closed already by age 11 years. Further, because two years of treatment is not uncommon, in order to take advantage of growth the treatment should precede maturity by two years! In considering treatment sequences, together with the selection of modalities, the decision may be based on the anticipation of an "effective grower" contribution. A determination of an individual's maturity level is required.

The term "Corrective", because it refers to patients of any age with permanent teeth present, needs to be abandoned perhaps. As a replacement, the term "Intermediate" is proposed. This would pertain to the young patient at age 9 to 14 in females and age 11 to 17 in males. In essence, as growth is the consideration, any **patient prognosed to have "effective growth" still available and with the permanent teeth available** would be classified as the "Intermediate Phase".

Dr. Darryle Bowden's work seemed to indicate that the second phalanx of the little finger may serve as a marker. When the diaphysis is still wider than the epiphysis then growth, to an effective degree, may still lie ahead **(Fig. 7-1)**. When the width of the shaft and the plate is precisely even the patient may be presently experiencing the adolescent growth dynamic. When the epiphysis is wider a child may be through rapid growth. When the cartilage plate is calcified any growth, for real benefit for clinical use, is over.

B. Late treatment

When no growth is anticipated, or not enough to be counted on for maxillo-mandibular correction help, that patient is in effect to be treated as an adult. This is now "late treatment". Hence age 11 from a developmental



Tracing of wrist plate of 11.06 year old male. The epiphysis of the little finger middle phalanx is narrower than the diaphysis. When it reaches the same size, the patient is in the "spurt".

FIG. 7-1

standpoint, may already be "late" when maturation is considered as the basis for the classification.

C. Rehabilitative

Adult orthodontic classification was called "rehabilitative". Study of a large number of treated adults led to the description of six types. These were:

Ameliorative	-	for improvement only
Comprehensive	-	for full detailed correction
Reconstructive	-	Aid for operative or prosthetic dentistry
Reclamative	-	for a comprimised periodontium
Orthopedic	-	for T M J conditions
Surgical	-	Orthognathic surgery

For the present lecture the concern is with methods of correction for the juvenile patient from age 3 to age 10 years. But first some arguments should be recognized.

II DETERRANTS TO JUVENILE TREATMENT

From questioning clinicians or students, four main deterrants to treatment of young patients were the most commonly expressed.

The first was the uncertainty or fear of the unknown future. This may stem from two other uncertainties; (1) the lack of trust or knowledge of forecasting, and (2) the lack of information and trust in the possibility of changes with treatment in the young patient.

The second deterrent focussed was the fear of the treatment dragging out over long periods of time. The clinician may become "hooked" by gradually adding more and more appliance and never knowing when to stop and stand by to permit more growth and development to occur.

The third deterrent is the fear of "relapse in the young patient" and facing the need of it "all to do over again". Along with this fear is the accepted belief that any treatment of the deciduous teeth has no effect on the development of the permanent dentition which was taught unfortunately as a basic truth.

The fourth deterrent discovered was the lack of training in our institutions regarding successful modalities in the young child. This was combined with the fear of management of the juvenile patient. Some clinicians simply didn't want to be bothered with the children at the "tender ages" particularly before age 9 or 10 years.

This lecture deals with the fourth deterrent - the modalities proven to be amazingly successful when understood and skillfully applied.

It is **recommended that each clinician obtain a gram measuring gauge and employ it until familiar with the forces (pressures) that are appropriate for the child patient** (Fig. 7-2).

III EFFICIENCY CONCEPTS

But, before dealing with modalities perhaps a brief discussion of efficiency with the Bioprogressive approach should be sited. Efficiency usually relates to the **work put in relative to the production turned out.** Time and expense enter into the efficiency concept. However, **quality and stability cannot be sacrificed** for **expediency.**

There is power in knowledge.
There is power in the ability to utilize contemporary technology.

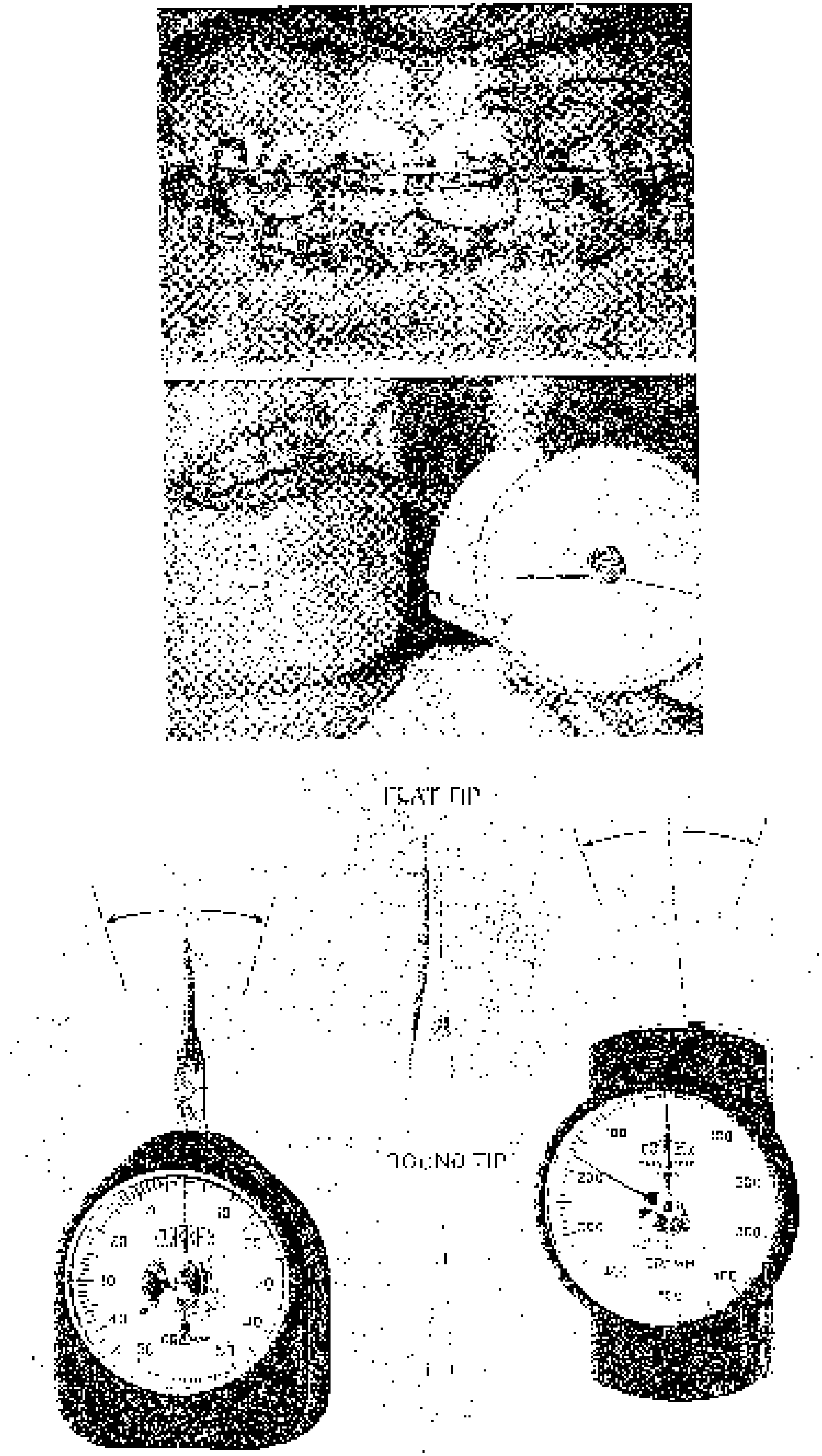


FIG. 7-2

There is power in skill of action.

There is power in making correct judgements and setting proper targets

There is power in making decisions that require no further debate.

There is power in the procurement of all available information for the diagnosis, prognosis, designing of objectives based on possibility and for establishing a therapeutic regime.

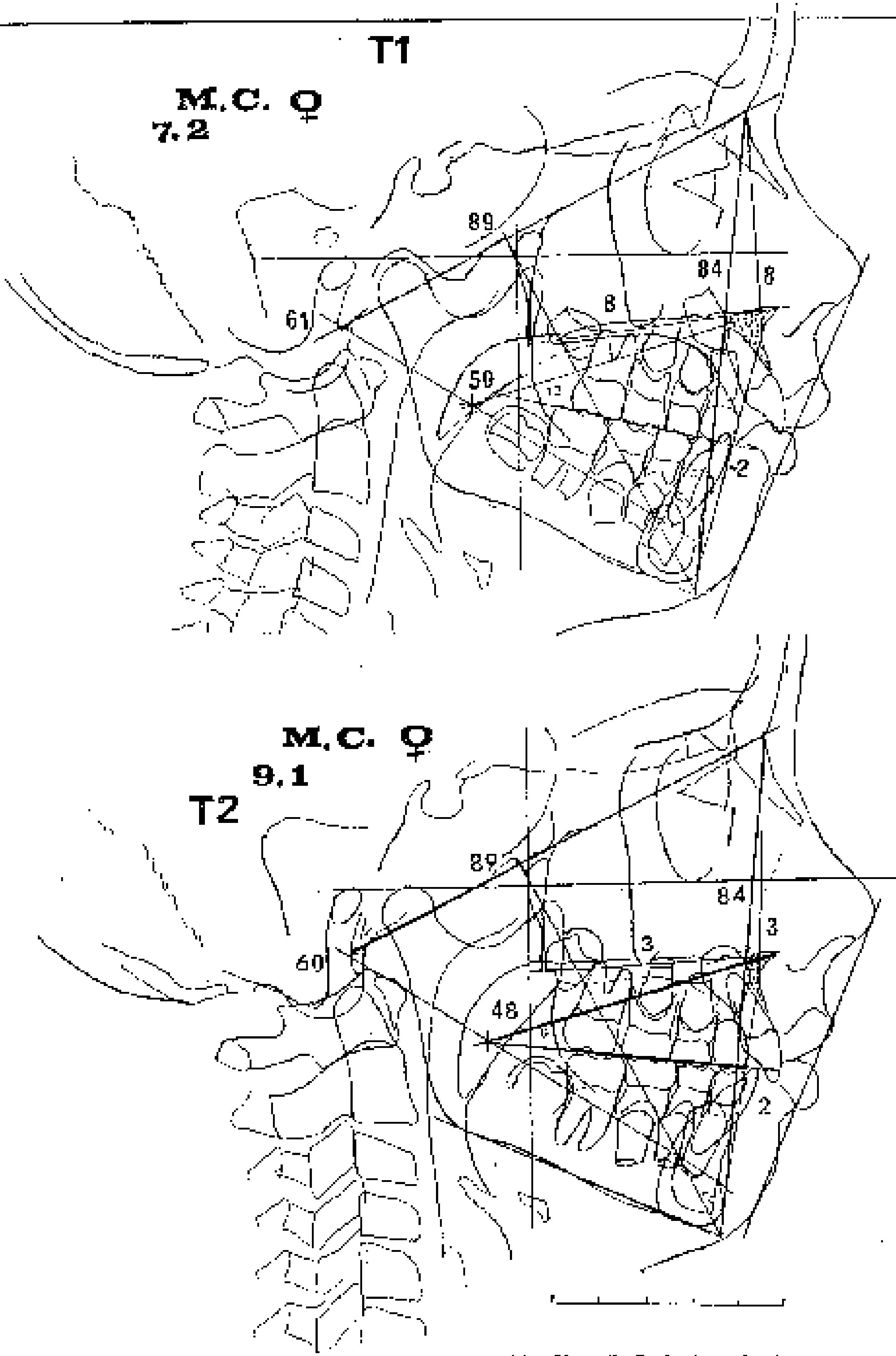
* * * * * * * * * *

To be more specific with the concept of efficiency ten facts are basic to the development of a young patient clinical practice:

Fact One;

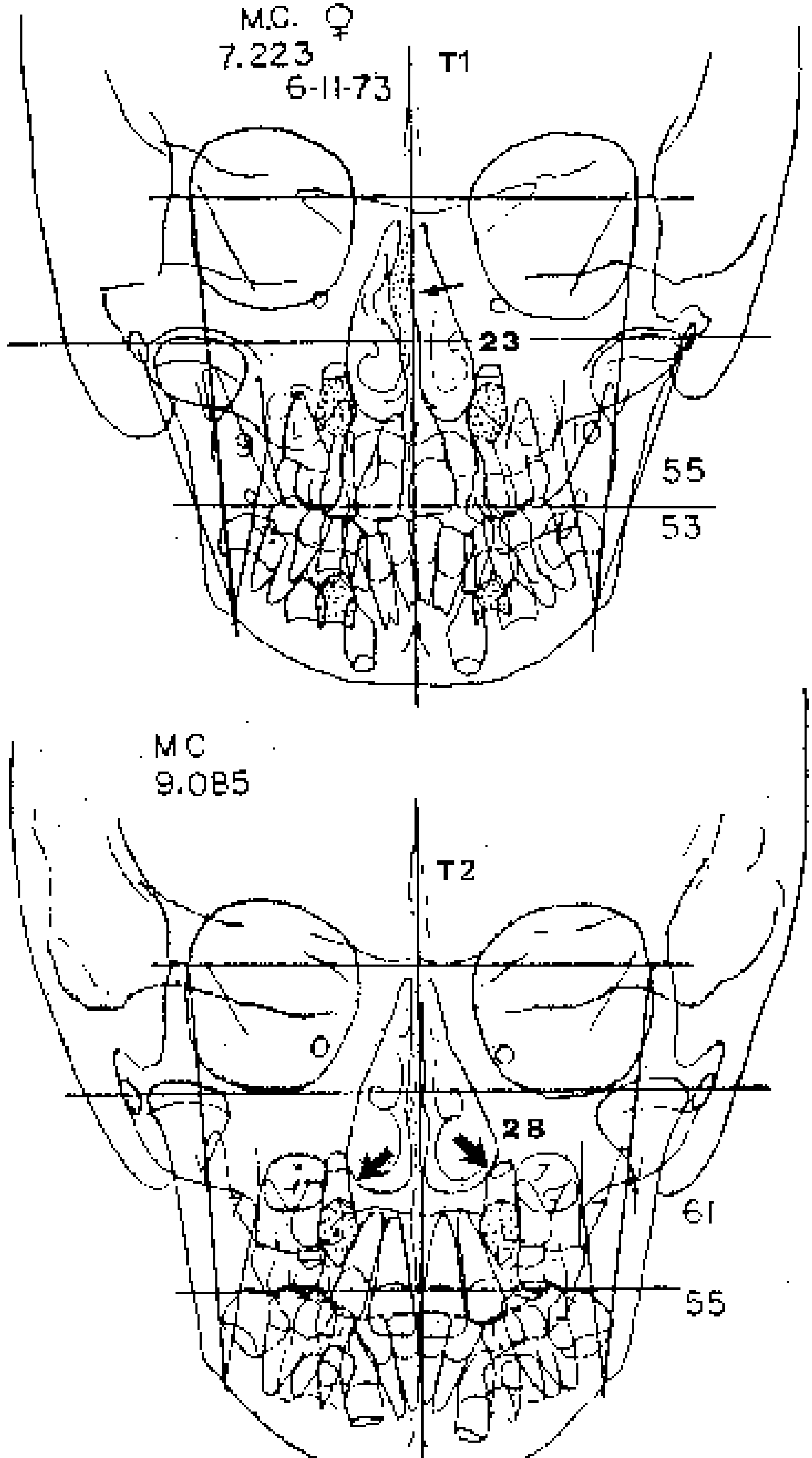
If the whole jaw can be altered, there is no need to move the individual teeth. "Structural alteration" has been referred to as skeletal, basal or orthopedic. It is a change beyond the alveolar process. The upper jaw complex has been proven to be changed significantly in all three planes of space **(Fig 7-3A, B & C)**.

The mandible has been **temporarily** advanced with certain Class II modalities. The long term behavior of the mandible with induced condyle distraction methods is being studied. Scientific work has not shown in long term however, that the mandible can be stimulated to grow beyond its natural potential with posturing techniques. Yet, the mandible has been shown to be inhibited in growth, sometimes permanently, particularly with superior-anterior condylar compression.



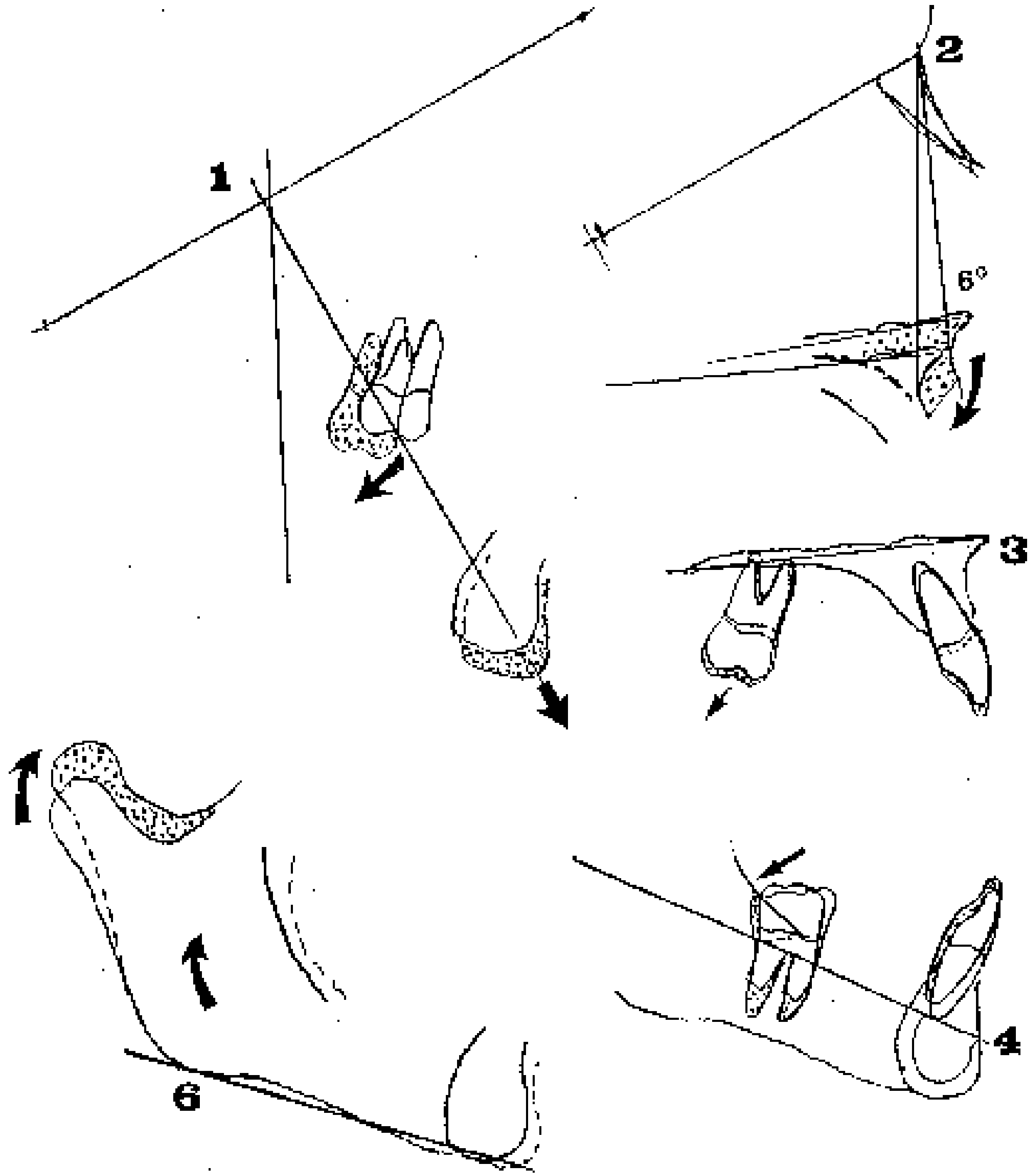
T1 M.C. Female age 7.2 years with severe open bite Class II. Patient received a quad helix for 3 months and cervical traction and no other appliance.
T2 The same patient age 9.1. Note the convexity change and reduction of lower facial height (see Fig. 7-3B and C).

FIG. 7-3A



Frontal analysis of Treatment on patient M.C. seen in 3A. Note in T1 nasal width of 23 mm. and deviated septum. In T1 the nasal width is 28 (increased 5 mm.) and the septum is straight. Maxillary width increased from 55 to 61 mm. and lower molar increased 2 mm.

FIG. 7-3B



Four Position analysis of T1 to T2 in patient M.C. treated with cervical traction for open bite Class II.
1. Growth straight down the Facial Axis and distal movement of molar. 2. Reduction of Nasal Angle is 6°. 3. Very little upper arch movement occurred. 4. Lower molar intruded and uprighted. 6. Note the bend in the mandible and vertical growth of the condyle from the mandibular plane at gonion.

FIG. 7-3C

Fact Two:

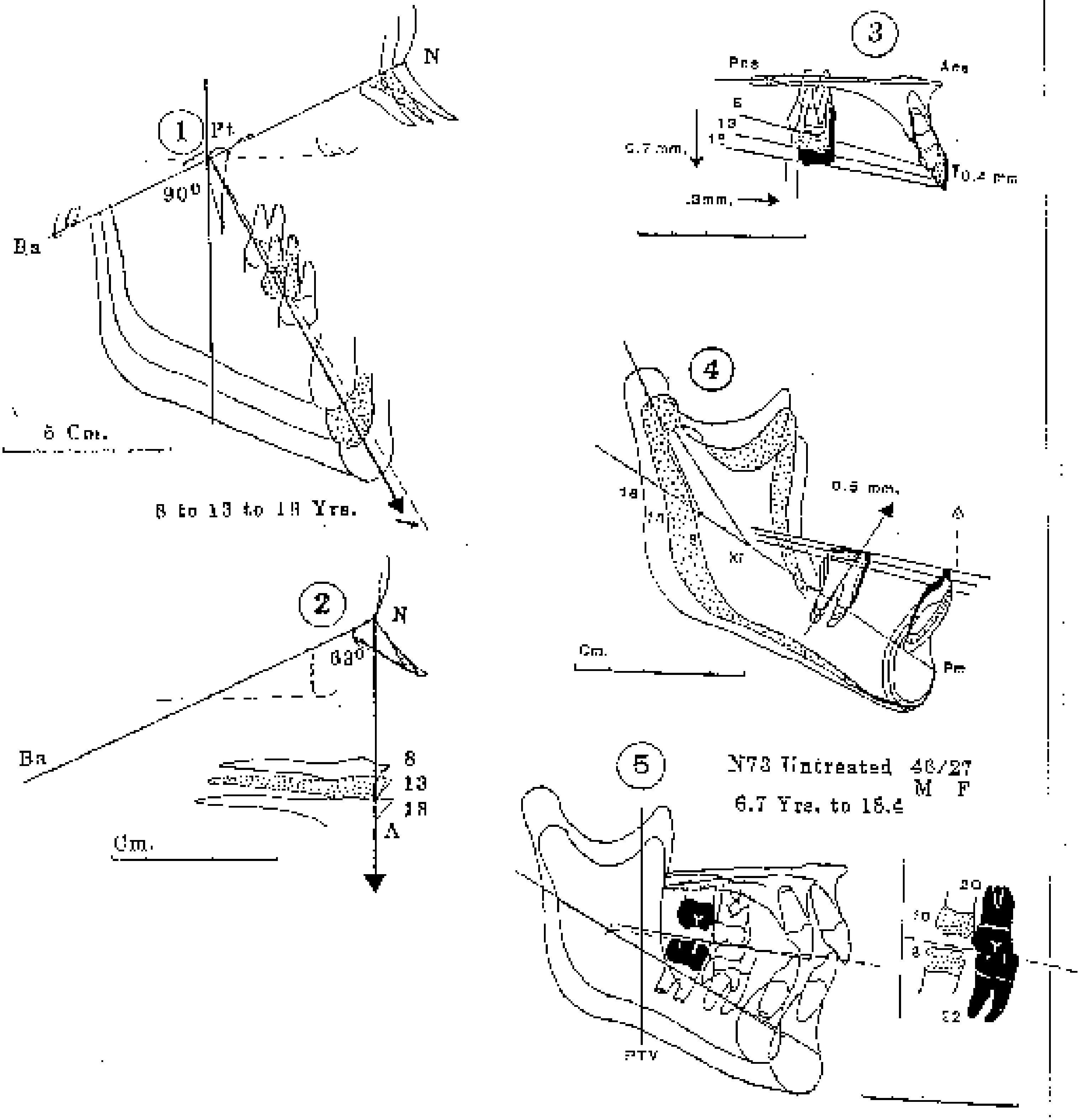
Therapeutic regimes should be designed to utilize natural growth (or **put growth to work**). Some theories of growth based on inadequate methods employed for measurement have not been supported with sophisticated research. The monitoring methods of growth change needs to be specific. Hence the four or five position analysis was founded **(Fig 7-4)**. Said again, if growth can carry the whole arch, the individual teeth may need less movement or maybe no changing at all.

Fact Three:

Through the processes of orthopedic and growth changes with the obtaining of maxillo-mandibular skeletal harmony, a natural functional correction usually will follow. Muscles are attached to the jaws. The direction and amount of tension of muscles changes with basal correction in three planes of space. Thus, the oral environment is improved or entirely corrected **(Fig 7-5)**. When it does not occur naturally myofunctional therapy may be indicated.

Fact Four:

Through the operation of the first three facts, the **natural forces of occlusion are recruited**. The seven forces of occlusion are (1) eruption, (2) drift, (3) the incline planes of cusps, (4) the oral muscles, (5) the muscles of mastication and (6) the entire kinetic chain and (7) growth. When all of these are in harmony, development with nature has a chance to normalize. The last force related to is the effects of occlusion, **degenerative joint disease** which causes a recessive change in mandibular position.



Sertal analysis in Five Positions. (1) Chin – Facial Axis at Cc (Pz)
(2) Maxilla – BaNA – Nasal Angle. (3) Upper teeth – Palatal Plane at Ans.
Note normal occlusal plane. (4) Lower teeth – Corpus Axis at Pm.
Note occlusal plane to Xi. (5) Differential development of molars from
Xi Point at occlusal plane.

FIG. 7-4

POSITION ONE

Function: Indicator of Direction and
Amount of Growth (or change in chin)

Change Values: <u>Direction</u>: 0° (+2° in 10 years)
Standard Variation:
1.5° at 5 years
2.0° at 10 years

<u>Amount</u>: 2.5 mm. each year,
or 10 mm. each 4 years.
C.D. = ± 0.5 mm. each year

POSITION TWO

Factor: Basion-Nasion at Nasion

Function: Indicator for Direction and Amount of Growth (change) in Anterior Maxilla

Change Values: <u>Direction</u>: 0° Standard Variation ± 1.0
(Very rare cases: slightly +)

<u>Amount</u>: For ANS Vertical, 1.15 each year.
C.D. = ± 0.25 each year.

POSITION THREE

Factor: Palatal Plane (ANS-PNS) at ANS
For reading of incisor - Molar + Occlusal Plane

Function: Indicator for Maxillary Denture Change

Change Values: <u>Forward</u>: 0.3 mm. each year. C.D. = ± 0.1 mm.
Occlusal Plane - drops at molar more,
0.6° each year, i.e. 3° at 5 years, 6° at 10 years.
$\underline{6}$ = 0.7 mm./year $\underline{1}$ = 0.4 mm./year

POSITION FOUR

Factor: True Occlusal Plane to Corpus Axis at PM point

Function: Indicator for Change in Lower Denture

Change Values: 0° change in Occlusal Plane

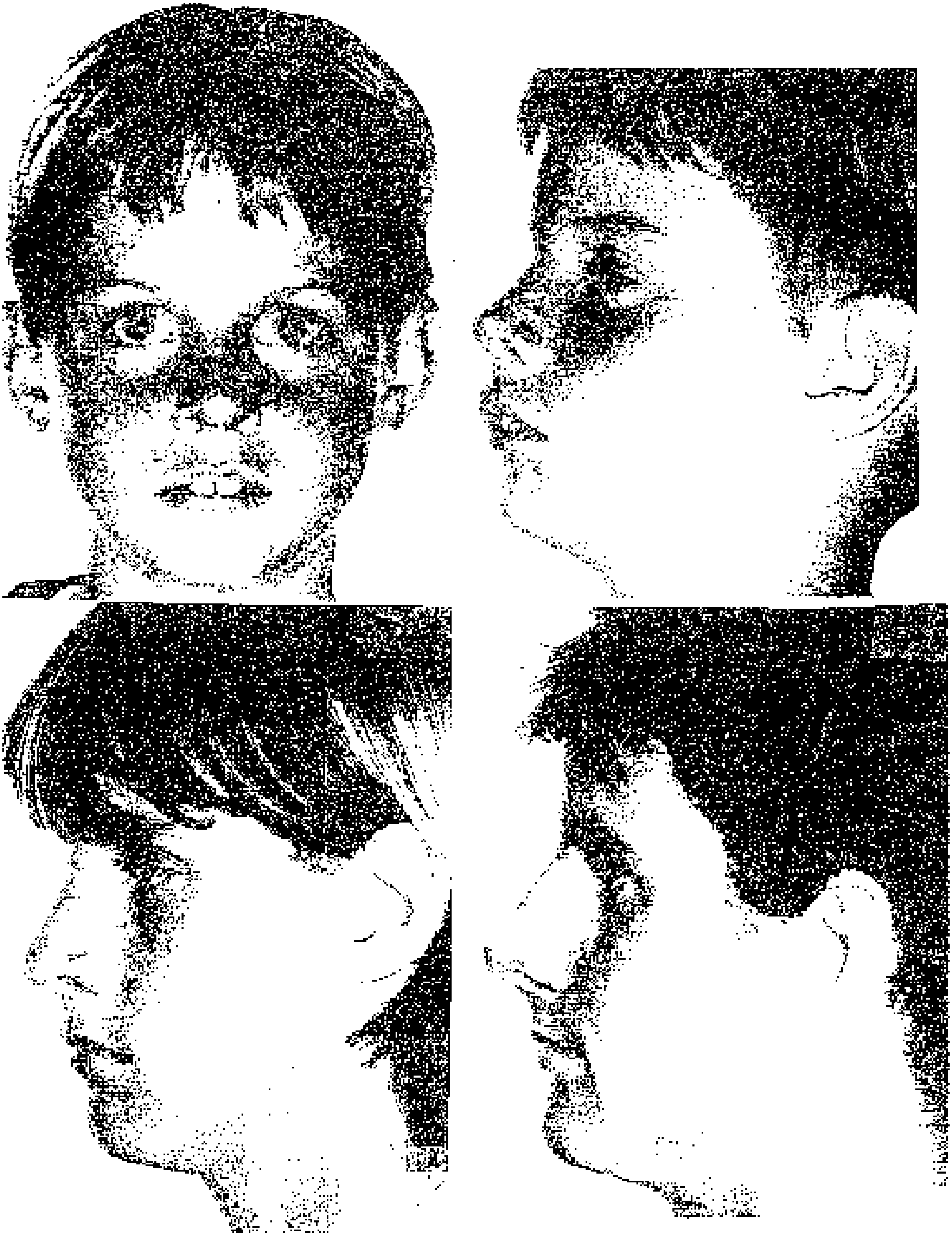


FIG. 7-6A

FIG. 7-5B

Fact Five;

The orthodontic therapeutic ideal tooth arrangement is a target. If a definite destination is not known, the traveler may wander aimlessly. Having a specific tooth to tooth and arch to arch relation in mind tends to direct action and promotes efficiency **(Fig. 7-6)**.

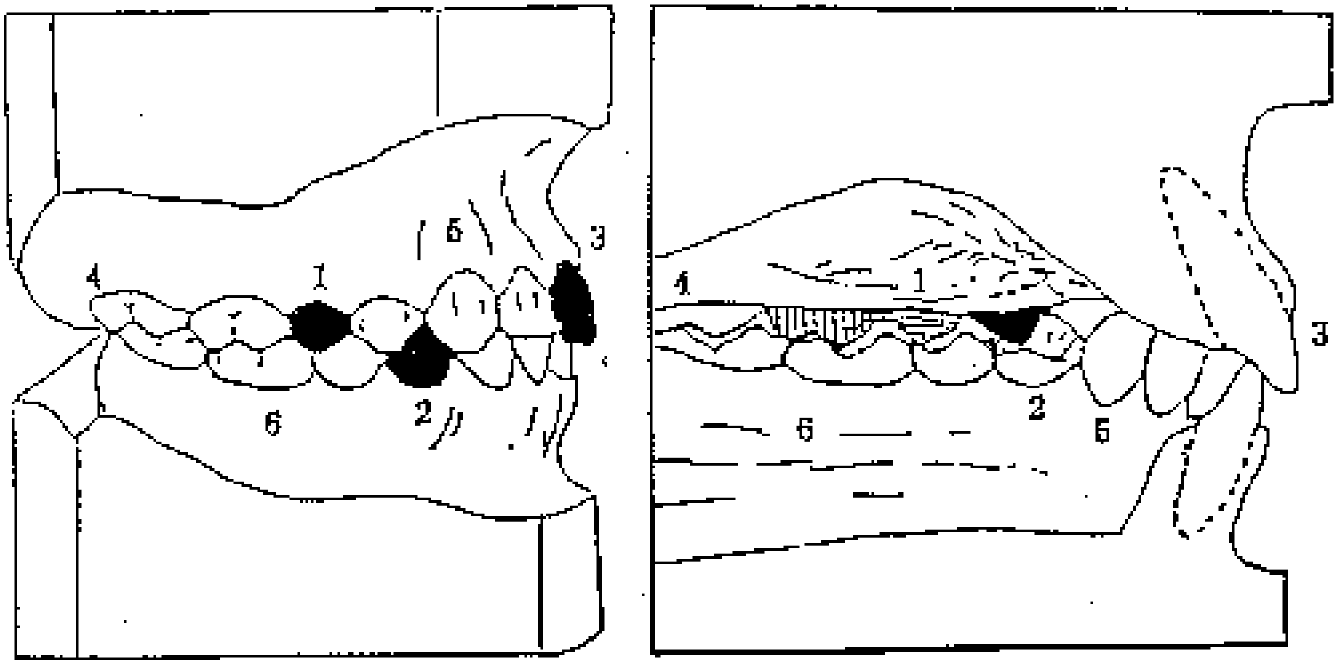
Fact Six:

Root rating scales are known and applied. Science has revealed with certainty that optimum pressure values are of profound value for the understanding of anchorage or the production of displacements of teeth and jaws. A set of values (of one gram per mm^2 of root surface) is applied to cancellous bone. This is doubled at least for anchorage particularly against cortical bone. But the pressure is cut in half for modification of the alveolar **ridge (Fig 7-7).**

Fact Seven;

Staging - sequences are applied for accomplishing specific objectives. Priorities are established. A hierarchy is selected (the unlocking principle). Each step is carried out before a new "locking" of the movements is encountered. A **staging matrix** form has been developed as a mechanical planning guide **(Table 7-I)**.

The Keys to Fit of the Teeth



#1 Upper second premolar is the key to both molars.

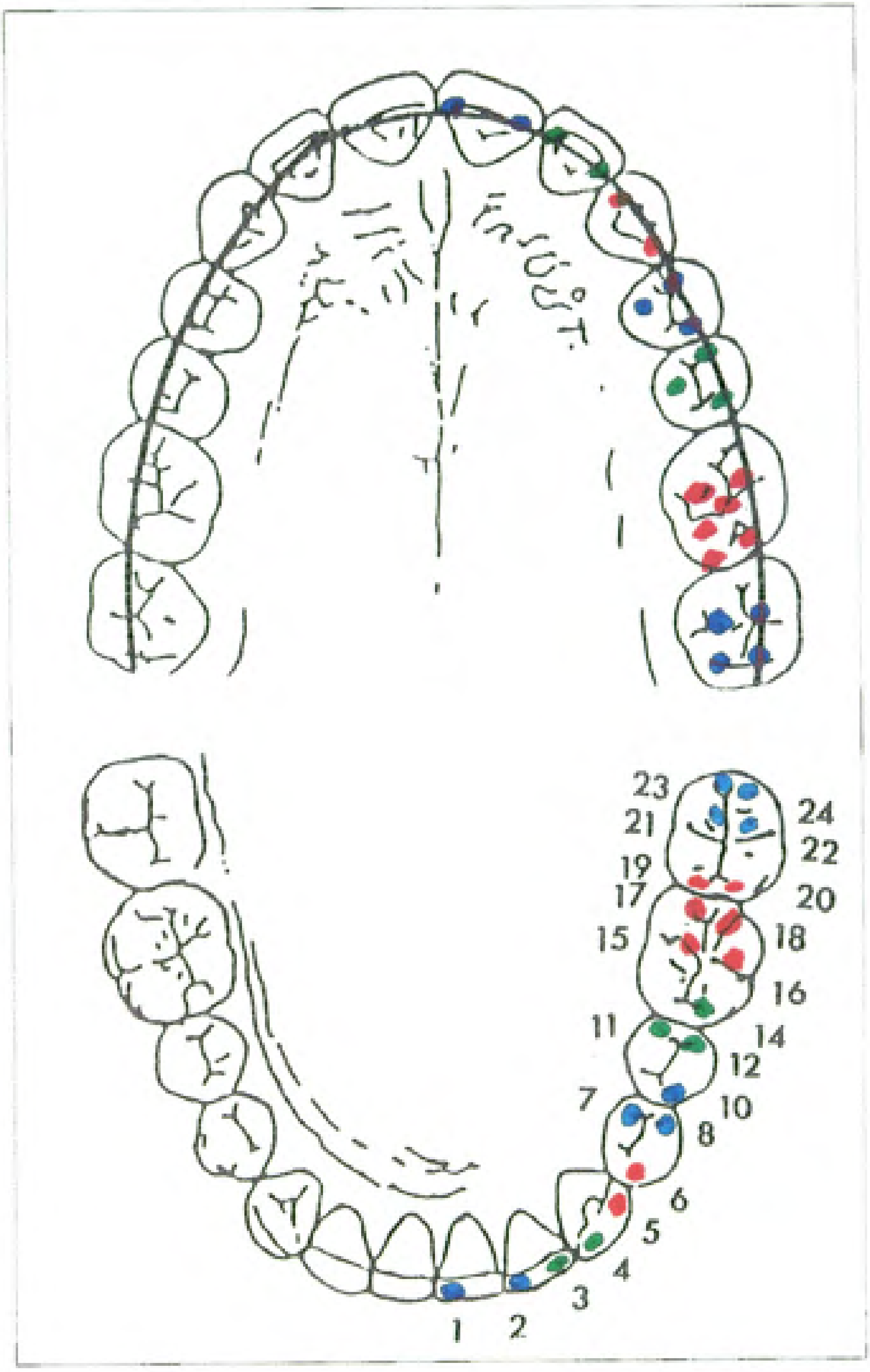
#2 Width of the lower first premolar is the key to the upper canine.

#3 Upper incisor Torque

Ricketts' Six Keys to Occlusion in sagittal and transverse fit.
The first three are explained.

Key #4 is the curve at the second molar.
#5 is canine angulation and torque.
#6 is Arch forms.

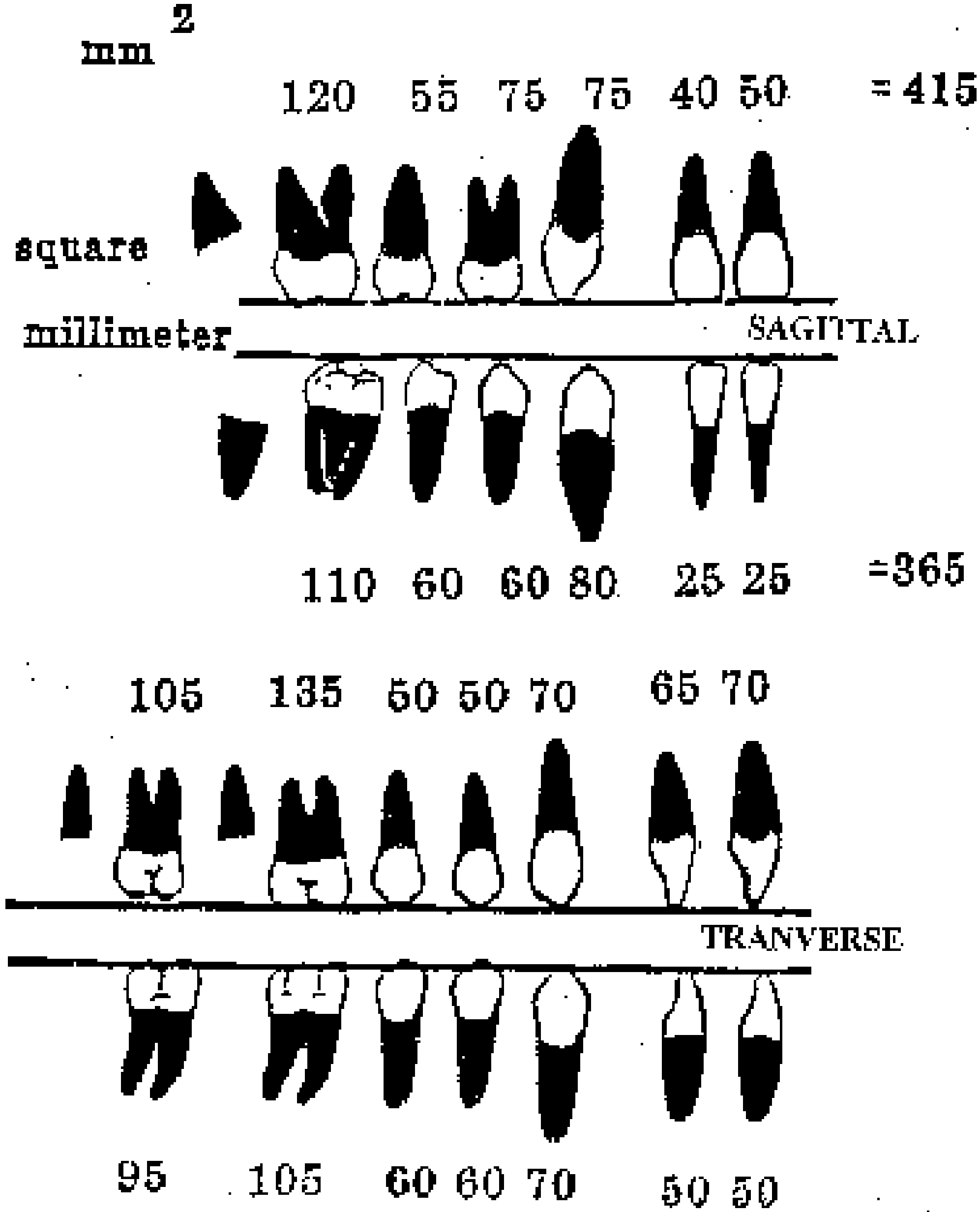
FIG. 7-6A

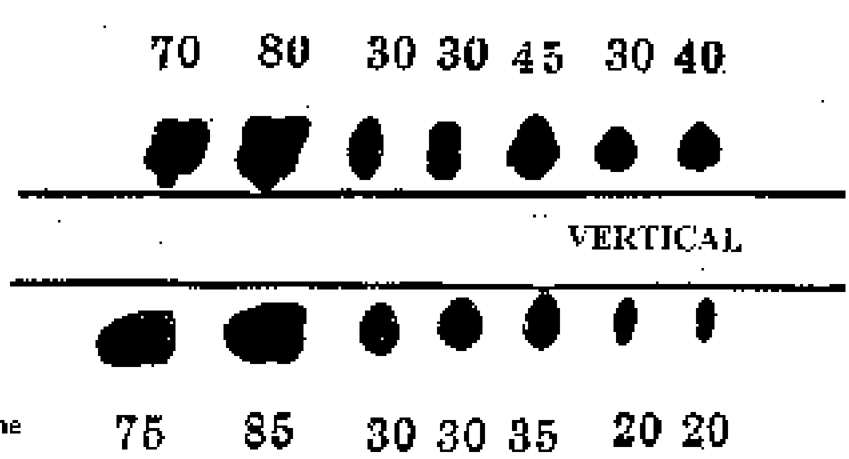


Keys to occlusal fit in vertical stops color coded and symbol coded.

FIG. 7-6B

ROOT RATING SCALE





The mean size of teeth are Assessed in three dimensions. Movement within the alveolus recommended to be 1.0 gram per mm2.
When alteration of cortical bone is desired, the pressure is 0.5 grams per mm2.
When anchorage is intended, the force per unit area is x2 or x3 the usual.

FIG. 7-7

TABLE 7 - 1

COMMENCING	BIOPROGRESSIVE	
CONTINUING	BIOPROGRESSIVE	
CONSOLIDATING	BIOPROGRESSIVE	STRAIGHT WIRE
COMPLETING	BIOPROGRESSIVE	STRAIGHT WIRE

STAGING MATRIX

STAGE		STEPS	
I	COMMENCING	1.	Starting Procedure
		2.	Carry out
II	CONTINUING	3.	Intra-arch Regulation
		4.	Inter-arch Correction
III	CONSOLIDATING	5.	Intergration and Torquing
		6.	Idealization and Co-ordination
IV	COMPLETING	7.	Finishing and Over-treatment
		8.	Retention and Stabilization

The Staging Matrix
The First two objectives are for orthopedic reductions and gross care for the overbite or open bite or cross-bite. The last two are for detailing.

Fact Eight;

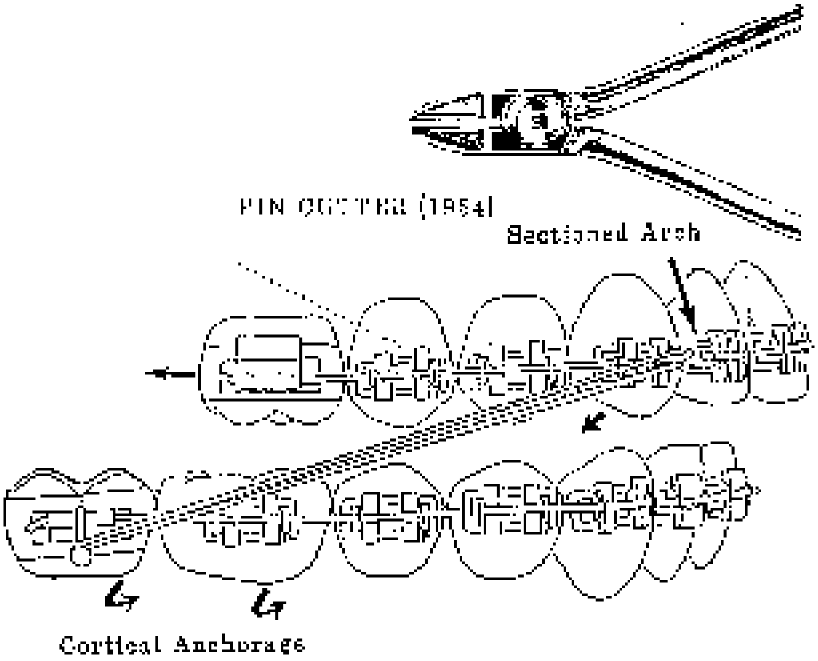
Sectional and segmented operation may accomplish objectives not possible with straight wire modalities. Control of single teeth or groups of teeth are worked out on the basis of anchorages. While rapidity of movement is glamorous, the preservation of anchorage is noble **(Fig. 7-8).**

Fact Nine:

Mandibular growth and its rotational behavior in the face can be controlled. The idea of liberal mandibular rotation as an aid for class III correction is obvious. However, opening rotation for correction of Class I or Class II deep bite or for arch correction is a **distinct disadvantage.** For this reason, deep bites are treated by intrusion of anterior teeth. **This maintains the natural physiologic face height.** In the transverse dimension keeping the oral gnomon low permits natural arch width increases and better insures stability **(Fig. 7-9).**

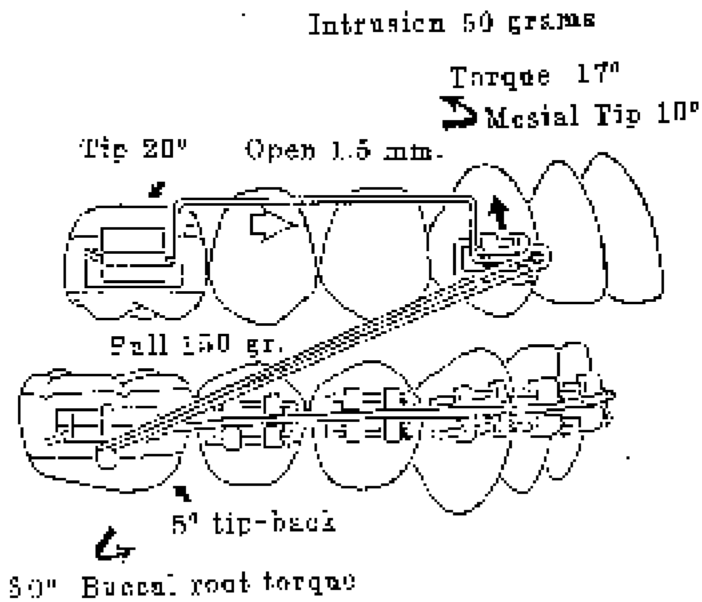
Fact Ten;

By forecasting the natural growth and behavior and designing the objective, a direct course of treatment can be set. When a VTO or a VTG is analysed, the "cybernetic circle" can be applied. This is the secret to the establishment of sequences. Through **periodic monitoring** of patients during the course of treatment mistakes can be uncovered and mid course corrections taken. Arcial mandibular growth behavior has been a vast aid for accuracy of forecasting.



Standard upper Utility Section

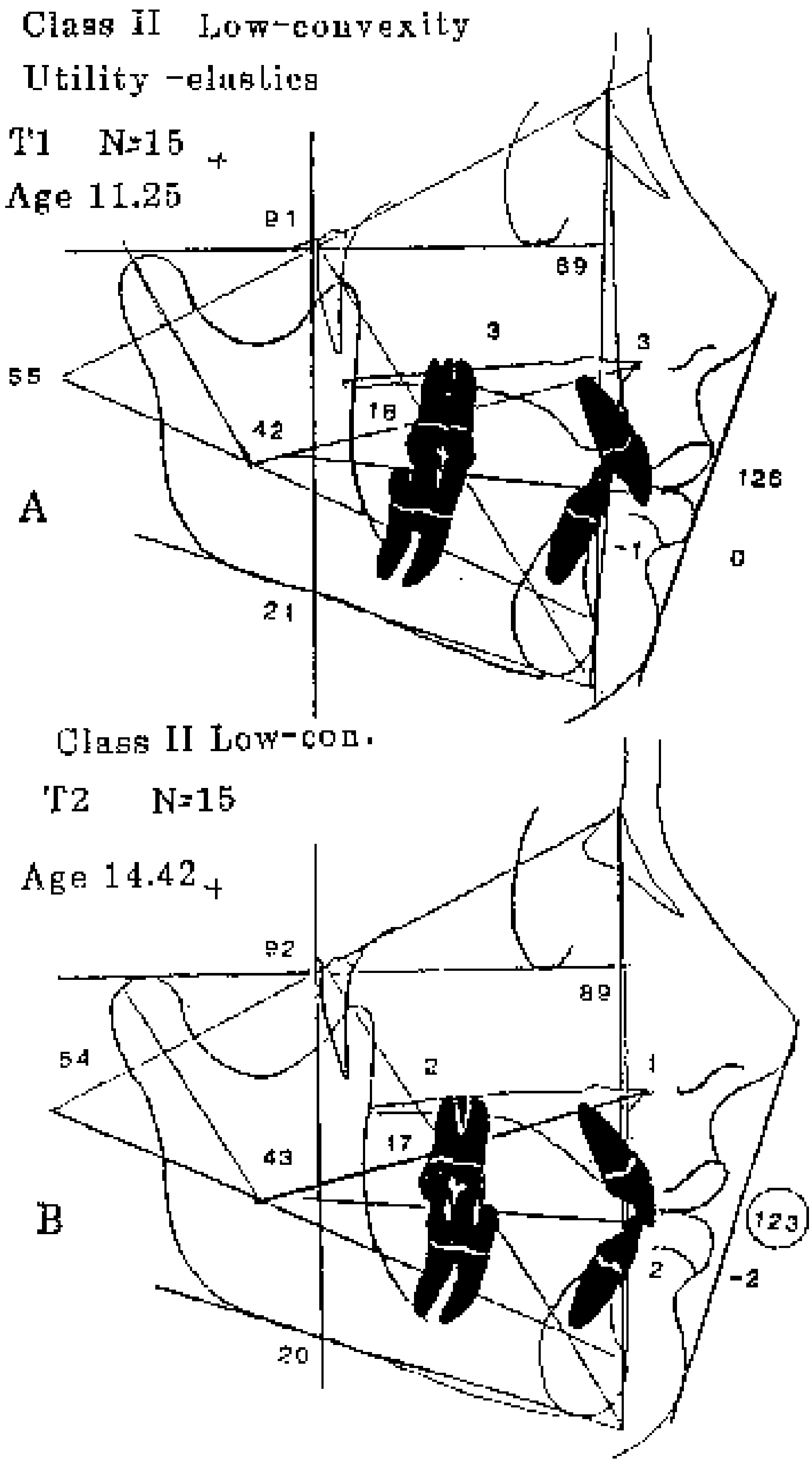
.016"X.016"



A. For anchorage purposes and for control of the overbite, the arch was experimentally sectioned in 1954 together with the discovery of cortical anchorage of the lower buccal plate.

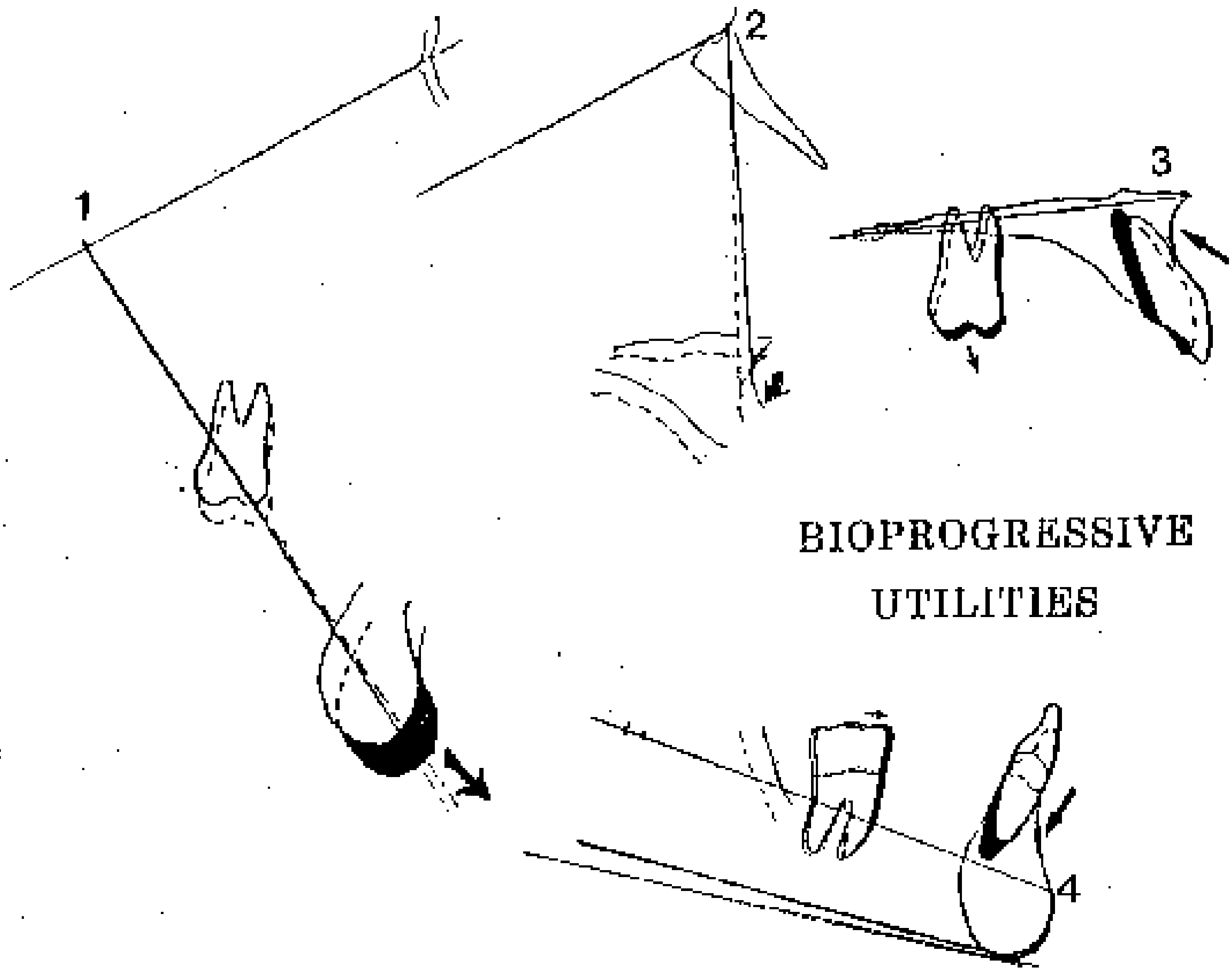
B. Sophistication developed to the use of sectional utility forms. Ligations can be employed for mixed dentition patients.

FIG. 7-8



This before-and-after shows a sample of patients treated with utility arches and elastics only. Notice the oral gnomon at 43° and the inter-incisal angle of 123°. Note the opening of the deep bite but closing of the Facial axis 91° to 92°.

FIG. 7-9A



CORTICAL ANCHORAGE -- ELASTICS

The Four Position analysis of N=15 patients seen in Fig. 7-9A treated with intrusion mechanics and elastics. Note Closing ofFacial Axis, slight orthopedics on maxilla and intrusion of both upper and lower Incisors. Patients were decidedly stable.

FIG. 7-9B

IV PROBLEMS AND PRINCIPAL MODALITIES

A Entanglements Concerning Modalities

In preparing this lecture it was realized why treatment in the juvenile patient can be so bewildering. A distinct need to sort out or cut through entanglements became obvious. As the saying goes, the appliances used are "multi-factorial". When complications are recognized, the best start for finding a resolution is to establish an order or organization. **The mind, when assisted by order, sequence and staging, or selecting priorities, can handle complicated problems and deal with complexity.**

Factors

First, is the identification and listing of the factors that cause the complexity. Without an attempt to establish a hierarchy the following fifteen proposals for complexity are submitted:

1. complexity caused by visualization of the possibilities of orthopedics (skeletal change) in three planes of space

2. complexity of lack of the possibilities of orthodontics (dental change) in three planes of space (intrusion of lateral expansion) and distal movement of molars)

3. the factors characterizing the deciduous dentition malocclusions

4. the complication factors added at the mixed dentition development

5. the possible contribution of growth to any correction

6. the difficulty compounded by the absence of growth or presence of unfavorable growth

7. the dilemma and confidence in growth forecasting

8. the recognition and management of discreet functional "habits" at their inception

9. the timing of the interception and management of functional occlusal problems

10. the distinguishing of racial types

11. the recognition of developing extreme individual morphologic types within the races

12. the differences between growth behavior in males and females

13. the unfavorable resultants with the misuse of specific appliances

14. the recruitment of the forces of occlusion

15. the ultimate esthetics for the specific patient at the time of maturity

When the clinician is confronted with any or all of these factors, it is small wonder a confusion may be presented.

B Bioprogressive Modalities and Early Treatment

A list of twenty general appliances or auxiliaries are listed that may be integrated with bioprogression (**Table 7-II**).

The major modalities are described in detail in other separate manuals but they are herein abstracted for discussion for the juvenile patient. Under complete orthodontic mechanics seven classes of appliances or procedures were described. These were: orthopedic orthodontic, auxiliaries, stabilizing, shielding, conditioning and surgical. For this discourse, four general categories of appliances are taken up. These four, very effective for the juvenile patient, are:

a. Extra Oral Traction (orthopedic and orthodontic)
b. Transverse Correcting Modalities
c. Intra-Arch Corrections within the Individual Arch
d. Five Maxillo-mandibular Correction Options

V EXTRAORAL TRACTION

A full separate manual has been prepared for extraoral traction application.

A Cervical Traction – for Reduction of Maxillary Prognathism.

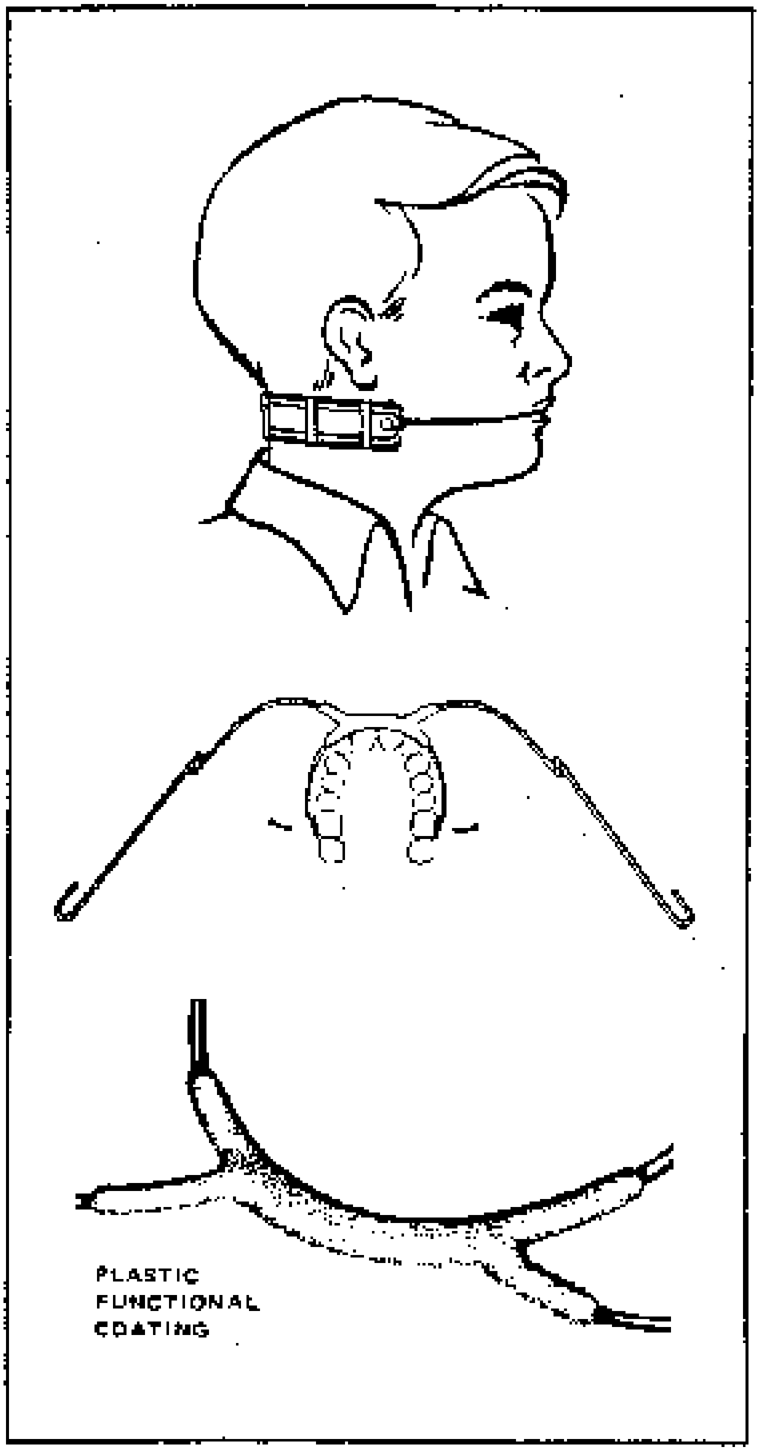
The "face bow", activated from a neck strap, is considered by the author to be primarily an orthopedic appliance (**Fig. 7-10**). With the outer bow elevated **about 1 cm. above the molar** it slightly extrudes the upper molar. It operates in keeping with natural change of the occlusal plane. It assists in lowering the occlusal plane posteriorly. However, the occlusal plane moves normally with Xi point or the entrance of the neurotropic bundle into the mandible.

TABLE 7 - II

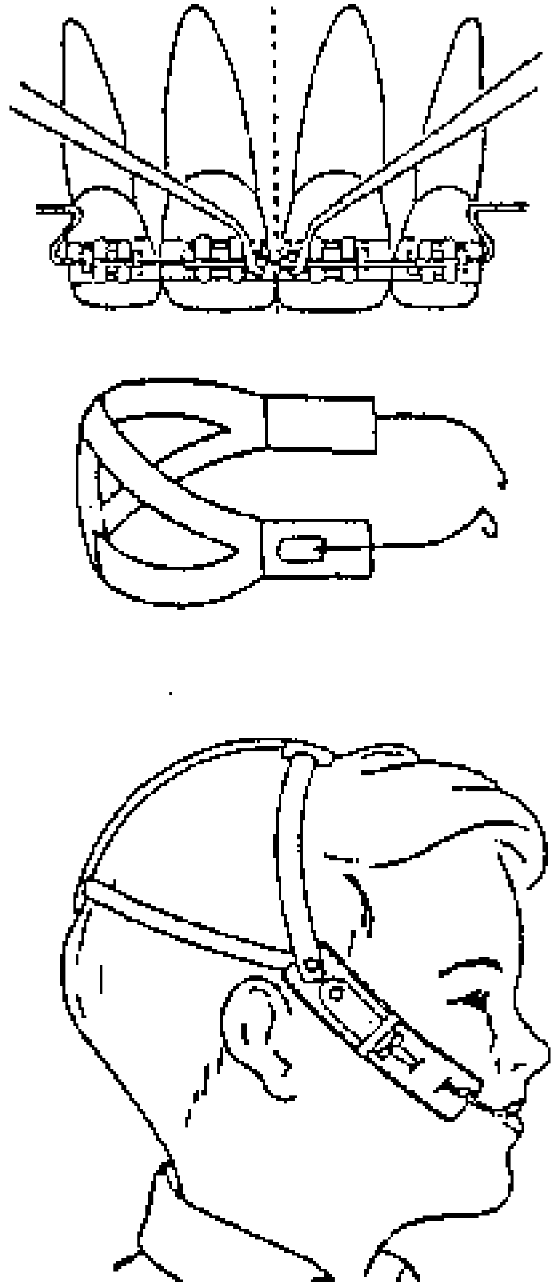
APPLIANCES

1.	Extra oral	Neck, Face
2.	Quad Helix	
3.	Crickett	
4.	Utility Arch	
5.	Sectionals (3)	
6.	Bumper-Bar	
7.	Lingual (4)	
8.	Upper Incisor Intrusion	
9.	Posturing (6)	
10.	Elastics	
11.	Threads	
12.	Straight Wire (Ricketts Classic)	
13.	Squeeze	
14.	Myofunction	
15.	Biotemplate	
16.	Simple Surgeries (4)	
17.	Jaw Surgery	
18.	Ligation Methods (4)	
19.	Wire Size .016" x .016" (Bending)	
20.	Intra Oral Regulation	

Appliances and Procedures employed in the Bioprogressive regimen. The first four are the mainline of earlier intervention.



Cervical strap with Ricketts' headgear design to be worn no more than 14 hours per day.



High pull anterior for augmentation of upper utility and for gummy smile correction (50 grams each side).

FIG. 7-10

It is difficult for the student to visualize the occlusal plane tipped downward posteriorly while the palatal plane is being tipped downward and backward anteriorly with the neck strap. One component is the dental (the occlusal plane) while the other is basal bone (the palatal plane) (**Fig. 7-11**).

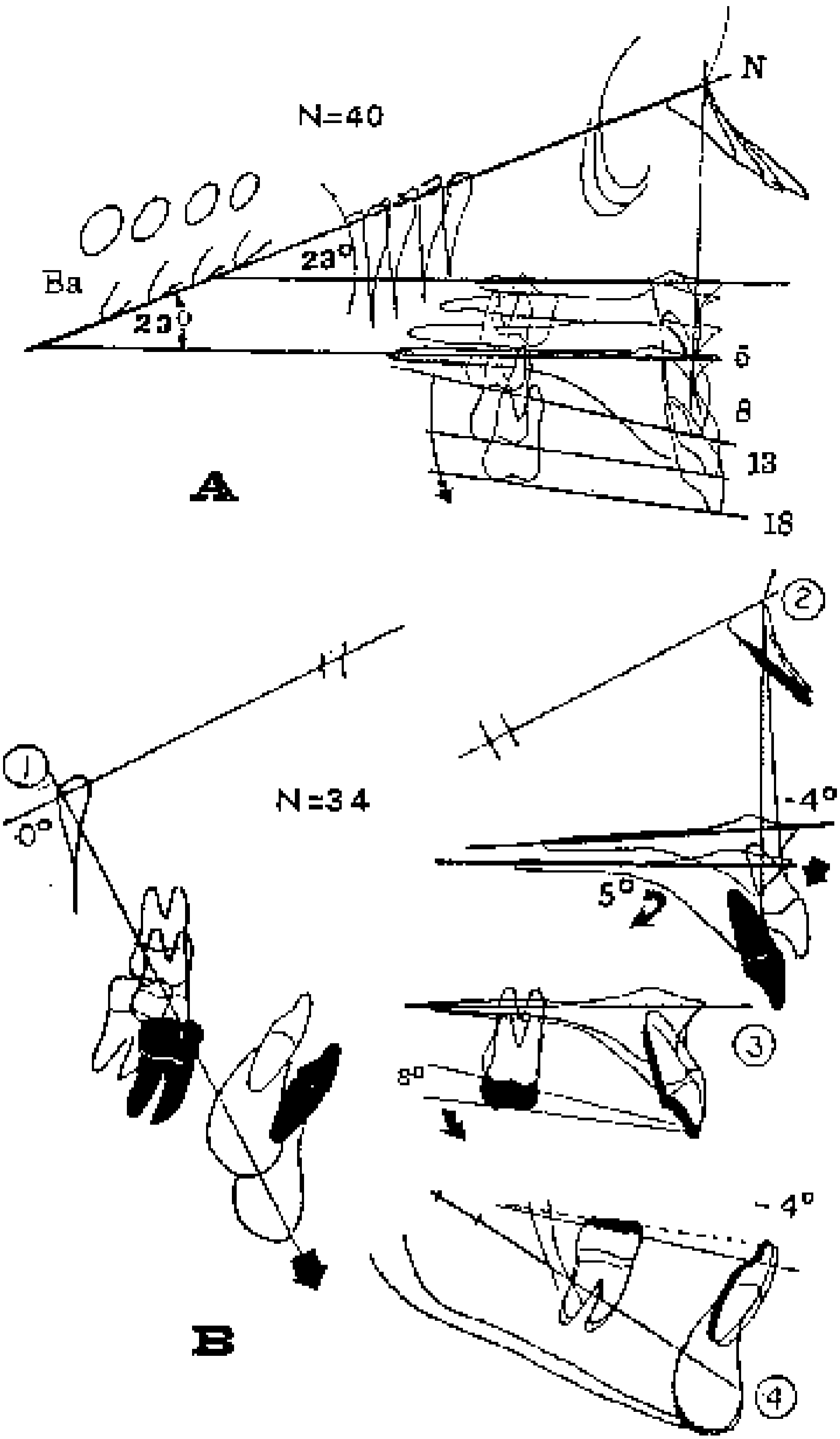
When managed properly, and without abuse, and when worn only 12 to 14 hours per day (and without arches or bite plates), several critical objectives are achieved with the face bow-cervical traction. Three hundred (300) grams is adequate on the neck strap on the deciduous upper second molars. Five hundred (500) grams is effective on the first permanent molar in the mixed dentition. These forces yield 150 grams on each deciduous second molar and 250 grams on each first permanent molar teeth respectively. This amount of pressure theoretically **scleroses the periodontal area.** This magnitude of pressure transmits forces to the basal bone at the sutures.

In deep bites the lower incisors are intruded first with a utility arch. In some open bites the lower incisors may ironically require intrusion to create enough space for maxillary rotation.

The following principles obtain:

1. With careful management, as described, the maxillary complex for each side is moved in three planes of space; backward, outward and downward (see Fig. 7-3).

2. Because the basal bone is altered the maxillary teeth likewise erupt backward or are moved also outward and downward.



A. The normal behavior of the Palatal and Occlusal Plane in N=40 children untreated. Note parallel palatal planes to BaN and slight drop of occlusal plane posteriorly.

B. Palatal and occlusal plane from age 8 to 13 in N=34 children treated with cervical traction for Class II Four Position analysis shows total changes.

FIG. 7-11

3. Through the forces of occlusion the lower molar is either intruded or prevented from erupting. It is often uprighted in two planes (mesio-distally and bucco-lingually)

4. With **decompression of the condyle** the mandible **may grow more vertically** than expected. This in short term directs a stronger growth arc (or bends the mandible closed). This maintains or improves the facial axis. This was shown in a publication in 1952.

5. With reduction of a class II open bite the lip function is corrected and the lower arch length problems are mitigated. The environment of the lower incisor is changed and in open bite conditions the lower incisors often move forward and space themselves as correction of the arches and tipping of the palate occurs. The lower face height angle may be reduced.

6. Nasal cavity widening is obtained and a septal deviation may straighten. Therefore correction of respiratory obstruction may occur. Thus increases nasal breathing and permits easier lip seal during swallowing! This is therefore truly a functional appliance of the greatest type.

7. With light pressures (100 grams on the deciduous molar to 1200 grams for the permanent molar on the strap) the molars are moved distally without as much orthopedic change. The lighter pressure yields 50 grams on the deciduous molar and 100 on the permanent.

8. **Recommended forces for orthopedic change** is **300 grams** (at the **neck strap) for ages 3 to 6; It is increased to 500 grams at ages** 7 **to 10 and as much as 700 grams after** age **11 years**. Expansion at each adjustment together with molar rotation at each appointment will prevent upper second molar problems but will slow down their eruptive development.

9. Overtreatment is advised as adequate molar rotation and expansion is routine.

10. The face bow is lightened and worn as a retainer every third night for about one year after correction is attained.

Patience and monitoring and good motivation is required for routine success. Confidence comes with a few successes. Ten cervical traction groups have been studied statistically and composited and 100 patients were compared to 100 controls. What more science or proof is required. Orthopedics with cervical traction has been proven statistically by other researchers as well?

B Face Mask – for maxillary advancement.

In the young patient, a forward pull on the maxilla will alter its development dramatically. It is interesting to discover that only two teeth, the first molars, (or the second deciduous molars in the preschool child) provide sufficient anchorage to move the whole basal bone. This is when forces of 2 to 3 grams per mm^2 of root surface are applied

In Class III the objective is (1) to advance the maxillary base and (2) to rotate the mandible backward for correction of maxillo-mandibular relation for the age of the patient. Over correction is suggested routinely by the author. The following techniques with resultant favorable changes are expected.

1. An activated preferably soldered quad helix is recommended first. This is activated for a one month period in order to stimulate sutural activity and stretch the sutures in the mid facial complex.

2. The same total orthopedic forces are applied as for the Class II. However, it is now divided for each side on the face mask assembly, i.e. 150 grams on each side for the deciduous and 250 gram on each side for the mixed. Remember measurements of the force should be made until the operator can judge the pull with experiance.

3. The face mask is adapted to the face and padded to prevent facial discomfort. Showing the VTO to a child helps in the motivation immensely **(Fig. 7-12)**.

4. The intraoral elastic is placed around the posterior loop of the quad helix and hooked to the spur on the face mask of the opposite side. The same action is provided for the other side which makes the elastics cross over the tongue. This prevents soreness at the corners of the mouth.

5. The presence of the elastics palatally may also aid in mandibular rotation. The **chin cup should be positioned well down on the chin lest it may produce pressure atrophy on the labial gingiva** of the **lower incisors.**

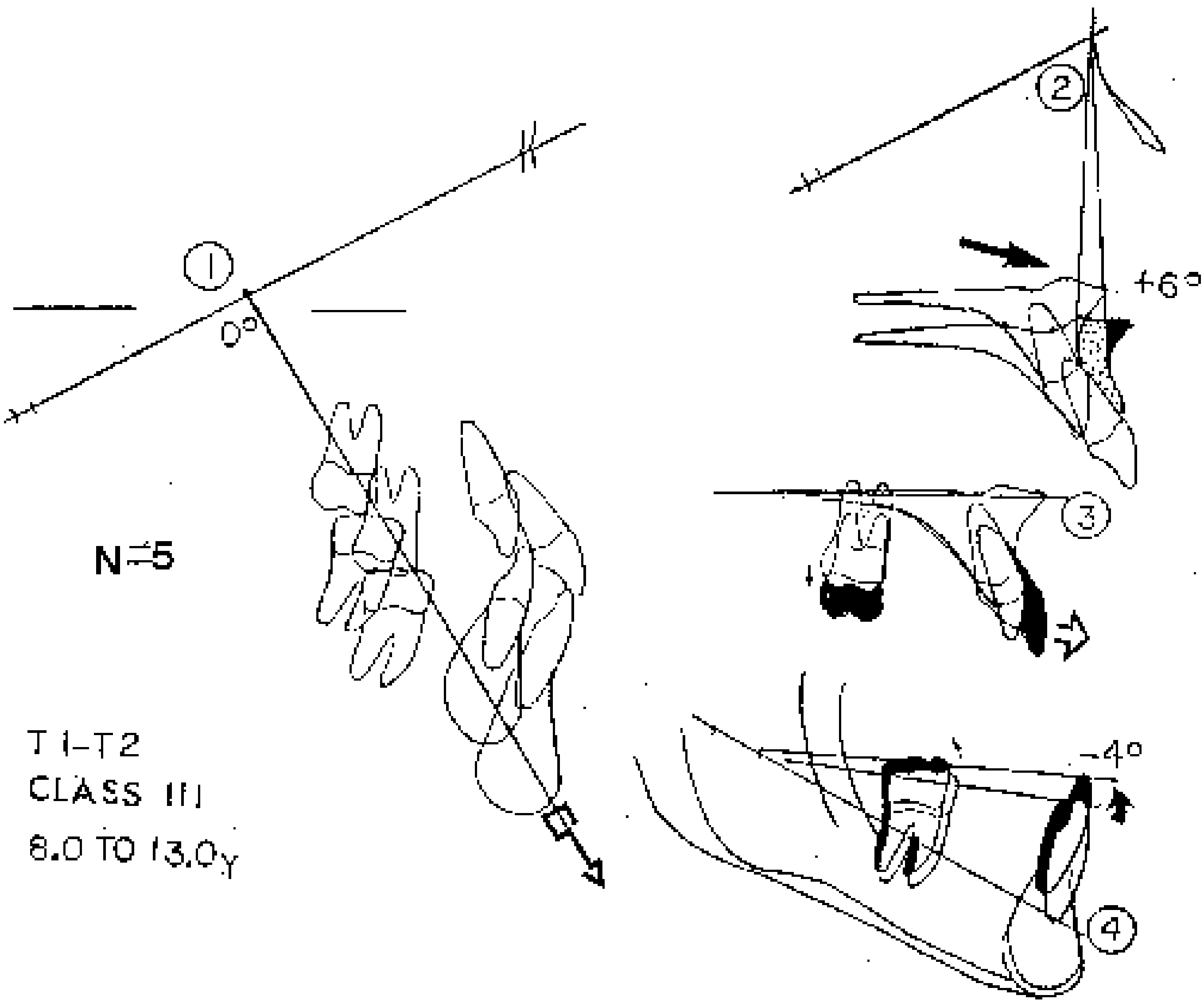
6. **Overtreatment** is required as in the Class II.

7. Night wear only is sufficient if it be worn regularly (12 hours).

8. Wearing every other night or every third night will provide retention.

9. Utility arches may be employed later for incisor control. They can be ligated to deciduous canines.

10. Patience and confidence by the operator and good management principles are applied.



Composite of five Class III patients at age 8 years all treated with face mask. Four Position analysis shows growth down the Facial Axis. Note the dramatic change in the maxilla forward positioning of the upper incisor. Elastics were employed for finishing.

FIG. 7-12

C High-pull Anterior Augmentation

In extremely deep bite when the upper permanent incisors have erupted and gummy smile prevails, the upper incisors need to be intruded. This will prevent the need for Le Fort surgery.

From the molar the distance to the distal of the upper lateral is nearly 30 mm. At a capacity of 2000 grams – mm. of moment a .016^2 blue Elgiloy wire will deliver about 70 grams. In order to intrude one upper central incisor a usual force of 40 grams is needed. The lateral has a rating of 30 grams. Therefore the wire at 70 grams is just barely strong enough to depress the upper incisors.

For better efficiency, two steps may be taken. First only the two centrals can be intruded with the .016^2 blue Elgiloy utility wire. The laterals may be ligated upward later. Secondly when all four incisors are to be moved en masse, the upper utility **can be augmented with** a **high pull** extra oral bone with hooks adapted to the midline. The central incisors are ligated together to prevent spacing (see Fig. 7-10). The high pull anterior also helps direct the force directly down the long axis of the teeth (as shown by Jarabak)

When conducted properly, the upper incisors have been seen to be intruded the length of their roots. A word of caution is that **too much force will sclerose** the area and transmit the force to the maxillary base and be self defeating. In addition, **excessive force may kill the incisors.** The following objectives usually obtain:

1. The alignment of anterior teeth in order to enhance their control (if the irregularity is moderate)
2. Intrusion of the centrals first in Class II Div 2 conditions followed by thread ligation upward of the laterals later.

3. A rule of thumb is the tip of the incisor root is one to three mm. relative to the Org line (Xi-Ans line) (See Fig. 7 3).

4. Often later the canine may need to be intruded to harmonize with the lip line.

5. Composites have revealed gummy smiles are produced by **failure of descent in the development of the palate and the zygoma**. These leave the muscle attachments high and expose the gums during the smile

6. The occlusal plane is dictated by mandibular growth. The upper teeth compensate by super eruption and therefore show excessive gum. A forecast will show whether or not the lower incisor needs to be extruded or intruded to satisfy the lip level.

7. A word of caution is to prevent the root of the lateral incisor from entering the crypt of the canine. **Flaring of the crowns and converging the roots is no problem therefore and can be easily managed later.**

VI TRANSVERSE CORRECTIONS - EXPANSION AND CORRECTION OF CROSSBITE

Semantic problems exist in planning total "arch length increases". Any overall arch length increases often have been called "expansion" meaning that arch size has been enlarged to accommodate crowded teeth. A distinction has been necessary because direct "transverse increases" are practiced by many clinicians for both arches, while other procedures such as fixed full engagements with so called straight wire tends to displace the incisors forward first.

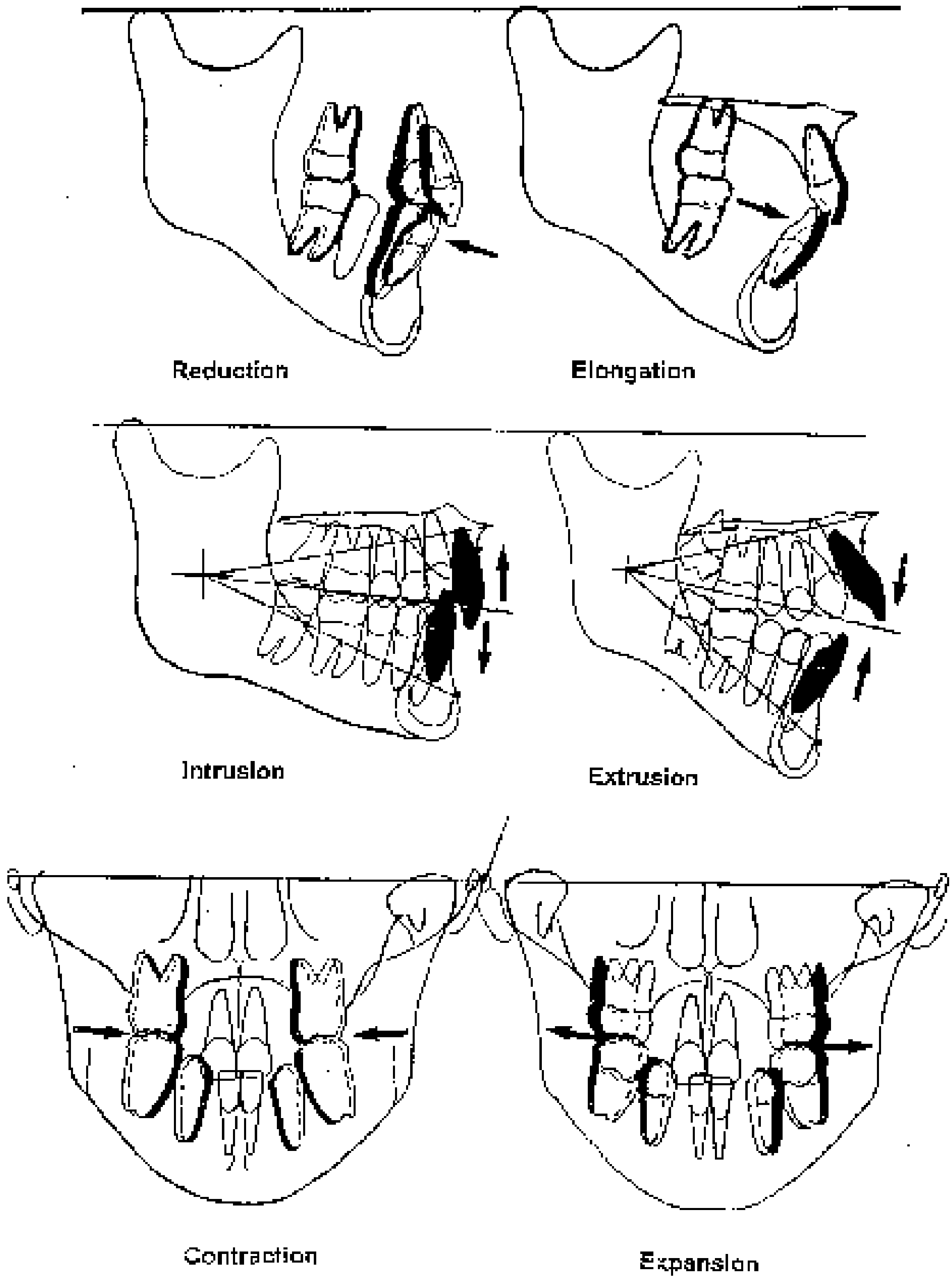
Therefore the following semantic terms have been suggested **(Fig. 7-13)**. The term "**elongation**" has been chosen for the saggital plane for increase in arch depth. When the incisors are retracted relative to the molars, this may be considered arch "**reduction**". When straight buccal movements are accomplished, this is termed "lateral **expansion**" as opposed to the "**contraction**" when narrowing is accomplished posteriorly.

Vertical changes have been described simply as "**intrusion**" or "**extrusion**" understanding that this application of the terms may not properly coincide with dictionary terms (see Fig. 7-13).

A. Controversies in Lateral Expansion – Palatal Suture Modification

Lateral expansion is at least 150 years in practice. Screws were used and springs were employed before X-ray analysis was available. In fact, the 1910's was referred to as the "palatal splitting age" but was ridiculed by Angle and Ketchum as being unnecessary. They were, as understood currently, without doubt separating the suture with the E Arch but more slowly.

Rapid palatal expansion (RPE) was renewed by Haas in the U.S. and studied by Krebs in Denmark. Hendrickson in Australia studied sutural splitting



Semantics for movements in different directions.

FIG. 7-13

and suture ankylosing in experimental animals. Ligaments in the suture are designed for tension. The pressure at right angles to a suture is converted to tension by the serrations which meet at right angles as the push is changed to a pull as on the root of a tooth.

But ligaments stretch! Ligaments cannot withstand permanent deformation! They elongate and actually are ruptured from the very heavy forces in a jackscrew measured to be 1500 grams or around three pounds.

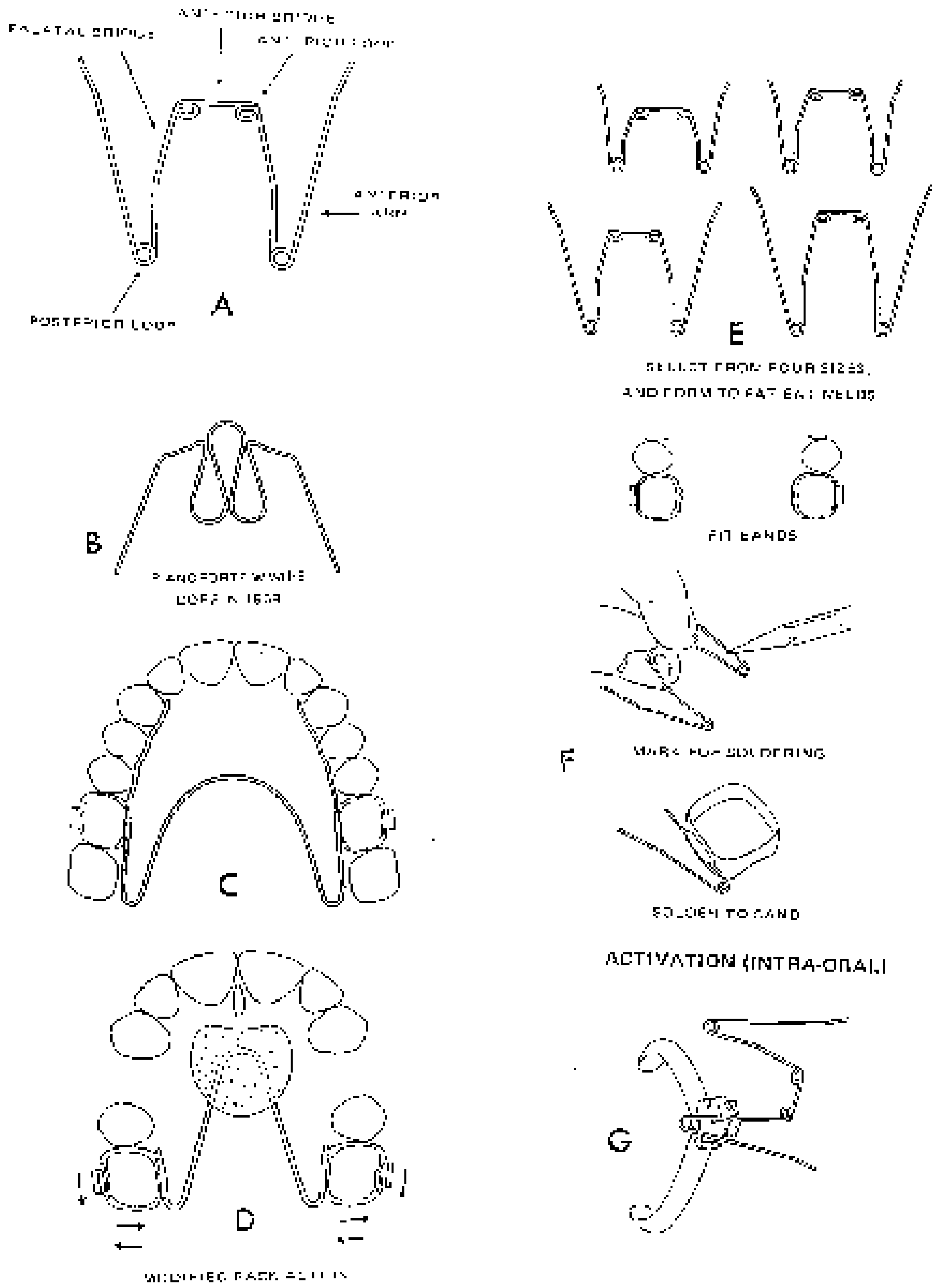
Several sutural mechanical splitting designs have been described. They may be tooth borne or tooth and palatal tissue borne. Ricketts and Bench studied the results of sutural splitting with frontal cephalometric and tomographic analysis. After considering the effects, the costs, and the remaining problems, Ricketts opted to employ exclusively the quad helix. This was due to its versatility, its efficiency and economics, and the combined effects of a **three dimensional and rotatory activity**.

B. Quad Helix

A special manual has been prepared dealing with the full application of the helix type appliances.

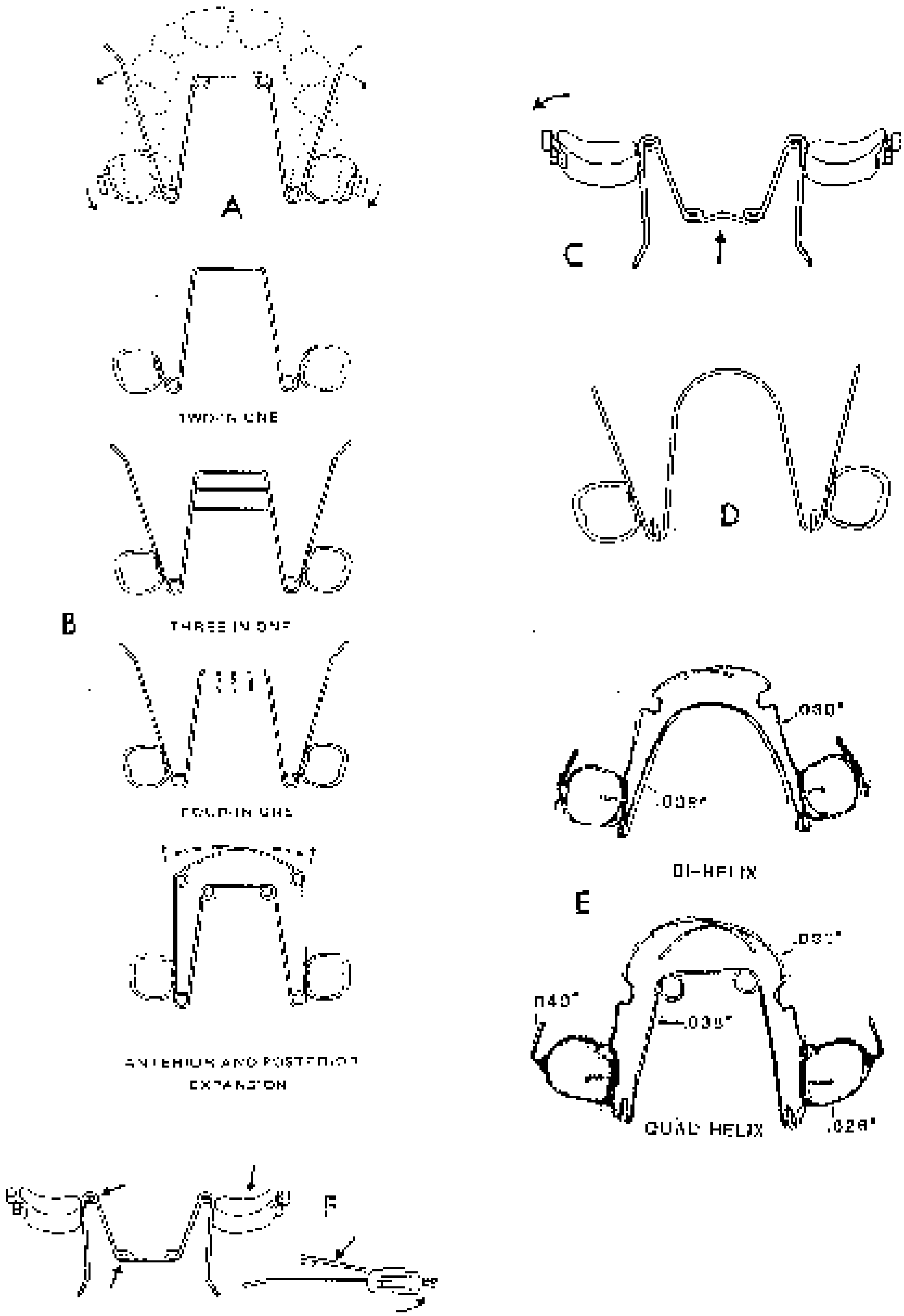
Three fundamental designs are available commercially. Ricketts prefers his original soldered quad helix to be activated intraorally after placement. It is constructed directly at the chair and is provided in four sizes for those not wishing to fabricate it by themselves. It is made in .038" blue Elgiloy (**Fig. 7-14**).

Adjustments made vertically at the anterior bridge of the quad helix controls molar tipping bucco-lingually (**Fig. 7-15**). Adjustments for molar rotation expansion were made in the palatal bridge.



A. Description of parts of the quad helix.
B. The figure "W" to C. the Pollack appliance.
D. Modification of the W to make "back action" on holding arch.
E. Four commercial sizes.
F. Technique steps.
G. Intra oral adjustments.

FIG. 7-14



A. Molar moved first. B. Variations of the principle. C. Vertical bend in anterior bridge keeps molars from tipping buccally. D. A fixed bi-helix for the lower. E. The helix principle for clasped removable crickett. F. Loops and .036" blue Elgiloy permits up to 600 grams of force.

FIG. 7-15

A second type, a removable (the Wilson), is made in .036" true chrome steel. It likewise is provided in sizes and fits into vertical friction lock tubes. A third type is a folded wire that fits into horizontal tubes in which steel wire also is employed.

All types can be made "orthopedic" or "orthodontic" in action. For **orthodontic** (tooth only) expansion, **only 70 grams of force** is recommended for development of the ridge at the molars. For "orthopedics" (palatal widening) in the growing child, forces of up to 600 grams are employed which widen the palatal suture but may also in some patients split it (see Fig. 7-7).

1. Face Bow as an Expander

Often lost sight of is the recognition of the benefits in lateral expansion offered with the face bow use. Nearly all severe **Class II conditions are cross-bite** in the transverse dimension and require lateral expansion. Routine widening of the dental bow with rotation included, **may also affect the palatal suture**. Face bow with cervical traction is, in the opinion of the author at least, the most profound modality available for increase of nasal volume! By viewing the frontal headfilm, these results are immediately revealed (see Fig. 7-3).

C. Lower Lateral Expansion

Throughout history, several devices have been employed for lower arch expansion. These were in the form of removable plates or removable cribs and a variety of fixed modalities. Two significant differences are recognized as contrasted to the upper. First there is no suture to modify. Secondly, the tongue prevents a direct force being applied from one side to the other as in the upper. Therefore arched appliances are employed.

The Mershon half round tube employed in the labio-lingual modality was the first appliance learned by the author. Fingersprings soldered from the lingual arch were employed for expansion and other types of action.

The fixed lingual was replaced by clasps by Crozat. In order to make it a removable a .048" gold wire was employed for expansion or for a lingual controlling device. The Crozat was in turn modified by Ricketts to a bi-helix .038" Elgiloy with additional clasps and modified finger design and was called the Cricket (see Fig. 7-15).

Others have modified the Mershon tubes such as Wilson for the vertical friction lock device. Sizes of appliances were provided for adaptation to the individual requirement.

Ricketts also developed the .038" bi-helix as a fixed device (see Fig. 7-15). In the lower however, it is more difficult to adjust intraorally and may be removed, cleaned, adjusted and recemented in the time often taken to remove, adjust and replace a removable lower.

In the young patient, one of four choices may be employed for lower lateral expansion by the author in the following hierarchy : the Cricket, the fixed Bi-helix and the Wilson lingual removable. The other choice for the lower is the utility arch.

However, it should be constantly in mind that influence on the lower arch is provided by extraoral or intraoral mechanics on the upper arch.

D. Contraction

All palatal or lingual modalities are also capable of contraction. These are useful in buccal cross-bite correction. However, **sectional mechanics** and criss cross elastics offers intrusion as well as transverse correction.

VII CORRECTIONS WITHIN THE INDIVIDUAL ARCH

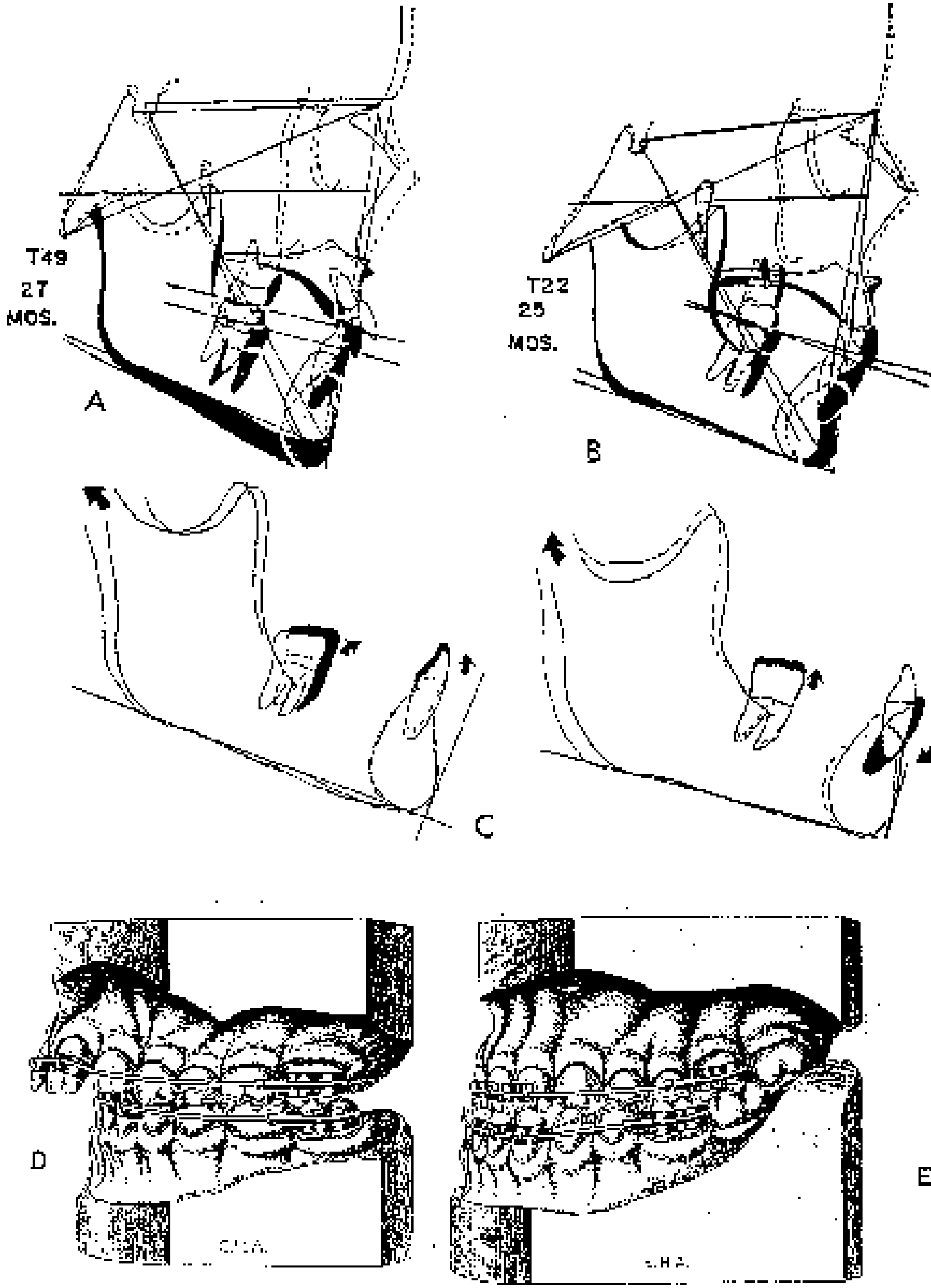
A. The Utility Arch

In traditional edgewire mechanics, arch leveling, space creation and rotations of teeth with alignment become the primary goals.

Prior to the development of the "Utility Arch", several methods for treating individual arches in young patients were employed. Lateral expansions and forward movement of anterior teeth were described previously. However **three planes of space are involved** in correction of deep bite. This involves the vertical dimension as well as sagittal and transverse considerations. Problems exist in trying to "level" the arch with straight wire while deciduous buccal teeth are being shed. Therefore the buccal teeth are "by passed".

In 1948 the author recorded a patient treated with the edgewire .022" x .028" gold wire but with the "Ribbon Philosophy". The patient was a Class II Div 2 with a mixed dentition. The four first permanent molars were banded and Edgewire tubes were placed. The four upper and lower incisors were engaged with .022" slotted brackets. The rectangular wire was adapted and "molar tip backs" were activated on each arch. This intruded and torqued the incisors in both arches **(Fig. 7-16).**

After bite opening was achieved (by intrusion), hooks were soldered on the upper wire distal to the lateral incisors and Intermaxillary elastics were applied. The result was a spectacular intrusion of the lower incisor and a vertical growth of the ramus! At the time this was accepted as a natural expression of the growth pattern. That explanation became challenged. The question now is "could vertical condylar behavior have been induced in some manner?"



A. Typical behavior of edgewise non extraction at age 12 (from 1948 samples).
B. A patient introced with 2 x 4 treatment. Note closing of Y Axis.
C. Analysis of difference produced in the two patients.
D. From Angle (1916) in the application of Ribbon for Class II.
E. Application for Class III. Note the deciduous teeth were "bypassed".

FIG. 7-16

Following that experience, the author worked in a practice in which the Ribbon technique was employed. The Ribbon was formed by a rolled and flattened .030" round wire to a .022" x .036" dimension which fits into the vertical slot of the Ribbon bracket (see Fig. 7-16). Ordinary use witnessed a bending of the wire mesial to the molar tubes from the forces of mastication. This induced a molar tip back and produced an incisor segment intrusion.

The study of these patients led to the discovery of "cortical anchorage" underneath the buccal plate or the external oblique ridge (Fig. 7-17).

1. The Utility Form

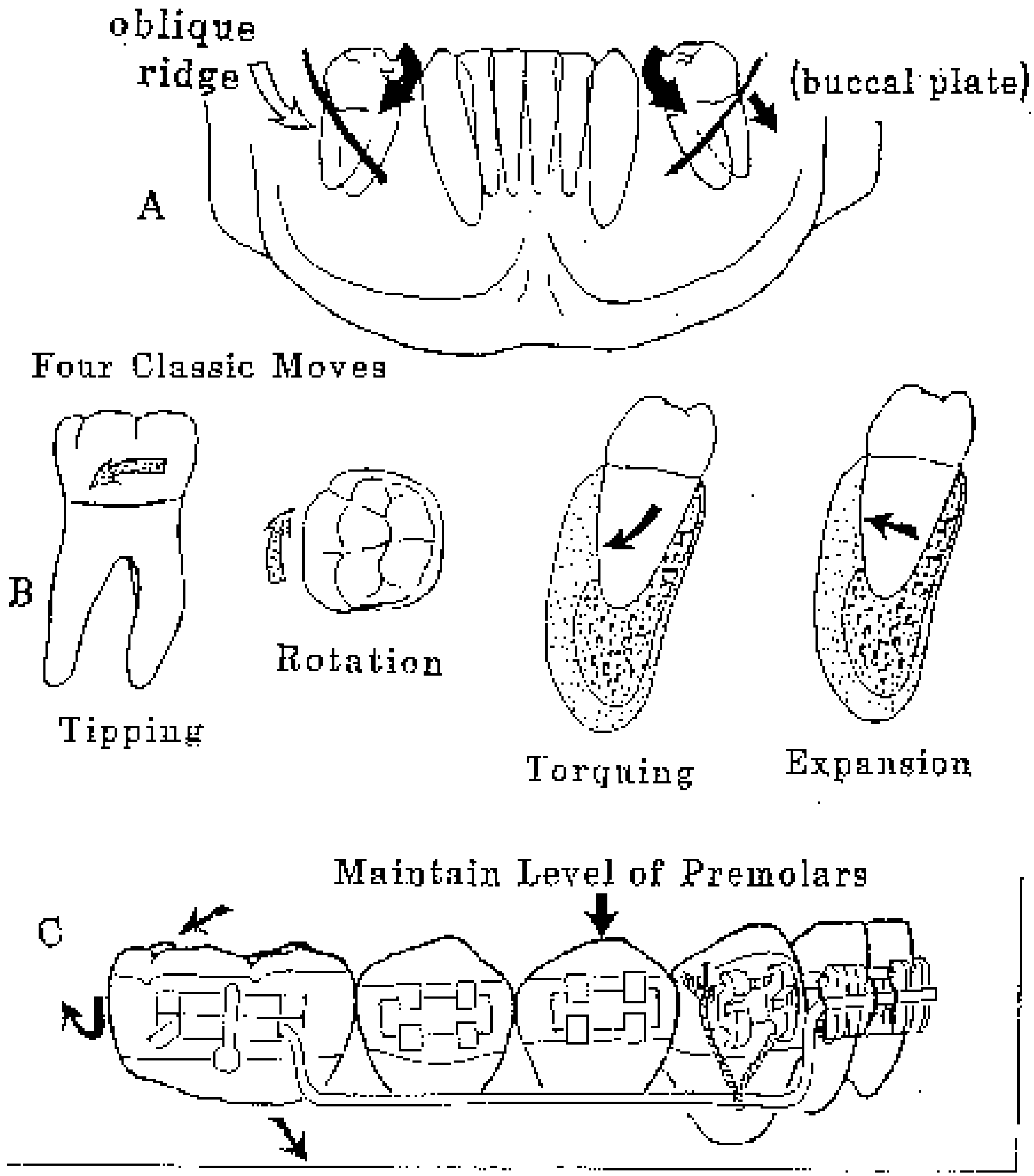
When later intrusion was shown to be possible with the .016" x .016" Elgiloy blue wire, the need to protect against occlusal force warping of the wire was recognized. The wire needed to be dropped downward away from masticatory damage. In addition, the introduction of an "open loop" would permit adjustments for arch length modification. Thus the utility arch was born in 1960 (see Fig. 6-15).

The Utility arch got its name by an assistant who remarked "Dr. Ricketts, you do everything with it". Indeed it is very versatile in capability and the label was appropriate.

The following objectives can be satisfied with this .016" Elgiloy Blue wire form with various configurations with the principle (**Fig. 7-18**):

1. The step down and step up constitutes an open loop with an average 25 mm. bridge. This provides an opening or closing of space between the incisors and the molars.
2. By placing a "Z" shape, the loop has an open delta loop shape. This permits a wider range of action for either opening or closing buccal space.

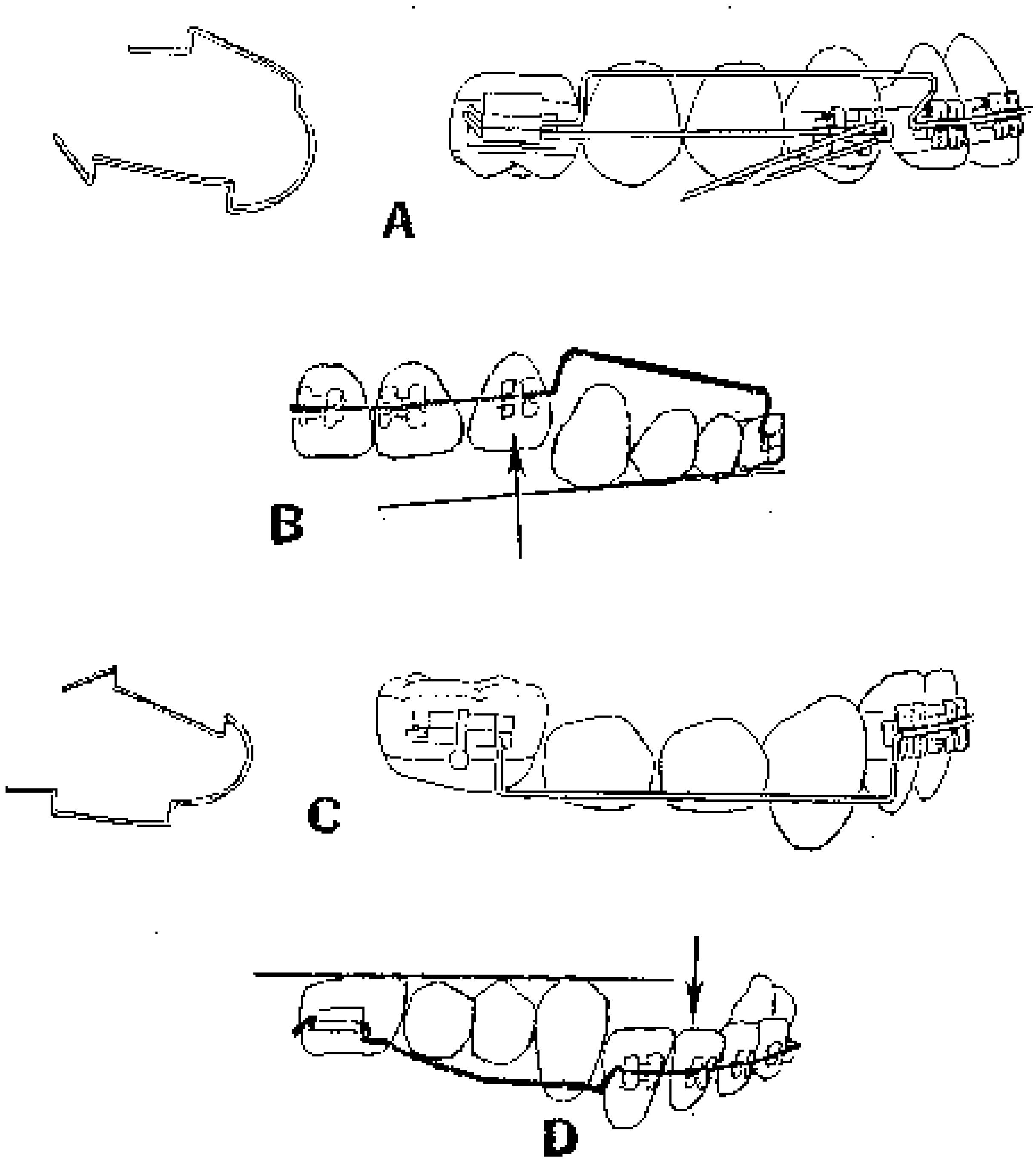
CORTICAL MOLAR ANCHORAGE



A. Buccal root torque anchors the lower molars.
B. Four moves for the molar with the Utility Arch or square wire.
C. Objective is to treat to the lower first premolar level. Note lower utility arch and double molar tubes.

FIG. 7-17

UTILITY ARCHES



A. Diagram of classic upper Utility arch with "Z" shape for elastics and opening of closing action.
B. Rough tracing of intraoral photo showing intrusion of upper anterior section from occlusal plane.
C. Classic lower Utility.
D. Dramatic lower incisor intrusion shown in tracing of photograph

FIG. 7-18

3. By placing helix loops inside the Utility, a lighter and more continuous expansion action is possible (Fig. 7-19).

4. By placing a helix loop outside the contraction action can be enhanced.

5. The Utility arch is flared through the buccal bridge to produce a shield or "lateral bumper" to the buccal cheek musculature which invites a lateral premolar and permanent canine movement with development.

6. The lower anterior segment can be controlled for ;

   Intrusion,

   Extrusion,

   Labial crown torque (or lingual root),

   Lingual crown torque (or labial root).

7. Loops can be added between the incisors for ;

   levelling,

   alignment,

   rotation,

   shielding of the lip,

   protection of the gingiva,

   lighter torquing action – against planum alveolare or palatal plate.

8. Molars can be controlled for ;

   Tip back anchorage for retraction of incisors,

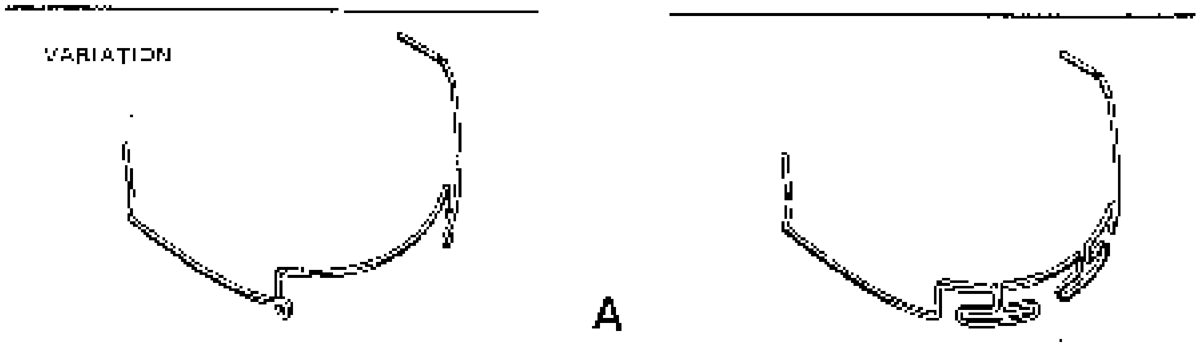
   Buccal root torque for anchorage enhancement.

9. With molar anchorage under the buccal plate intermaxillary anchorage for elastics is supplied and little or no movement of the lower arch takes place! **Thus the whole lower arch can be uprighted and still employed for anchorage which is remarkable.**

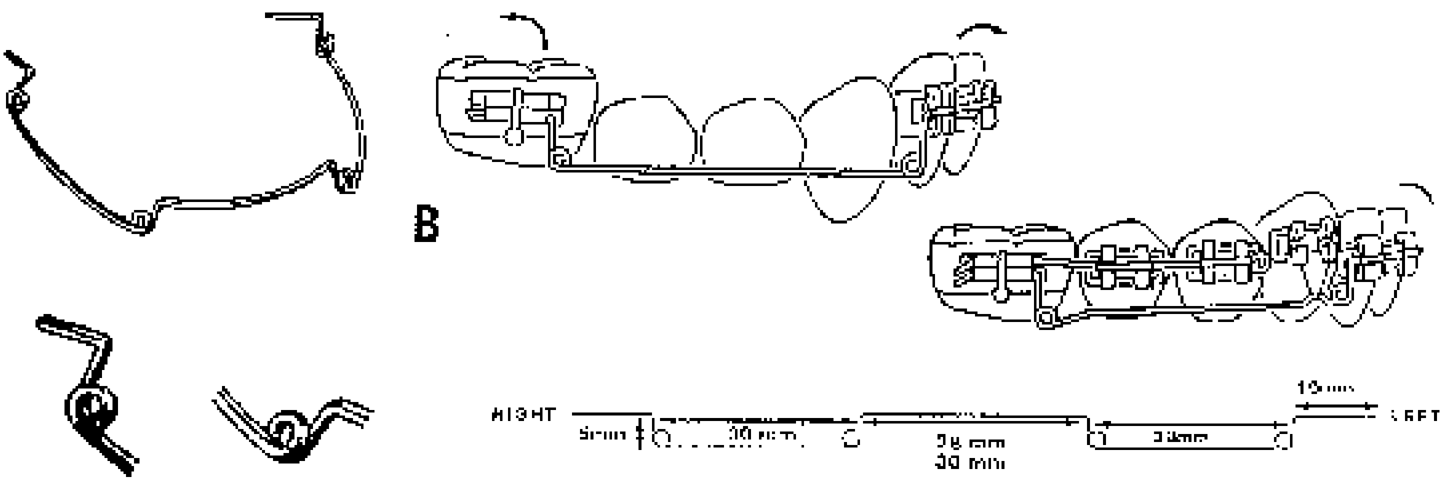
10. The Utility form in the upper can be modified for elastic traction as desired.

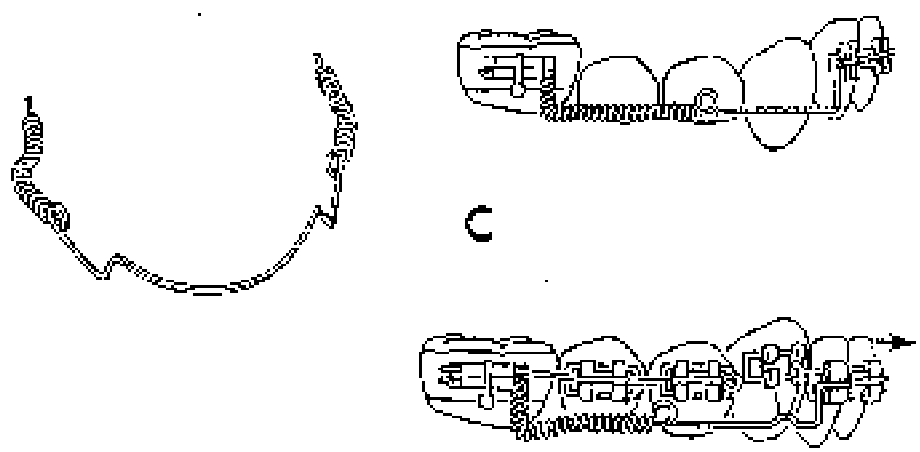
11. The Utility principle can also apply to "sections". Even push coils can be added to insure primary action on the molar.

12. Double elastics can be employed which raises force values to an orthopedic level.



MANDIBULAR — ADVANCING UTILITY ARCH - .016 x .016 BLUE ELGILOY®





A. Variations of the Utility principle (Closing and Leveling)
B. Opening Utility
C. The McAndrews option of push coil spring

FIG. 7-19

13. After management of the molar and incisor segment, the canines and premolars can be managed by concatenated wire or straight wire sections in the late mixed case.

VIII SUMMARY

For this lecture, the focus has been on choices of mechanics for the deciduous and mixed dentition patient. A part of the problem has been the lack of agreement on possibilities. In addition there is inconsistent discipline of the application of various techniques. Trust in stability of the early treatment has been a problem because of the traditional failures with older methods, i.e. posturing and elastics.

Perhaps the concept of efficiency has not been understood. When the entire jaws are changed, the **individual teeth need not be moved.** When growth is harnessed and when the natural forces of occlusion are recruited, **nature is put to work** in the favor of the patient and the operator.

With the objective of (1) structural change, (2) correction of function and (3) enlistment of natural forces employed in that order, the job at hand becomes clear. For orthopedic change in maxillary prognathism or retrognathism, the extraoral traction is highly effective when used correctly. For transverse change the quad-helix has won the game and the author prefers it soldered.

The utility arch with its variety of modifications is very effective to manage sagittal and vertical changes within the arch.

Mandibular posturing, while an enticing modality, moves teeth more than true orthopedics. It becomes a fourth choice. Maxillo-mandibular corrections of bone and teeth become the next issue. However, it would be well to review the factors that changed attitudes toward early treatment as viewed in **Table IV**.

TABLE 7 - IV

Factors that changed the outlook in Orthodontics from a Doctrine of Limitations to one of Possibilities

a) growth forecasting with cephalometrics,
b) sectional and segmented mechanics,
c) the change in results offered by cortical anchorage,
d) the shift to .018" bracket,
e) the application of lighter forces and the whole pressure concept,
f) the earlier and progressive orthopedic use of extraoral mechanics,
g) the findings from the use of bumpers,
h) the three-dimensional control with concatenated wires,
i) the benefits of mandibular posturing technique,
j) the drama of changes in the transverse dimension,
k) the freedom of lower arch development with third molar germectomy,
l) the change in muscle influenced by myofunctional therapy,
m) the profound difference offered by surgical lip release,
n) the cultural shift, in concepts of beauty, toward full lips,
o) the findings that extraction was not a guarantee against crowding.

Note:

Separate manuals have been prepared as follows:

1. Progressive Cephalometrics – Paradigm 2000
2. Consummate Occlusion
3. The Logic and Keys to Bioprogressive Philosophy and Treatment Mechanics
4. Differences Between Straight Wire Techniques and Bioprogressive Philosophy
5. Understanding the VTO : Its Construction and Mechanics for Execution
6. Concepts of Mechanics and Biomechanics
7. The Doctrine of Possibility : Thirty Critical Principles
8. The Latest Style in Thought and Action in Orthodontics
9. Three Ideologies and the Need for Communication
10. The Wisdom of Sectional Mechanics

In Process are:

11. Early Treatment (present series of lectures)
12. Extra oral Traction
13. Quad Helix – Bi-Helix and Crickett
14. Utility Arch Application
15. Extraction Mechanics
16. TMJ and the Bio-template
17. The Divine Proportion
18. Surgical Lip Releases

LECTURE EIGHT – BIOPROGRESSIVE PRINCIPLES RELATED TO EARLY TREATMENT

I INTRODUCTION

II MAXILLO-MANDIBULAR CORRECTION OPTIONS IN THE CHILD PATIENT

- A. Mandibular Posturing
- B. Intermaxillary Elastics
- C. Palatal "Back Action"
- D. Intraoral Action
- E. Vertical Condylar Activation
- F. Implant
- G. Ankylosis

III FUNCTIONALISM THEORY

- A. Functionalistic Views for Class I
- B. Functionalistic Views for Class II
- C. Functionalistic Views for Class II.
- D. Fixed Appliances and Functionalism

IV TRADITIONALISM AND VIEWS ON EARLY TREATMENT

- A. Emergence of Limitation Concept
- B. Other Traditional Theories
- C. Prognathism and Genetics

V THE BIOPROGRESSIVE PRINCIPLES

- A. The New Approach
- B. Theories of Force and Pressure
  1. Force Classification

LECTURE EIGHT – BIOPROGRESSIVE PRINCIPLES RELATED TO EARLY TREATMENT

I INTRODUCTION

An ideology is an integrated body of ideas which may or may not represent truth. One concept of philosophy is considered, to be an integrated body of **principles**. A principle is a usually trustworthy truth but not without exception. Natural laws have no exception.

Probably no other clinical aspect has through the years been more controversial than the "timing" of treatment. The argument of when to start needs to be reduced to principles. Actually, philosophy precedes science. In many aspects instead of a philosophy, perhaps the Bioprogressive approach should be considered a science because it is based on solid research.

Orthodontics started with "functionalism." Functional problems were sought as the etiology. Functional correction was an objective of treatment. Function was employed to produce changes. The result was a desire for the belief that skeletal changes or basal changes in the mandible could be produced almost with impunity.

II MAXILLO-MANDIBULAR CORRECTION OPTIONS IN THE CHILD PATIENT

Arch length problems are usually not manifested in the primary dentition. However, dysplastic jaw relations are often serious when present. Maxillo-mandibular basal or skeletal corrections as well as dental arch corrections are to be considered **three dimensionally**. The idea is to work toward acquiring normal jaw and denture proportions before the permanent teeth are present.

Historically, the maxilla was considered (1) the most normal, (2) the most fixed and (3) the most immutable of the facial structures. The methods of correction were therefore sought by the **alteration of the mandible**. The first modalities in young children were "bite jumping" for Class II. Extra oral restraint on the chin (mandible) was used for Class III probably before Kingsley in 1850.

When patients were considered past their growth prime, extraction of premolars was the practical answer by the old guard. The upper first premolars were extracted in Class II, the lower first premolars were removed in Class III. Extractions were common in both arches in severely crowded conditions. Dr. Calvin Case in 1920 considered the Class I double protrusion a malocclusion. He removed four premolars on esthetic grounds alone.

A. Mandibular Posturing

Mandibular posturing before 1900 was the only source of horizontal correction of the jaws to each other and the arches to each other. By 1906 Herbst had developed a fixed mechanism to posture the jaw forward in Class II. Angle earlier had placed a fixed bar on the upper and curved guide on the lower in order to posture the mandible forward. In the 1900's A.P. Rogers attempted to jump the bite with myofunctional methods and no appliances.

B. Intermaxillary Elastics

In 1898 it was demonstrated by Baker that continuous elastic traction could correct the dental arches. In the 1930's, Rogers combined the incline plane with intermaxillary elastics. Speculations naturally arose relative to whether teeth or basal bones were affected by the use of the intermaxillary elastics. But arch corrections were made possible for Class II, Class III and crossbite with the use of intraoral rubber elastic traction. Thus by 1900, two choices existed for maxillo mandibular correction; one posturing, the second, elastics.

C. **Palatal "Back Action"**

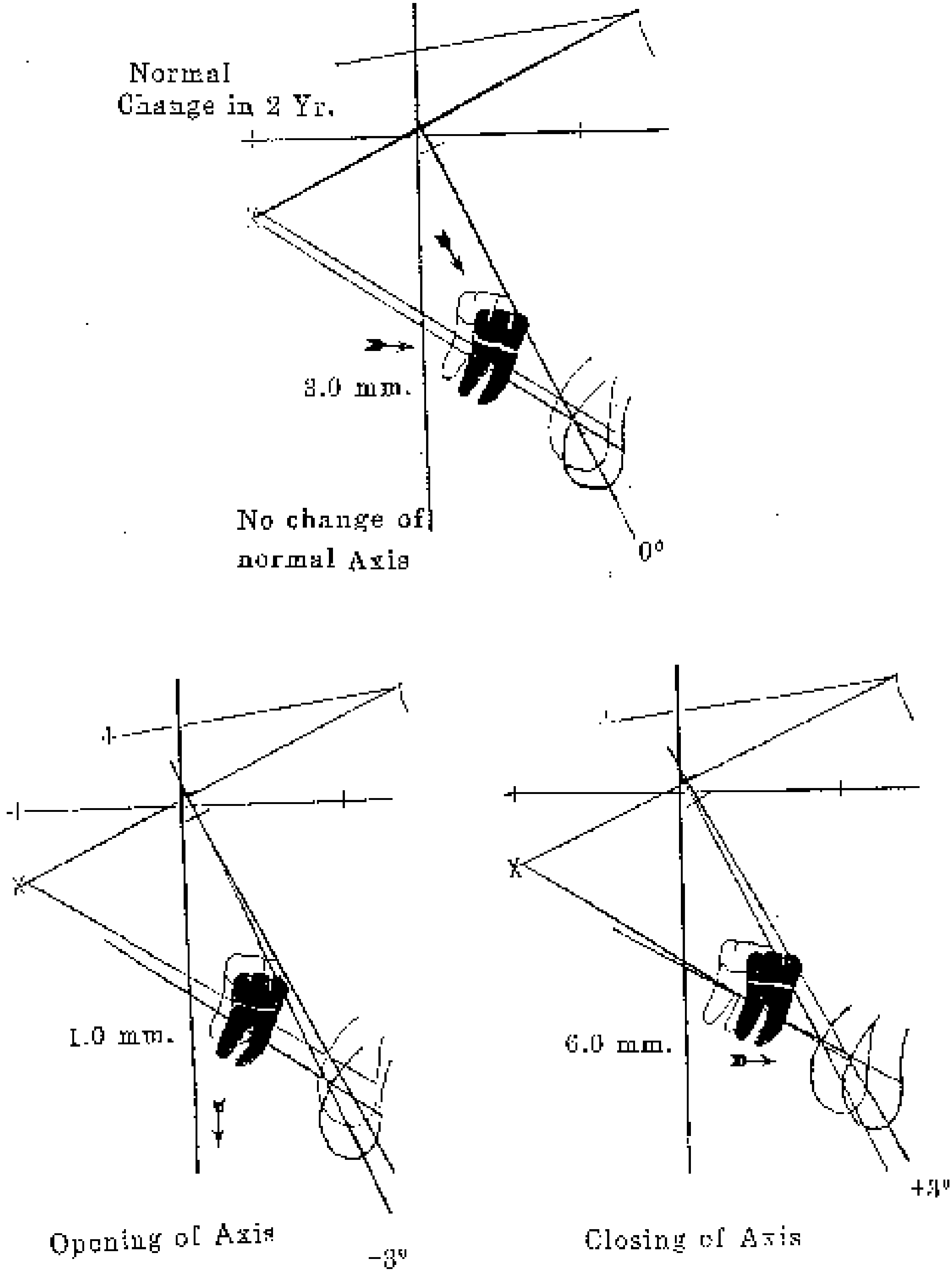
The third method for minor arch and jaw correction was subtle. It emerged on the result of the "W. appliance" and the "back action" palatal holding appliance. Reciprocal action tended to rotate upper molars and prevent their forward drift during the tooth eruption. The Oliver guide plane was used to help manage the upper as well as reposturing the mandible. In addition, the removable minded clinicians aimed their treatment at preventing the eruption of the upper molars.

As the **quad helix** was developed, unilateral action was shown to be effective in asymmetrical Class II (or sub-division cases) and distal movement of molars occurred with symmetrical activation.

Growth developments excited the idea that natural growth could play a deciding role in Class II correction and a hindrance to Class III resolution. This was one of the factors to produce interest in "growth prediction" by the author in 1950. If the chin were to "swing" forward, growth could easily contribute toward correction of convexity and arch correction (**Fig. 8-1**). However, if the chin were to swing backward, it would work against Class II correction but favor Class III correction by a reduction of facial concavity. Thus by 1950, four methods were available to the clinicians, these were ; posturing, elastic traction, upper molar restriction and growth use.

D. **Intraoral Traction**

A fifth method for skeletal correction was to emerge in the 1950's. Dr. Albin Oppenheim using the Angle Head Cap design with a swivel connection,



Normal
Change in 2 Yr.
3.0 mm.
No change of
normal Axis
0°
1.0 mm.
Opening of Axis
-3°
6.0 mm.
Closing of Axis
+3°

FIG. 8-1

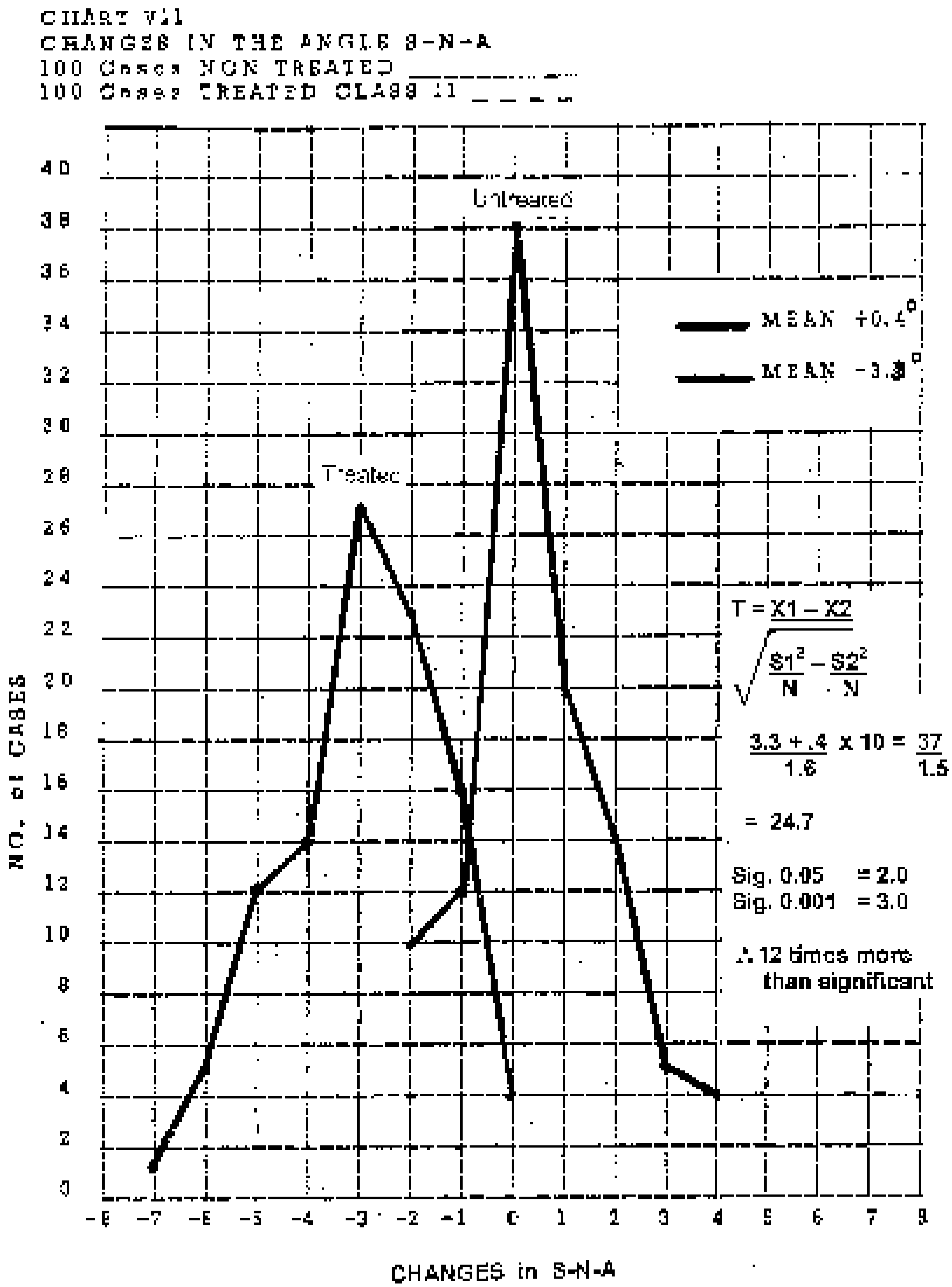
had demonstrated in 1936 that Class II correction was possible dentally in an adult female who was an actress who rejected visible appliances. On learning of Dr. Oppenheim's success, several clinicians including Dr. Silas Kloehn started working with extraoral traction. Kloehn soldered the dental bow (of .045" wire) to the facial bow (of .050" wire) into one unit.

Research in the 1950's by several workers, suggested changes other than than teeth to be possible. By 1960, Ricketts, using 100 untreated control subjects, compared to 100 treated patients, proved conclusively the changes were possible in the whole maxillary complex **(Fig. 8-2)**. Thus a fifth method was available. Skeletal change together with dental change was demonstrated.

E. Vertical Condylar Activation

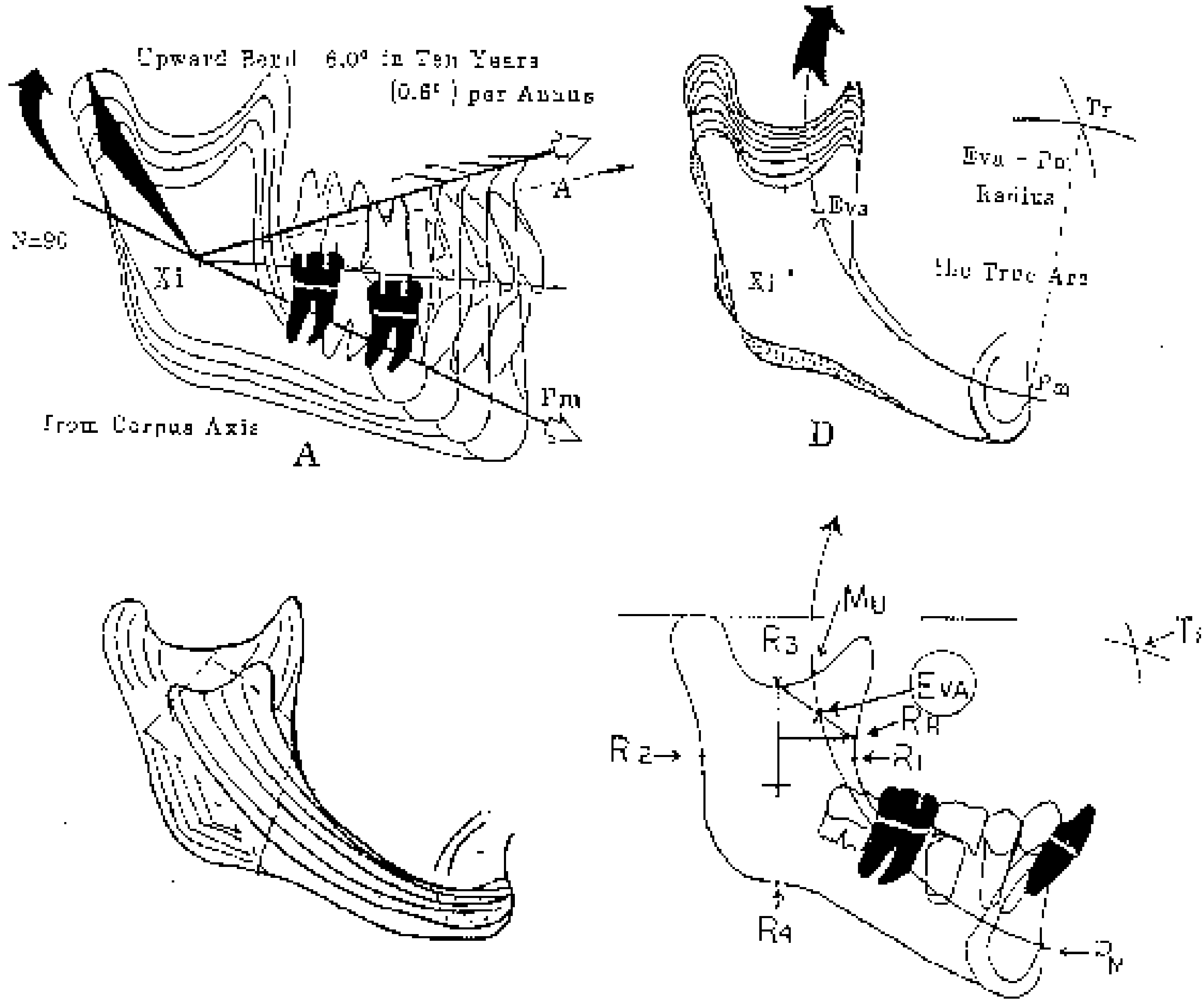
A sixth factor however, was discovered following the computer studies of the 1960s. It was the realization of a **mandibular growth arc.** The condyle in healthy subject was demonstrated to grow upward or upward and forward – not upward and backward as long theorized **(Fig. 8-3)**. This phenomenon brought with it two scenarios. The first was an explanation of why mandibular rotation by functional phenomenon or iatrogenics with orthodontic modalities, could compress the growth cartilage and inhibit, to a lesser or greater amount, the ramus growth.

The arcial growth phenomenon however, **opened the possibility that growth stimulants at least in short term could be possible by posterior occlusal height increases**, causing a mild condyle distraction. Isolated patients and composites verified this possibility. As the shorter arc is activated, the chin moves forward. As shown By Ricketts in 1952 and Bjork in 1969, forward and upward growth contributes to forward development of the chin while backward growth of the condyle leads to vertical rotational behavior.



Histograms showed proof of maxillary orthopedics in 1960. Curve on right is SNA change untreated (100 subjects). Curve on left is behavior of SNA Angle in 100 treated patients with cervical traction.

FIG. 3-2



A. Sample of 90 untreated growing children showed an upward bending behavior.
B. The true radius point (Tr) was located from Eva point centered at the base of the coronoid.
C. The central core of the mandible is basic to genotype while theoretically the processes are environmental.
D. The method of arriving at the arc at the base of the coronoid.

FIG. 8-3

Of equal importance, is the affects of opening rotation in the growing Class III child. Rotation tends to compress the growing layer of cells in the condyles and the pattern has been noted to be changed and quite dramatically so! Thus, **stimulation** or **inhibition of condyle** growth took on a different possibility and became a sixth proposition.

F. Implant

The seventh modality mostly for tooth correction, is in experimental stages. This is the fixation of implants within the individual's jaw structure as anchorage for tooth movements.

G. Ankylosis

Experimental ankylosis of sutures constitutes an eighth and final option. It could act as an ankylosed tooth.

III FUNCTIONALISM THEORY AND YOUNG PATIENTS

Orthodontics started with "functionalism". Functional problems were sought as the etiology. If function caused it function can fix it! Therefore functional correction was an objective of treatment and "function" was employed to produce changes. The result was a search for a basis for the belief that skeletal change or basal bony changes in the mandible could be produced almost with impunity with various methods.

A. Functionalistic Views for Class I

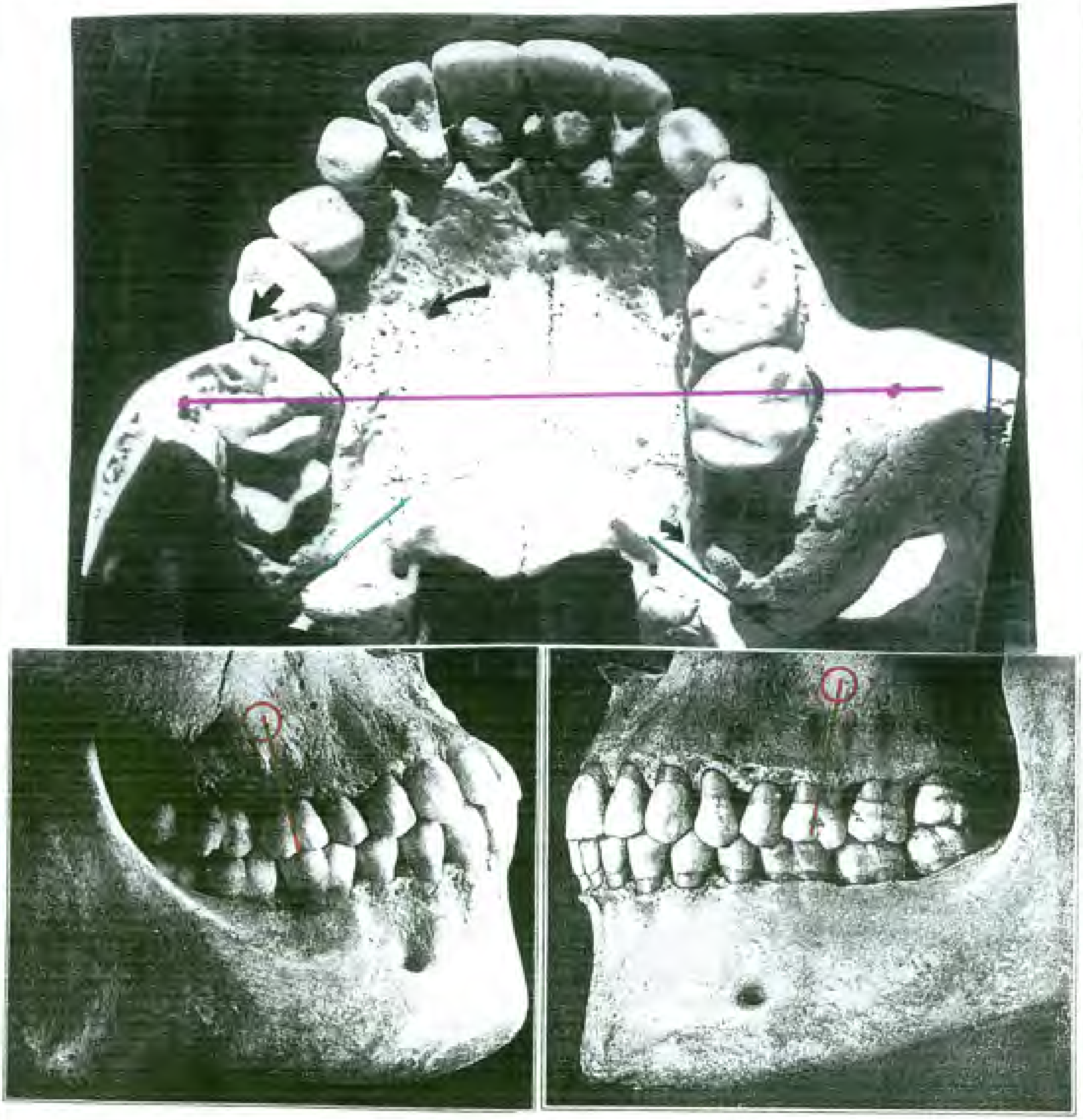
For Class I, the functionalist idea is to enlarge or "expand" the arches in order to create space for the dental alignment. This takes the form of major posterior expansion to prevent unsightly protrusion and lip strain. Posterior expansion and palatal splitting is an objective. This is to enhance but also to produce nasal breathing and for "growth stimulation". It is speculated that expansion of the arches and the creation of normal function is an input to produce the "growing of bone." The correction to a normal occlusion, made protrusive, is thought perhaps to be a stimulus for the jaws to overtake or contain the full denture. The question comes; is bone growing limited to alveolar process and if so what are the boundaries of basal skeletal bone and alveolar?

As it turns out, the correctness of that approach lies in the correct forecasting of which face can ultimately take expansion. Certainly the maxilla can be affected but the mandible, if not damaged, has been found to be genetically or constitutionally endowed and any modification for stimulation is subsequently cancelled out.

B Functionalistic Views for Class II

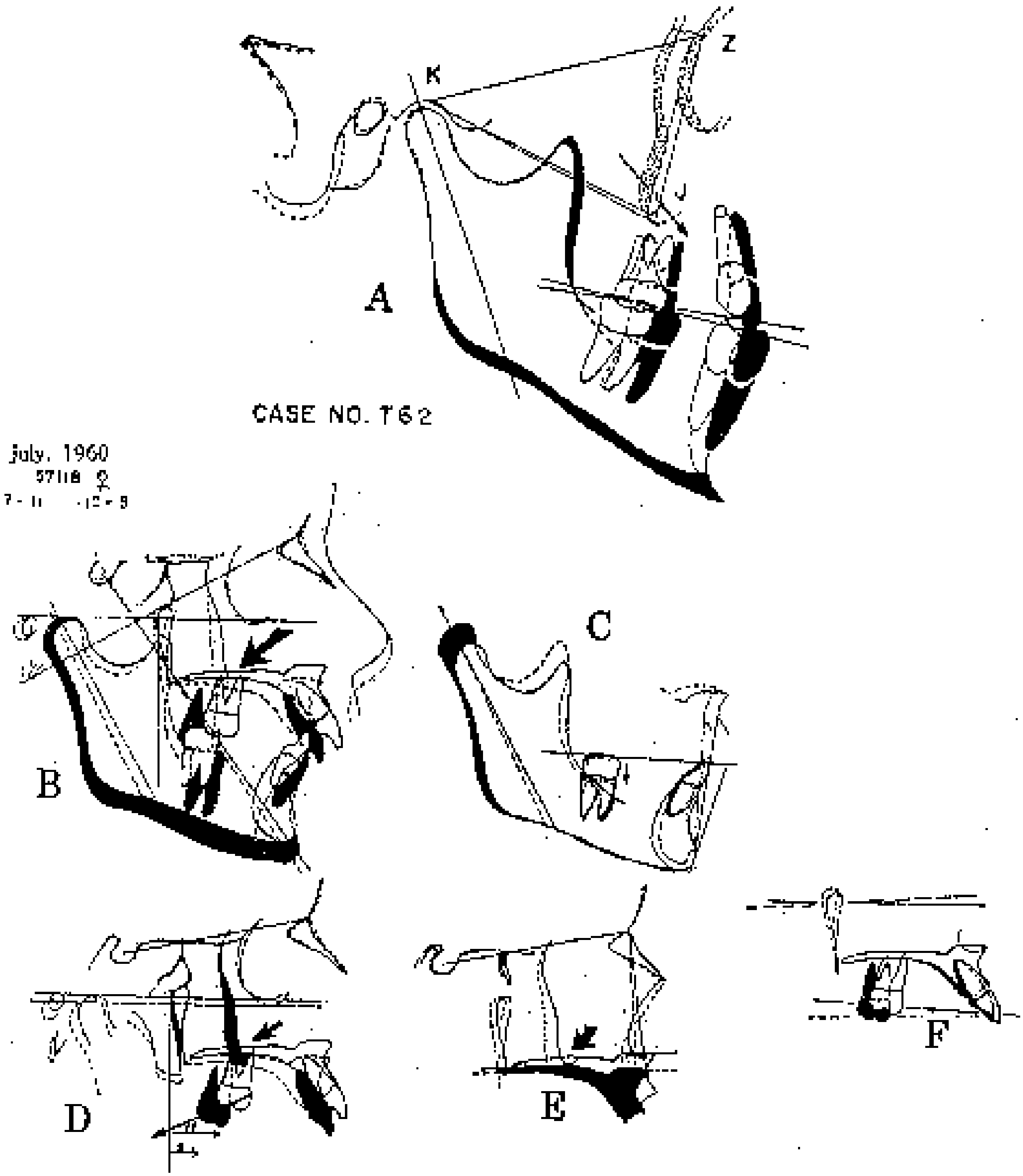
Angle examined dried skulls and patients directly. He found a general agreement in position of the upper first permanent molar relative to the jugal process of the maxilla. The upper molar thus became his "key" for classification. The X ray outline of the curve of the maxillo-jugal ridge (often on the zygomatic bone) thus became the "key ridge" **(Fig. 8-4)**. Unfortunately however, Angle had no method to evaluate the forward or backward relation of the jugal process itself (see Fig. 8-4).

Yet, the upper molar was declared to be the "most normal" and most logical starting point for reference and hence used for the Angle classification of malocclusion which has been the most used in the profession for 100 years. Because the molar was the most normal and it had three roots, it was also imagined to be the most immutable. The upper first molar therefore, became not only the reference for diagnosis but the **basis for treatment planning.** In Class



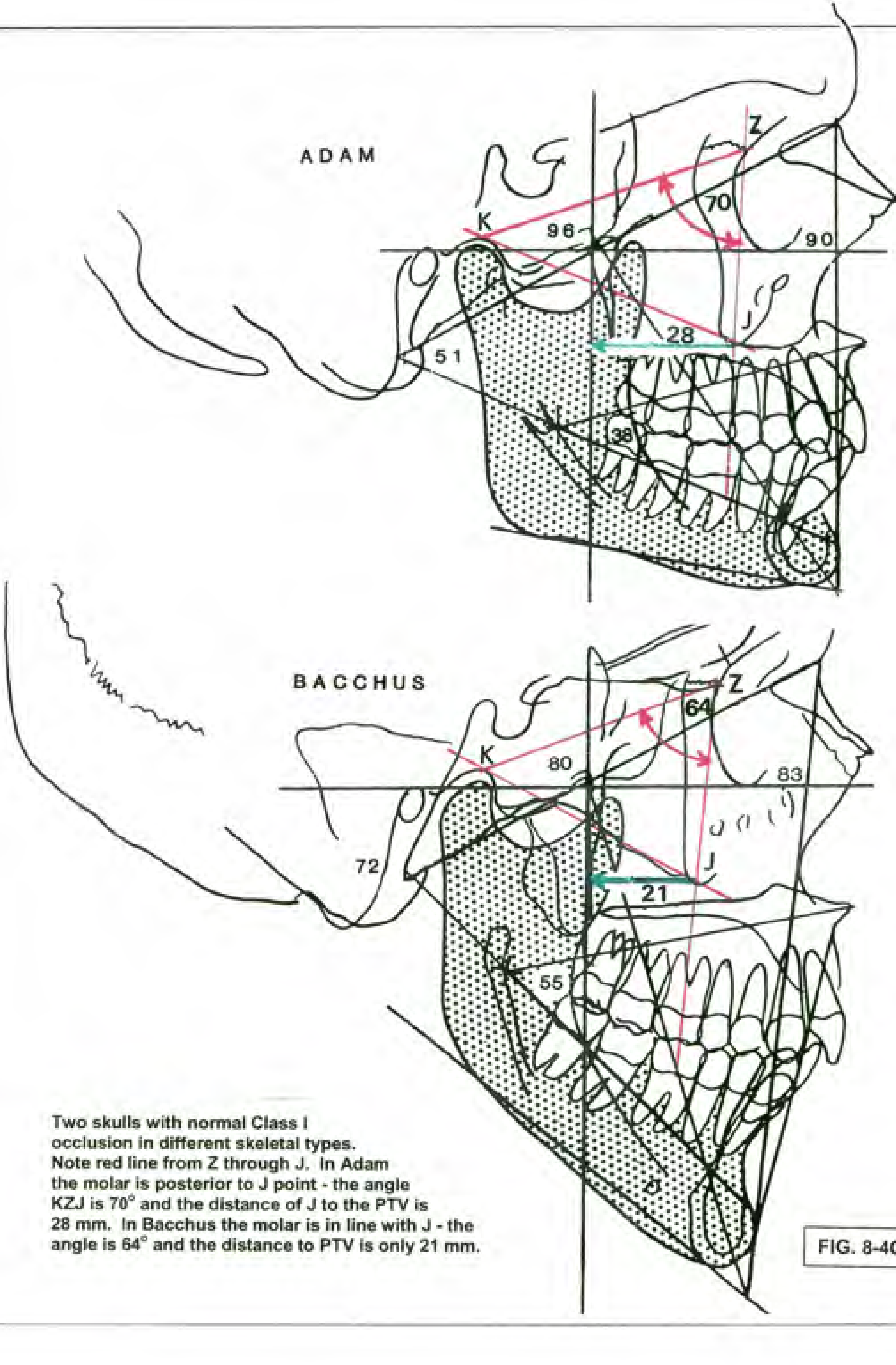
Angle's concept of upper first molar relation to the Jugal Process – above - a child in the mixed dentition – the purple line is from the center of the process . Note in green the angle of the Pterygoid Buttress. Note blue line at the Key ridge found in the X ray – arrows indicate directional tendencies with cervical traction. Below, Circles are at the Jugal Process through the long axis of the molar.

FIG. 8-4A



A. Triangle method for location of point J - (From K and Z). Note normal downward and forward direction in extraction Case #62.
B. A female buccal cross bite and Class II treated with cervical face bow. Note change in direction of point J at arrow.
C. Note molar intrusion.
D. Reference from Pterygoid Vertical for Key Ridge and molar (at arrows)
E. Superimposed at SN on N shows backward movement of Jugal Process.
F. Shows tooth movements in the maxilla.

FIG. 8-4B



Two skulls with normal Class I occlusion in different skeletal types. Note red line from Z through J. In Adam the molar is posterior to J point - the angle KZJ is 70° and the distance of J to the PTV is 28 mm. In Bacchus the molar is in line with J - the angle is 64° and the distance to PTV is only 21 mm.

FIG. 8-4C

II the mandible, or the lower arch, was considered to be small or retropositioned or in "distocclusion" in Angle's classification.

For the application of upper first molar theory, treatment for Class II became focused on techniques for the forward propulsion of the mandible. In the young patient, posturing of the mandible forward was conducted to theoretically produce increases in sagittal mandibular length. This treatment took the form of (1) bite guides from the molars, (2) bite jumping devices, removable and fixed, (3) clutches to hold the mandible forward or (4) blockers to command forward posturing.

Because cephalometrics was not available, the clinician could only speculate on the mechanisms that accounted for corrections. Relapses were often thought to be due to poor patient compliance.

The clinicians advising mandibular propulsion in children, however, recommended that upper premolars be extracted in patients past their growth period. Before 1936, extraoral traction was directed at only the movement of the upper anterior segment backward (to include the canines). This, in a sense, was an admission that **growth** in the child or anticipation thereof somehow directed the treatment plan.

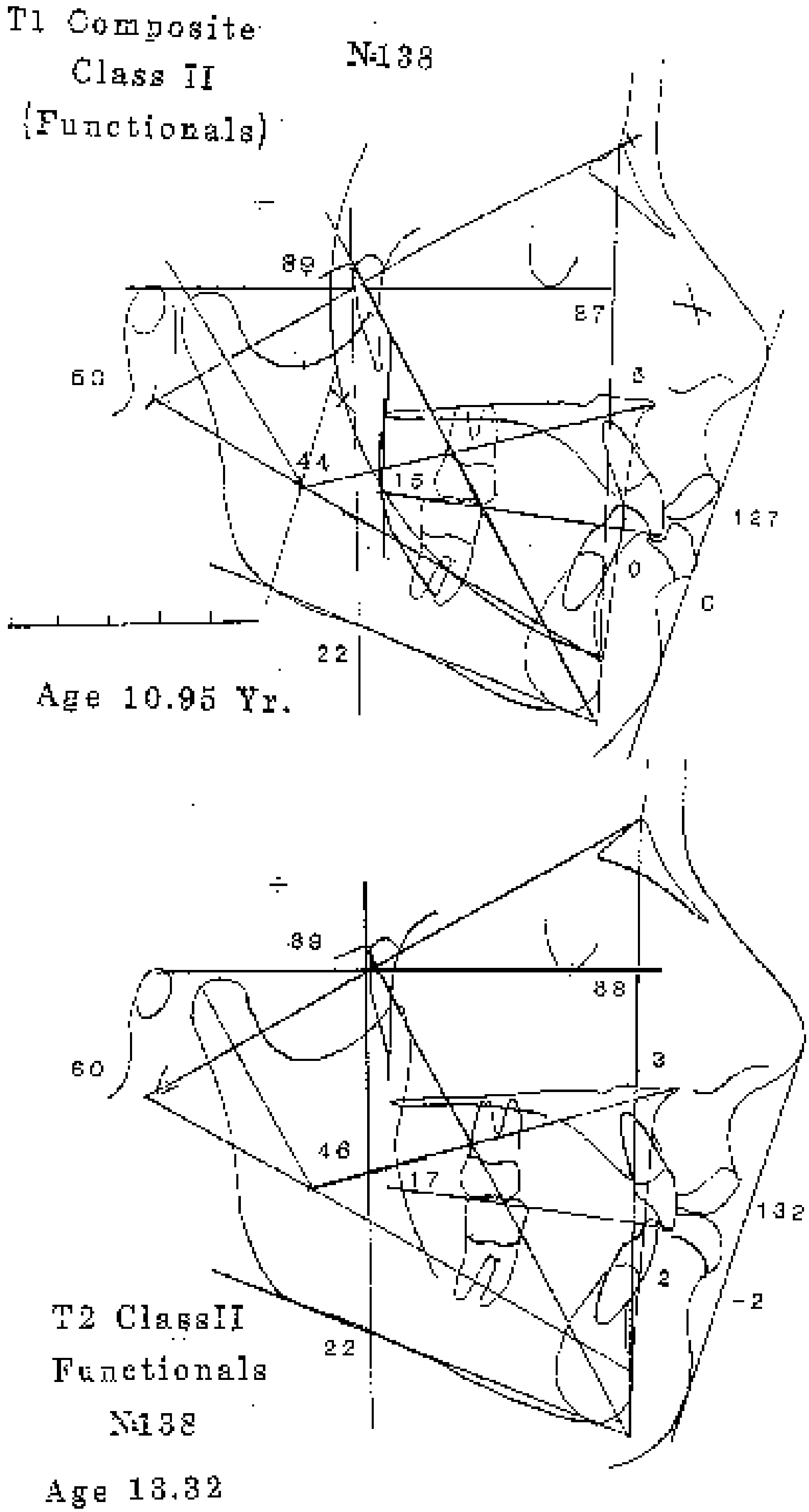
The idea of mandibular propulsion is practiced and does achieve corrections. The author has studied **seventeen groups of patients with posturing devices with computer composites.** Increased growth in long range beyond the normal predicted has **not** been demonstrated with the those methods. Short range changes with open bending of the mandible has been evident. Distraction methods however hold some promise and are still being investigated.

From the total of 17 groups of patients studied with computer composites both in short term and long term (to maturity), four groups were combined as shown in N=138 patients (**Fig. 8-5**). These were Activators, Biometers, Bimlers and Frankel cases. Fifty (N=50) treated by Dr. Kurt Faltin in Brazil are composited in **long term (Fig. 8-6)**.

C. Functionalistic Views for Class III

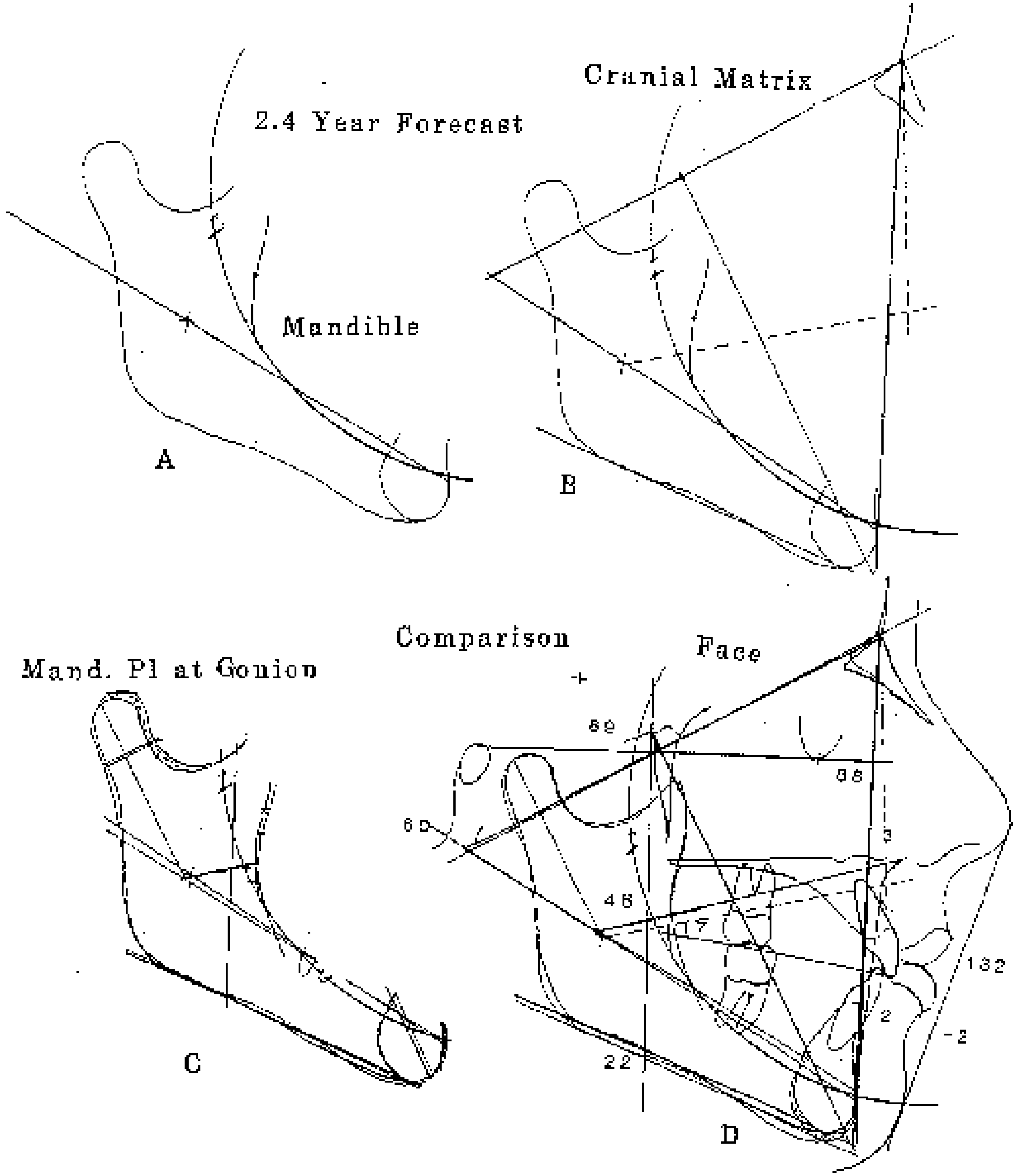
The writings of Kingsley, 1850 - 1960, described the chin cup to be advocated for treatment of Class III. In the Angle classification, the Class III was a mesio-occlusion or a forward position of the lower molar. This led to the idea that Class III was primarily due to a large mandible that needed to be contained. Angle impressed on his students that the **Class III patient be started early**. When started too late, years of treatment may be required and still may often lead to surgery. One clinician was heard to say I don't use chin cups because "they seemed to make the mandible grow faster." Success with chin cups has been shown and is a strong argument in the "Functional Doctrine." Patients from prolonged neck braces have been shown to undergo complete condyle destruction. Therefore a force great enough and of long enough duration can degenerate the joint.

Many clinicians using the functional discipline have tended to employ removable appliances. Others have combined the posturing approach with fixed appliances. The fact remains, however, that if growth is to be influenced, or to be a part of the treatment situation, the patient **must be started at a time that growth will be present to work with in the Class I and Class II condition and inhibited if possible in the Class III.**



T1 Composite of Four different groups of patients treated with Activators, Bimlers, Bionators and Frankels.
T2 The same patients 2.4 years later. Note the good result.

FIG. 8-5A



Forecasts for the time period between T1 and T2 seen in Fig. 8-5A.

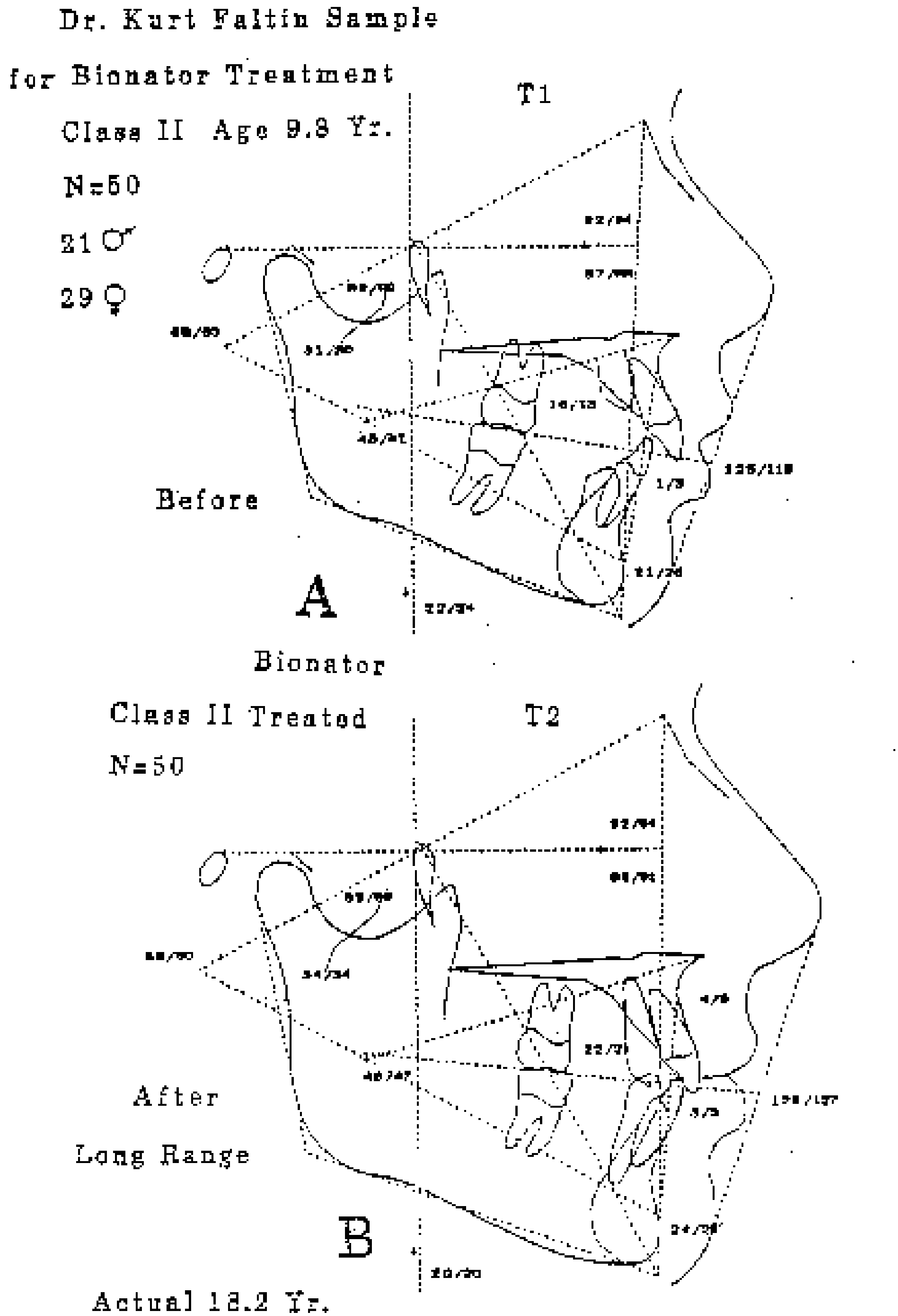
A. Mandible on arc.

B. Cranial and maxilla dotted.

C. Superimposed on gonial angle shows very slight undergrowth (not increased growth).

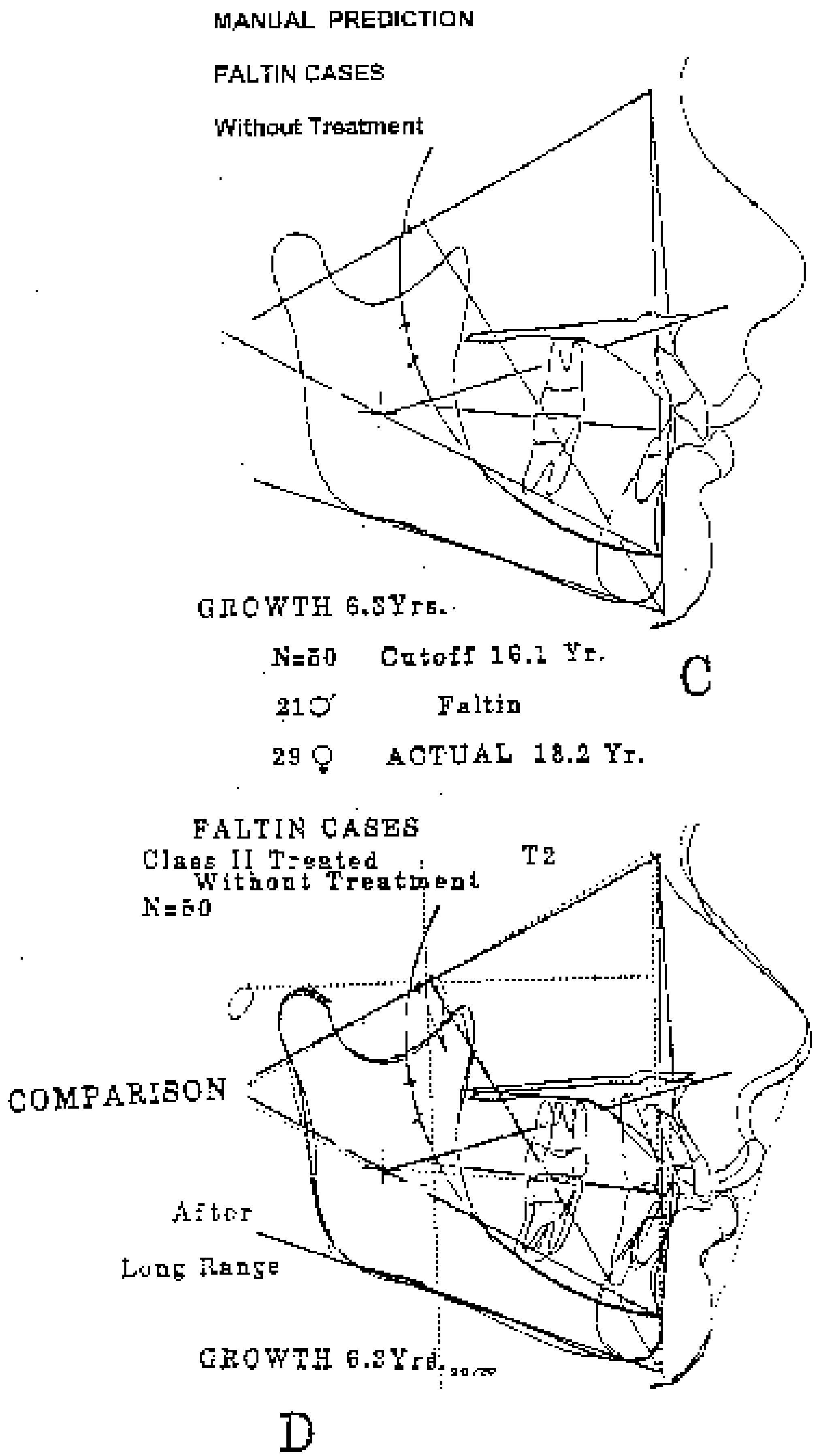
D. Result was very good but not a stimulated mandible.

FIG. 8-5B



A. Composite of N=50 Class II children started at age 9.8 years with Bionator treatment.
B. After retention at age 18.2 for the same group. Calculations were made for sexes and prediction was made (Fig. 8-6B)

FIG. 8-6A



The same group as shown in Fig. 8-6A, a group of 50 children treated with bionator. The long range, compared in D, shows the actual almost identical to the prediction but very slight flattening of the condyle with treatment.

FIG. 8-6B

D. Fixed Appliances and Functionalism

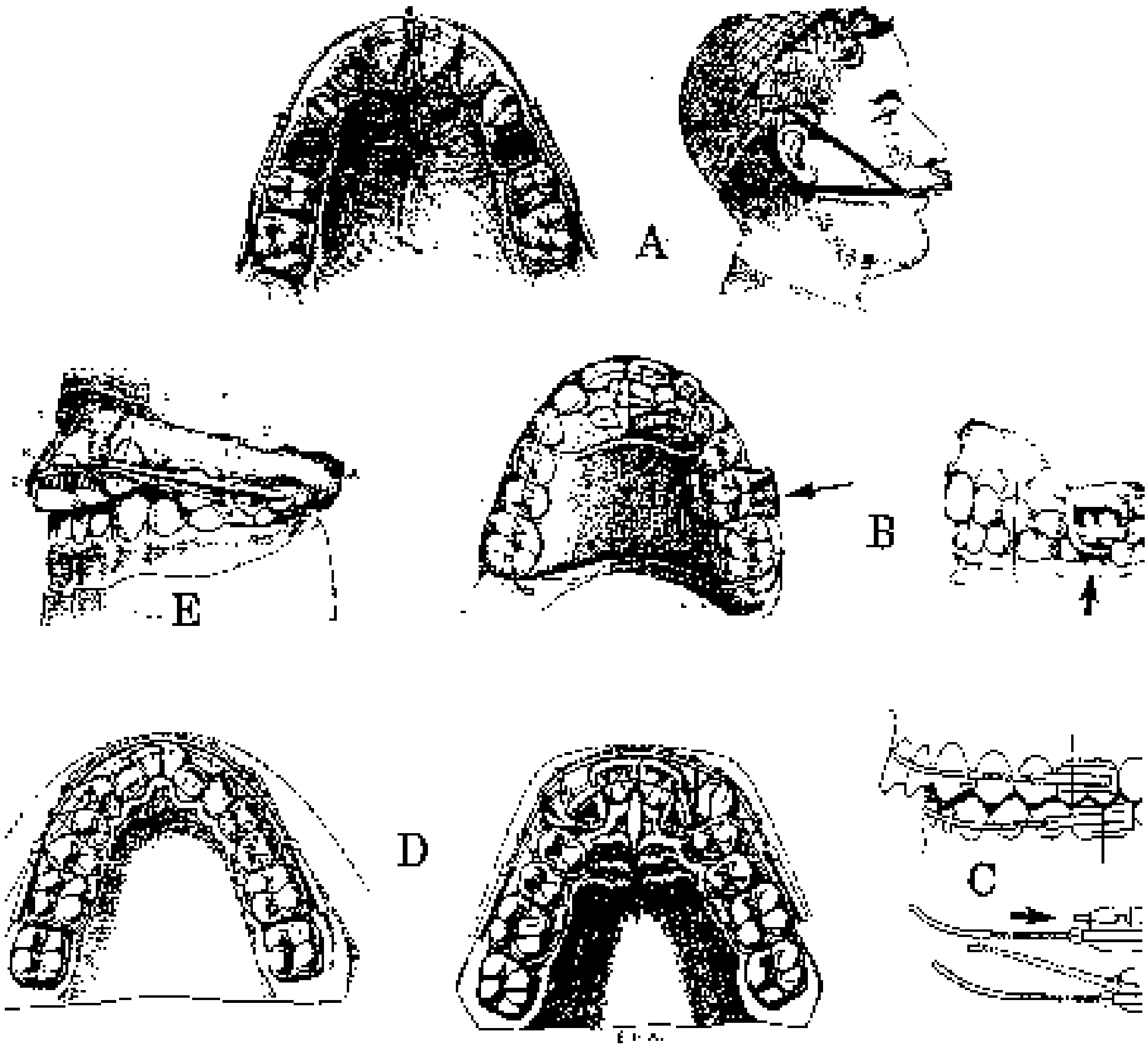
Dr. E.H. Angle was a functionalist, as were most of the "fathers" of the profession. He originally postured the mandible with fixed ramps on the buccal side of the molars **(Fig 8-7)**. The fixed Oliver guide plane was also used. When the benefits of intermaxillary elastics were discovered, rigorous elastic traction was used by Angle with his "E Arch". **This was originally intended to help the mandible grow**. This idea was carried through to the development of the Ribbon appliance. It was also implicit in the procedures with the early edgewise appliance as Angle condemned extraction.

However, after Angle's death, problems arose. A shift of opinion became a strong movement away from Angle's non-extraction theories. Many of his students, following the original Edgewise experience, began to change their point-of-view regarding the full complement of teeth.

IV TRADITIONALISM AND VIEWS ON EARLY TREATMENT

Because the Edgewise mechanism was taught and handed down Class to Class, it was called Traditional Angle's research and experimentation led to his invention of the Edgewise bracket. He turned the flat vertical ribbon wire on its edge to a horizontal opening and used a rectangular form for the wire. As this happened, also full banding and simultaneous movements were prescribed. Tooth to tooth or proximal regulation entered into use. Another factor introduced as a result was **rapid treatment**. All teeth were to be manipulated at once while at the same time arch correction was made by elastic traction from one arch to the other arch **(Fig 8-8)**.

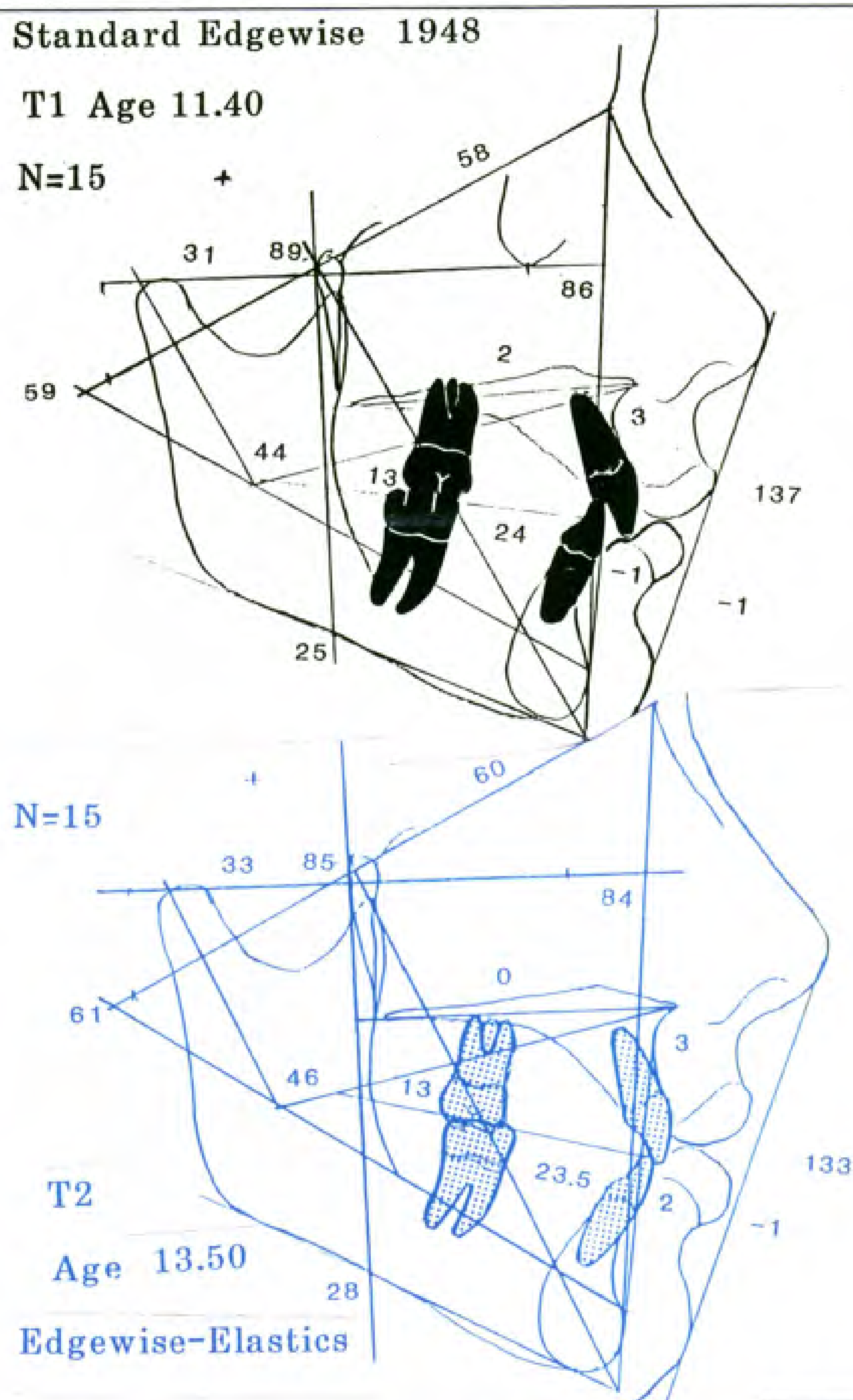
Thus, the permanent teeth had to be available in order for treatment to be started. This precipitated a strong movement away from treatment before the age of adolescence. Starting treatment before all the teeth were present was



From Angle (1907)

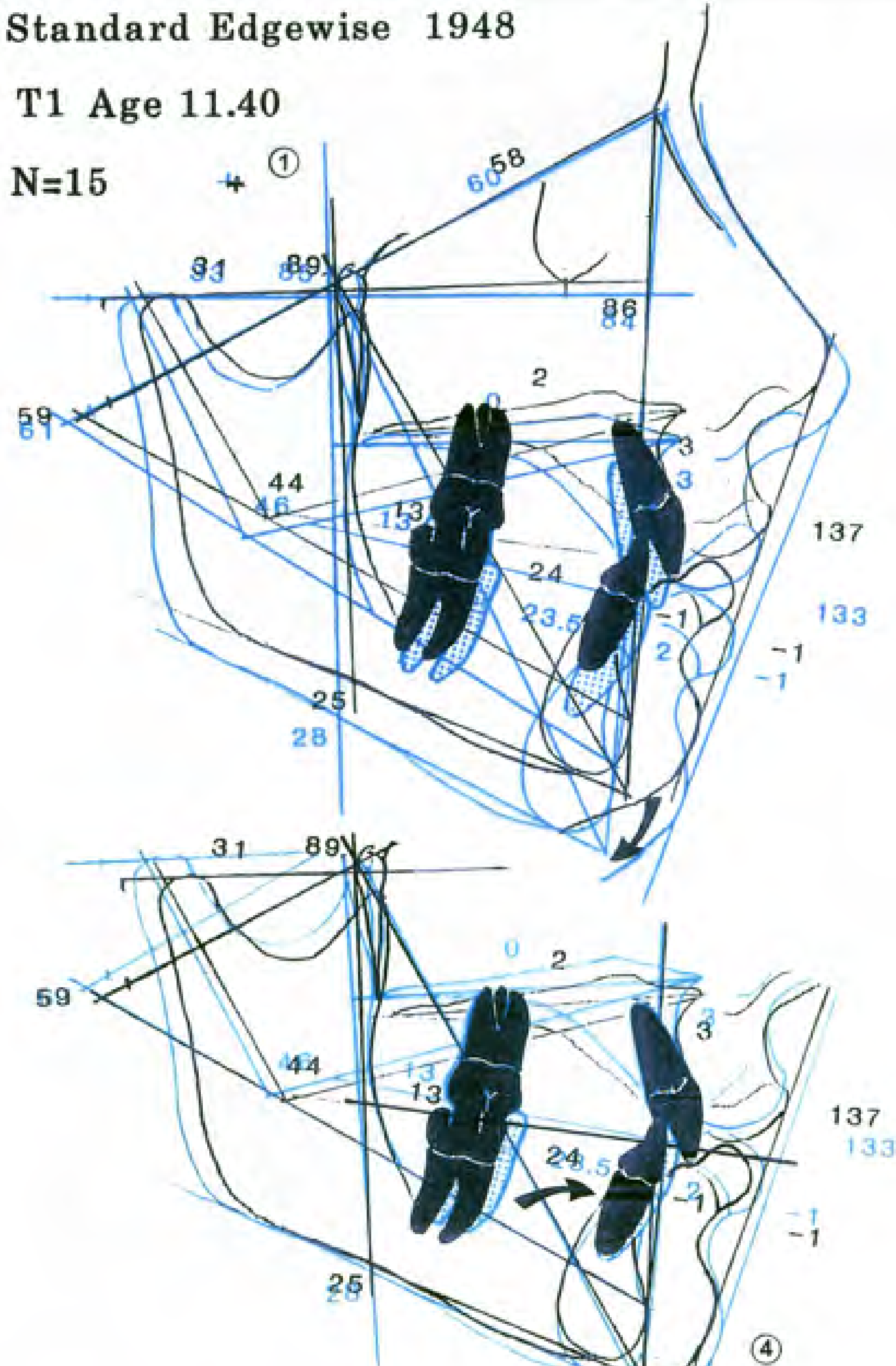
A. Head gear was employed for nocturnal anchorage for retraction of anteriors in extraction treatment.
B. Shows ramp on upper second deciduous molar (at arrow) with positioning bar from the lower.
C. After elastics were successful, they were employed for arch correction with the "E" arch.
D. The use of the expansion arch.
E. Another mode of anterior retraction with sectional mechanics.

FIG. 8-7



T1 - Before
T2 - (Blue) 2 years later
Arch leveling was followed by elastics for correction – rotated the Facial Axis.

FIG. 8-8A



Changes with straight leveling followed by elastics.
Position① shows 4° rotation of Facial Axis
Position④ shows forward movement of lower arch. No time 3 available.

FIG. 8-8B

considered a mistake. Class I severely crowded conditions were started toward extraction of premolars by extraction of deciduous canines in order to relieve incisor crowding.

A. Emergence of Limitation Concept

The early treatment for Class II and Class III, by the means available (intermaxillary elastic traction) by 1945 was found to be of questionable value. Because the treatment was rapid and discontinued too soon, the relapse was often rapid. These conditions fortified a doctrine of limitation. The grand theory to delay treatment until the permanent dentition resulted.

Thus the "Edgewise Experience" in the 1930's, led to several negative ideas which were formulated in a Doctrine of Limitation to wit:

- Early treatment would relapse;
- Any treatment on the deciduous teeth had no effect on the permanent dentition;
- Nothing skeletally or basal could be accomplished with treatment;
- Prediction of facial growth and/or development was impossible;
- Expansion of arches of forward movement of lower incisors was dangerous;
- Teeth could not be intruded;
- Molars could not be moved distally;
- The muscular environment could not be changed.
- Teeth were to be treated to conform to the "pattern".

B. Other Traditional Theories

With the major limitations imposed on the thinking of a traditional clinician another phenomenon was applied to the patient with the complete mixed dentition. It concerned arch length and tooth mass. As determined by G.V. Black, the total widths of the buccal deciduous teeth in the lower were 1.7 mm. longer than the permanent canine and premolars. This totaled 3.4 mm. for the lateral adjustment of the incisors. However, it was further concluded that the space was rapidly occupied by the mesial drift of the molar. It offered no help and in deep bite the crowding over time would worsen.

The data of Dr. C. Moorrees in 1959 differed from that of Black. When averaged for Males and Females, the difference was greater than 1.7 mm. being 2.44 or a total of 4.88 mm. When the second molar alone was present, the advantage totalled 5.2 (2.6 mm. on each side). If the first permanent molar could be held backward before the second deciduous molar was lost, it may change patients from a decision to extract. The following data was compiled **(Fig. 8-9):**

Deciduous

	Males	Females
c	5.92	5.74
d	7.8	7.65
e	9.83	9.64
	23.55	23.03

x = 23.28

Permanent

	Males	Females
3	6.96	6.47
4	7.07	6.87
5	6.29	7.02
	21.32	20.36

x = 20.84

= 2.44 Difference (not 1.7)

The mean difference between the width of the second deciduous molar and the second premolar was:

	Males	Females
c	9.83	9.64
5	7.29	7.02
	2.54	2.62

= 2.58 (2.5)

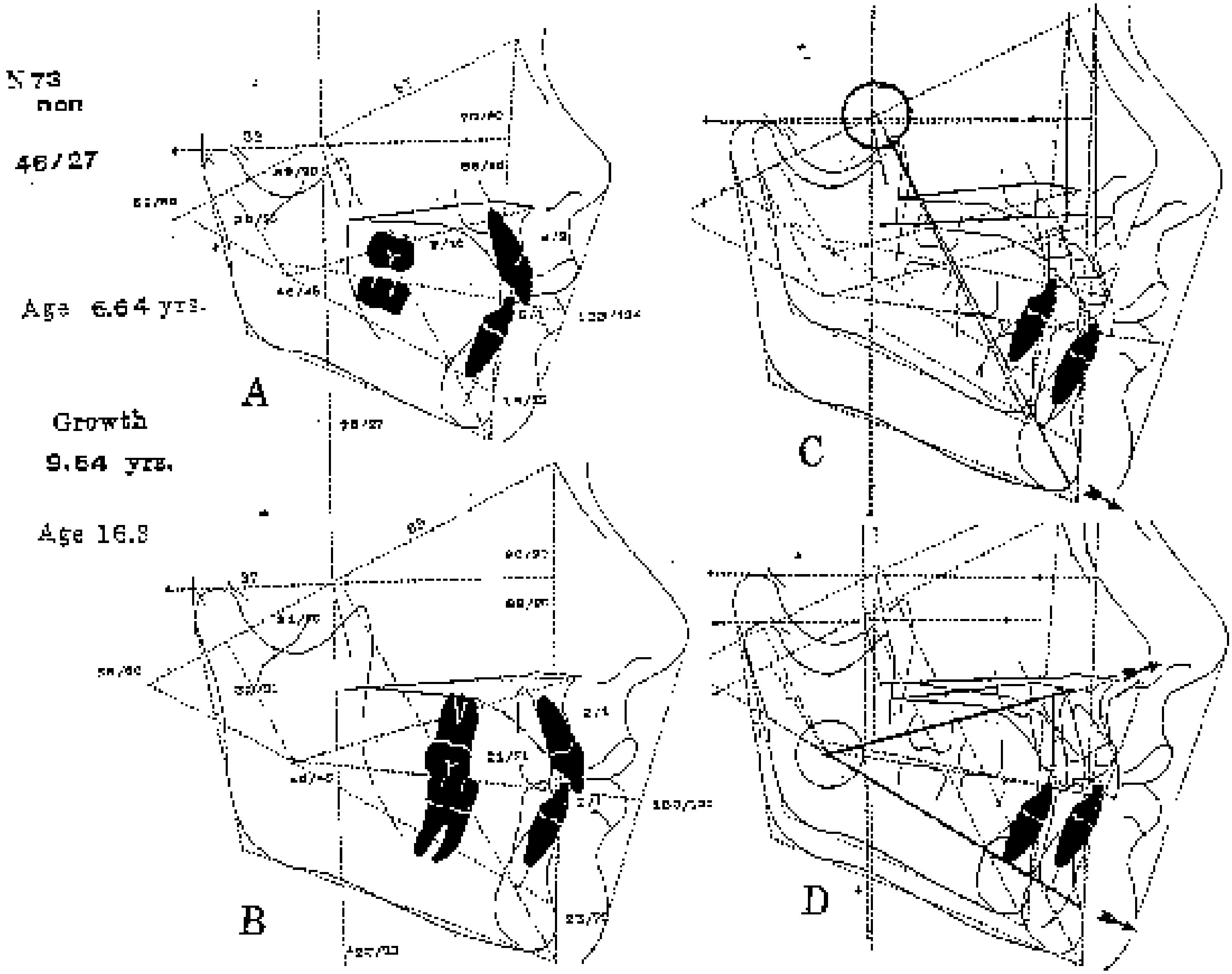
Therefore the main advantage is the 2.6 mm. space picked up if the lower first molar could be stabilized.

FIG. 8-9

Other findings are added to the transition phenomena. In the mixed dentition, the arch depth (from the terminal line at the distal of the deciduous second molar) is about 26.0 mm. to the center of the incisor edge. This shortens to 23.0 mm. commonly in the permanent denture. Therefore, according to the Steiner rule, when both sides are added, 6 mm. of total arch length would be needed for natural development. Steiner made no allowance for arch width increases at the premolars and molars.

But, still further, the cephalometric method used was one of superimposing for appraisal of arch development on the symphysis at Menton and the lower border of the ramus. (the Mandibular Plane). This suggested that during growth in the long term, the incisor would normally move upward and backward **(Fig. 8-9A&B)**. Thus the die was cast – arch expansion was risky. In order to relieve crowding, the **removal of teeth was thought to be mandatory.** Extraction was to start with the removal of deciduous canines if they had not been shed early already. A second plan was to extract first deciduous molars to invite the early eruption of the first premolars for their early extraction. Still another method, advocated by some, was to enucleate the first premolar with the extraction of deciduous canines and first deciduous molars. One clinician recommended removal of all deciduous teeth plus early first premolar enucleation with delay of any treatment until the permanent canines and second premolars had erupted. This was in order to practice the Edgewise full wire idea.

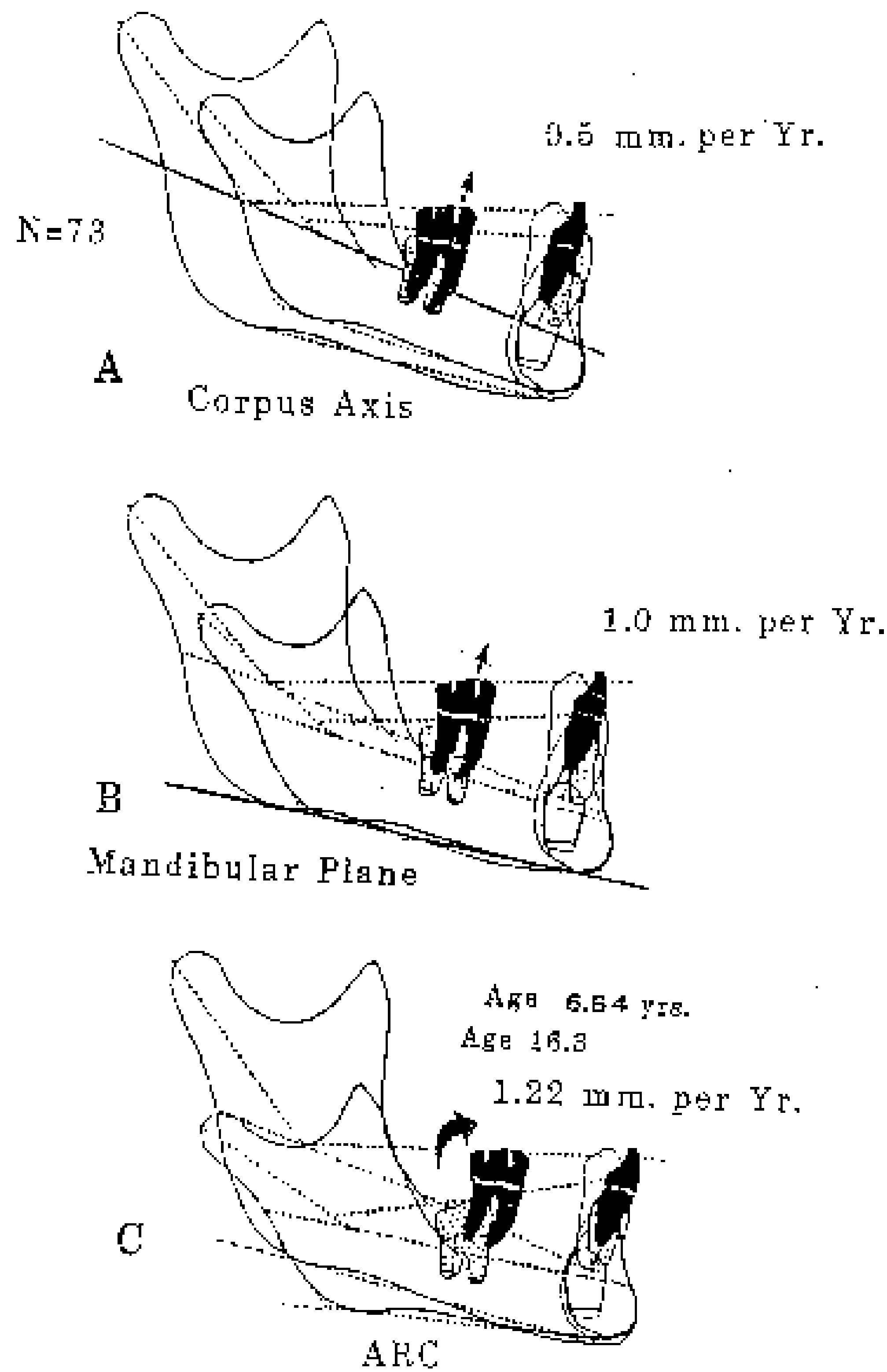
Many clinicians had no recourse but to embrace the limitation doctrine. Consequently early treatment largely meant serial extraction and "waiting for teeth". A composite was made of 10 patients serially extracted with no orthodontic treatment **(Fig. 8-10).**



A. Composite of 73 children at age 6.64.
B. The same group untreated at age 18.5 but growth cut-off at 16.3 (for females).
C. The Facial Axis closed slightly and angle BaNA changed less than a tracing error.
D. The oral gnomon got its name from the stability shown from Xi Point.

FIG. 6-9A

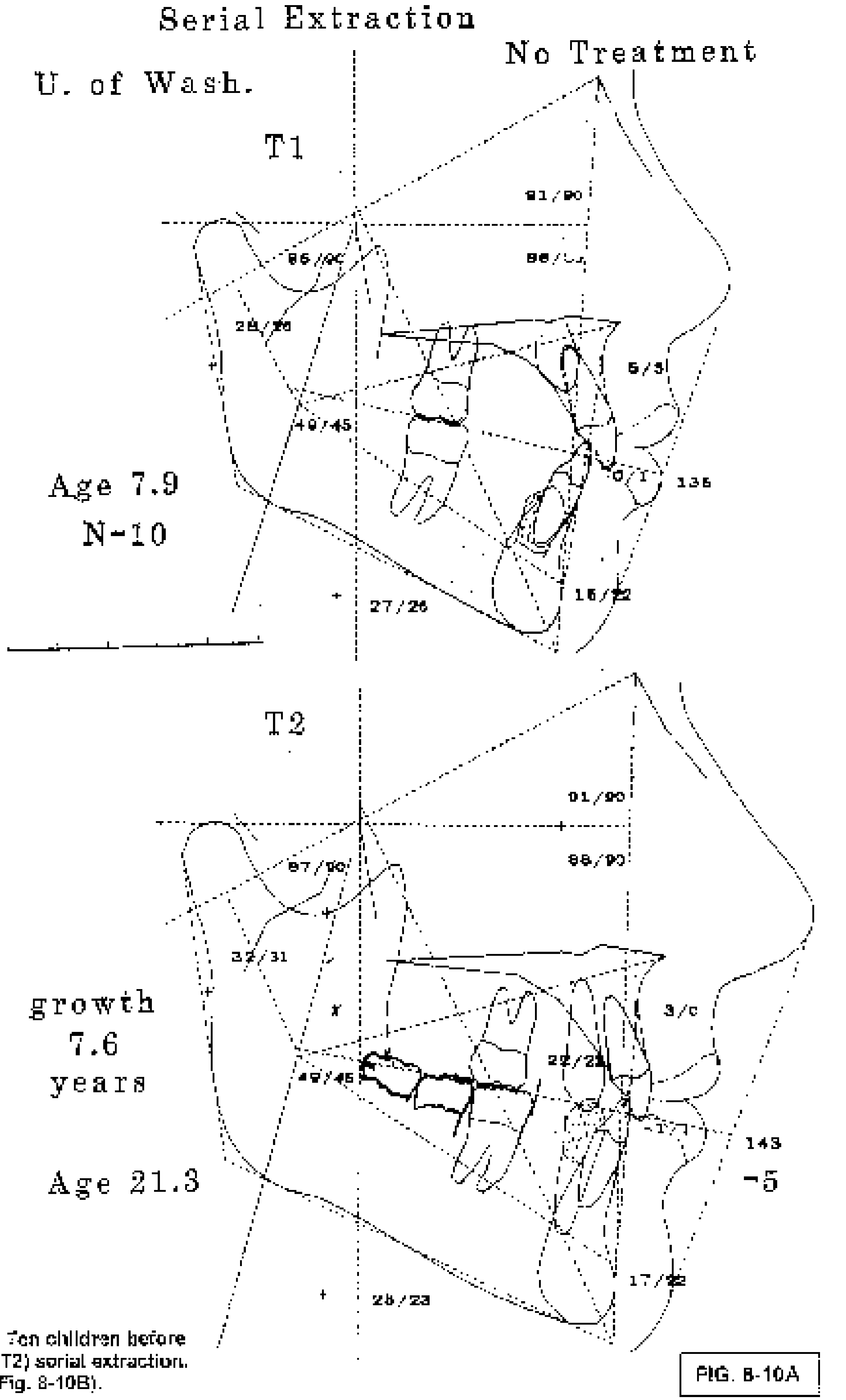
Eruption and Method of Analysis



Different analyses of lower eruptin as taken from N=73 non treated subjects with 10 year growth experience seen in Fig. 6-9A. The interpretation of the eruption of the lower molar is contingent on the method of superpositioning.

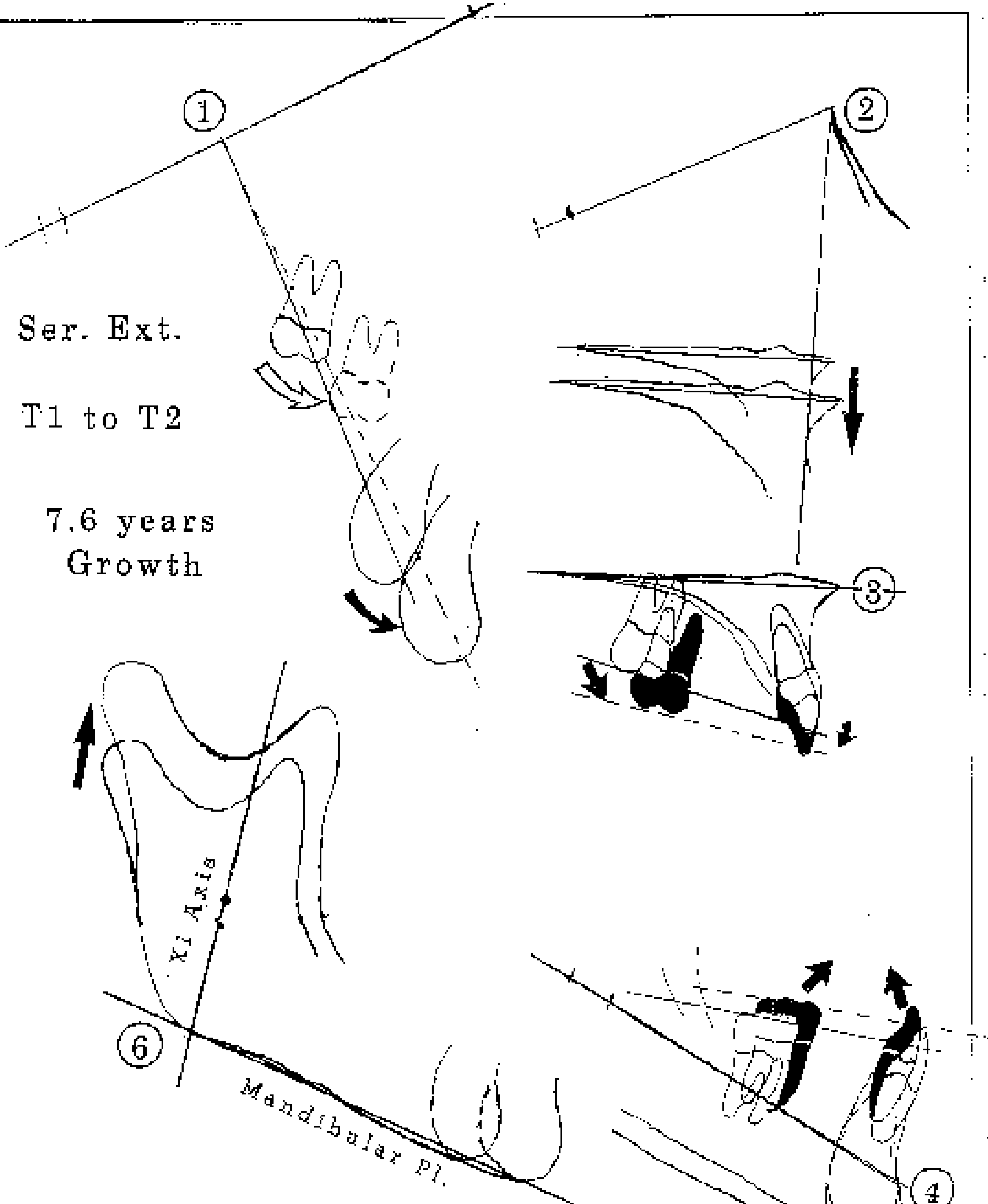
A. From the corpus axis it is 0.5 mm. per year.
B. From the mandibular plane the molar erupts 1.0 mm. per year.
C. From the mandibular arc and the anterior border of the ramus the molar erupts 1.22 mm. per year.

FIG. 6-9B



Composites of Ten children before (T1) and after (T2) serial extraction. See Analysis (Fig. 8-10B).

FIG. 8-10A



Positional analysis of Serial Extraction results.

1. Closure of Facial Axis
2. No change in Point A or Palatal Plane angle.
3. Forward drift of 6 and lower lip containment of upper incisor
4. Space closure of the molar and incisor.
6. Vertical ramal growth.

FIG. 8-10B

C. Prognathism and Genetics

Contrary to the ideas of functionalism the "pattern" idea emerged. The traditionalist blamed genetics almost totally for malocclusions to develop. There was much to support their belief. The "Aleutian dentition", a Class I with lingually locked upper laterals was widespread over the Mongoloid race. Class III in the mongolion also was prominent. Double protrusion were found to be present in Class I in many "types" of all races. Class II was more characteristic of Anglo-Saxon heritage.

Some habits were viewed as untreatable and the theories, as accepted, meant the delay of treatment for orthognathic surgery to be practiced. Oddly, the chin cup still was used for severe cases but often at an age too late to be highly effective. The chin cup was also employed for the vertical pattern open bite also usually too late to be dramatically successful.

V THE BIOPROGRESSIVE PRINCIPLES

Through research experience starting in 1947, the author began to discover that many of the theories imposed by the limitation doctrine were not valid. This was particularly noted from the study of laminagraphic cephalometrics following the treatment of young patients. It started with the doubts about the purported "constancy of the pattern and the factors" responsible for stability of rest position of the mandible. Changes in breathing and deglutition were studied.

Orthopedic findings of skeletal change was noted in early expansion with the "W" appliance. This was anecdotally derived but was consistent in all the cleft palate patients treated. The limitation idea became further challenged when it was observed that anterior teeth could readily be intruded when managed from the **molars directly rather than proximally from the canines.**

In 1950 the author spent two days in the practice of Dr. Silas Koehn observing extra oral traction on his patients. Changes were observed that were difficult to believe possible without skeletal change. Lower arches gained arch length unexpectedly when treatment was conducted only on the upper arch. Perhaps the upper molar was preventing the lower molar from mesial drift and gaining the leeway space.

Thus, with experience in the early 1950s a simple fact emerged. With the forces employed, the **anchorage of the two deciduous second molars was sufficient to alter the skeletal mid-face before age 7.** The upper first permanent molars at age 8 years were sufficient (in anchorage) to change the palatal plane in patients treated in the mixed dentition. No one expected such findings. Currently, a half-century later, many still do not accept the idea even as a possibility. More often the whole arch is strapped up for a strong purchase on the midface which locks up the flow of orthopedics.

A. **The New Approach**

With the new scientific findings, a new approach in the field was needed. The practice of selecting a hierarchy of appliances in order to satisfy objectives became evident. The employing of growth in a deliberate manner emerged. In addition, the attempt was made to **make orthopedic changes first.**

The practice of starting with full banding (or full bracketing) was rejected except for adolescent patients needing minor correction or detailed finishing. **The younger patient, therefore, became the proper candidate for care teleologically.**

This approach, actually beginning in 1948, was in retrospect almost a quarter of a century in developing before it received the label *Bioprogressive* by students during the teachings in a two-week seminar in 1972. A new form of cephalometric analysis had emerged. Short and long range forecasts were being perfected and new possibilities were noted with an integration of some 20 different modalities. This happened together with the application of the computer for management. Diagnostics and imaging for the interested clinician had become available through a RMO service. New views on anchorage and arch development were offered **(Fig. 8-11)**.

By this time, also the orthodontic "forces" employed were reduced. Measurements were now associated with the application of "pressure" or force per unit area. Orthodontics had graduated from mechanics and a craft to a true science. By 1980 even "esthetics" was approached on a more objective basis via Divine Proportions.

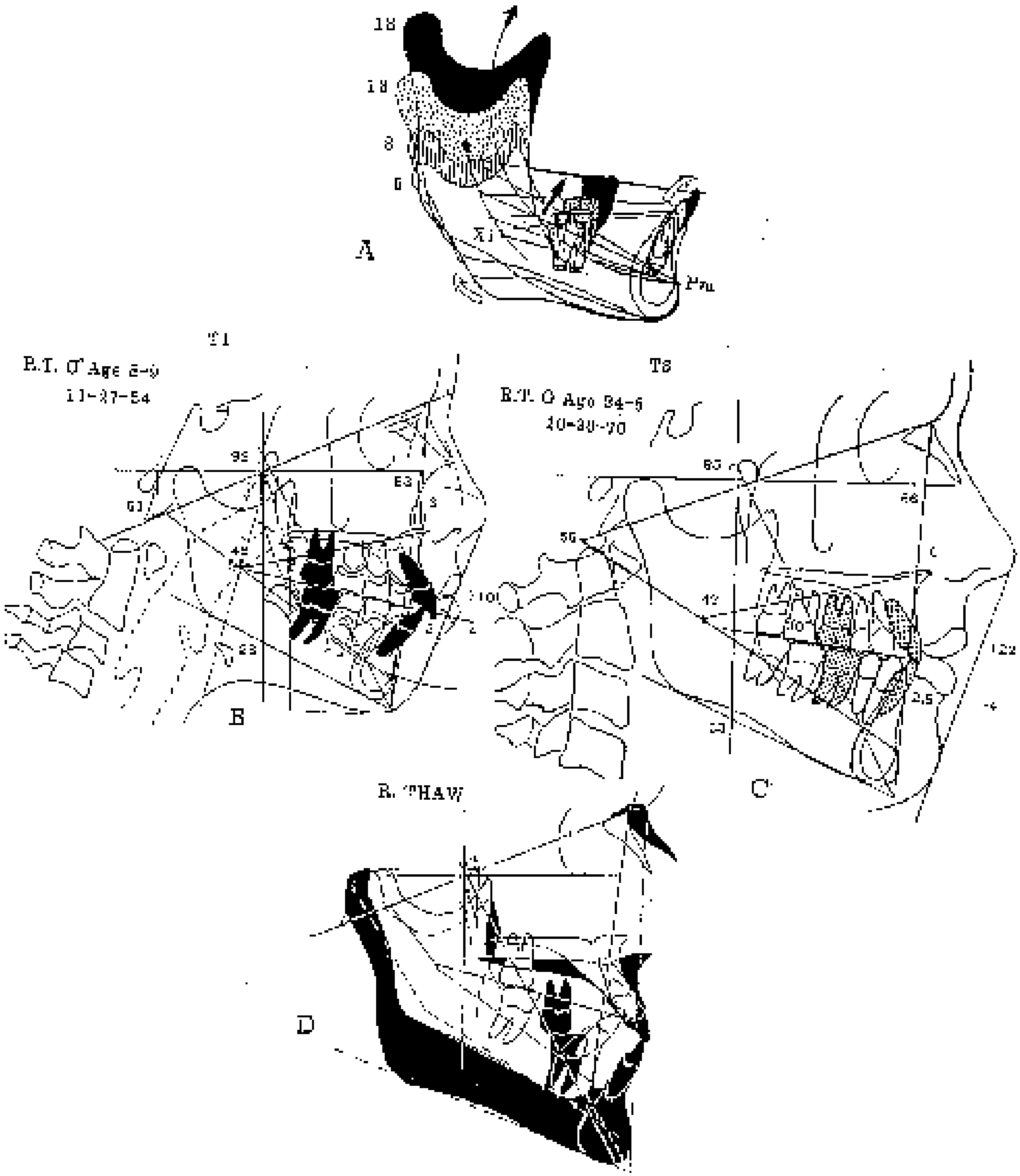
When compared to functionalism and, thence, to traditionalism, the Bioprogressive movement could be considered **the third wave**. It became the contemporary movement in the orthodontic specialty. Some of the features of the first two ideologies were still embraced however in its application.

B. Theories of Force and Pressure

A manual was prepared by the author called *"Mechanics and Biomechanics"* for general orthodontic consideration. For this lecture, orthopedic forces are discussed and forces for modification of the developing alveolar process are explained.

1. *Force Classification*

During the 1950s, orthodontists referred to "light force" and to "light wire." As was pointed out by Stoner, the distribution of the force became a matter of concern. However, light force had no exact meaning or description. In an effort to organize the problem, Ricketts worked out a scale in the attempt to determine



BEGINNING TO FINAL

A. The Arcial Growth and upward and forward development of the whole arch. Note that in order to hold the arch backward, the molar needs to be held downward.
B. T1 on R.T. age 8.9, a double protrusion serially extracted early. Note the data.
C. T3 is the patient with third molars in function at age 24.8.
D. The T1 to T3 comparison on Position 1. The facial axis closed. Note the dramatic forward positioning of the molars and upright of the incisor. With the amount of growth observed lbs election for extraction is questioned.

FIG. 8-11

"orthopedic force" and settle on some values with which to communicate. These were given to Dr. K. Reitan and Dr. J. Storey for evaluation and were agreed upon **Table 8-I**.

The five parameter categories ranged from half an ounce to as much as three pounds. Dr. Charles Burstone, et al., analyzed the moments of force for various teeth because the mechanical purchase is on crowns but the force is applied to the roots. Moments of force were measured in force times and length of the lever arm (or wire). Simply put continuous force could be delivered better **when the arm was longer and the wire more flexible.** Molars moved with 2000 gram-mm. of moment and canines moved with 1500 gram-mm of movement.

Dr. Brian Lee of Australia theorized the distribution of force or force per unit area on teeth. The enface presentation of the root had a surface area. The size of the root could be calculated as in the silhouette. He theorized a force of 200 grams per square centimeter or 2.0 grams per mm^2 to be the optimal value.

2. *Pressure Consideration*

By 1969, we had developed a template for tracing aid in headplates after four years of study. The area of each tooth was calculated and grossly rounded out for aid in application and practical use for the permanent teeth **(Fig. 8-12).** Measurements clinically and results led to a gradual reduction to 1.0 gram per mm^2 **when anchorage considerations** were included. This matched favorably some laboratory research calculations of Dr. Fujio Muira in Japan who found 0.83 grams per mm^2 to be the appropriate value.

Thus, a science for tooth movement was founded. Differential **pressures** could be applied. The root rating scale was proposed in three dimensions (see Lecture Seven). For work in younger patients, a synopsis was prepared of

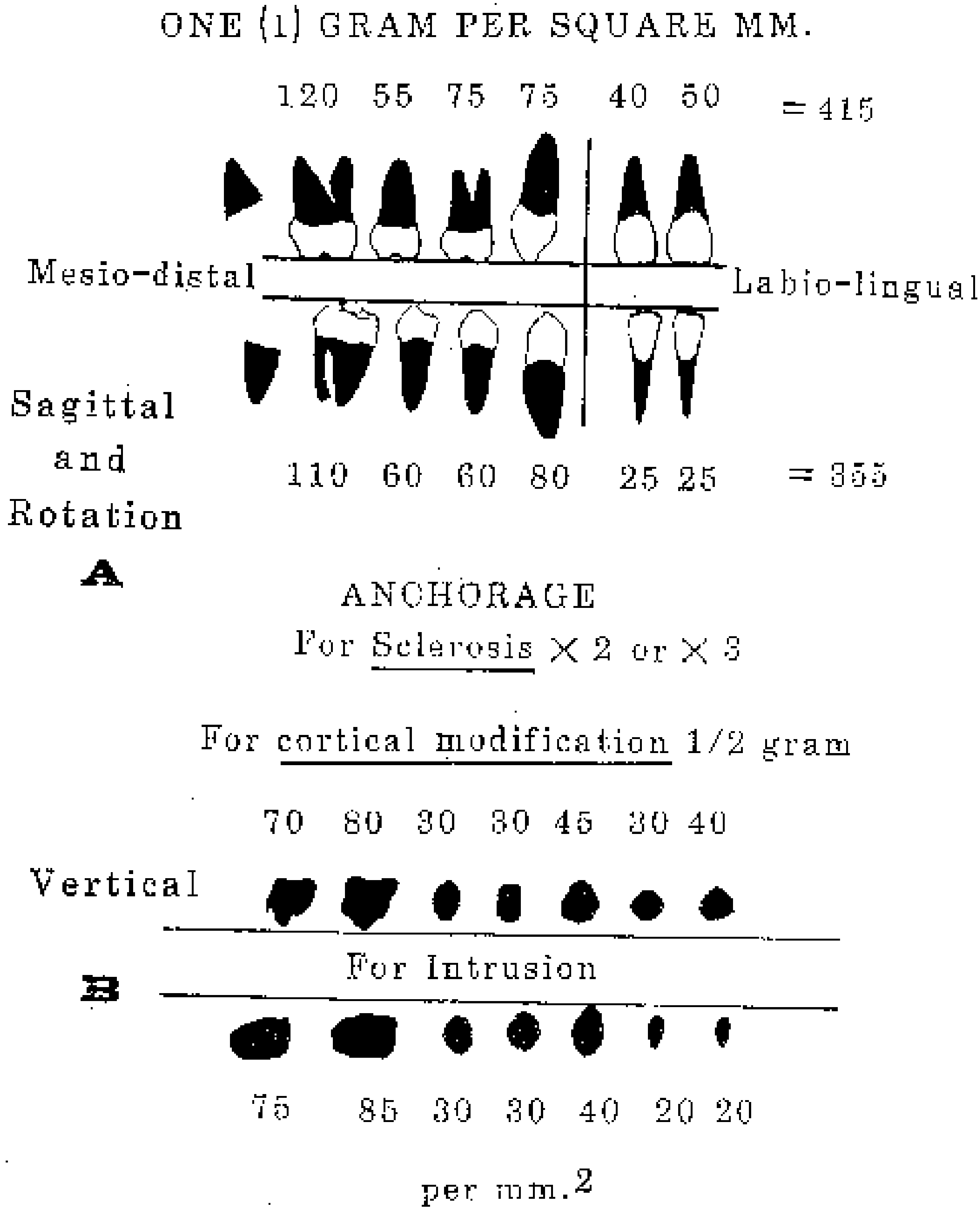
TABLE 8-I

CLASSIFICATION OF FORCE

Relationship of Grams to Ounces

Ounces	**Grams**	**Force**
0.5	14.17	Very light
1	28.3495	
2	56.6	Light
3	84.9	
4	113.2	
5	141.5	
6	169.8	Intermediate
7	198.1	
8	226.4	
9	254.7	
10	283.0	
11	311.3	Heavy
12	339.6	
13	367.9	
14	396.2	
15	424.5	
16 (1 lb.)	453.6	Very heavy
32 (2 lbs.)	907.2	
48 (3 lbs.)	1,360.8	

For rounding out for clinical use, one ounce is considered roughly 30 grams. Thus three ounces for intermaxillary traction, for example, is nearly 100 grams and five ounces is considered about 150 grams. Rounding out in this manner makes it easier to calculate.



Root ratings for permanent teeth
A. Mesio-distal is labio-lingual in the sagittal plane.
B. In the Vertical plane, movements are extrusion and intrusion. Values are for cancellous bone.

FIG. 8-12A

Prescribed force per square millimeter

of ROOT-BONE engagement

(1) For ordinary Cancellous bone
1.0 gram per $mm.^2$

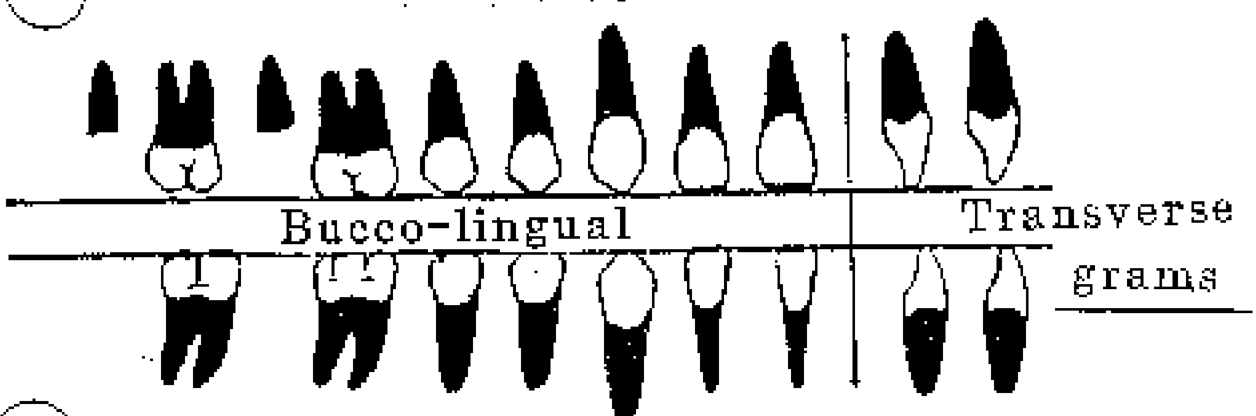
(2) For ridge modification
0.5 gram per $mm.^2$

(3) For cortical anchorage or sclerosis
2.0 to 4.0 grams per $mm.^2$

(3) 200 300 150

(2) 50 75 25 25 40 (20) (25)

(1) 105 135 50 50 70 40 50 65 70



(1) 100 105 60 60 70 25 25 50 50

(2) 50 55 30 30 35 (15) (15)

(3) 200 200 150

Root ratings in the transverse plane become complicated. Labio-lingual movement of the incisors are chosen for comparison. (1) All values needed in the small margin of cancellous bone. (2) Values for ridge change (0.5 grams). (3) for sclerosis and anchorage use 2.0 to 4.0 grams per mm^2.

FIG. 8-12B

approximately a 3 to 5 ratio for the deciduous teeth as applied to second deciduous molars and the first permanent molar (**Fig. 8-13**).

C. Pressure Variance

One hundred years ago, Guilford described the "medullary space" between the inner and outer plates of the alveolus. He explained that easier movement could be made when teeth were moved parallel to this channel. When perpendicular movements to this channel were to be made, he advised that they be made **very slowly** (or against the labio-lingual plates).

1. *Cortical Anchorage and Cortical Avoidance*

In 1954 the author, upon studying anchorage from intermaxillary elastics cephalometrically, recognized that patients having lower molar teeth roots positioned buccally under the external ridge possessed superior resistance to movement. Further investigation and experiments led to the deliberate placement of roots in bucco-lingual "tow-hold" rather than mesio-distal toe-hold as advocated by Tweed. Thus, the principle of "cortical anchorage" was used for stabilizing as contrasted to "cortical avoidance" when movements were desired (see Lecture Seven).

Dr. E. Storey had shown that when too much force was employed a "stasis" was produced. He described it as a production of a "cell free area." Reitan called it a "hyaline like" area more resistant to resorption. Ricketts observed thickening of the bone around molars under treatment in tomographic x-rays. He called it "sclerosis." Thus, another aspect was added to an already complicated subject. The type of bone, the direction of movement and the amount of pressure all became clinical issues.

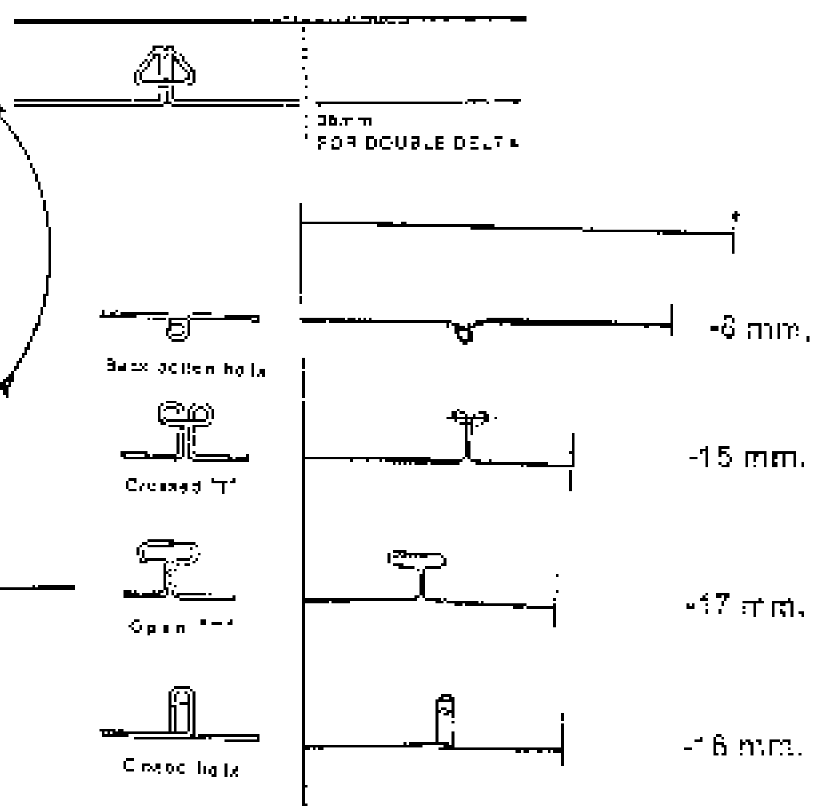
CAPACITY OF

.016" X .016"

BLUE ELGILOY WIRE

Conclusion about 2000 gram mm. of moment

LENGTH	FORCE OF BENDING
@ 40mm	+ 50 grams
@ 35mm	+ 60 grams
@ 30mm	+ 70 grams
@ 25mm	+ 80 grams
@ 20mm	+ 100 grams
@ 10mm	+ 200 grams
@ 5mm	+ 400 grams
@ 4mm	+ 500 grams
@ 3mm	+ 600 grams



Values rounded off for clinical use

The blue .016" square wire (0.41 mm.^{2}) is the standard with three-plane control. Note that at 3 mm. (the distance between two lower incisor brackets) it supports 600 grams. At 40 mm. it will support only 50 grams. The introduction of a Double Delta loop at 36 mm. of wire reduces force in the wire from 500 grams to 50 grams. Four common loops show the amount of wire incorporated in the bend. Simple loops introduce 8 to 17 mm. of wire between two teeth.

FIG. 8-13

After some years of work, Ricketts modified the 1-gram per mm^2 for (1) calculations in order to produce sclerosis (when desired) and (2) for modification of the alveolar ridge for expansion when necessary! (see Fig. 8-12 and 13). When force was raised to 2 to 4 grams per mm^2 of root surface sclerosis and increased anchorage would result. But when resorption and new apposition or **modification of the bone** of the ridge plate at the crest was desired, the force was reduced to 0.5 gram per mm^2 (or half that employed for movement within the septa). When intrusion was to be attained, the pressure 1.0-gram for mm^2 remained, as with rotation values. In remodeling instances the pressure needed to be as continuous and constant as possible. Interrupted action was employed when orthopedic pressures were applied in order to prevent necrosis.

D. The Elgiloy Blue .016^2 Wire and Protective Limits

Directions and pressures were analyzed and protective limits were determined. Wire sizes and types of alloys were tested on patients. Ricketts kept returning to the Elgiloy Blue square .016" wire employed in the .018" slot in a siamese bracket (see Fig 8-13). The square wire helped to produce translatory action and became "lighter" due to **engaging of a wider root surface area.** When lighter and more continuous action was prescribed, **loops were easily constructed.** The wire would reach a proportional limit when overstrained in the treatment experience and therefore contained a "practical limit".

Studies revealed that the .016" x .016" wire in the Elgiloy blue delivered 2000 gram-mm. of moment which Burstone had shown to be sufficient to move molars. Therefore, no stronger wire was indicated. Twisting of the wire with a lever in the vertical direction could deliver 90 grams at a 15-mm length. This, coming from each side, was sufficient for torquing of all four upper incisors at once and is more than enough when palatal plate resorption is intended.

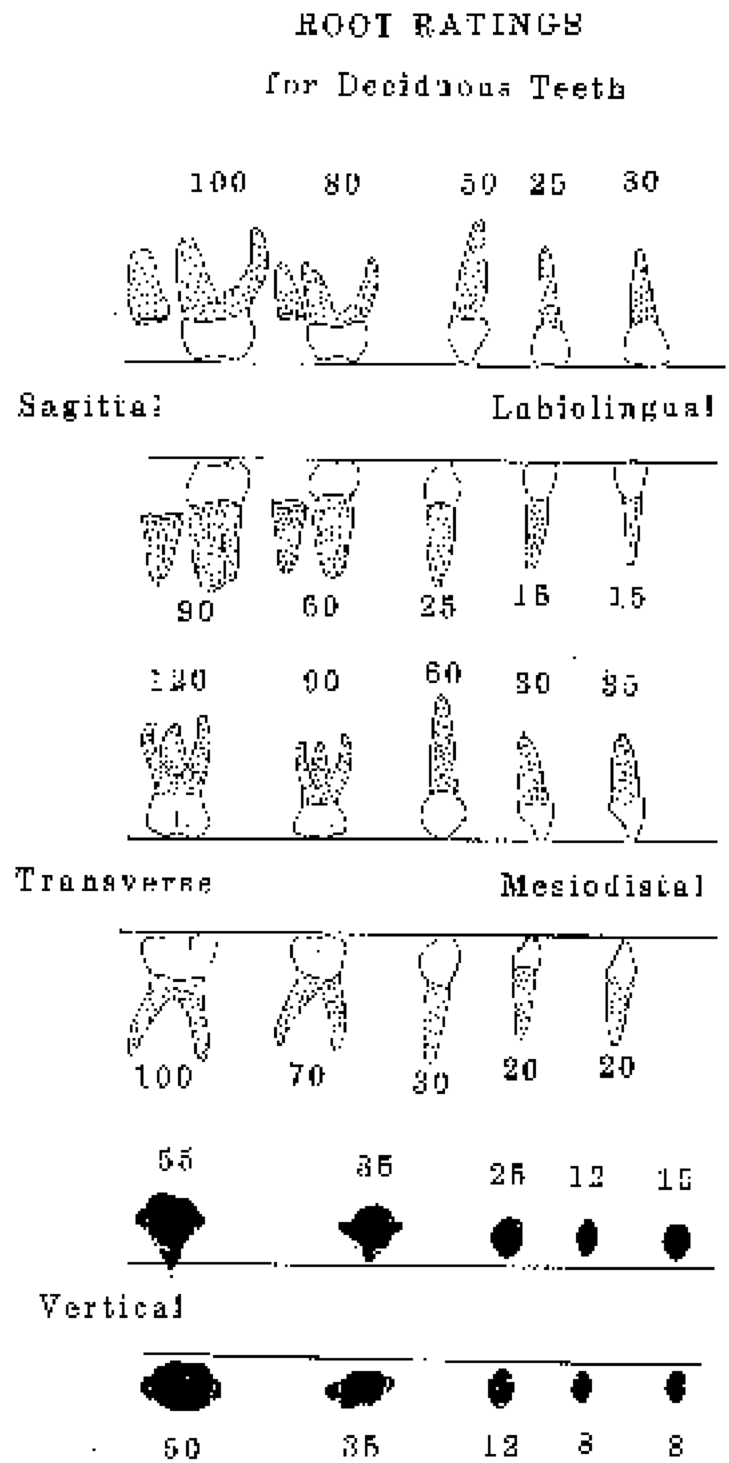
In addition, the .016 x .016 wire lent itself admirably for intraoral regulation. It was ideal for incisor intrusion. It became the answer to the author's needs. It could be used for old and young alike. It could be activated with finesse directly in the mouth so that arch changes were minimal.

While loops became pretty wild in the imagination only a few were found necessary to master. For this reason a reprint of a nugget to the Foundation for Orthodontic Research (FOR) by the author is included here:

E. Anchorage

When pressures are delivered at the sclerosing range, the force is delivered to a higher level - to the ligaments of the sutures of the midface. Calculations for the permanent first molar are about 120 mm^2. For orthopedic movement, this could mean 120 x 2 = 240 grams or 120 x 3 = 360 grams per molar. This would mean that when both sides were employed for headgear or extra oral traction at age 7 or 8 that the total force on the neck strap would be 480 to 720 grams. **This matches the values previously employed clinically for success even before the pressures were calculated.**

For the deciduous patient, a total neck force of 300 grams was found sufficient for maxillary basal change. This would suggest that the deciduous upper second molar root is 60% the size of the permanent first molar. A gross estimate of about 70 square mm would be made for the upper second deciduous molar root therefore. The calculation for the deciduous molar buccally (at 60%) would be about 80 square mm. The deciduous canines are about one-half the size of the permanent canines and, therefore, would need about 50% less force to move **(Fig. 8-14).**



Rounded out values for square mm. of root surfaces in different directions for the deciduous teeth. The second molar has surprisingly high values. Double these for anchorage and cut in half for ridge change.

FIG. 8-14

VI SUMMARY

In this lecture many of the principles of the Bioprogressive approach were defined. The theories are related to the possibility of orthopedic change and its predictability.

Treatment in the Bioprogressive practice consists of the application of pressure on the roots of the teeth.

In the last analysis the ligament stretches and bone become the anchor. Mean working values are supplied via a Root Rating Scale. Modifications are made for application for producing anchorage through differential pressure or secondly, lighter modifications for making changes in the "ridge". The application of one wire the .016" x .016" Blue Elgiloy is suggested as the base. However, the head gear wire is .045" and the quad helix is .038".

The student is asked to stretch his mind.

LECTURE NINE – COMPOSITE ANALYSIS OF TREATED GROUPS OF YOUNG PATIENTS

I INTRODUCTION – COMPOSITE ANALYSIS CONSTRUCTION
- A. Construction of Composites
  1. Manual Reduction
  2. Computer Application
  3. Polar Behavior – Mean Data
  4. Least Square Digitization

II THE NORMAL CONTROL SAMPLES
- A First Computer Composition (1968)
- B Verification (1985)
- C Second Computer Verification (1990)

III TREATED ORTHOPEDICS AT AGE 8 (1975)
- A Class II N=34
- B Class III N=5

IV TREATED CLASS II LONG TERM RESULTS (1990)

V THE 1999 CLASS II CERVICAL TRACTION STUDY
- A The 1999 Protocol (22 composites) -The Group and Breakdown
  1. Sample # 1 - Total Group (N=35 17/18)
  2. Sample # 2 - Total Open Bite (N=19 8/11)
  3. Sample # 3 - Total Deep Bite (N=16 9/7)
  4. Sample # 4 - Total Deciduous (N=12)
  5. Sample # 5 - Total Mixed Dentition (N=23 13/10)
  6. Sample # 6 and # 7 - Deciduous Open Bite and Mixed Open Bite compared

VI COMPARISONS AT PHASES AND TYPES

VII FINDINGS RESULTING FROM EARLY TREATMENT
- A Maxillary Skeletal Change
- B Dental Change
- C Mandibular Change
- D Joint Behavior
- E Occlusal Plane Behavior (Position 5) (Vertical Changes)
- F Esthetics

VIII GROWTH AND ITS FORECASTING

IX TOTAL COMPOSITE FORECAST PREDICTION

X SUMMARY

LECTURE NINE – COMPOSITE ANALYSIS OF THE NORMAL AND TREATED GROUPS OF YOUNG PATIENTS

I INTRODUCTION – COMPOSITE ANALYSIS CONSTRUCTION

The report of a single patient is just a story and considered anecdotal. However, individual case reports are regularly made in medicine and dentistry. Their value is that they show **possibility**. But when several subjects are **measured** and the data is processed by statistics, it is considered **scientific**. Problems do arise regarding the validity of science based on the manner in which a factor is related, assessed or measured. In other words, different analyses may lead to different conclusions.

The construction of a composite of a group of patients has value scientifically. It represents a **visual mean** value for the comparison, the mean values of other samples or to the same sample at a later date. This can show normal growth change or the changes induced by treatment. The composite therefore reveals a reasonable **probability** rather than a single case possibility.

The drawback to a composite is that the range and distribution and the curve of distribution is not exhibited. However, the curve of distribution is most often quite evenly divided when patients of a particular type are taken together. The value of the composite far outweighs the distribution problem. Most of the measurements to be considered have been shown to vary a standard deviation of change only about 1.5 mm. or 1.5° in normal behavior. The mean values therefore form a base line for clinical work.

A Construction of Composites

1. Manual Reduction

For their cephalometric work, Broadbent and Brodie performed a process called "manual reduction". The tracings of sixteen (16) subjects were employed.

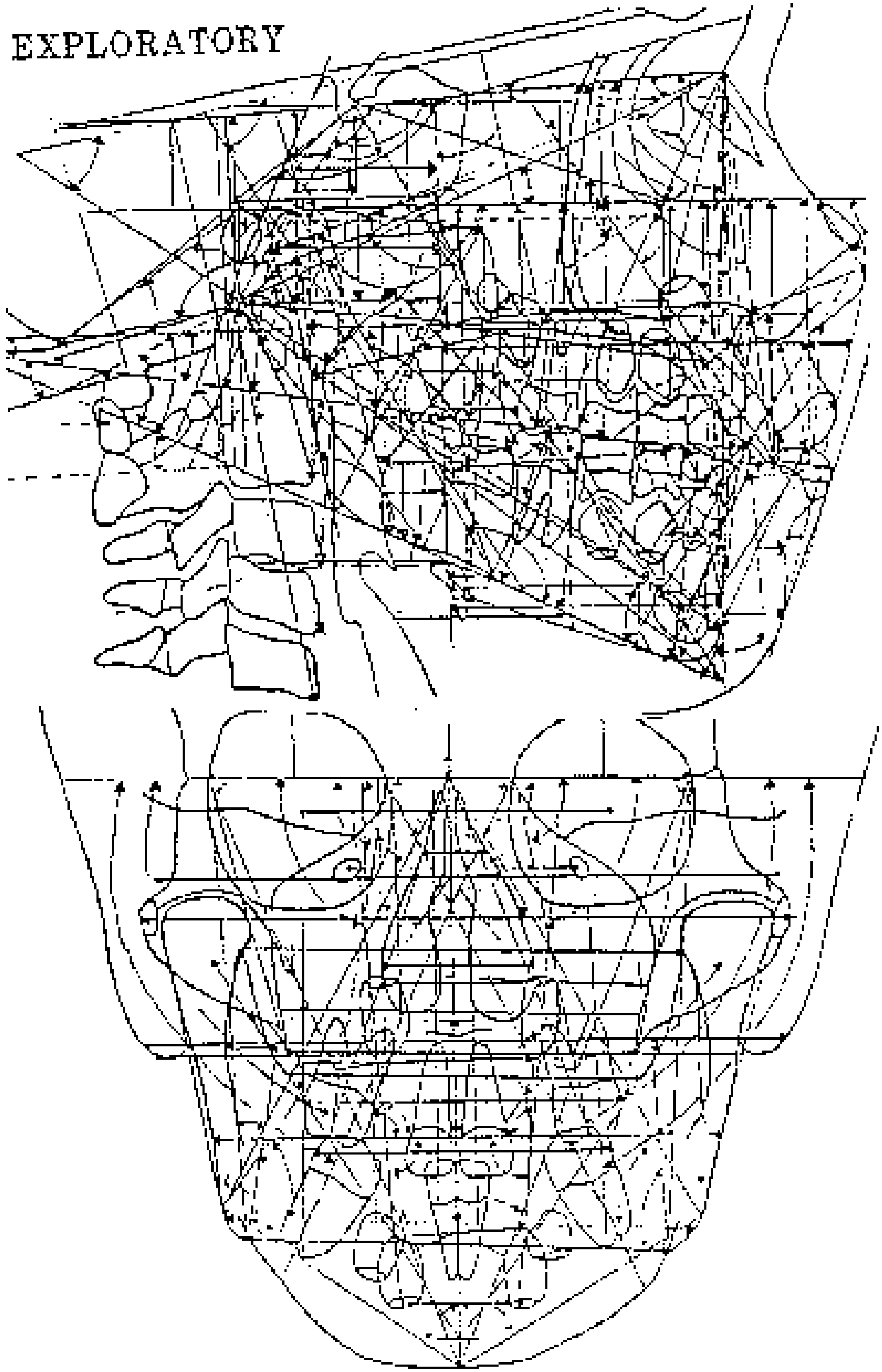
Pairs were selected and the points of reference of the two were averaged for a new mean tracing. Thus, the sample were reduced to eight (8). Two new mean tracings were taken again and reduced to four (4). The four were reduced to two (2) and the two were reduced to one (1). This represented the central tendency of the group as derived by a manual method.

2. Computer Application

With the computer, other methods have been employed. The first, by the author, consisted of manually plotting mean data for dimensions derived from 302 measurements made on each of 40 growing subjects. For safety and accuracy most critical points were triangulated. The measurements were made to include both the lateral and frontal **(Fig. 9-1)**.

From the data, a Time 1 and Time 2 was processed. Time 1 and Time 2 composites were constructed **(Fig. 9-2A & B)** made for the Lateral and Frontal. The original composites were correlated with the findings in the literature and rectified to represent a consensus of the Scientific Field in 1968. This produced a new standard which has stood for 30 years. The correlation of changes were studied. From an analysis of information, the "best" set of measurements were selected in order to obtain a basic matrix for the computer of the future and for the profession. The original composites constructed were then rectified by a concensus of the literature in order to produce the normal standards **(Fig. 9-2C)**.

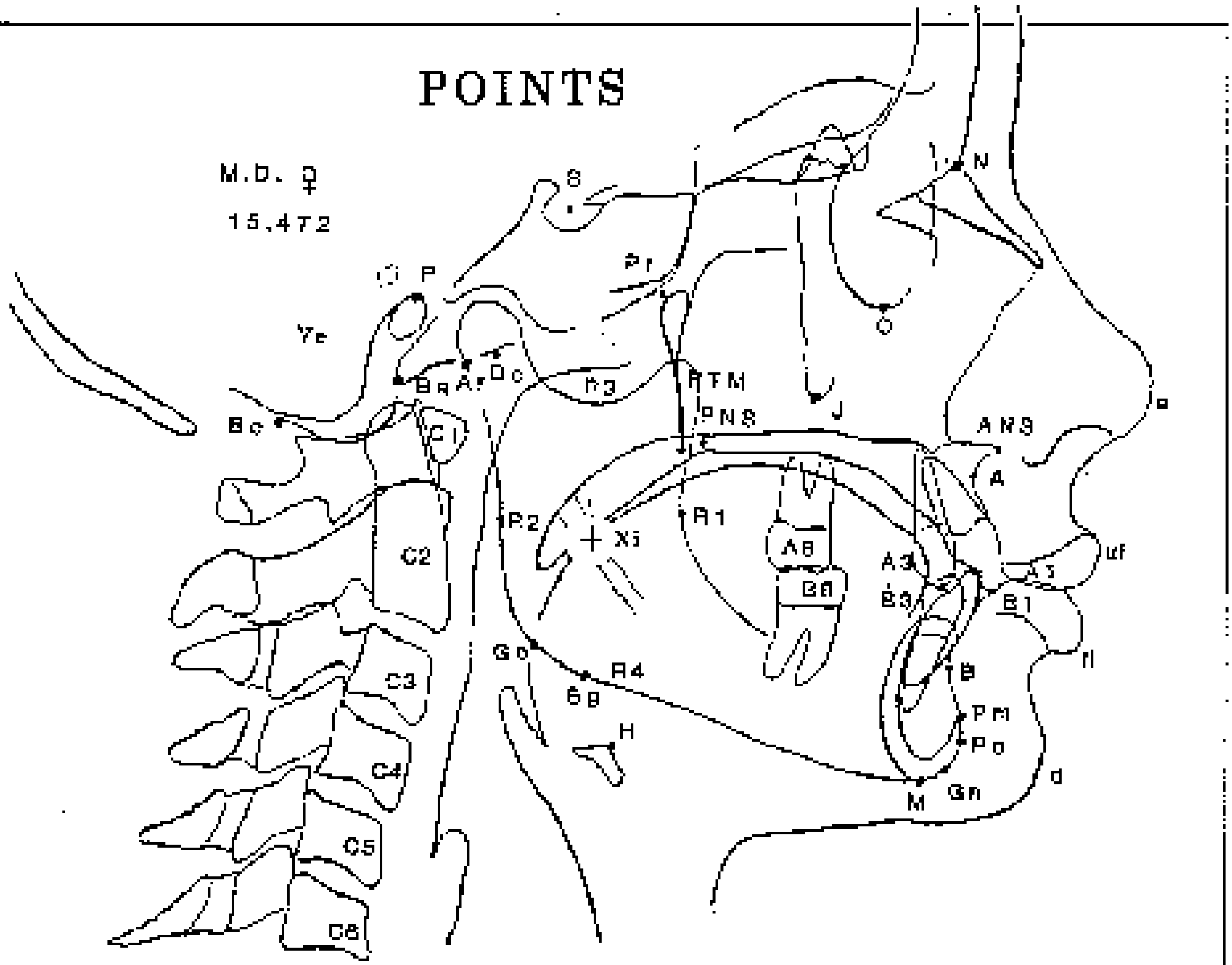
EXPLORATORY



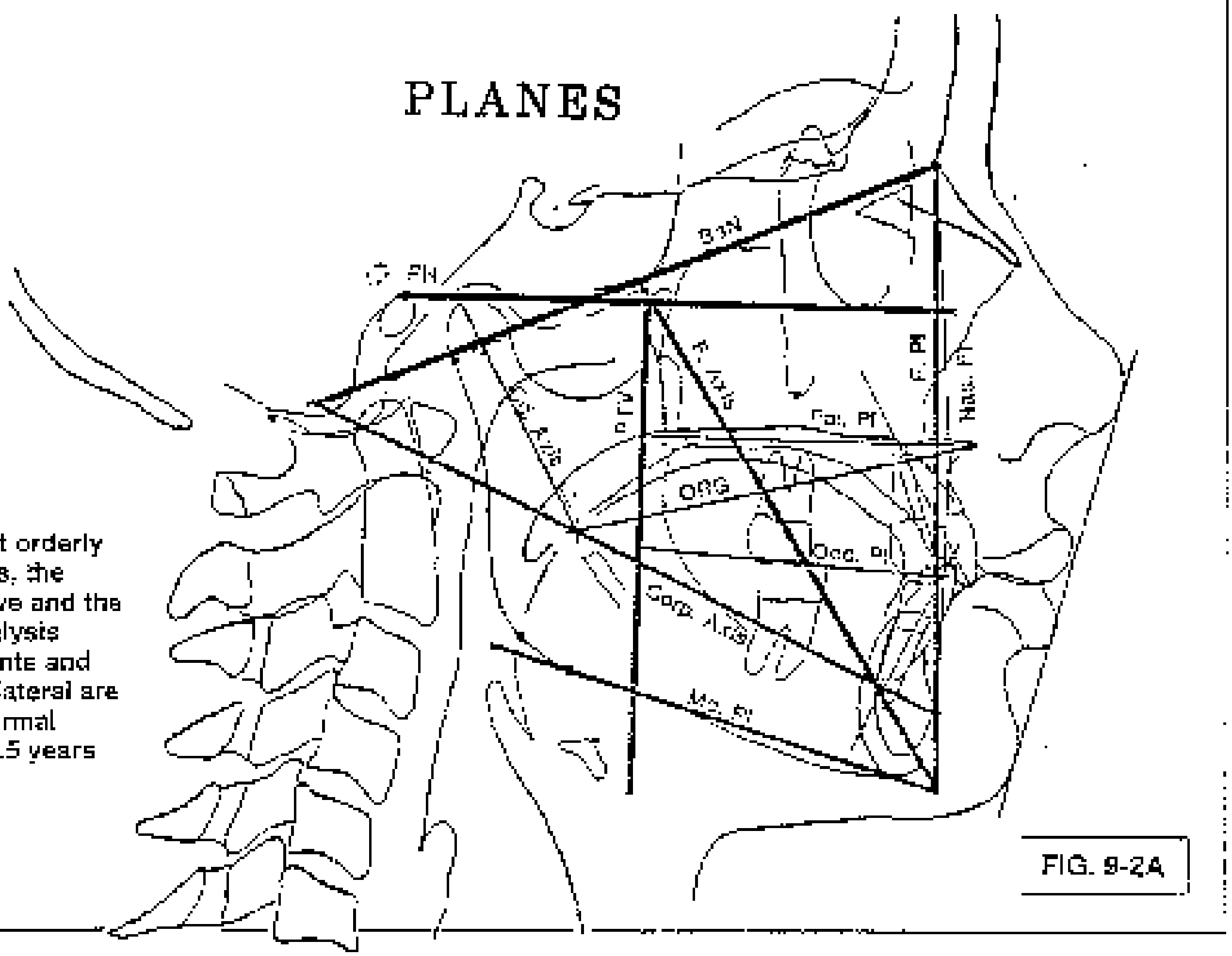
*1966 exploratory included 362 measurements many of which were triangulated to correct errors and all were intercorrelated. Data was derived at T1, T2 and T3 for different ages.

FIG. 9-1

POINTS



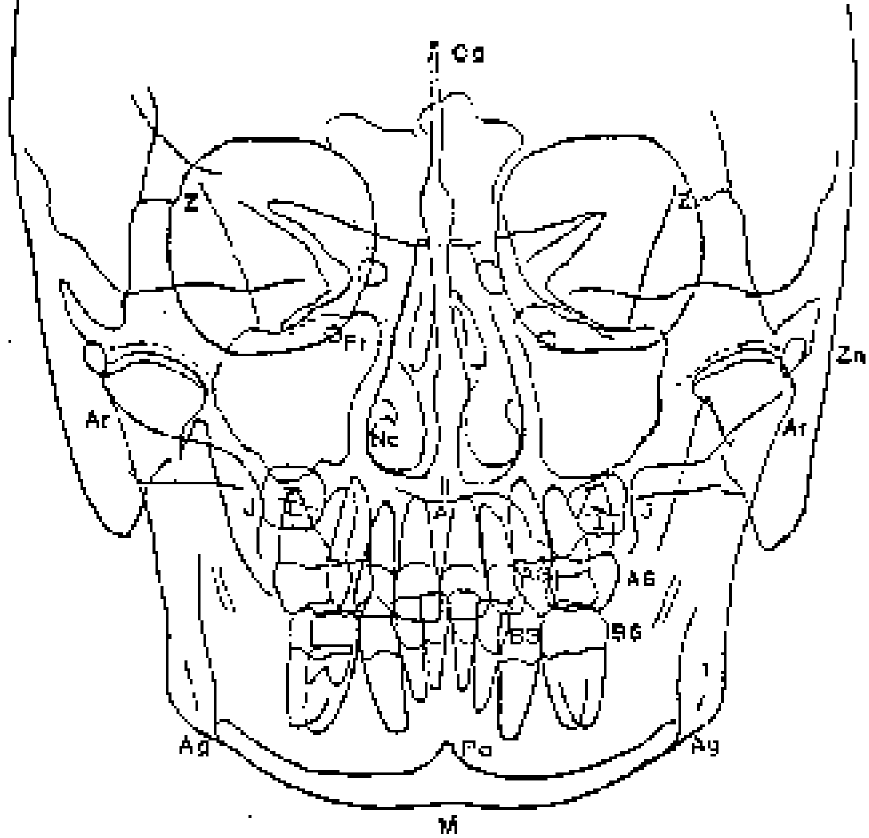
PLANES



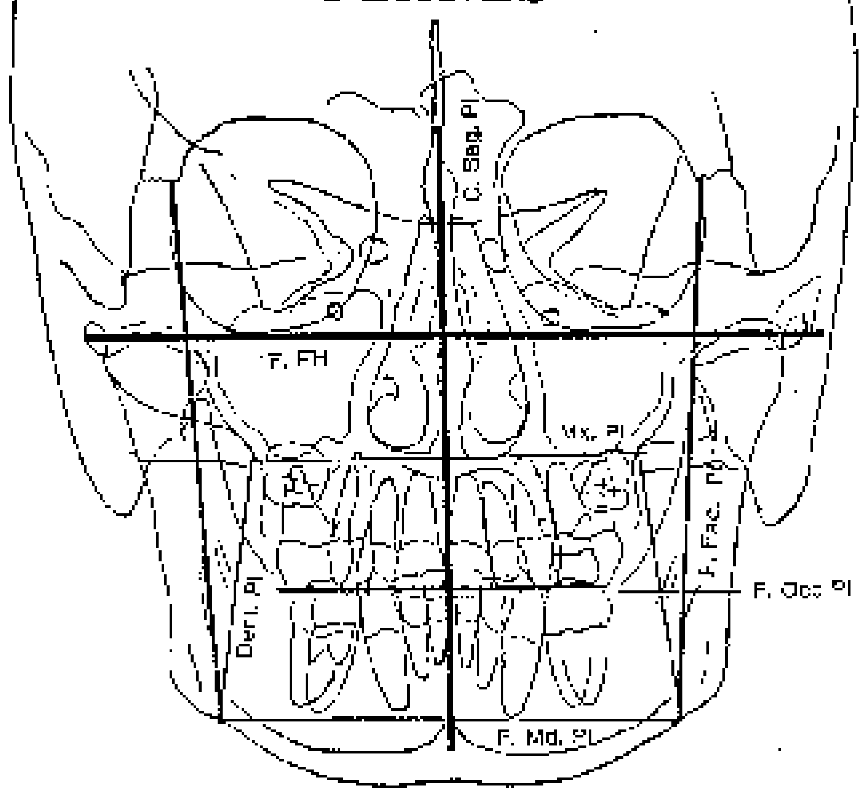
From the most orderly measurements, the Comprehensive and the Summary Analysis emerged. Points and Planes in the lateral are shown in a normal female age 15.5 years

FIG. 9-2A

POINTS



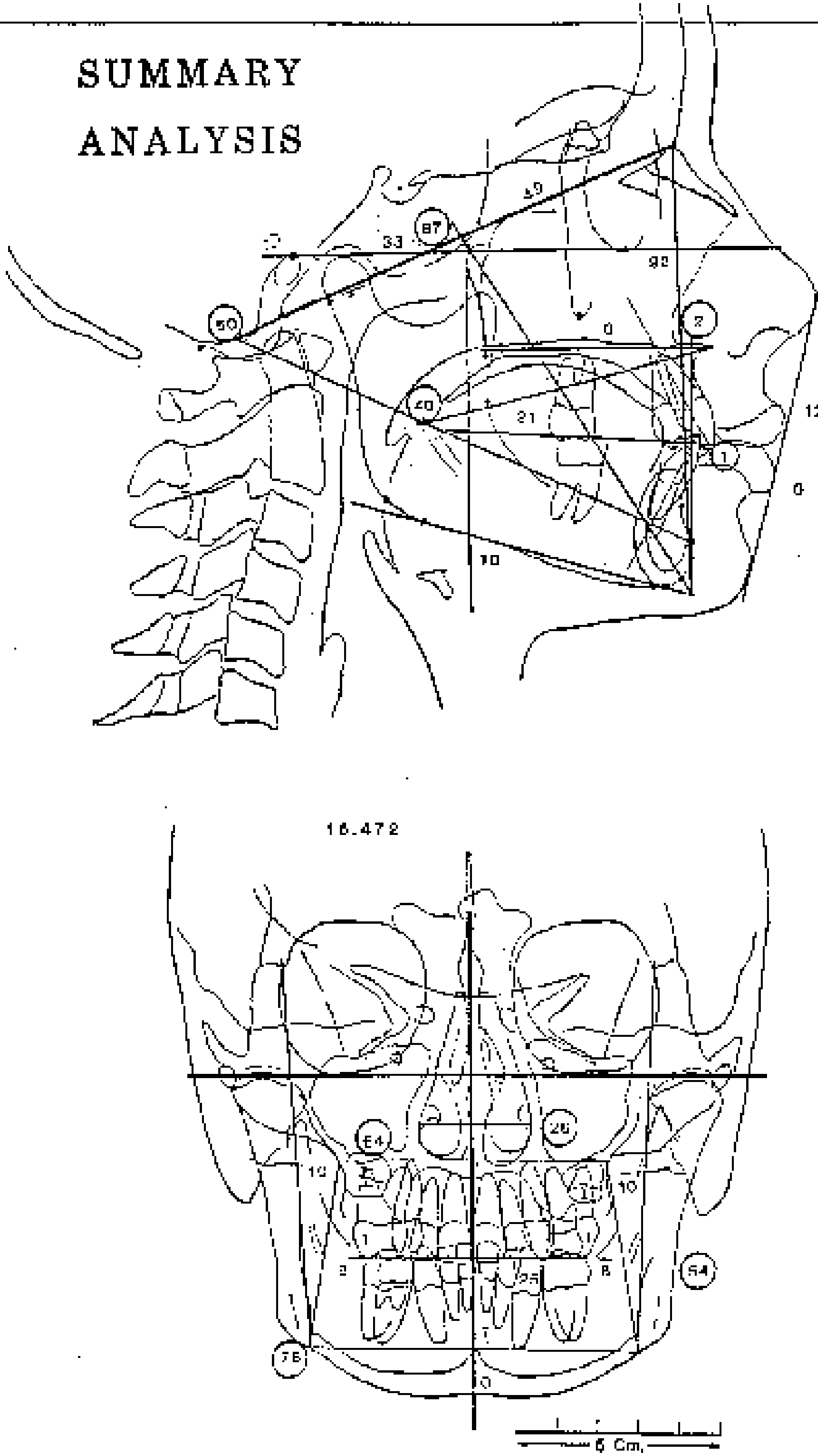
PLANES



Points and Planes that proved valuable for the first workable frontal analysis.

FIG. 9-2B

SUMMARY ANALYSIS



The Summary Analysis is shown with thirteen measurements in the lateral and twelve measurements in The Abstract Analysis measurements circled.

FIG. 9-2C

3. Polar Behavior – Mean Data

The composites were subjected to a grid analysis. This led to the "polar growth phenomenon" and "gnomonic revelations" which have also held up for now 30 years (**Fig. 9-3A, B and C**).

4. Least Square Digitization

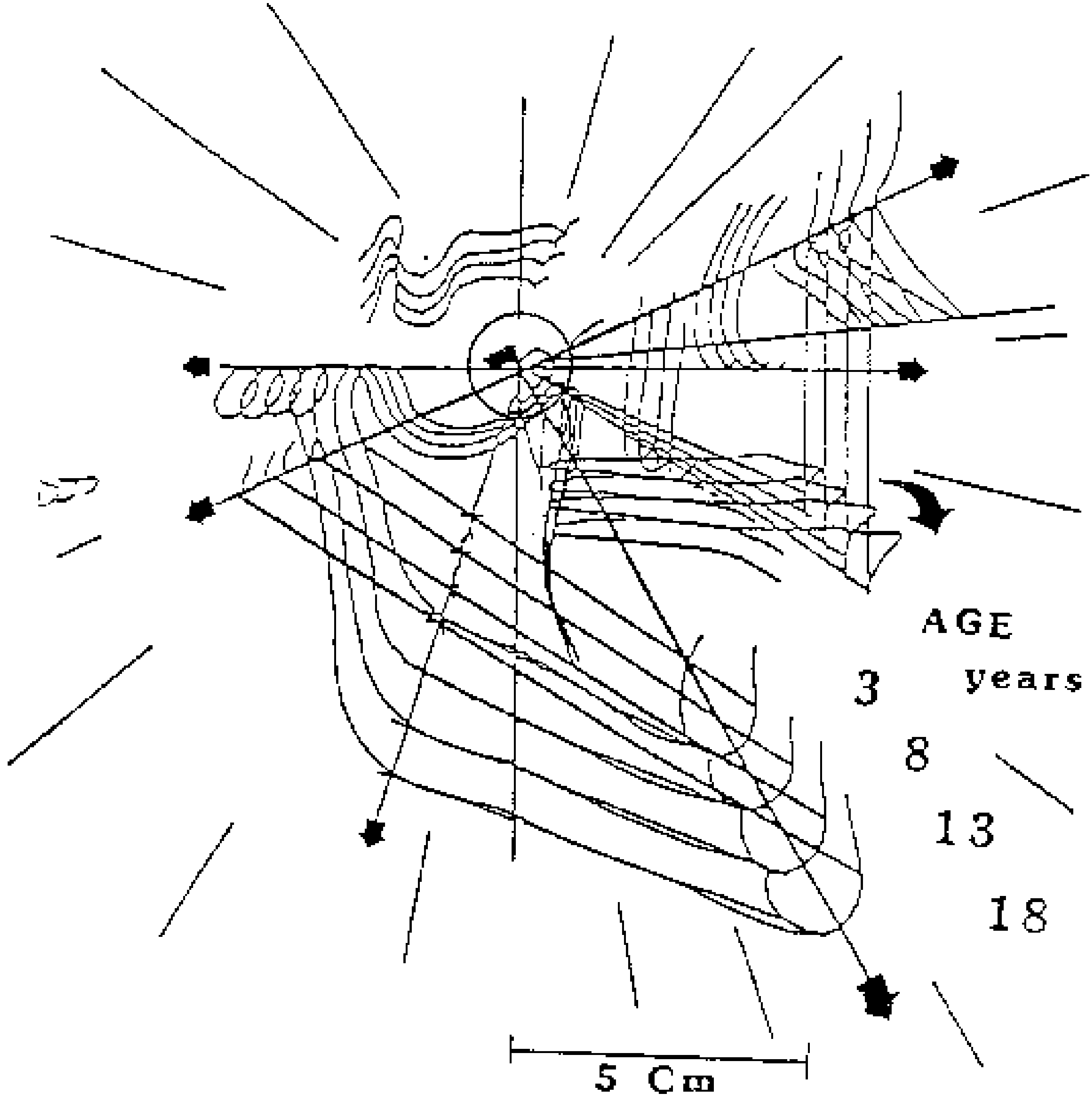
The current method for computer composite construction is produced by digitization. The specific reference points are chosen and the mean of each critical point becomes a bench mark reference. Because a large number of points are available, the program in the computer then prints out the composition. This represents the central tendency of any given sample treated or untreated.

One beauty of computer composites' use is that it permits a comparison rather than requiring the imagination for the interpretation of large lists of measurements. Tables are often confusing with misunderstood statistical symbols complicating the process.

From the visual comparisons of the composites and the ordination with the grids, even new patterns developed from the massive data. A new "four position analysis" emerged. In the opinion of the author, every student of orthodontics should know this method completely and employ it routinely. Other methods are obsolete in comparison and it has come to be necessary to know the data even to read the current literature (**Fig. 9-4A, B and C**).

II THE NORMAL "CONTROL" SAMPLES

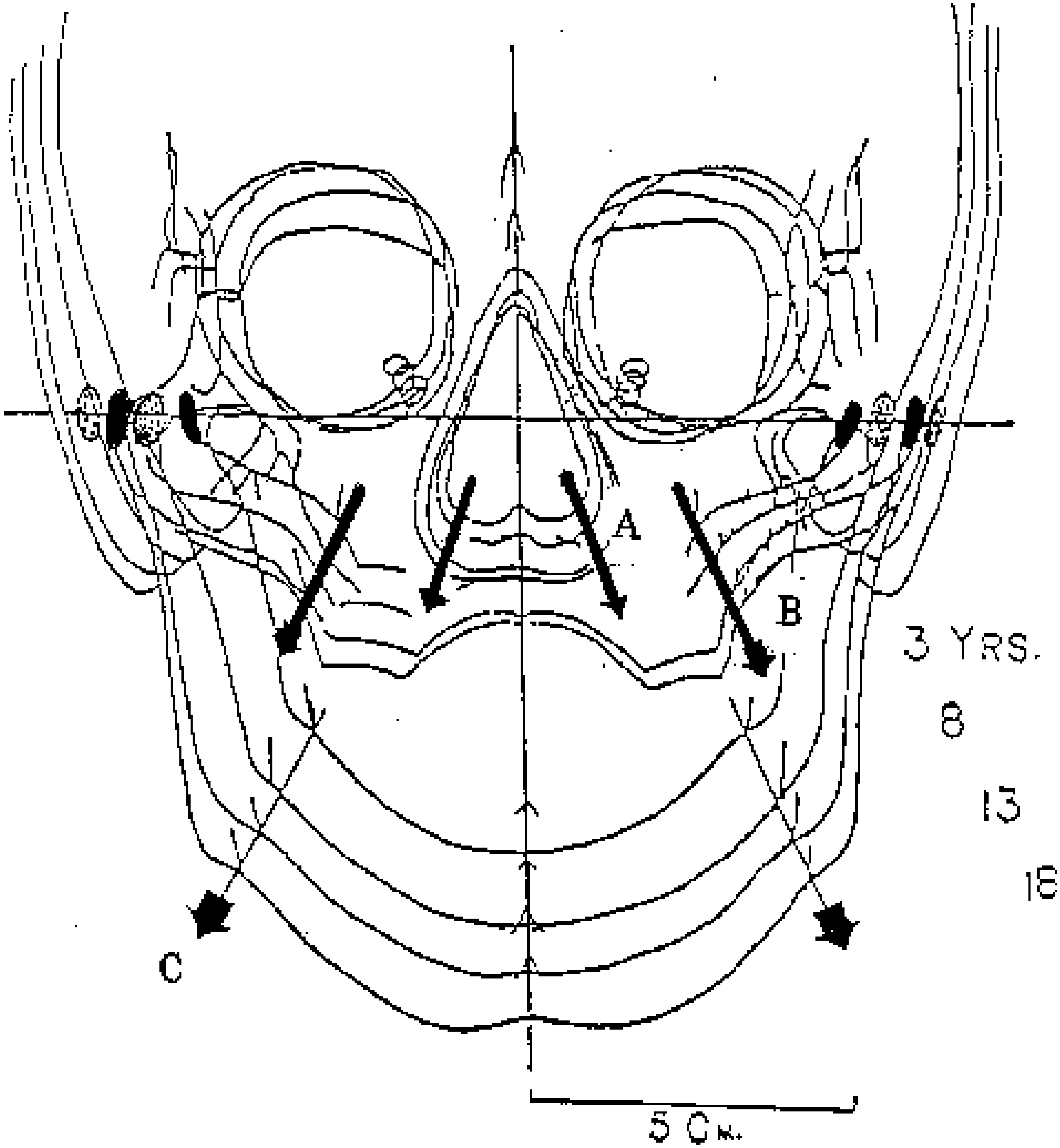
For the programming of the original computer service, three critical conditions had to be met. First was the selection of the **most clinically valuable points and planes of reference**. Hence the testing of so many measurements. Second was to determine **norm values** as a base of reference for morphologic



RICKETTS METHOD

Lateral Composites plotted on Polar grids located the "center" at the lower border of the foramen rotundum. Original work suggested the Facial Axis to be steady.

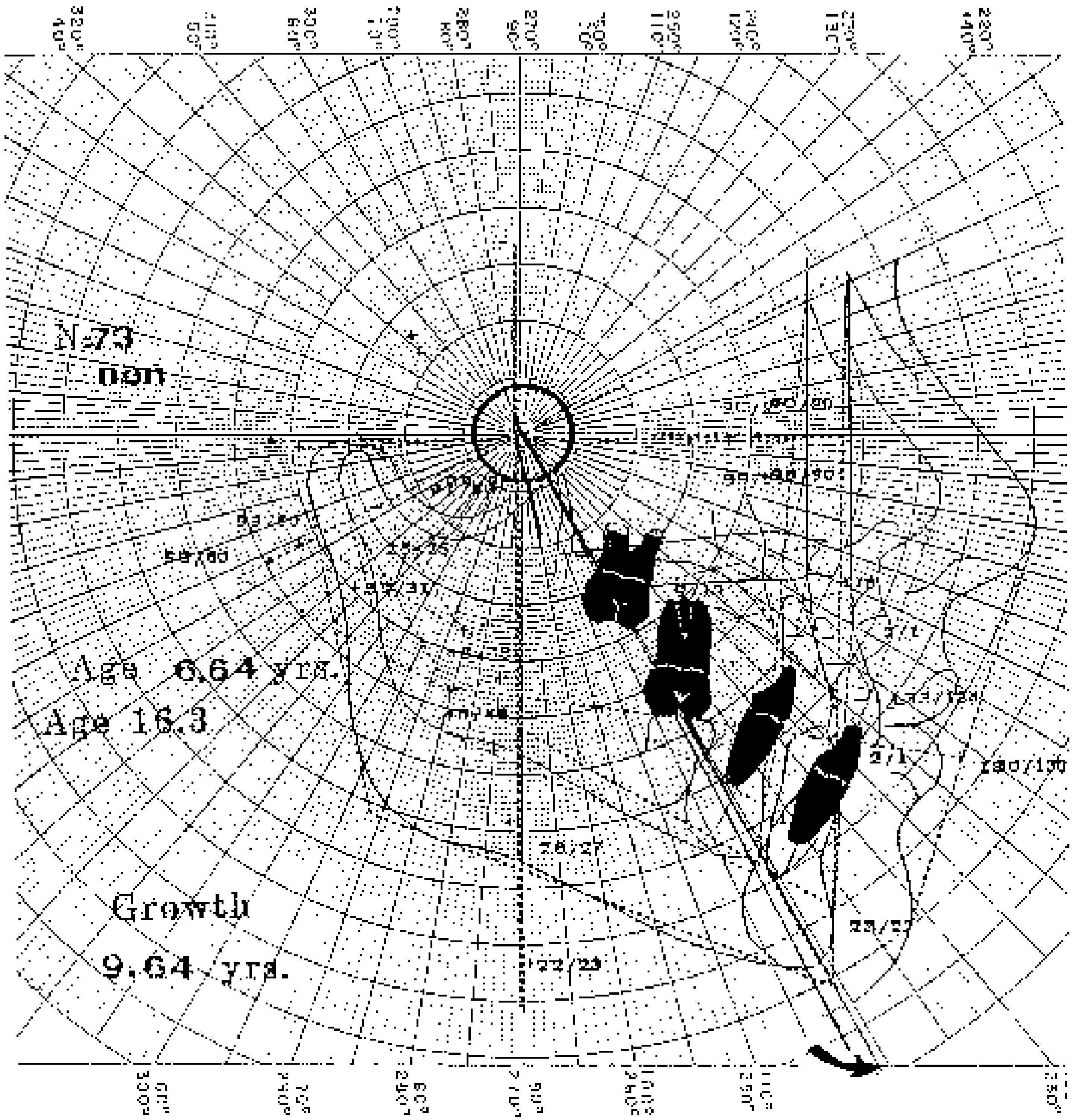
FIG. 9-3A



Growth of Upper Jaw Complex in Frontal Perspective (Transverse)
Composites of ages 3-8-13-18 year old subjects N=40

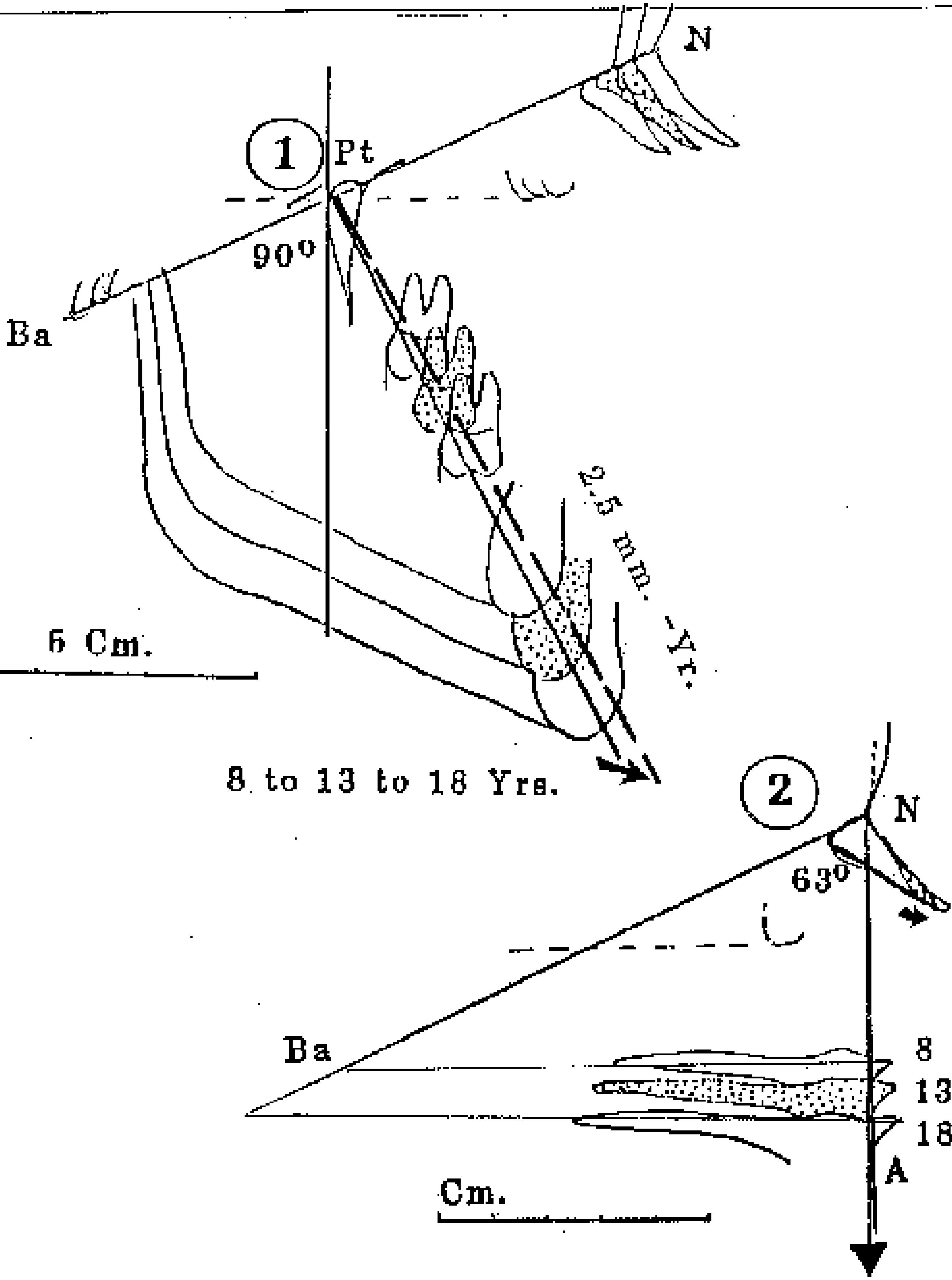
A. Growth of nasal cavity
B. Growth of maxilla and development of zygomatic arches
C. Mandibular growth

FIG. 9-3B



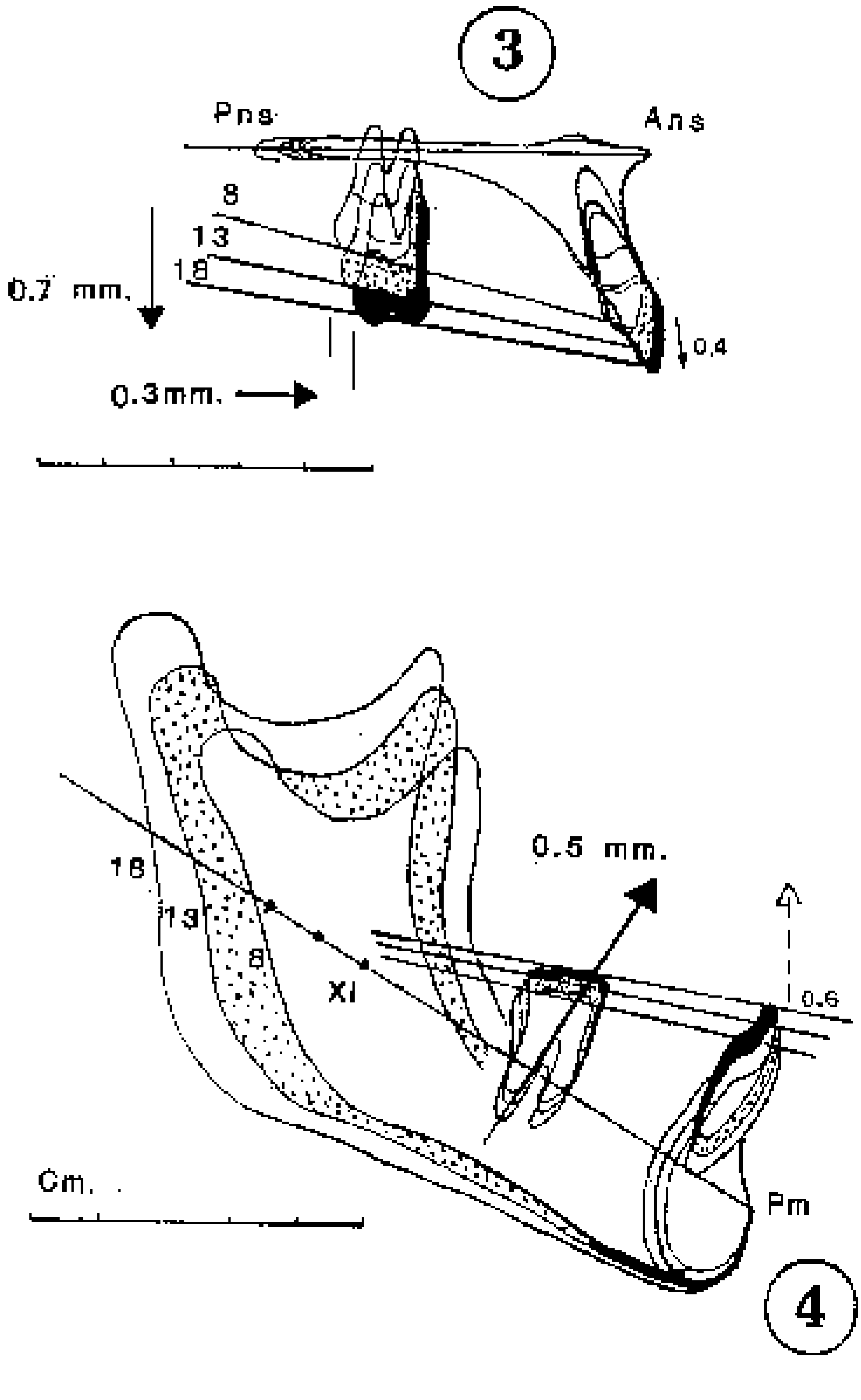
The 1990 study of N=73 Children with T1 and T2 composites superimposed on polar grid. It showed the Facial Axis to close about one degree each seven years but confirmed all other points behavior.

FIG. 9-3C



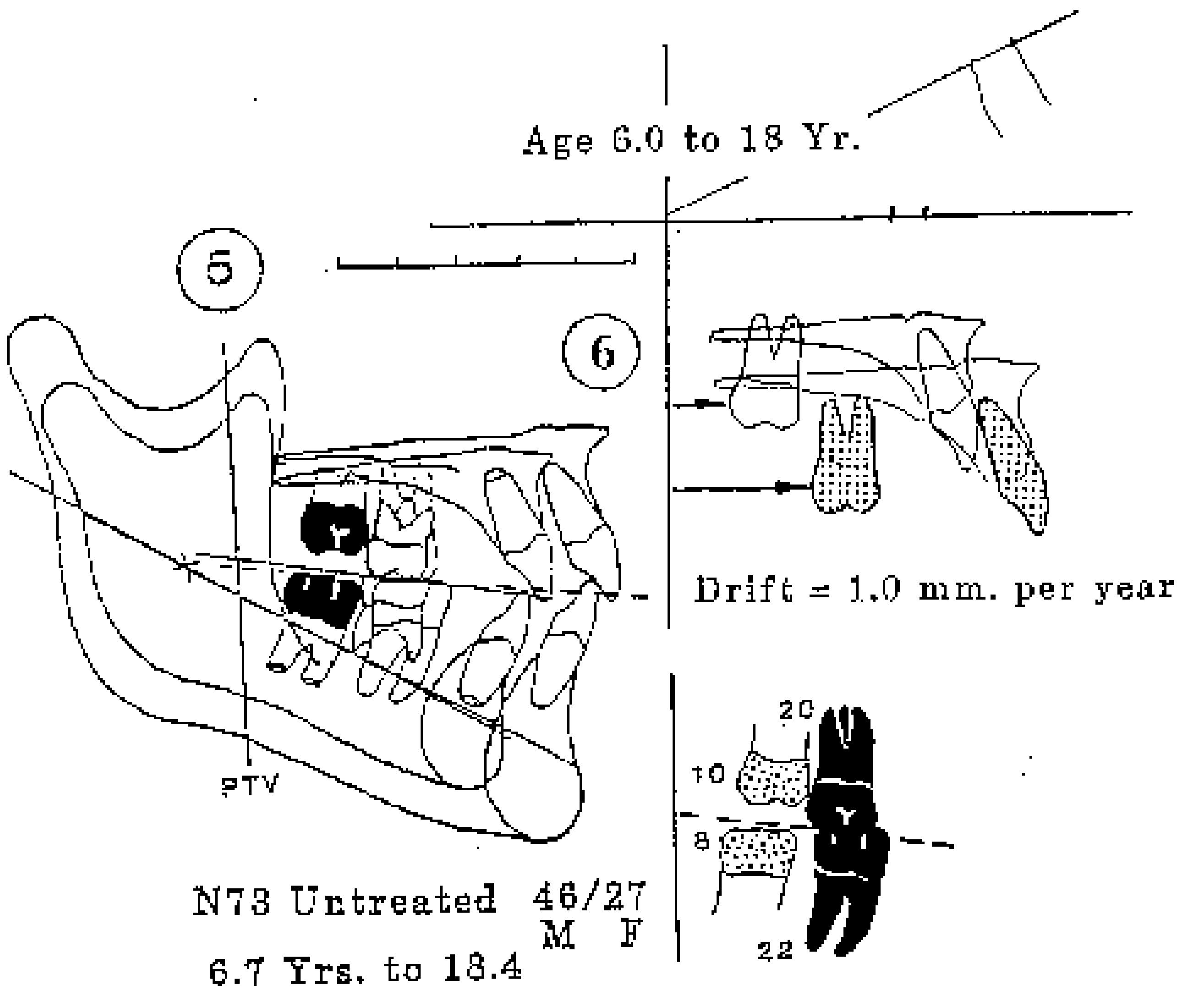
Position ① Pt to Gn @ 2.5 mm. per year angle closes 1.0° each 7 years.
Position ② BaNA angle highly regular, Palate drops (from N) 0.9 mm. per year

FIG. 9-4A



Position③ The occlusal plane drops downward at molar 0.7 mm. per year and 0.4 at incisor while drifting forward 0.3 mm. @ year.
Position④ From the Corpus Axis at Pm the occlusal plane changes but little, the molar erupting at 0.5 mm. and the lower incisor at 0.6 mm. per year. Note with this method the arch depth shortens 3.0 mm.

FIG. 9-4B



Position⑤

Factor: Pterygoid Vertical Plane at Crossing of Buccal Occlusal Plane.
Function: Indicator for relative position of molars from a terminal referance (could be Xi Point).
Change Values: Once erupted the upper molar moves forward 1.0 mm. per year. The lower molar moves forward 1.4 mm. per year.

FIG. 9-4C

descriptive analysis. Hence the aggregation of the literature. The third was the most cogent **references for growth** together with the best data to be employed as a frame for a clinical guide.

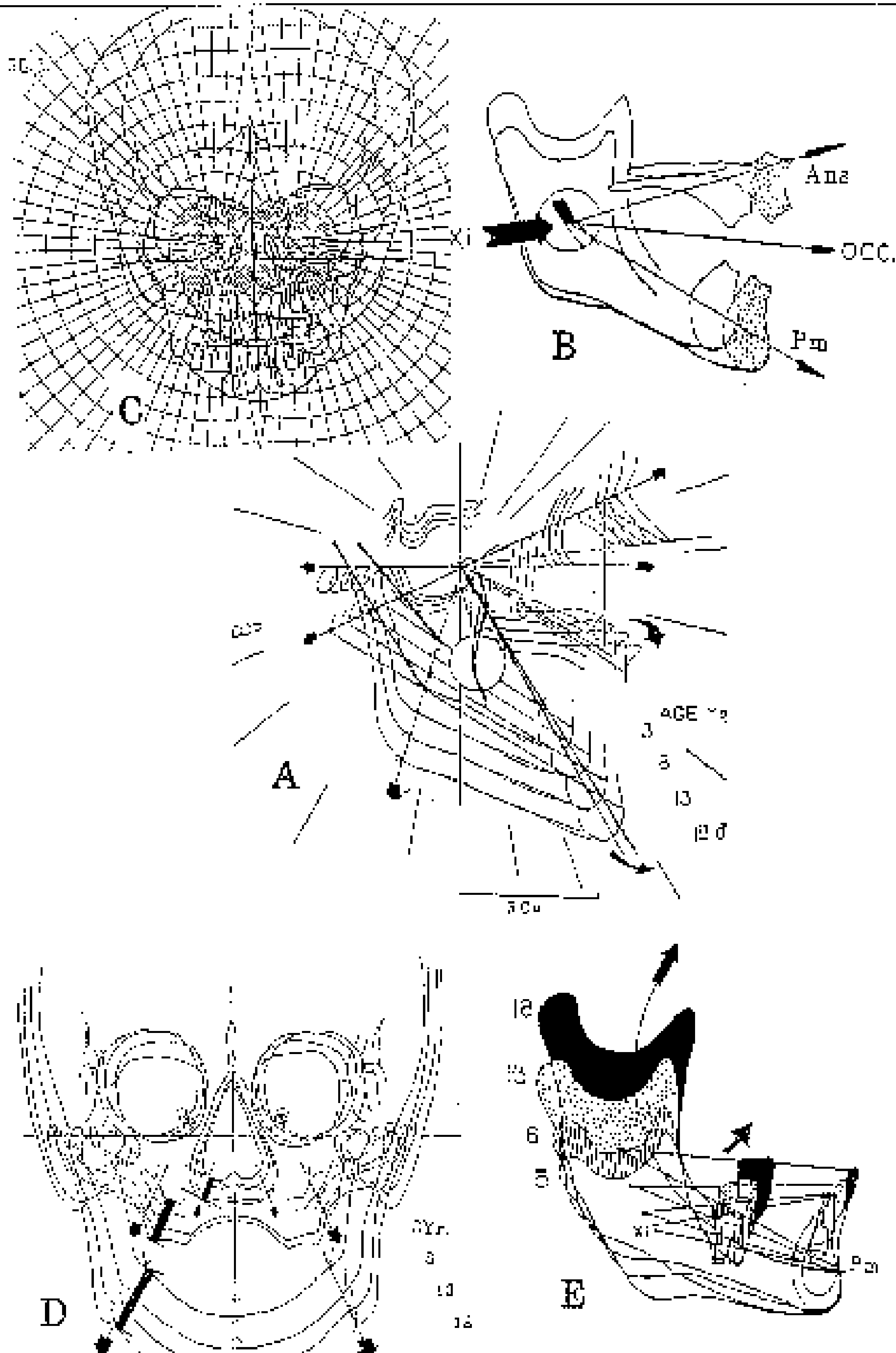
The original data permitted the construction of a composite for ages 5, 8 and 13 years. For growth, the literature was consulted. Originally the Facial Axis was suggested to move forward slightly. However, data from Broadbent, Sassouni, Bowden and McNamara suggested a mean constancy. Confidence could be placed on the data due to its testing and verification. A group of 3 year olds and adult males were composited in order to fill out the 5 year growth intervals. This was the original picture resulting from a six year study (see Fig. 9-3).

A First Computer Composition (1968)

The objectives as set forth were achieved. **Clinical norms for sexes and races were determined** when the composite was placed on a grid. "Polar Growth" was discovered in the sagittal view at the area of the maxillary nerve exit from the skull (see Fig. 9-3). Gnomonic values were determined for the facial cavities. Gnomonic verticies were employed in the frontal for the nasal cavity, the maxilla (at J) and the mandible (at Ag).

A summary form of growth and treatment change analysis took the plot of the four positions for superimposing. A fifth position showed differential forward development of the arches. While shown before, it is displayed here again for immediate reference (see Fig. 9-4). The behavior of lower jaw was first (position 1) and the upper jaw second (position 2). The upper teeth came next (position 3) and the lower teeth last (position 4) (see Fig. 9-4).

New references and data led also to the discovery of and Arc for the growth of the mandible. An entirely different concept of orthopedics emerged **(Fig. 9-5)**.



A. Polar growth. Note the bending of the Corpus Condyle Axis which led to the discovery of Arc on the mandible and new view of eruption of Arch (E).
B. Gnomonic Growth of oral matrix from Xi Point.
C. Bipolar growth in frontal results from two neurotropic bundles (nerves)
D. A 1-2-3 growth in the frontal was Fibonacci like.

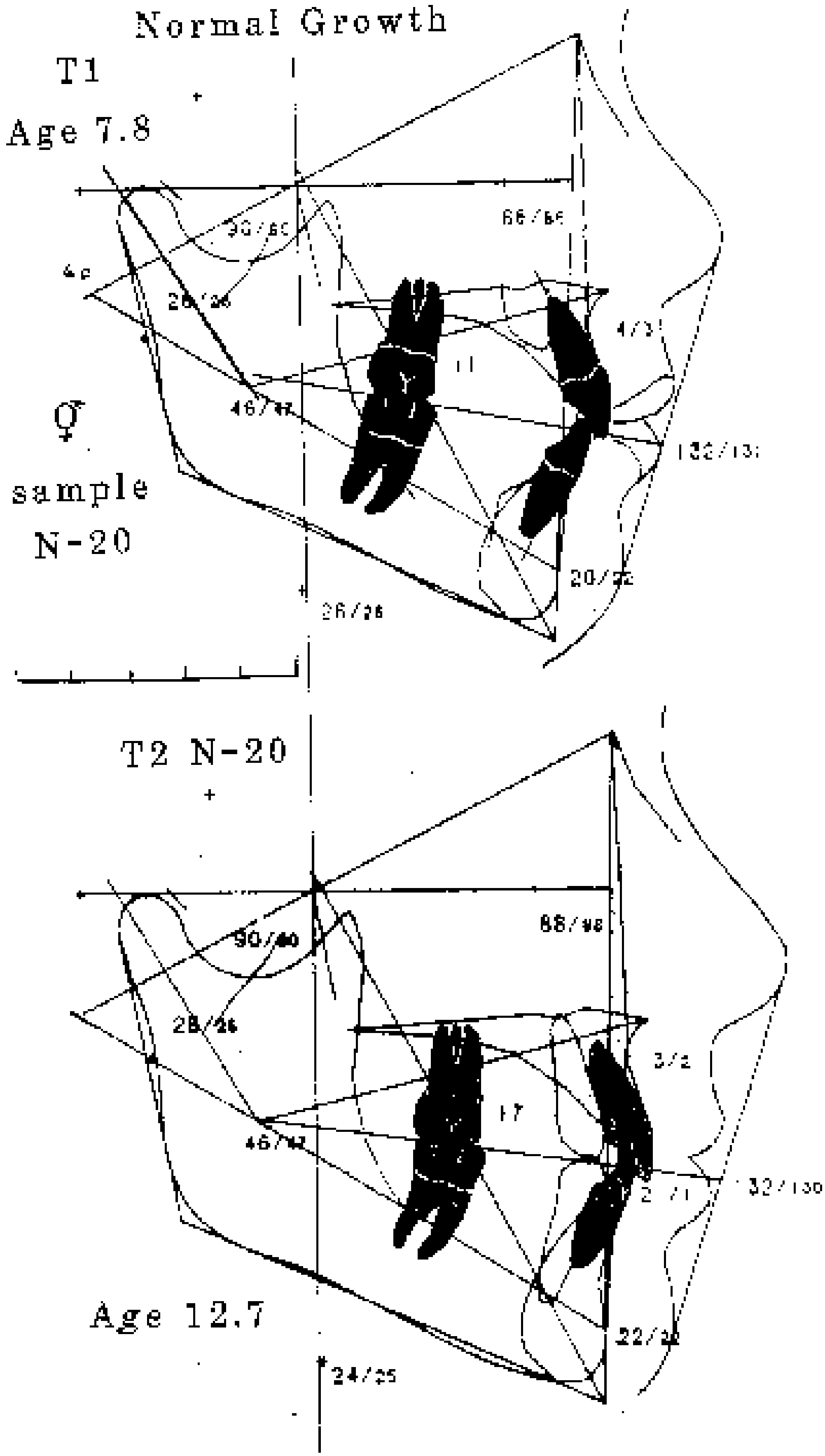
FIG. 9-5

B Verification (1985)

A second group of untreated children was selected in 1985 for reconfirmation of a five year growth experience. This was a group of 7.63 year old children composited again at age 12.67 (**Fig. 9-6A and B**). This was a verification of the original data needed because many colleagues had questioned the documentation even though it was twice the number of patients used by Broadbent, Brodie and Downs and represented in addition an aggregate of the literature on different points of reference. The new sample showed a slight forward shift of the chin position (Position 1).

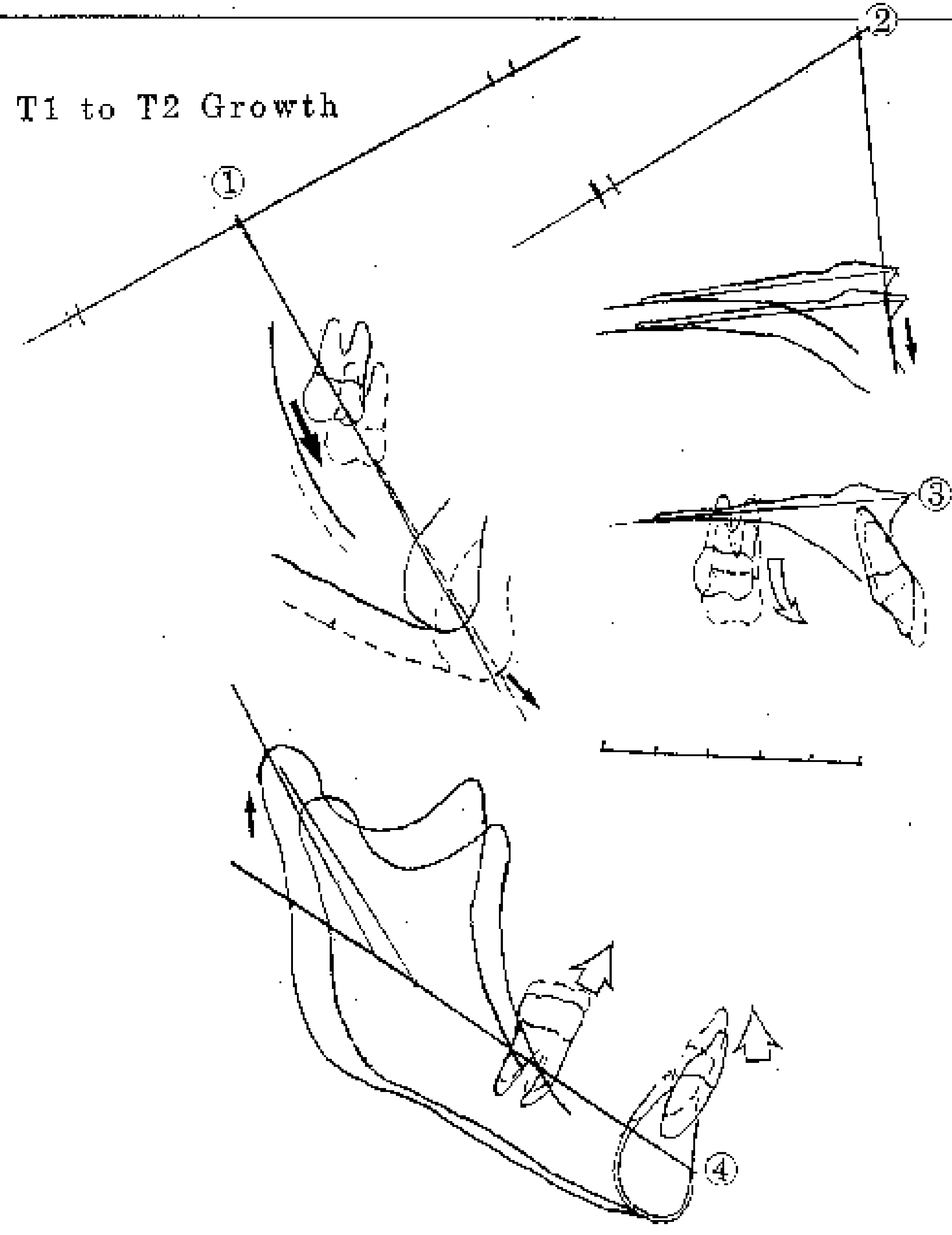
C Second Computer Verification (1990)

An extensive third test was completed in 1990. One hundred thirty three subjects (N=133) were followed from age 6 (some started at age 4) to maturity. Sexual cutoffs were found. For females it was 14.8 years and for males it was extended to 19.0 years. Seventy three (73) received no treatment whatsoever and were employed as still another verification of the control data. The findings are demonstrated in (**Fig. 9-7**). Sixty of the 1990 patients were treated. In summary the untreated control data was derived in 1968 with an exhaustive effort. The data was retested for almost 20 years and in 1985 was significantly verified. It was, in addition, reverified and fine tuned in 1990 with a long term sample. The data has been found to be trustworthy. Different racial types (negroid and mongoloid) have also been added for modification of the caucasian race.



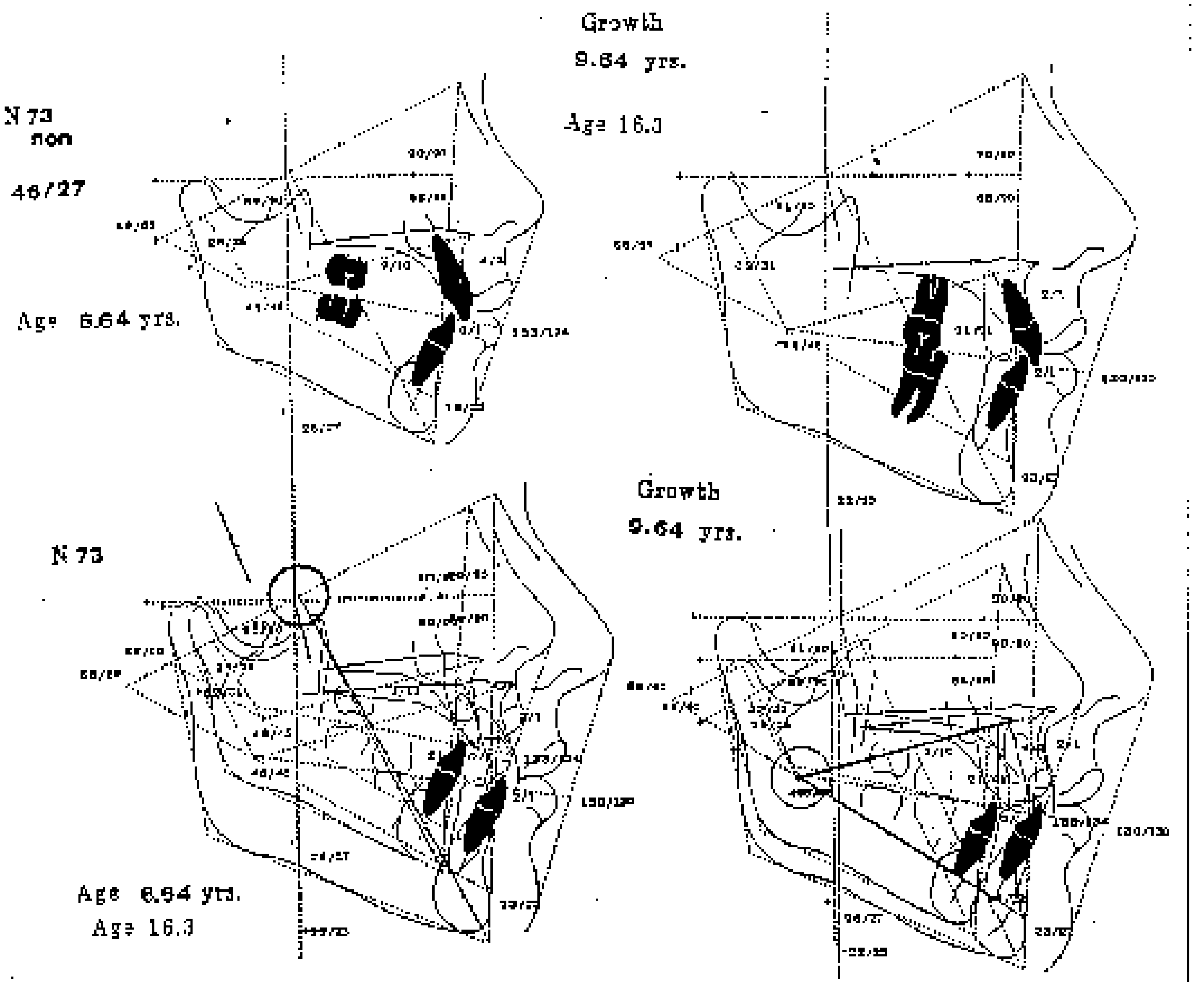
1965 Normal children untreated to reconfirm the computer data. Five years normal behavior in mixed group of mixed dentition.

FIG. 9-6A



The Four Position Analysis of untreated children seen in Fig. 9-7A Five year Behavior
① Very slight closing of Axis
② No change in Point A
③ Downward and forward drift of occlusal plane
④ Typical eruption and bend of mandible with growth.

FIG. 9-8B



Composites and comparisons of 73 untreated children actually 12 years later but growth cut-off at age 16-3 for sex differences.

A. Age 6.6 years
B. Age 16.3 years
C. Superimposed at Cc on BaN
D. Superimposed on Xi

FIG. 9-7

III TREATED (ORTHOPEDICS)

A. Class II N=34

Almost 50 samples have been collected and computer composited which were treated. Different techniques employed had different results. Adolescent groups treated in various manners were also studied. For reference, for the basis for early treatment, two samples exhibited in other lectures are shown again here. One is a group of 34 Class II high convexity children treated at age 9.6 years all with cervical traction and restudied at age 13 **(Fig. 9-8)**.

B. Class III N=5

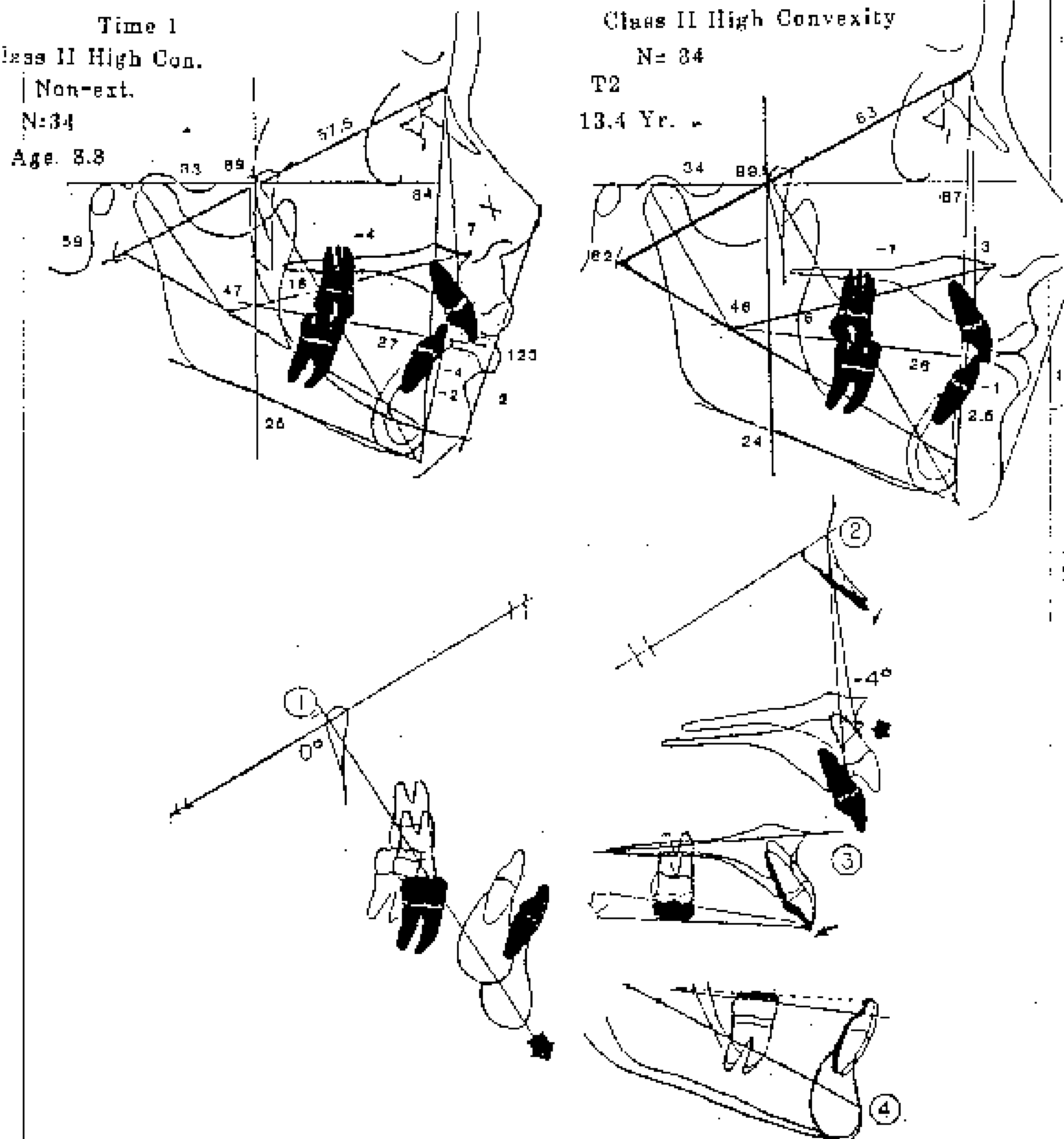
The second group is a small sample of five Class III children started at age 9 and recomposited at 13 years **(Fig. 9-9).**

IV TREATED CLASS II LONG TERM RESULTS (1990)

One 1990 composited sample was of 10 children who were treated at the University of Washington with serial extraction and no orthodontics. The composites are shown and analyzed in **(Fig. 9-10A, B, C and D).**

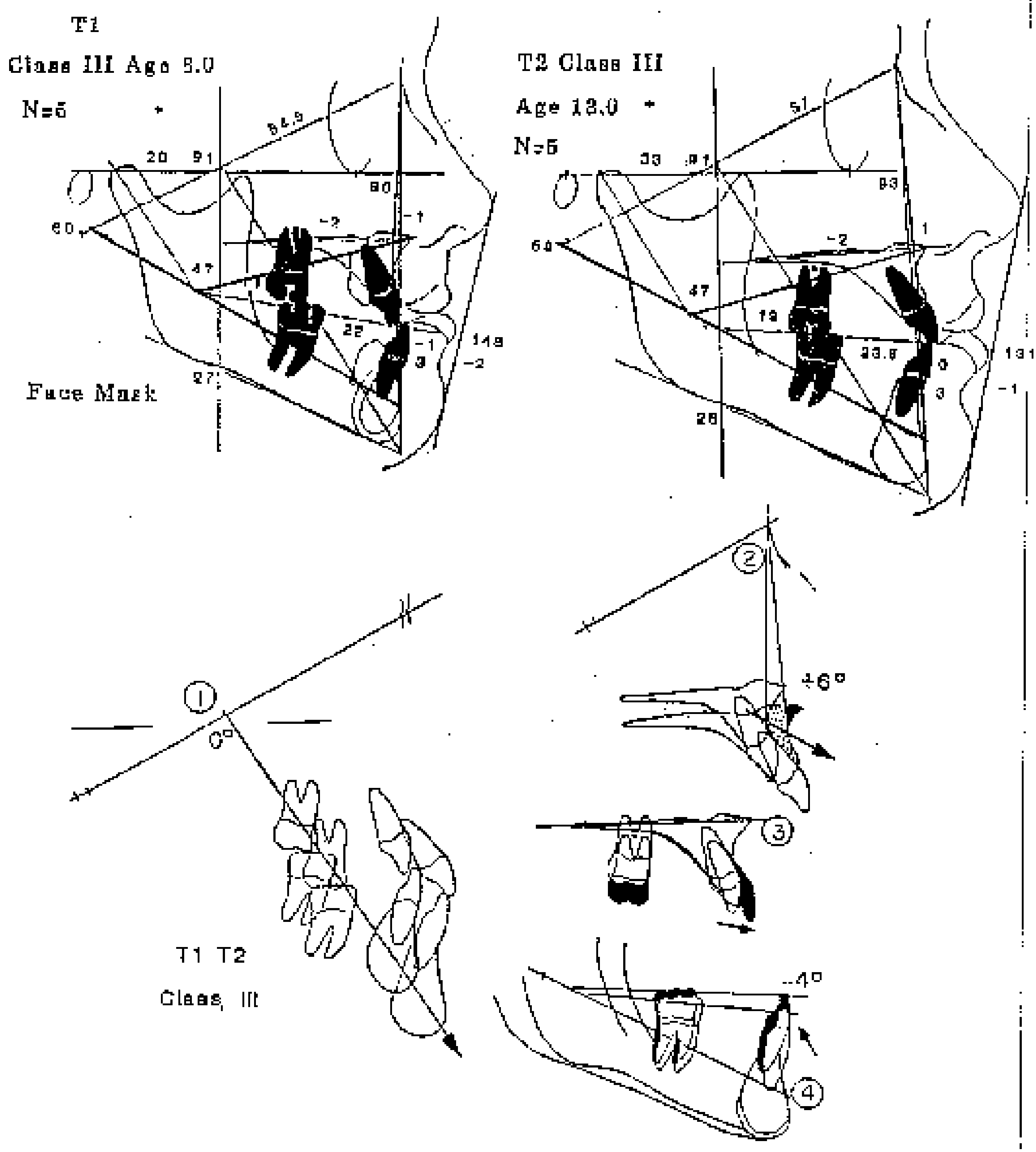
In the 1990 study, nineteen (19) children started at age 7.33 years had been treated with cervical traction and followed to maturity. Each had been forecasted without treatment and a composite was made of the forecasts. The comparison to the actual is shown in Fig. 9-11A, B, C, D, E and F. This experiment proved three important facts:

(1) Forecasting can be almost absolute in the mandible for the growth.
(2) The treatment in long range are exhibited no increased influence on mandibular form and size.
(3) The real orthopedic possibilities lie in the midface.



The analysis of 34 patients treated with cervical traction in deep bite Class II, Division 1 high convexity. T1 at age 8, T2 at age 13. Notice the group finished at 125° inter-incisal angle. The Four-Position Analysis: (1) The Facial Axis had not opened. (2) A 4° change, on average, of the Point A. (3) The Occlusal Plane is almost normal. (4) The lower incisor has moved lingually compared to its position at T1.

FIG. 9-8



A group of five (5) Class III at age 8.0 also composited at age 13.0. Note the concavity correction with face mask despite the strong mandibular growth. Four-Position Analysis: ① no change in Facial Axis, ② a six degree advancement of Point A, ③ forward movement of the upper incisor, ④ backward movement of lower arch. Compare to Fig. 9-8.

FIG. 9-9

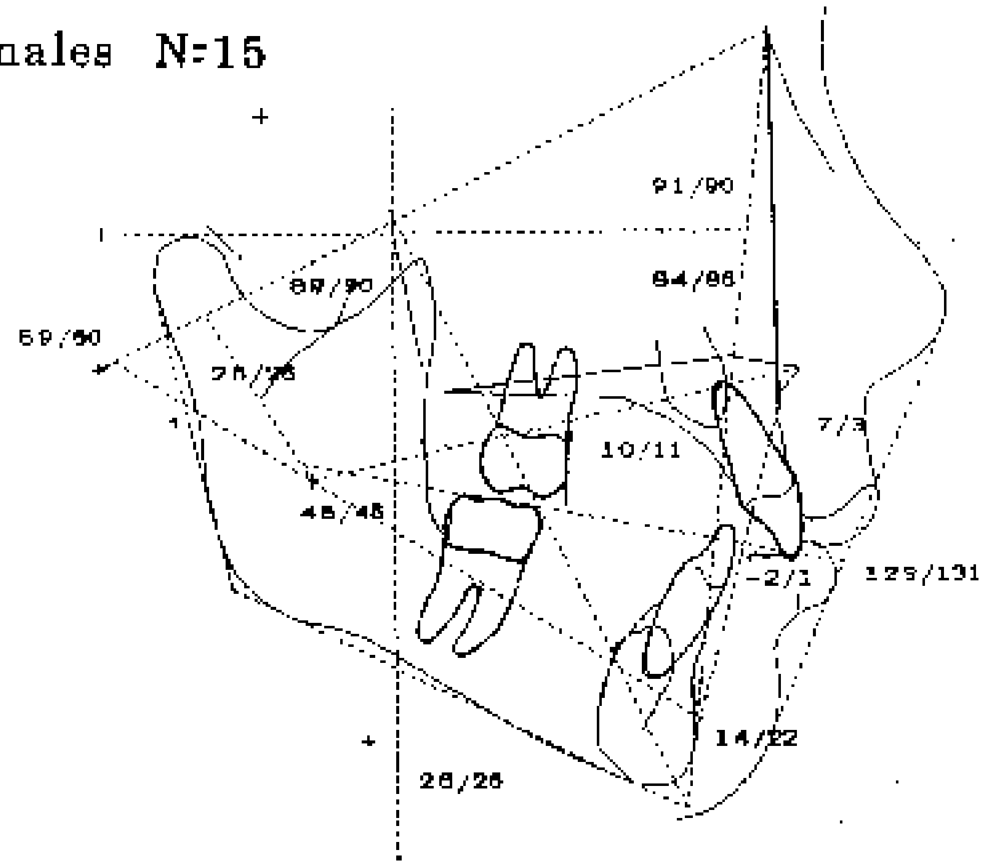
Treated High Convexity

Age 7.33

T1

Males N=4

Females N=15



FACIAL PATTERN MESOFACIAL

# FACTORS	MEASURED VALUE		NORM		CLINICAL DEVIATION	
Interincisal Angle	129.6	dg	131.0	dg	-0.4	
Convexity	6.5	mm	3.1	mm	1.7	*
Lower Facial Height	45.4	dg	45.0	dg	0.1	
A6 Molar Position to PTV	10.3	mm	10.7	mm	-0.1	
B1 to A-Po Plane	-2.2	mm	1.0	mm	-1.4	*
B1 Inclination to A-Po	13.7	dg	22.0	dg	-2.1	**
Facial Depth	83.6	dg	88.2	dg	-0.8	
Facial Axis	88.6	dg	90.0	dg	-0.4	
Maxillary Depth	90.9	dg	90.0	dg	0.3	
Mandibular Plane to FH	26.3	dg	26.4	dg	0.0	
Mandibular Arc	25.7	dg	25.5	dg	0.7	
Total Facial Height	59.2	dg	60.0	dg	0.3	

RMO 1996

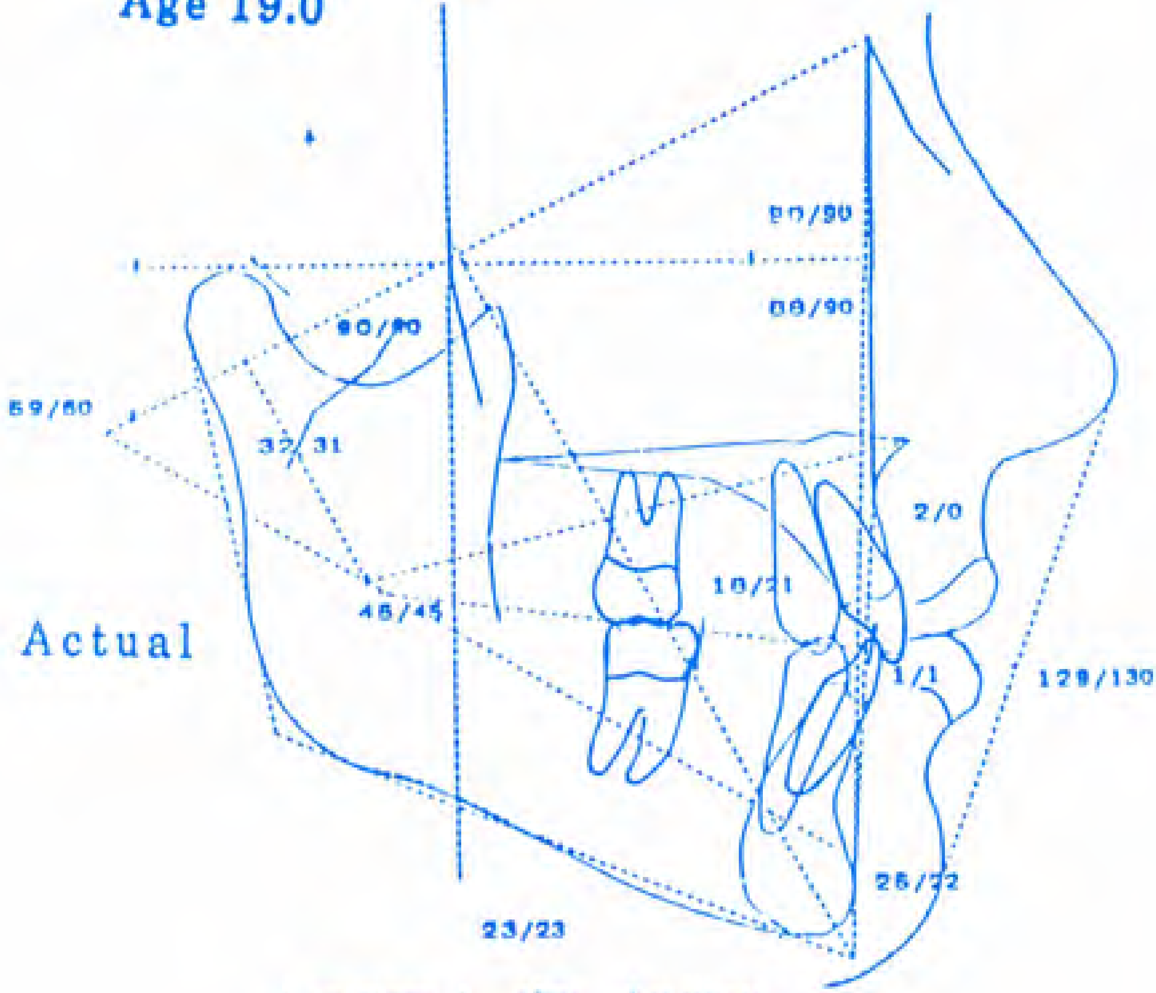
T1 of 19 children high convexity (7 mm.) Class II. All were treated with cervical traction. Facial Axis was 89° which was very typical of Class II samples.

FIG. 9-10A

Treated High Convexity

T2

Age 19.0



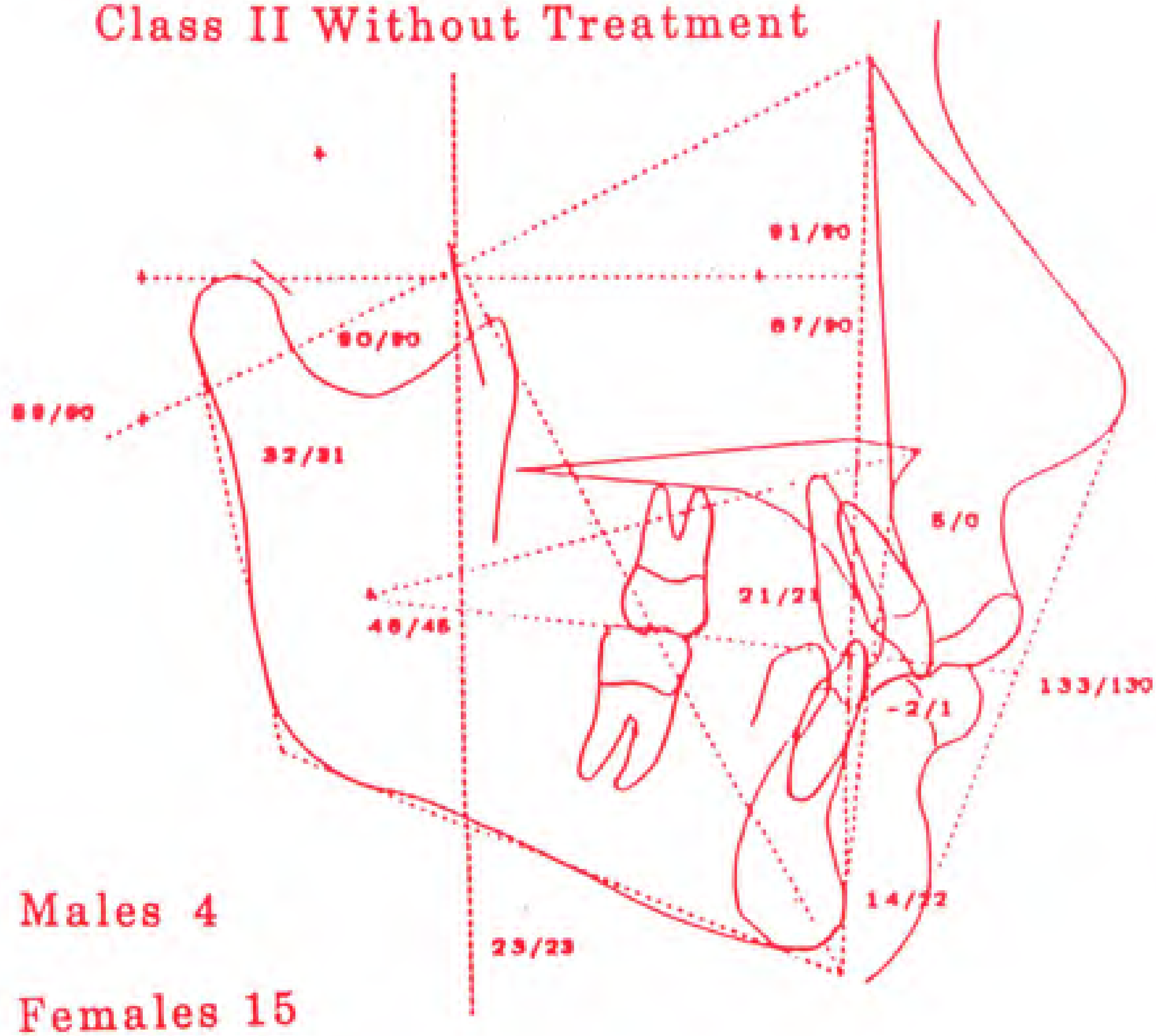
MEASURED VALUE		NORM		CLINICAL DEVIATION	
128.7	dg	130.0	dg	-0.2	
1.7	mm	0.5	mm	0.6	
45.4	dg	45.0	dg	0.1	
18.0	mm	21.0	mm	-1.0	*
1.4	mm	1.0	mm	0.2	
25.4	dg	22.0	dg	0.9	
88.0	dg	89.6	dg	-0.5	
89.5	dg	90.0	dg	-0.1	
89.5	dg	90.0	dg	-0.2	
23.1	dg	23.3	dg	0.0	
32.3	dg	30.7	dg	0.4	
58.8	dg	60.0	dg	-0.4	

RMO 1998

T2 of previous composite at age 19.0 years – 12 years later. Note the upper molar is 3 mm. posterior for type. Note the ideal convexity and profile.

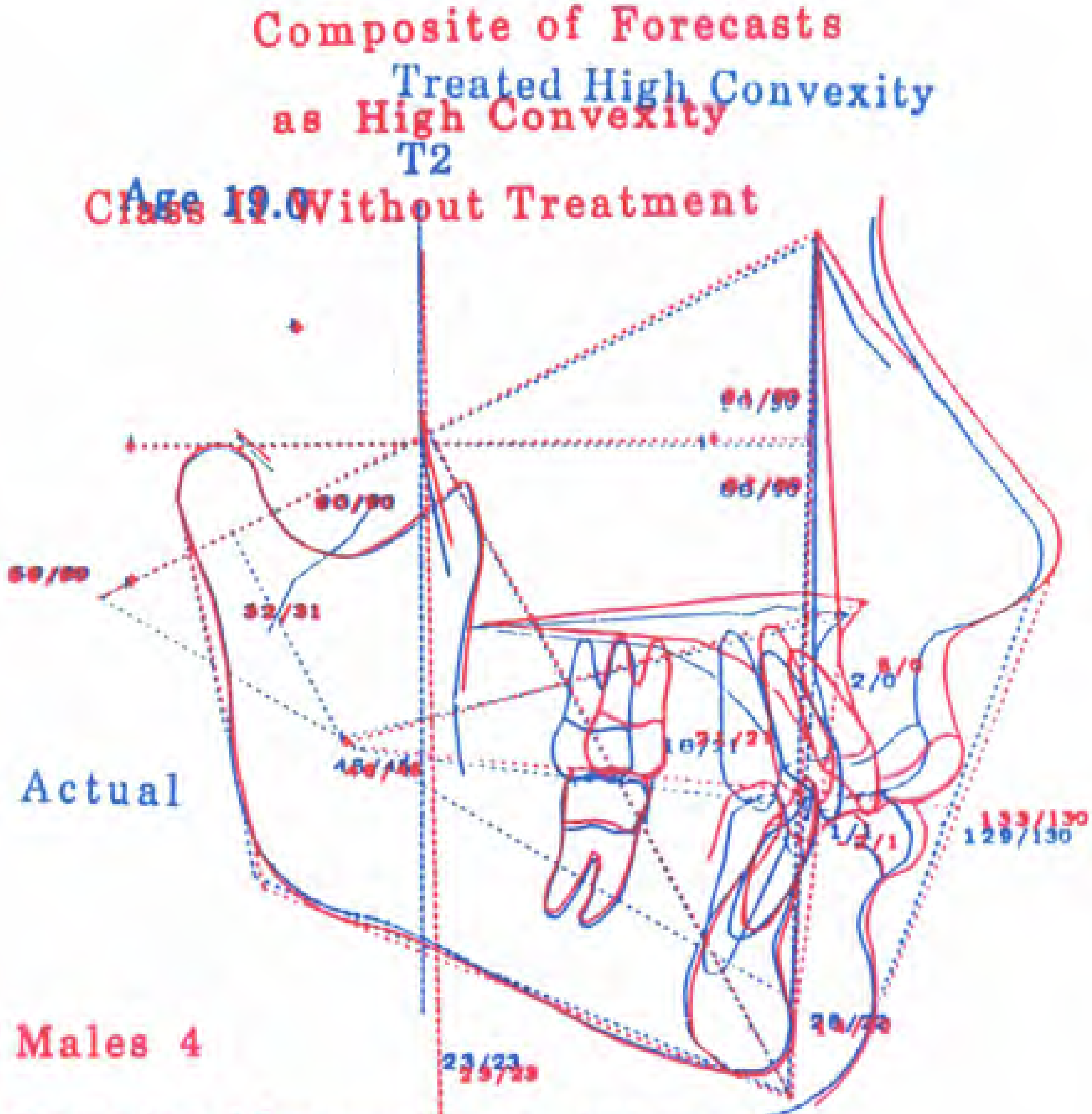
FIG. 9-10B

Composite of Forecasts as High Convexity Class II Without Treatment



Composites of forecasts without treatment of 19 patients to maturity. Females are cut off at age 14.8 years, Males at age 19. Note still a 5 mm. convexity but 90° Facial Axis.

FIG. 9-10C



MEASURED VALUE		NORM		CLINICAL DEVIATION	
128.7	dg	130.0	dg	-0.2	
1.7	mm	0.5	mm	0.6	
45.4	dg	45.0	dg	0.1	
18.0	mm	21.0	mm	-1.0	*
1.4	mm	1.0	mm	0.2	
25.4	dg	22.0	dg	0.9	
88.0	dg	89.6	dg	-0.5	
89.5	dg	90.0	dg	-0.1	
89.5	dg	90.0	dg	-0.2	
23.1	dg	23.3	dg	0.0	
32.3	dg	30.7	dg	0.4	
58.8	dg	60.0	dg	-0.4	

RMO 1998

Comparison of the Forecast (red) to the actual (blue). Notice the quality of fit of the mandible. Notice the orthopedics and orthodontics of the maxilla. Note the intrusion of the lower incisor. Note the profound profile change.

FIG. 9-10D

V THE 1999 CLASS II CERVICAL TRACTION STUDY

A. The 1999 Protocol (22 Composites) – The Group and Breakdown

For the 1999 study, thirty five N=35 young child patients were selected. Seventeen (17) were male and eighteen (18) were female. The mean age was 7.2 years at the start. Twelve (12) were started in the deciduous dentition at a mean of 5.7 years (preventive phase). All were Class II and all were treated with cervical traction.

Upon reexamination of the records, the effort was made to find the extremes of Facial Axis behavior. One patient, J.B., a female reported in Lecture 11, had received some "hi-pull" intermittently with cervical pull. This patient opened 3° and we came to entertain the idea that something with that technique tends to compress the joint area. Removal of this patient would make the findings of cervical traction even more favorable.

In these patients, only the second deciduous molars were employed as anchorage. Four were Class II deep bite and eight were Class II open bite. Twenty three (23) were started in the mixed dentition at the mean age of 7.9 years.

Original and progress films were composited and final head plates were composited in all patients **ten to twelve years later**.

For this research, Time 1, 2, 3 and 4 tracings were made on the series of headplates for 35 children (N=35). Twelve (12) were started in the mixed dentition at a mean age of 5.7 years. The twenty-three (N=23) mixed dentition patients were started two years later at age 7.9 years. The ages, type and sexes are shown in **Table 9-I.**

Sample #	Size	Type	Time	Ages	Sex distribution
# 1	N=35	Total	T1	7.2	
			T2	8.7	♂ 17
			T3	10.5	♀ 18
			T4	17.4	
# 2	N=19	Total Open	T1	6.9	♂ 8
			T2	8.4	♀ 11
			T4	17.1	
# 3	N=16	Total Deep	T1	7.7	♂ 9
			T2	9.3	♀ 7
			T4	18.7	
# 4	N=12	Total Dec	T1	5.7	♂ 4
			T2	7.4	♀ 8
			T4	16.5	
# 5	N=23	Total Mix	T1	7.9	♂ 13
			T2	9.4	♀ 10
			T4	18.1	
# 6	N=8	Dec Open	T1	5.9	♂ 2
			T2	7.5	♀ 6
			T4	15.9	
# 7	N=12	Mix Open	T1	7.7	♂ 6
			T2	9.0	♀ 6
			T4	17.3	

TABLE 9-I

In all, twenty-two composites were constructed by Rocky Mountain Information Services by Mr. Rick Schrager. The findings and comments are sited.

1. Sample # 1 – The Total group (N=35 17/18)

The series of T1 to T4 composites can be compared in true size (**Fig. 9-11 A, B, C, D, E and F**). The first (T1) was the beginning. The second was a progress film, eighteen months later. The third composite was made of tracings at the time of the early development of the permanent dentition at age 10.5 years (or nearly 2 years). The final was taken during or after retention. Some patients had no treatment and hence no retention at the permanent dentition.

The Four Position Analysis was made by superimposing the four tracings. Time 1 was black, T2 was red, T3 was again black and T4 was blue. The short and long term chin behavior at Position 1 was straight down the Facial Axis. In Position 2, the point A was reduced and stayed backward. Position 3 showed backward movement of the upper molar (which stayed backward). The corpus axis at Pm (Position 4) showed a normal upward and backward total arch displacement. The occlusal plane was located at the ideal level to Xi.

RMO™

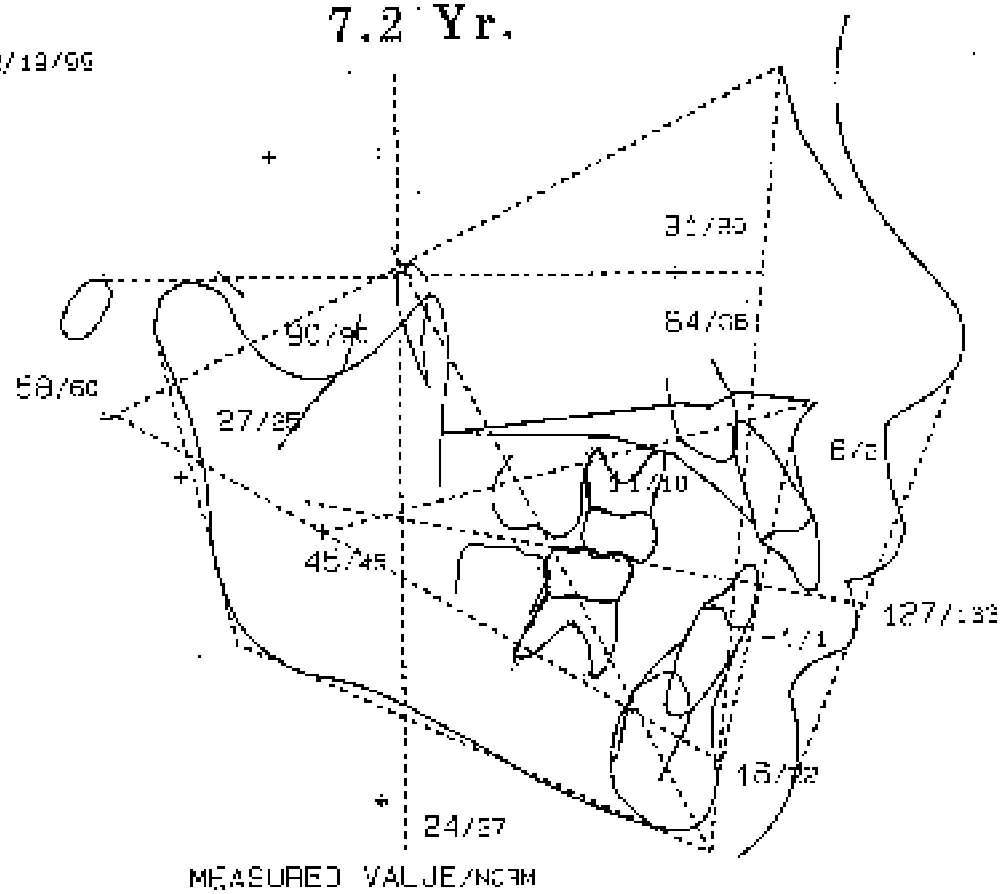
[illegible]
RICKETTS
M (CA) Caucasian
AGE: 7.2
[illegible]

TRACING
BEFORE TREATMENT

7.2 Yr.

T1

17/18



SIGNIFICANT CONSIDERATIONS	
CONDITION	REASON
Class II malocclusion	due to upper & lower molar
Severe Overjet	
Skeletal Class II	due to the mandible & maxilla
Adenoid blockage of the airway?	Probably not

FACIAL PATTERN: MESOFACIAL

# FACTORS	MEASURED VALUE	NORM	CLINICAL DEVIATION	
Interincisal Angle	127.3 dg	132.5 dg	-0.9	
Convexity	5.6 mm	2.3 mm	1.3	*
Lower Facial Height	44.8 dg	45.0 dg	-0.1	
A6 Molar Position to PTV	10.9 mm	10.[illegible] mm	0.2	
[illegible] to A-Po Plane	[illegible] mm	[illegible] mm	[illegible]	*
[illegible] Inclination to A-Po	16.0 dg	22.0 dg	[illegible]	*
Facial Depth	[illegible]	[illegible]	[illegible]	
Facial Axis	90.[illegible] dg	90.0 dg	[illegible]	
Maxillary Depth	90.8 dg	90.0 dg	0.[illegible]	
Mandibular Plane to FH	24.3 dg	26.[illegible] dg	[illegible]	
Mandibular Arc	[illegible]	[illegible]	[illegible]	

Composite of N=35 children Class II mean age 7.2. Seventeen (17) males Eighteen (18) females. N=16 were deep bite. All treated non extraction of premolars.

FIG. 9-11-A

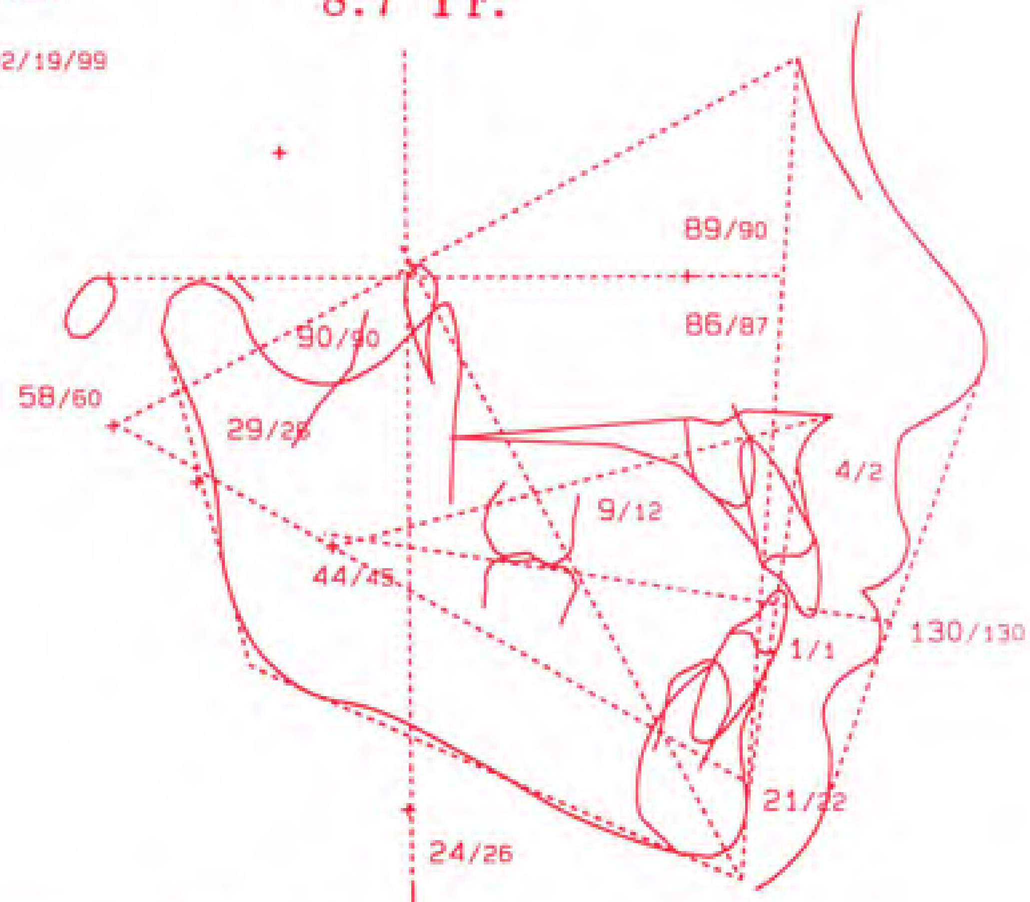
ETTOTAL2
RICKETTS
M (CA) Caucasian
AGE: 8.7
X: 12/07/98 - R: 02/19/99

TRACING

RMO™

8.7 Yr.

T2



FACIAL PATTERN: MESOFACIAL

# FACTORS	MEASURED VALUE		NORM		CLINICAL DEVIATION
Interincisal Angle	129.8	dg	130.0	dg	0.0
Convexity	3.6	mm	2.4	mm	0.6
Lower Facial Height	44.4	dg	45.0	dg	-0.2
A6 Molar Position to PTV	9.2	mm	11.7	mm	-0.8
B1 to A-Po Plane	0.6	mm	1.0	mm	-0.2
B1 Inclination to A-Po	20.9	dg	22.0	dg	-0.3
Facial Depth	85.5	dg	86.5	dg	-0.3
Facial Axis	89.6	dg	90.0	dg	-0.1
Maxillary Depth	89.4	dg	90.0	dg	-0.2
Mandibular Plane to FH	23.8	dg	26.1	dg	-0.5
Mandibular Arc	26.6	dg	26.0	dg	0.7

Total Sample T2 Age 8.7 years all treated with cervical traction

FIG. 9-11B

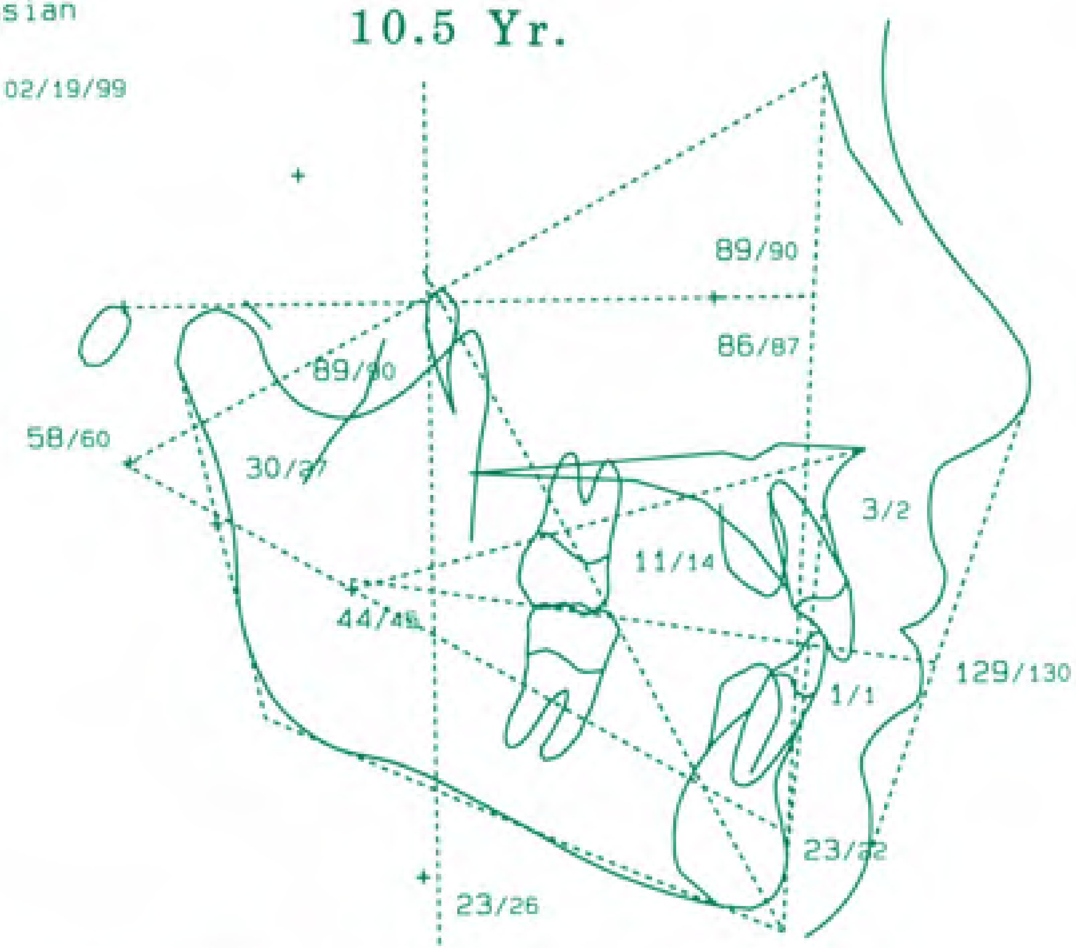
ETTOTAL3
RICKETTS
M (CA) Caucasian
AGE: 10.5
X: 12/07/98 - R: 02/19/99

TRACING

RMO™

10.5 Yr.

T3



FACIAL PATTERN: MESOFACIAL

# FACTORS	MEASURED VALUE	NORM	CLINICAL DEVIATION
Interincisal Angle	129.1 dg	130.0 dg	-0.2
Convexity	2.6 mm	2.2 mm	0.2
Lower Facial Height	44.2 dg	45.0 dg	-0.2
A6 Molar Position to PTV	10.9 mm	13.5 mm	-0.9
B1 to A-Po Plane	1.5 mm	1.0 mm	0.2
B1 Inclination to A-Po	23.3 dg	22.0 dg	0.3
Facial Depth	86.1 dg	87.1 dg	-0.3
Facial Axis	89.0 dg	90.0 dg	-0.3
Maxillary Depth	88.7 dg	90.0 dg	-0.4
Mandibular Plane to FH	23.4 dg	25.5 dg	-0.5
Mandibular Arc	29.9 dg	26.9 dg	0.7

Progress films of the same sample composite age 10.5 (2 years later). Note convexity reduction and locked Class I

FIG. 9-11C

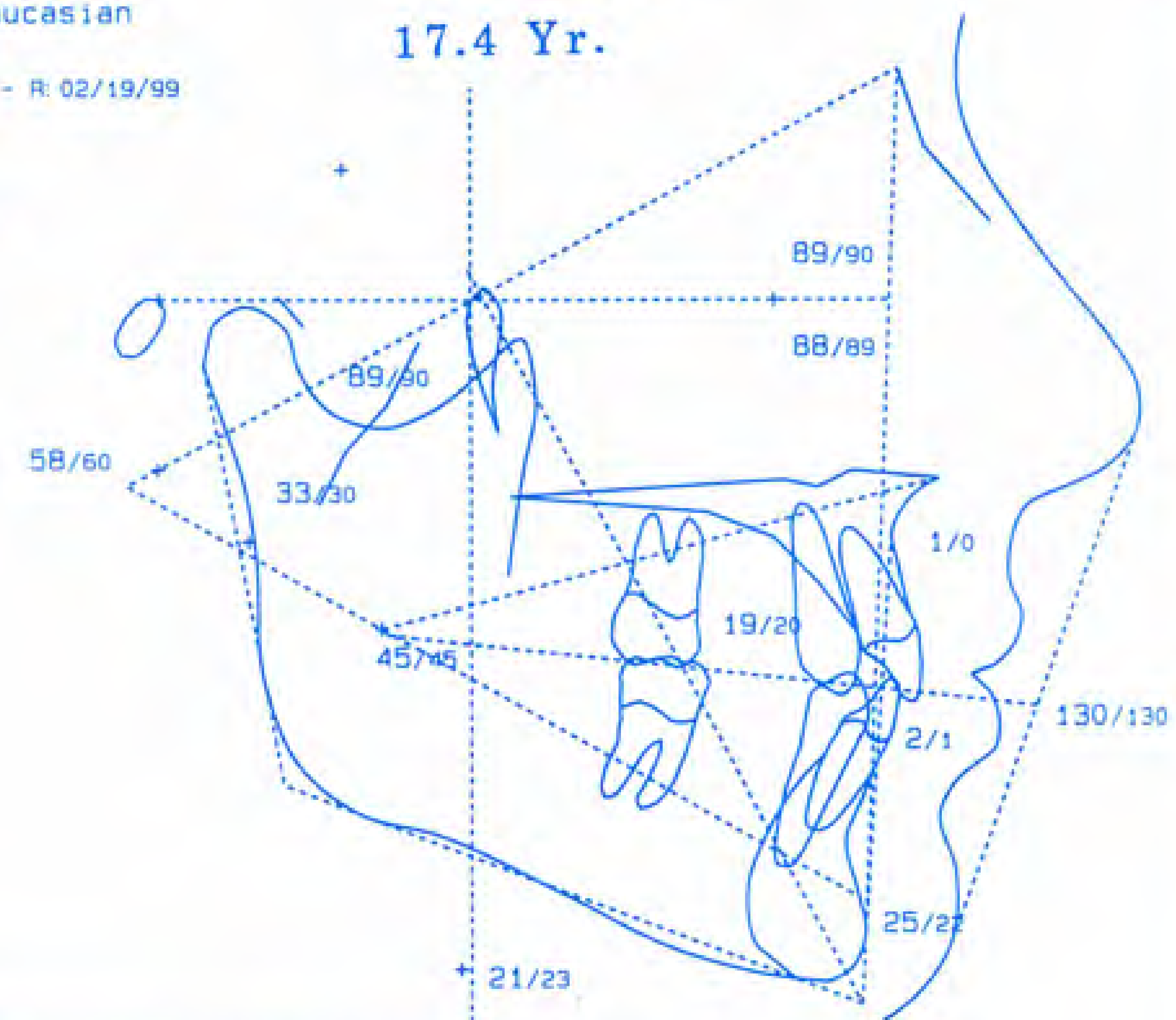
ETTOTAL4
RICKETTS
M (CA) Caucasian
AGE: 17.4
X: 12/07/98 - R: 02/19/99

TRACING

RMO™

17.4 Yr.

T4

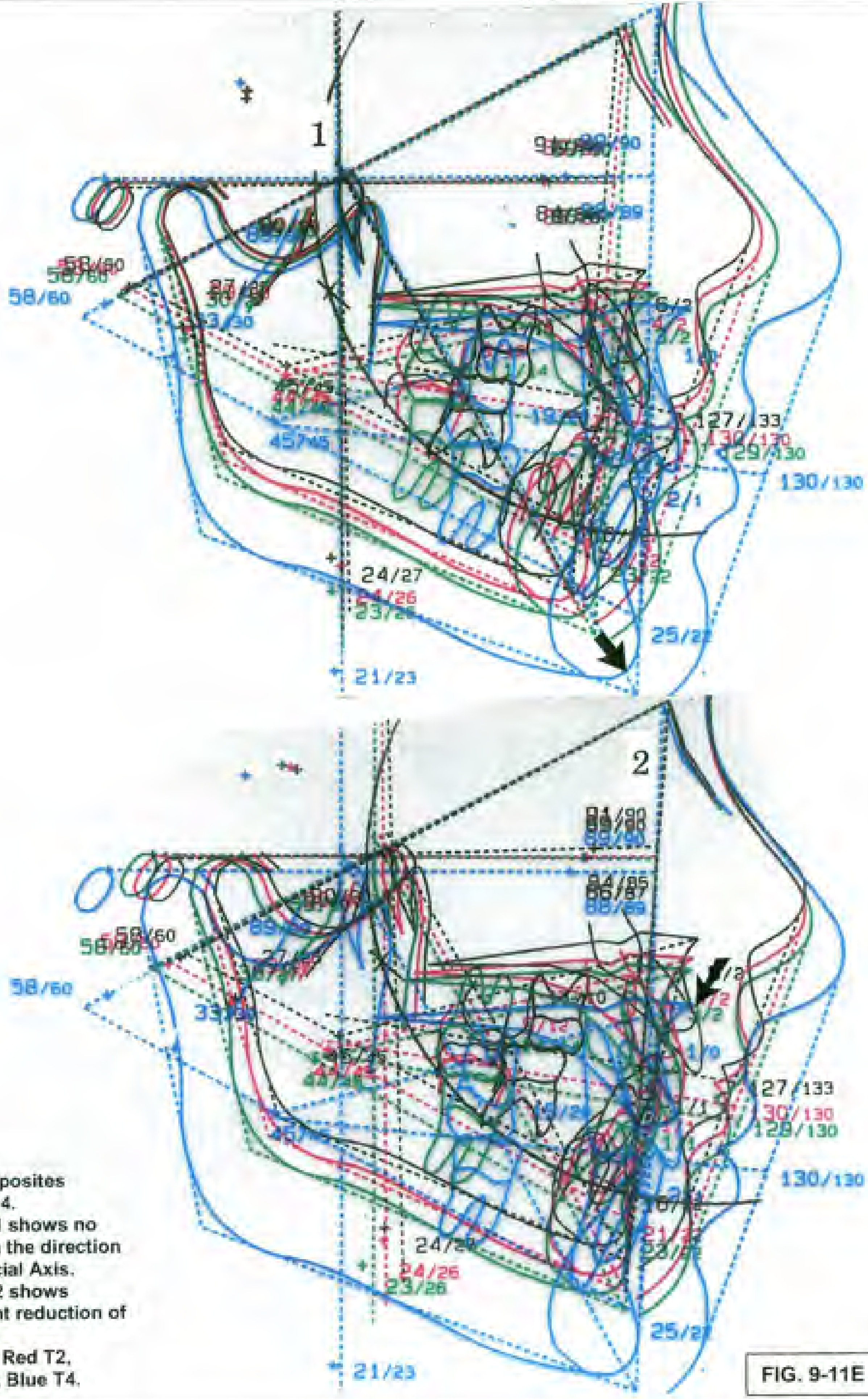


FACIAL PATTERN: MILD BRACHYFACIAL

# FACTORS	MEASURED VALUE	NORM	CLINICAL DEVIATION
Interincisal Angle	129.6 dg	130.0 dg	-0.1
Convexity	1.5 mm	0.1 mm	0.7
Lower Facial Height	44.6 dg	45.0 dg	-0.1
A6 Molar Position to PTV	18.7 mm	20.4 mm	-0.6
B1 to A-Po Plane	1.7 mm	1.0 mm	0.3
B1 Inclination to A-Po	25.4 dg	22.0 dg	0.8
Facial Depth	87.7 dg	89.4 dg	-0.5
Facial Axis	89.4 dg	90.0 dg	-0.2
Maxillary Depth	89.0 dg	90.0 dg	-0.3
Mandibular Plane to FH	20.9 dg	23.5 dg	-0.6
[illegible]lar Arc	33.0 dg	[illegible]	[illegible]

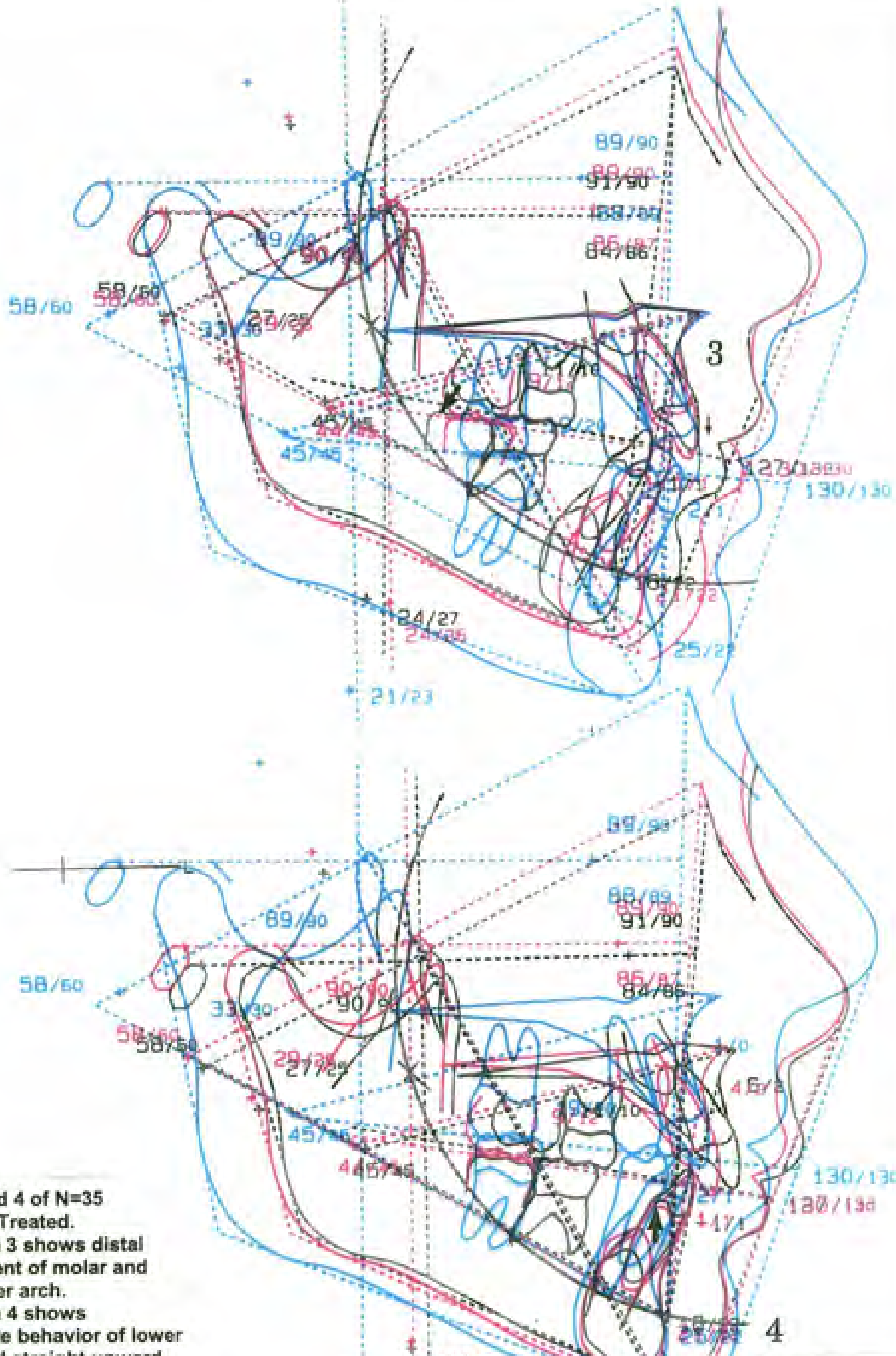
Composite of Retention Films of N=35 Class II. Sample mean age 17.5.

FIG. 9-11D



Four composites
Time 1 to 4.
Position 1 shows no change in the direction of the Facial Axis.
Position 2 shows permanent reduction of Point A.
Black T1, Red T2, Green T3, Blue T4.

FIG. 9-11E



T1, 2 and 4 of N=35
Class II Treated.
Position 3 shows distal movement of molar and the upper arch.
Position 4 shows favorable behavior of lower arch and straight upward eruption of first molar.

FIG. 9-11F

2. **Sample # 2 – Total Open Bite (N=19 8/11)**

These patients were started earlier (6.9 years) than the deep bites (7.7 years). It would be speculated that the reason was the unsightly nature of open bite which was more urgent in the parents' mind. The convexity was high at 7.0 mm. **(Fig. 9-12)**. Of the 19 patients, 8 were started in the deciduous dentition. These were at age 5.9 years whilst the mixed dentition children were started at age 7.7 years (in this sample).

The upper first molar was anterior compared to the position in the normal controls. The palate was tipped upward anteriorly about 5 degrees. Initial phase treatment moved the molar to a distal position relative to the controls. By age 17.1 years, the facial pattern as a mean, was essentially ideal and the denture was remarkably stable.

The composites were retraced and the T2 and T4 were colored to exhibit a Four Position Analysis. The mandible opened up a tracing error mostly due to two patients with dolichofacial natural growth patterns. The change in the palatal plane and point A went from a 7 mm. to a 2 mm. convexity as exhibited.

Sample # 3 – Total Deep Bite (N=16 9/7) (Fig. 9-13)

Of the sixteen (16) children, only four (4) were started in the deciduous dentition. One deciduous patient and one mixed had buccal cross-bite (Brodie Syndrome) which was a double factor for the production of mandibular rotation which did not occur in either patient.

The time of first phase took 1.6 years compared to the open bite treatment of 1.5 years. The Time 2 at age 9.3 years shows that the intrusion of the lower incisor was not addressed soon enough. After these early cases were

RMO™

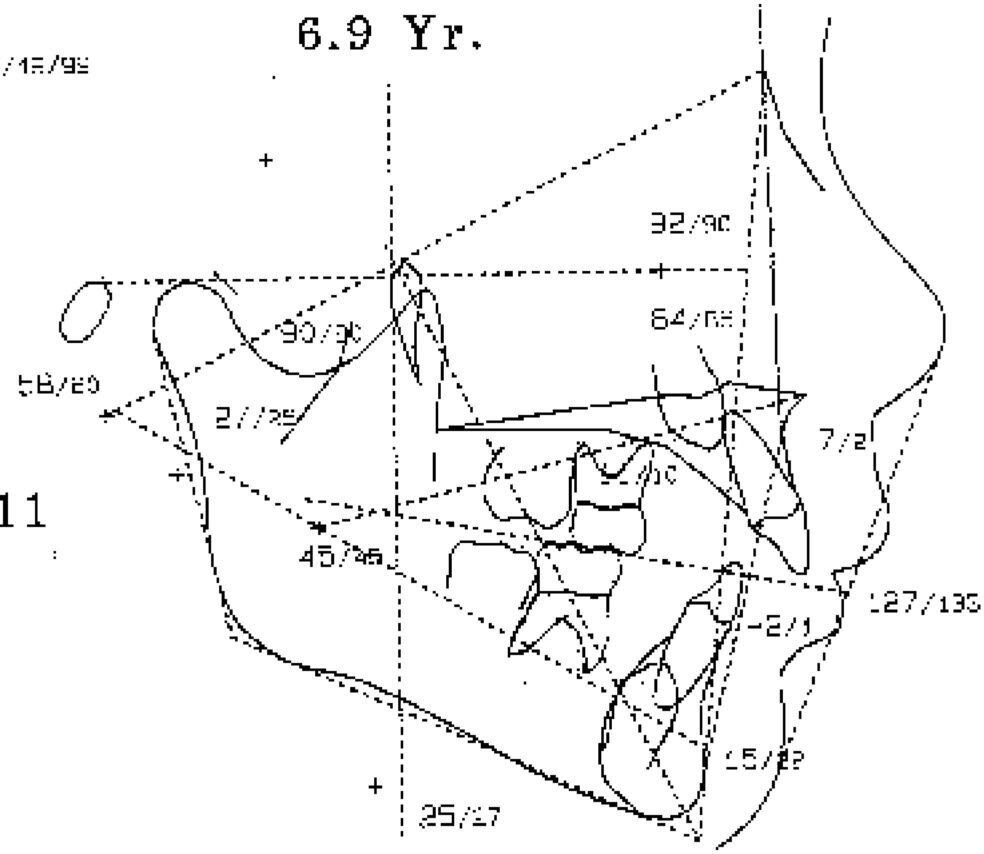
ETOPEN1
RICKETTS
M (DA) Caucasian
AGE: 6.9
X: 03/10/98 - R: 02/15/99

TRACING
BEFORE TREATMENT

6.9 Yr.

T1

8/11



MEASURED VALUE/NORM

SIGNIFICANT CONSIDERATIONS

CONDITION	REASON
Severe Class II malocclusion	due to upper & lower molar
Severe Overjet	
Severe Skeletal Class II	due to the mandible & maxilla
Open Bite	
Adenoid blockage of the airway?	Probably not

FACIAL PATTERN: MESOFACIAL

# FACTORS	MEASURED VALUE	NORM	CLINICAL DEVIATION	
Interincisal Angle	126.5 dg	[illegible] dg	-1.1	*
Convexity	5.5 mm	2.[illegible] mm	[illegible]	**
Lower Facial Height	45.0 dg	[illegible] dg	0.0	
A6 Molar Position to PTV	10.6 mm	[illegible] mm	0.[illegible]	
B1 to A-Po Plane	-1.5 mm	[illegible].5 mm	-1.[illegible]	*
B1 Inclination to A-Po	15.5 dg	22.0 dg	[illegible]	*
Facial Depth	84.[illegible] dg	85.9 dg	-0.6	
Facial Axis	90.2 dg	90.0 dg	[illegible]	
Maxillary Depth	91.6 dg	90.0 dg	0.5	
Mandibular Plane to FH	24.[illegible] dg	25.5 dg	-0.[illegible]	
Mandibular Arc	26.5 dg	26.1 dg	[illegible]	

T1 of all open bites (deciduous and mixed). Mean starting age 6.9 years.
N=19 8 males 11 females.

FIG. 9-12A

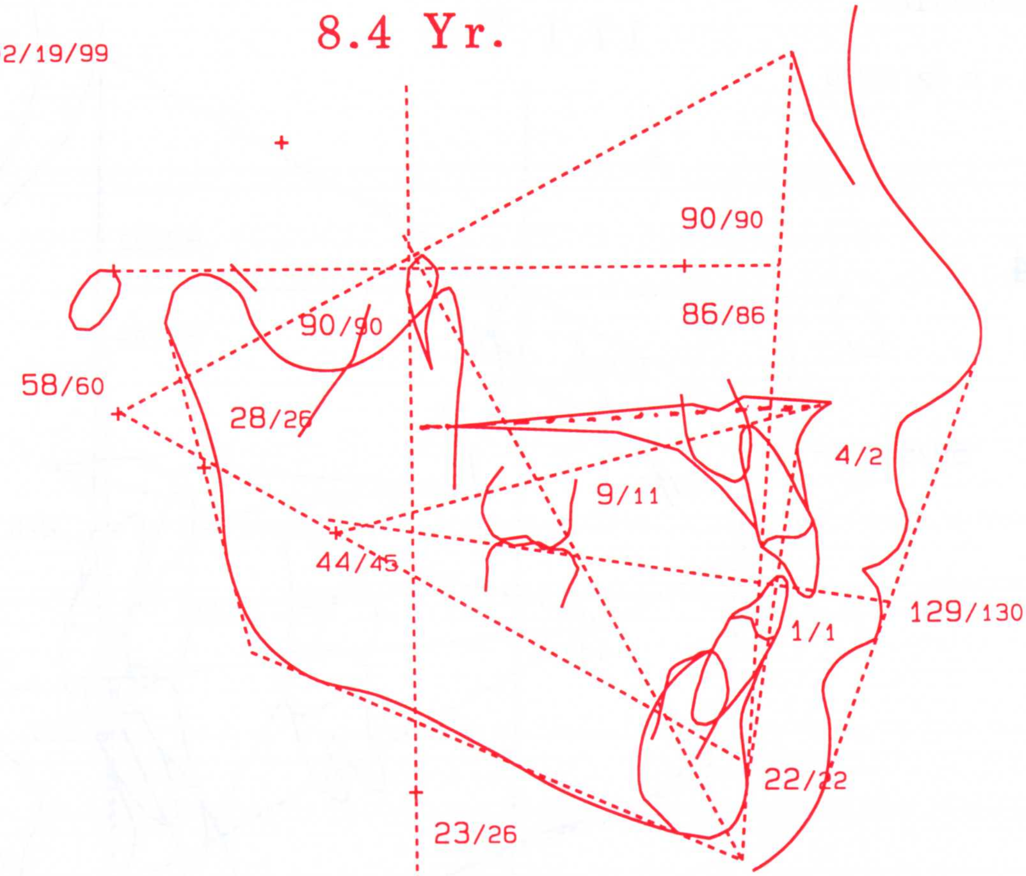
ETOPEN2
RICKETTS
M (CA) Caucasian
AGE: 8.4
X: 12/10/98 - R: 02/19/99

TRACING

RMO™

8.4 Yr.

T2



FACIAL PATTERN: MESOFACIAL

# FACTORS	MEASURED VALUE		NORM		CLINICAL DEVIATION
Interincisal Angle	129.2	dg	130.0	dg	-0.1
Convexity	3.8	mm	2.4	mm	0.7
Lower Facial Height	44.3	dg	45.0	dg	-0.2
A6 Molar Position to PTV	8.6	mm	11.4	mm	-0.9
B1 to A-Po Plane	0.8	mm	1.0	mm	-0.1
B1 Inclination to A-Po	22.0	dg	22.0	dg	0.0
Facial Depth	85.6	dg	86.4	dg	-0.2
Facial Axis	90.0	dg	90.0	dg	0.0
Maxillary Depth	89.8	dg	90.0	dg	-0.1
Mandibular Plane to FH	23.4	dg	26.2	dg	-0.6
Mandibular Arc	28.3	dg	25.9	dg	0.6

T2 of treated open bite Class II with cervical face-bow, age 8.4.

FIG. 9-12B

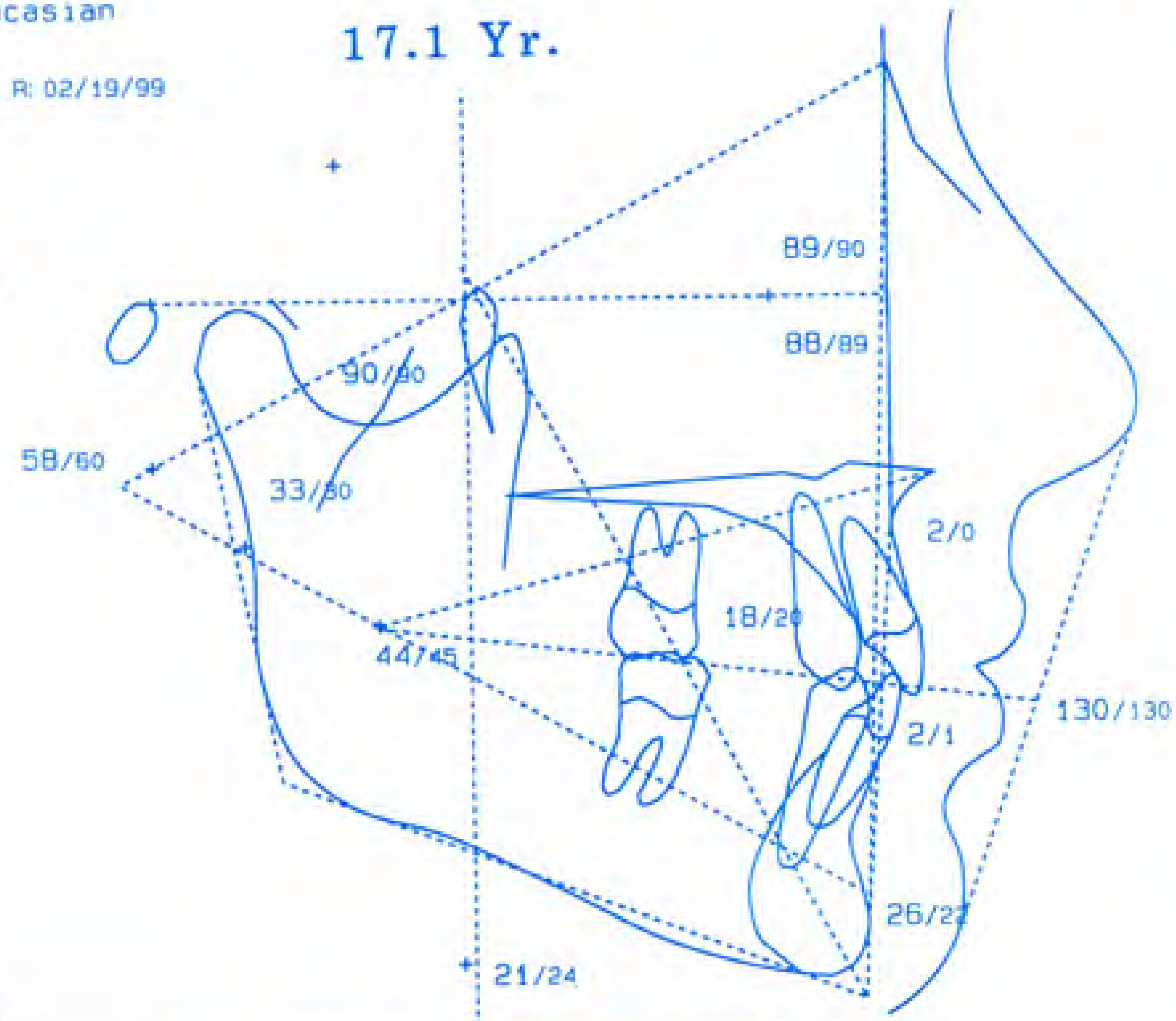
ETOPEN4
RICKETTS
M (CA) Caucasian
AGE: 17.1
X: 12/10/98 - R: 02/19/99

TRACING

RMO™

17.1 Yr.

T4

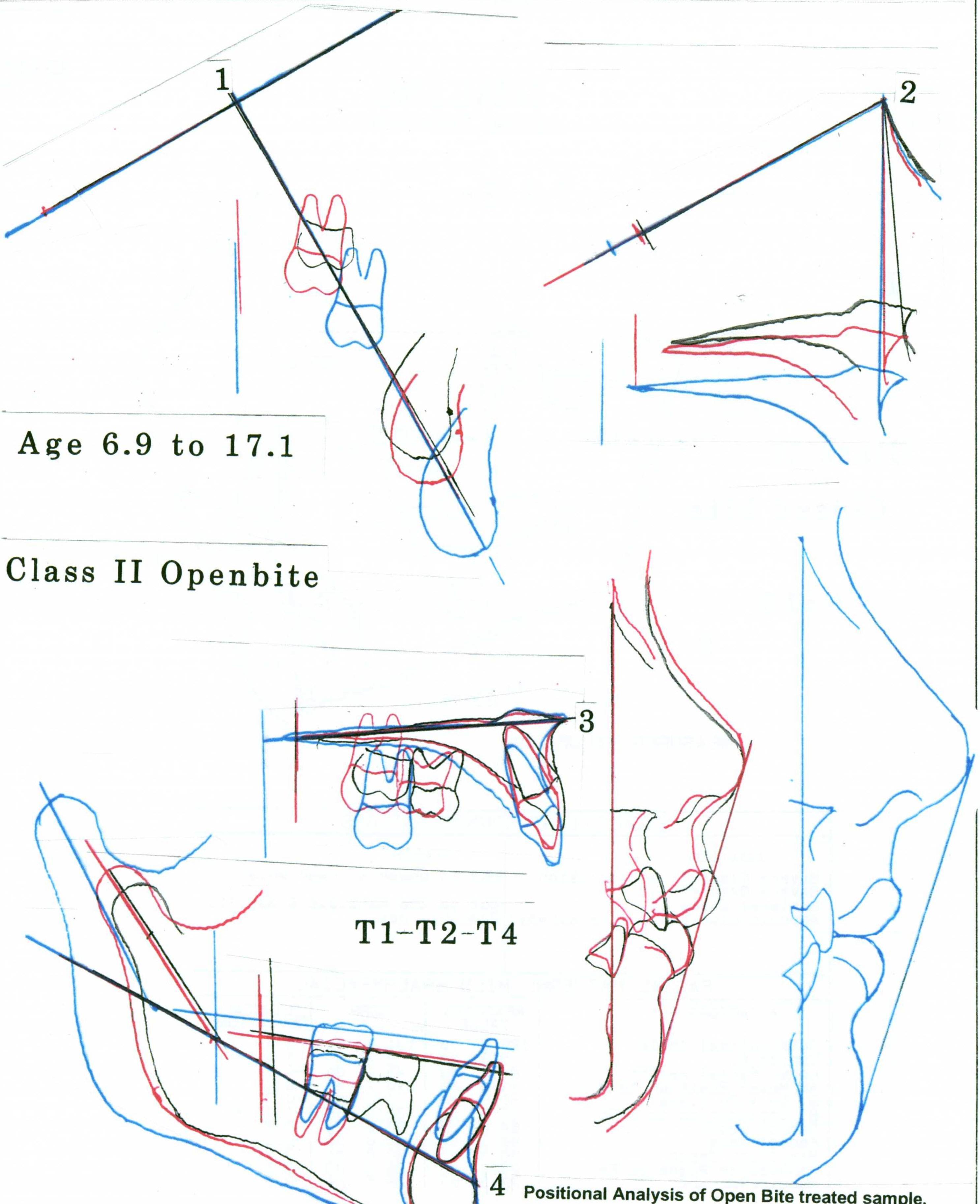


FACIAL PATTERN: MILD BRACHYFACIAL

# FACTORS	MEASURED VALUE	NORM	CLINICAL DEVIATION
Interincisal Angle	129.7 dg	130.0 dg	0.0
Convexity	1.8 mm	0.1 mm	0.8
Lower Facial Height	44.1 dg	45.0 dg	-0.2
A6 Molar Position to PTV	18.2 mm	20.1 mm	-0.6
B1 to A-Po Plane	1.8 mm	1.0 mm	0.3
B1 Inclination to A-Po	25.7 dg	22.0 dg	0.9
Facial Depth	87.8 dg	89.3 dg	-0.5
Facial Axis	89.8 dg	90.0 dg	0.0
Maxillary Depth	89.4 dg	90.0 dg	-0.2
Mandibular Plane to FH	21.1 dg	23.6 dg	-0.5
Mandibular Arc	32.8 dg	30.2 dg	0.6

T4 Age 17.1 after retention of opener bite.

FIG. 9-12C



Positional Analysis of Open Bite treated sample.
Black T1, First phase Red T2, Blue T4 after retention.

FIG. 9-12D

RMO™

ETDEEP1
RICKETTS
M (CA) Caucasian
AGE: 7.7
B: 12/10/90 T: 06/19/99

TRACING

BEFORE TREATMENT

7.7 Yr.

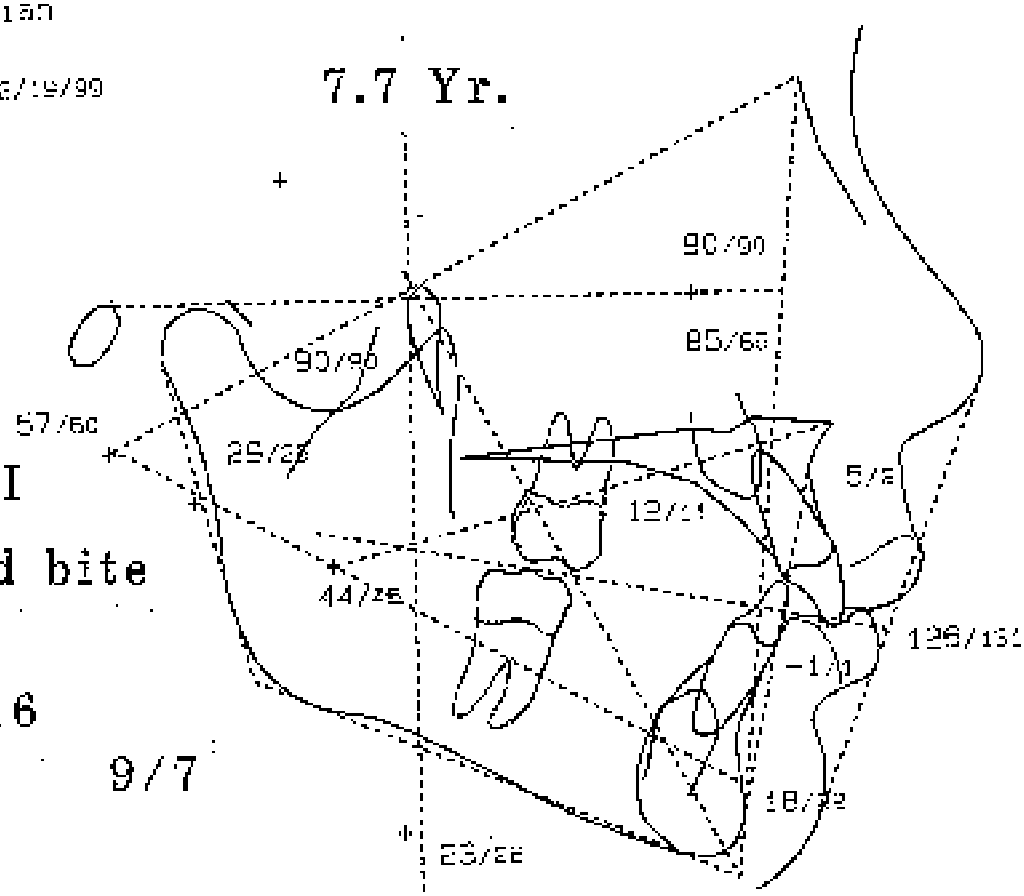
T1

Class II

Closed bite

N=16

9/7



MEASURED VALUE/NORM

SIGNIFICANT CONSIDERATIONS

CONDITION	REASON
Severe Class II malocclusion	due to upper & lower molar
Severe Overjet	
Skeletal Class II	due to the mandible & maxilla
Adenoid blockage of the airway?	Probably not

FACIAL PATTERN: MILD BRACHYFACIAL

A FACTORS	MEASURED VALUE		NORM		CLINICAL DEVIATION	
Interincisal Angle	125.3	dg	131.0	dg	-0.9	
Convexity	5.2	mm	2.4	mm	1.4	*
Lower Facial Height	44.2	dg	45.0	dg	-0.2	
A6 Molar Position to PTV	11.8	mm	10.7	mm	0.4	
B1 to A-Po Plane	0.3	mm	1.0	mm	-0.7	
B1 Inclination to A-Po	17.8	dg	22.0	dg	-1.0	x
Facial Depth	84.6	dg	86.2	dg	-0.5	
Facial Axis	90.3	dg	90.0	dg	0.1	
Maxillary Depth	90.3	dg	90.0	dg	0.1	
Mandibular Plane to FH	23.6	dg	26.4	dg	-0.7	
Mandibular Arc	29.7	dg	26.5	dg	0.8	

T1 All Closed Bite. N=16 Age 7.7 years, 9 males 7 females.

FIG. 9-13A

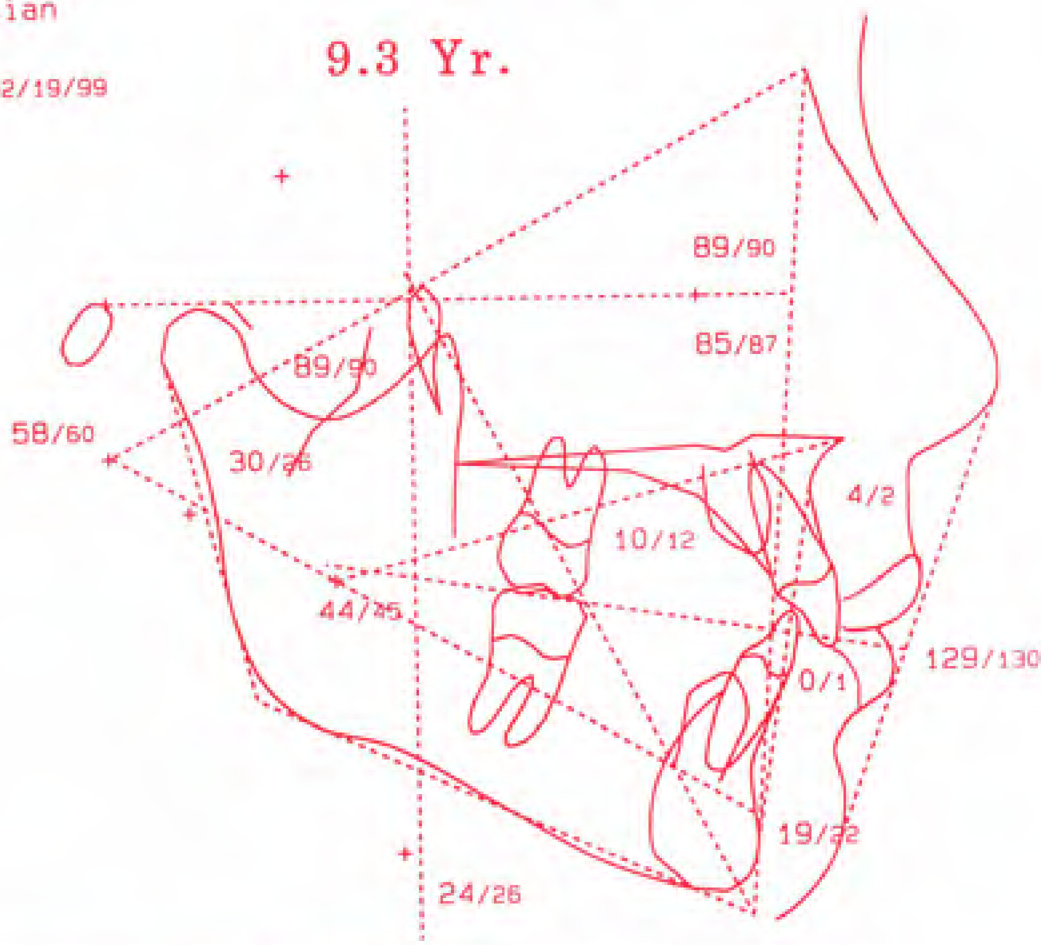
RMO™

ETDEEP2
RICKETTS
M (CA) Caucasian
AGE: 9.3
X: 12/10/98 - R: 02/19/99

TRACING

9.3 Yr.

T2



FACIAL PATTERN: MESOFACIAL

# FACTORS	MEASURED VALUE		NORM		CLINICAL DEVIATION
Interincisal Angle	129.5	dg	130.0	dg	-0.1
Convexity	3.8	mm	2.3	mm	0.7
Lower Facial Height	44.4	dg	45.0	dg	-0.2
A6 Molar Position to PTV	10.5	mm	12.3	mm	-0.6
B1 to A-Po Plane	0.3	mm	1.0	mm	-0.3
B1 Inclination to A-Po	19.2	dg	22.0	dg	-0.7
Facial Depth	85.4	dg	86.7	dg	-0.4
Facial Axis	89.3	dg	90.0	dg	-0.2
Maxillary Depth	89.4	dg	90.0	dg	-0.2
Mandibular Plane to FH	24.0	dg	25.9	dg	-0.4
Mandibular Arc	29.7	dg	26.3	dg	0.9

T2 Treated Class II Deep Bite Age 9.3.

FIG. 9-13B

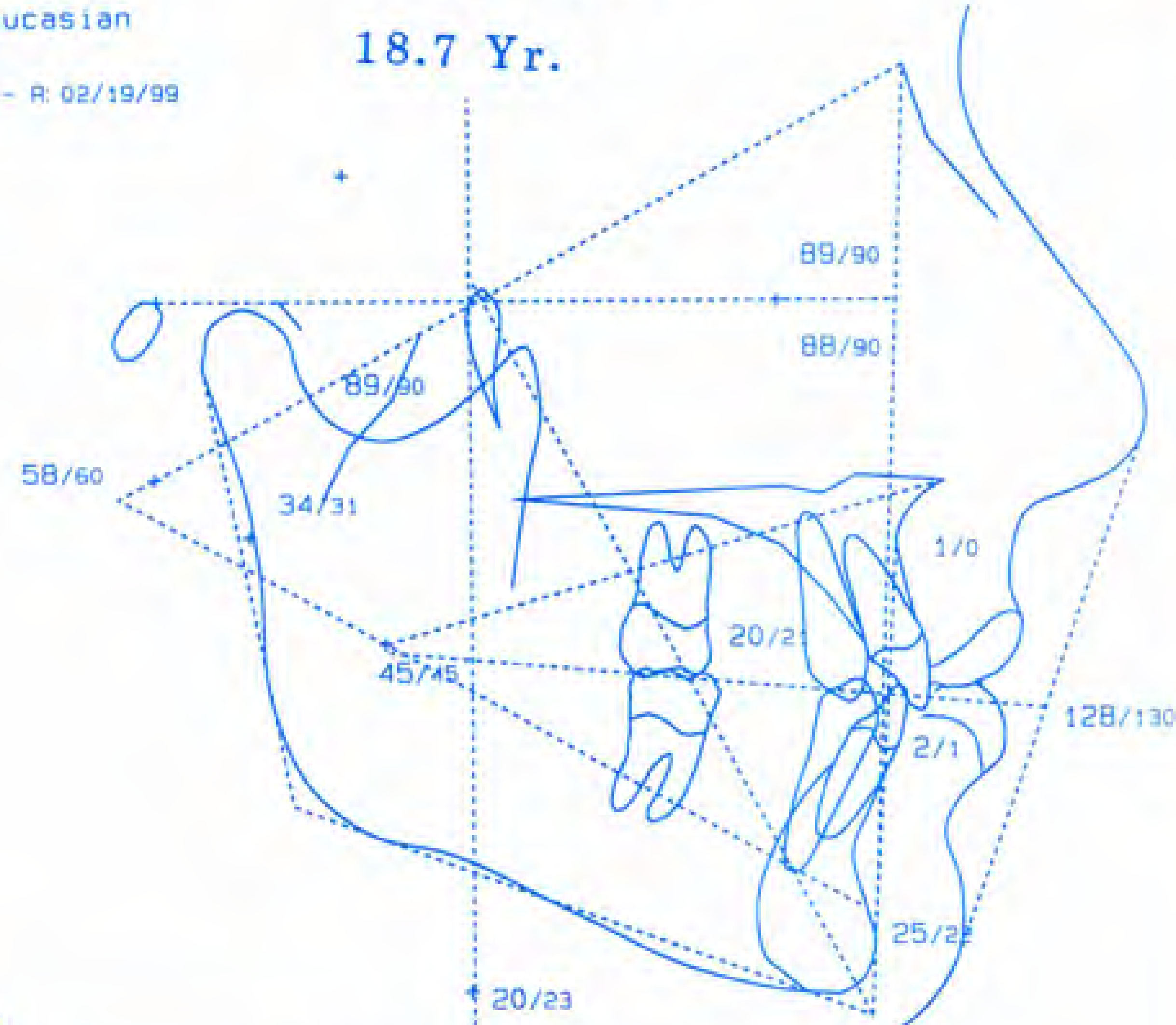
ETDEEP4
RICKETTS
M (CA) Caucasian
AGE: 18.7
X: 12/10/98 - R: 02/19/99

TRACING

RMO™

18.7 Yr.

T4

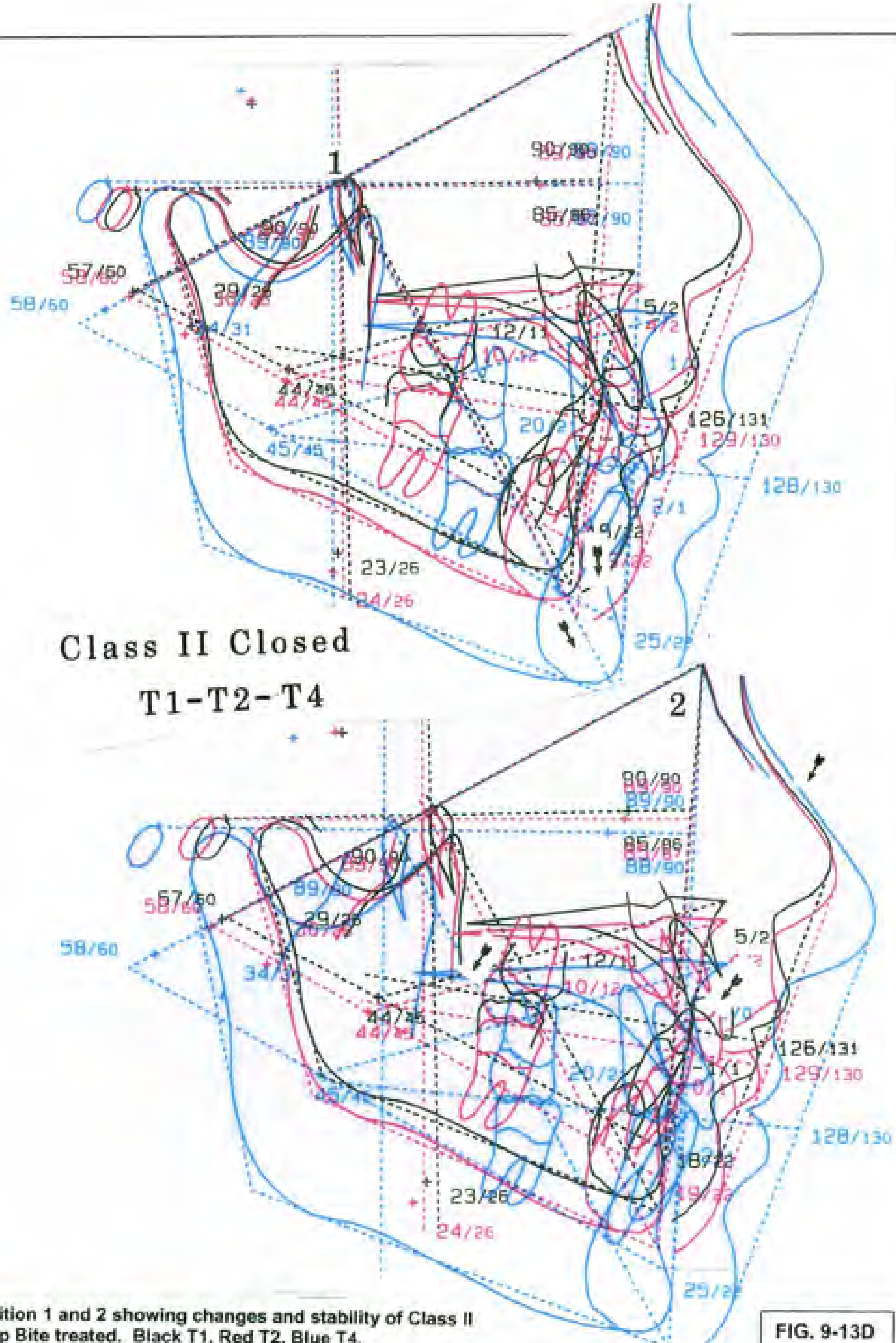


FACIAL PATTERN: MILD BRACHYFACIAL

# FACTORS	MEASURED VALUE		NORM		CLINICAL DEVIATION
Interincisal Angle	128.4	dg	130.0	dg	-0.3
Convexity	1.1	mm	0.0	mm	0.6
Lower Facial Height	45.1	dg	45.0	dg	0.0
A6 Molar Position to PTV	20.1	mm	21.0	mm	-0.3
B1 to A-Po Plane	1.9	mm	1.0	mm	0.4
B1 Inclination to A-Po	25.4	dg	22.0	dg	0.9
Facial Depth	87.7	dg	89.6	dg	-0.6
Facial Axis	89.3	dg	90.0	dg	-0.2
Maxillary Depth	88.7	dg	90.0	dg	-0.4
Mandibular Plane to FH	20.2	dg	23.3	dg	-0.7
Mandibular Arc	33.8	dg	30.7	dg	0.8

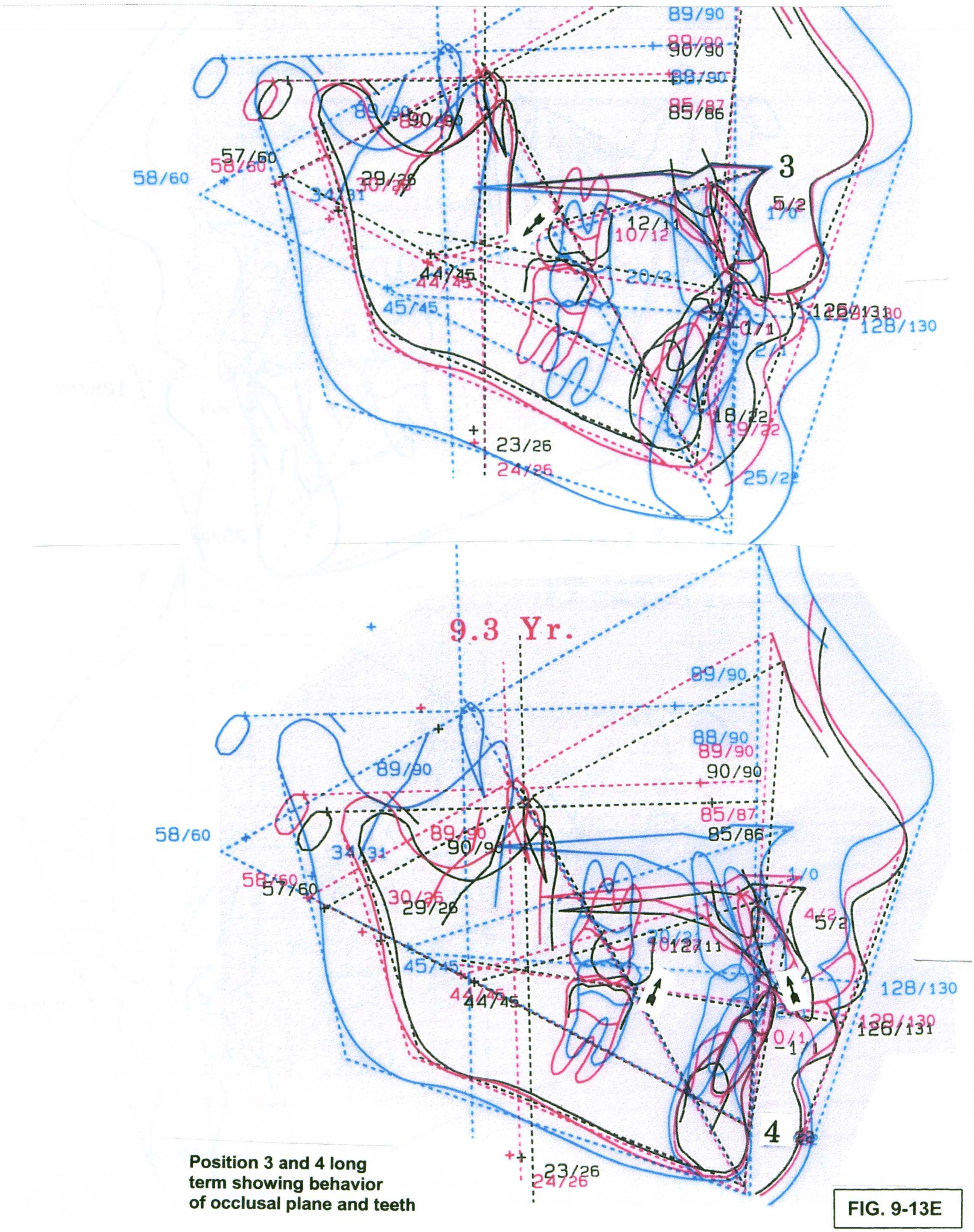
T4 of Total Deep Bites after retention age 18.7. Note 128° Interincisal angle and 1 mm. convexity.

FIG. 9-13C



Position 1 and 2 showing changes and stability of Class II Deep Bite treated. Black T1, Red T2, Blue T4.

FIG. 9-13D



Position 3 and 4 long term showing behavior of occlusal plane and teeth

FIG. 9-13E

experienced, the sequence in the treatment of deep bite at the mixed dentition was changed to the placement of a lower utility arch before attention was given to the Class II molar and horizontal arch relationship.

An analysis from the PTV revealed the upper molar in T1 to be forward of the control by one mm. Its position at T2 was two mm. posterior to the control. This meant a differential shift of three mm. This was similar to the open bite correction at the molar.

In this sample, as in the previous two, the **condyle (glenoid fossa) tended not to move posteriorly** (from PTV or Pt Point) during the treatment experience.

Even with the buccal cross-bite Class II, the Facial Axis remained steady. It remained stable at the T4 status. The deep bite treatment was finished in a phase two as shown. An excellent convexity reduction was obtained.

4. Sample # 4 – Total Deciduous (N=12) (Fig. 9-14)

Four children exhibited closed bite in this sample and eight were flat or open bite. Four were males and four were females. The patients were started at age 5.7 years with a moderately high convexity and an upward tipped palate. All but two were treated exclusively in the upper arch with second molars banded. The face bow was worn during the sleeping hours. The time between T1 and T2 was 1.7 years or about 19 months. The common time for correction was about 10 to 12 months with a holding action for the same amount of time.

The remarkable feature of this sample is that several received no further treatment except for minor details. The deep bite patients were treated in the mixed dentition because deciduous incisors were being shed during the first phase.

ETDEC1
RICKETTS
M (CA) Caucasian
AGE: 5.7
x: 12/10/98 - R: 02/19/99

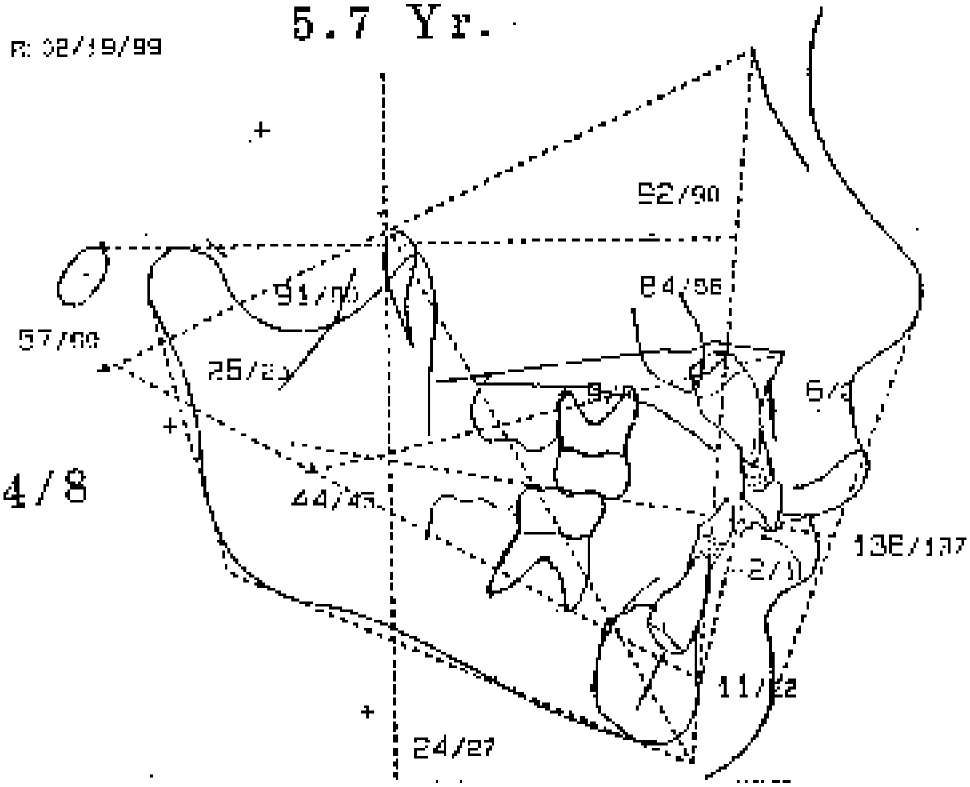
RMO™

TRACING

BEFORE TREATMENT

5.7 Yr.

T1



SIGNIFICANT CONSIDERATIONS

CONDITION	REASON
Severe Class II malocclusion	Due to upper & lower molar
Mild Overjet	
Skeletal Class II	due to the mandible & maxilla
Adenoid blockage of the airway?	Probably not

FACIAL PATTERN: MESOFACIAL

# FACTORS	MEASURED VALUE		NORM		CLINICAL DEVIATION	
Interincisal Angle	138.2	dg	137.0	dg	0.2	
Convexity	5.1	mm	2.2	mm	1.9	*
Lower Facial Height	44.1	dg	45.0	dg	-0.2	
A6 Molar Position to PTV	9.2	mm	9.7	mm	0.2	
B1 to A-Po Plane	-2.1	mm	1.0	mm	-1.3	*
B1 Inclination to A-Po	11.4	dg	22.0	dg	-2.5	**
Facial Depth	84.3	dg	85.5	dg	-0.4	
Facial Axis	91.3	dg	90.0	dg	0.3	
Maxillary Depth	92.0	dg	[illegible]	dg	0.7	
Mandibular Plane to FH	24.3	dg	[illegible]	dg	-0.6	
Mandibular Arc	25.5	dg	[illegible]	dg	0.2	

T1 of N=12. All deciduous Class II treated with cervical traction (4 had deep bite) started age 5.7 years

FIG. 9-14A

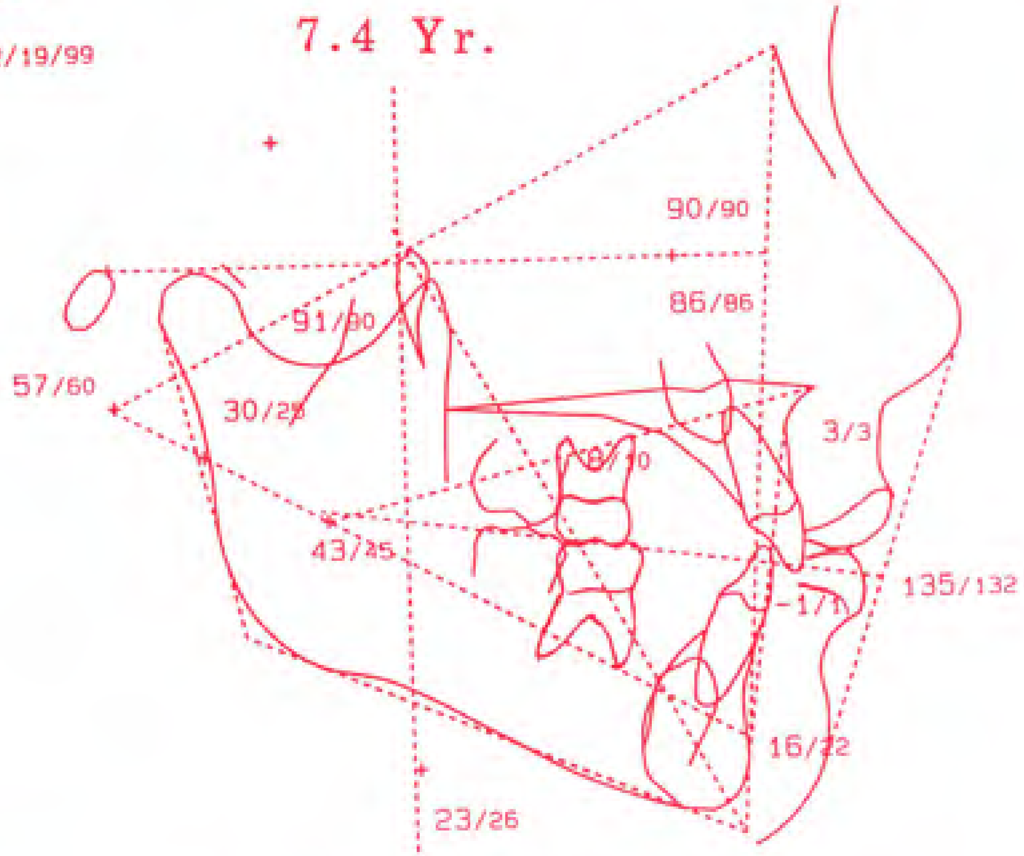
RMO™

ETDEC2
RICKETTS
M (CA) Caucasian
AGE: 7.4
X: 12/10/98 - R: 02/19/99

TRACING

7.4 Yr.

T2



FACIAL PATTERN: MILD BRACHYFACIAL

# FACTORS	MEASURED VALUE		NORM		CLINICAL DEVIATION	
Interincisal Angle	135.2	dg	131.8	dg	0.6	
Convexity	3.3	mm	2.7	mm	0.3	
Lower Facial Height	43.1	dg	45.0	dg	-0.5	
A6 Molar Position to PTV	7.9	mm	10.4	mm	-0.8	
B1 to A-Po Plane	-0.8	mm	1.0	mm	-0.8	
B1 Inclination to A-Po	15.6	dg	22.0	dg	-1.6	*
Facial Depth	86.1	dg	86.1	dg	0.0	
Facial Axis	90.6	dg	90.0	dg	0.2	
Maxillary Depth	89.9	dg	90.0	dg	0.0	
Mandibular Plane to FH	23.0	dg	26.5	dg	-0.8	
Mandibular Arc	29.6	dg	25.4	dg	1.1	*

Deciduous treated at age 7.4. Cervical face-bow on the second deciduous molars only.

FIG. 9-14B

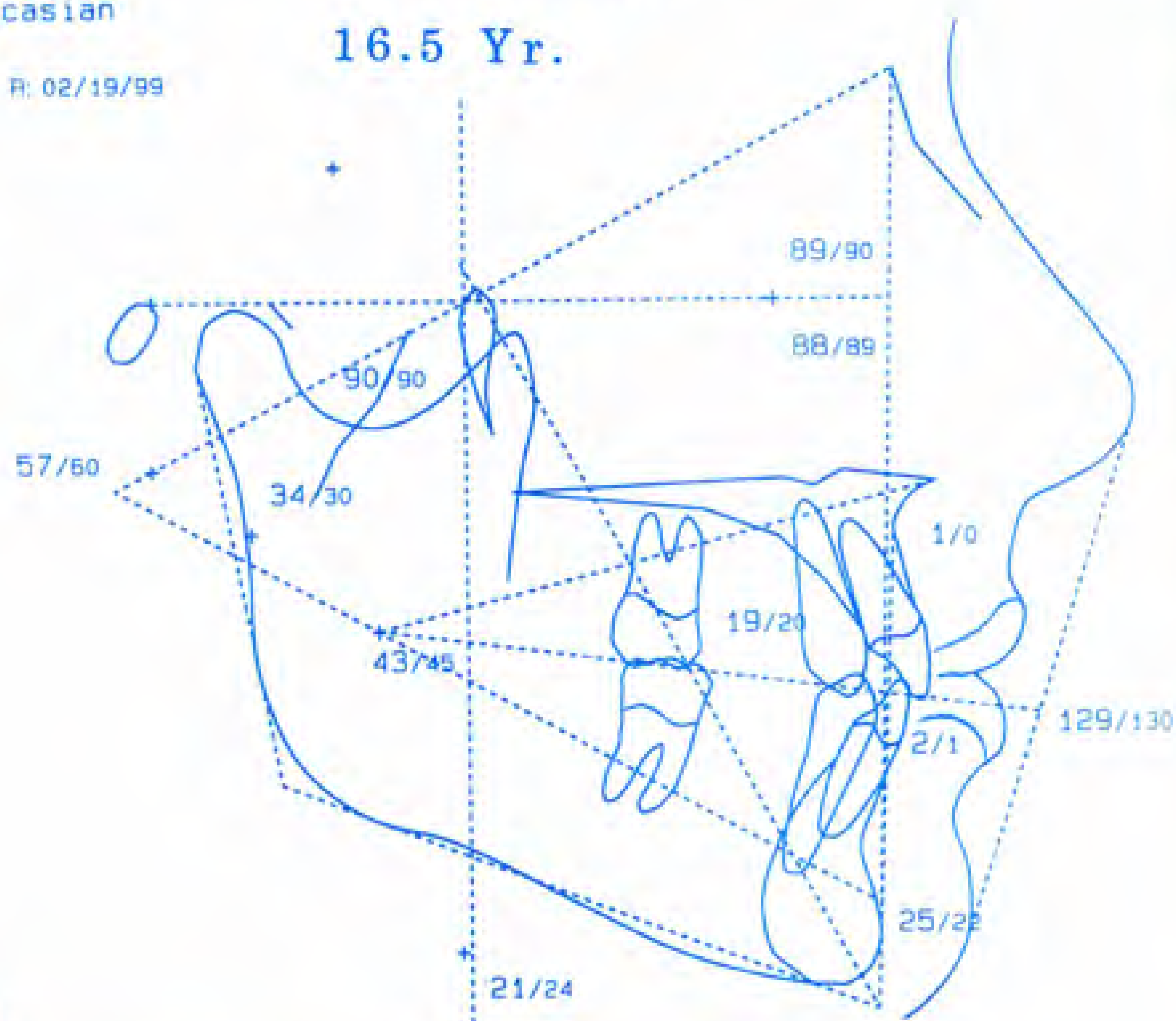
ETDEC4
RICKETTS
M (CA) Caucasian
AGE: 16.5
X: 12/10/98 - R: 02/19/99

TRACING

RMO

16.5 Yr.

T4

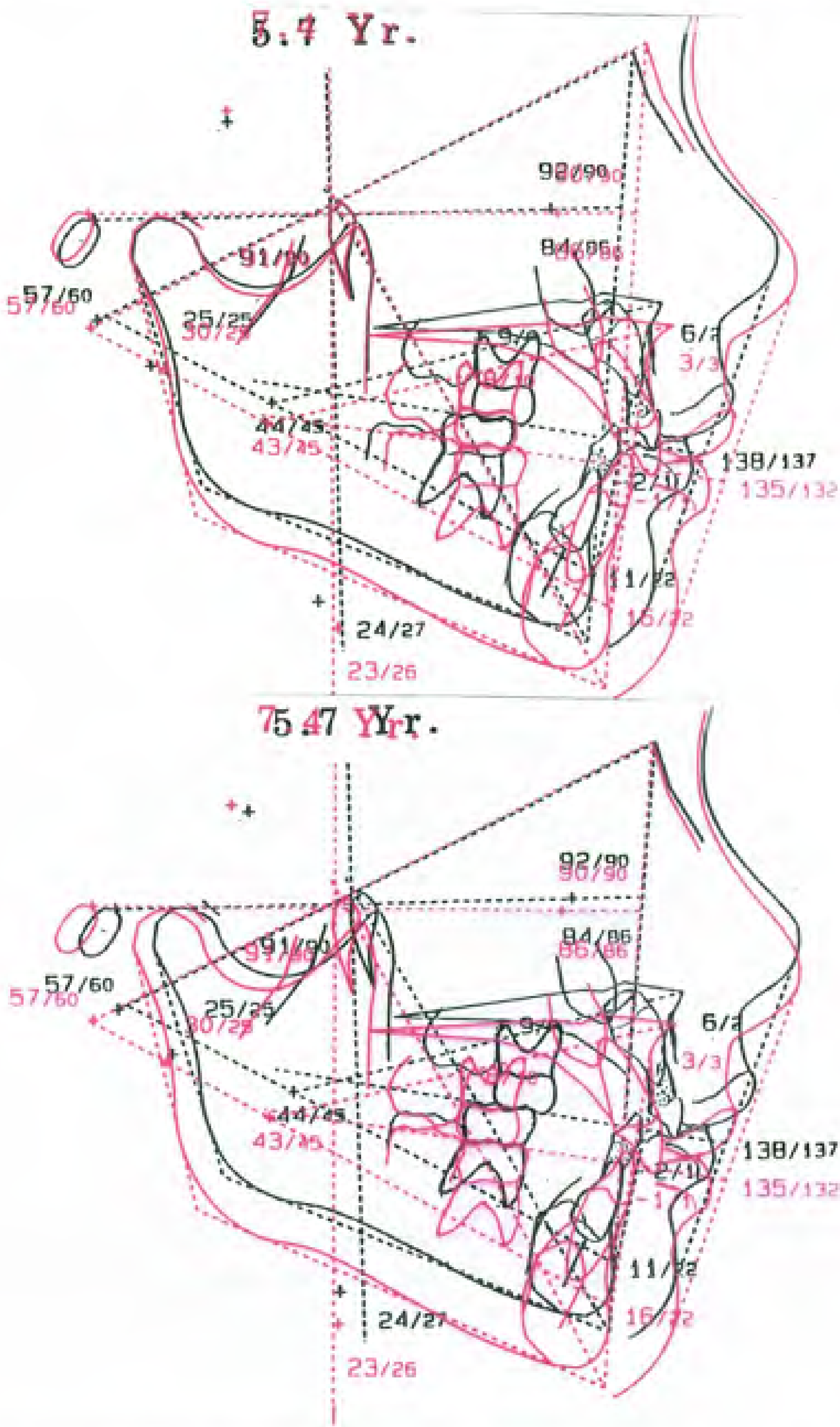


FACIAL PATTERN: MILD BRACHYFACIAL

# FACTORS	MEASURED VALUE		NORM		CLINICAL DEVIATION
Interincisal Angle	128.9	dg	130.0	dg	-0.2
Convexity	0.9	mm	0.2	mm	0.3
Lower Facial Height	43.4	dg	45.0	dg	-0.4
A6 Molar Position to PTV	18.7	mm	19.5	mm	-0.3
B1 to A-Po Plane	2.0	mm	1.0	mm	0.4
B1 Inclination to A-Po	25.5	dg	22.0	dg	0.9
Facial Depth	88.4	dg	89.1	dg	-0.2
Facial Axis	90.5	dg	90.0	dg	0.1
Maxillary Depth	89.3	dg	90.0	dg	-0.2
Mandibular Plane to FH	21.2	dg	23.7	dg	-0.6
Mandibular Arc	33.5	dg	29.9	dg	0.9

T4 Treated deciduous at age 16.5 years. Note the beauty and stability

FIG. 9-14C



Comparison of T1 and T2 of Deciduous treatment Position 1 and 2. Note relative stability of the Facial Axis. Note cross-over of nose and maxillary orthopedics.

FIG. 9-14D

The esthetic improvement in the first phase was quite rewarding. The stability and lovely face at age 16.5 was quite satisfying.

5. Sample # 5 – The Total Mixed Dentition Class II Composite (Fig. 9-15)

The interesting feature of this 7.9 year old sample was the continued developing convexity pattern and severity of the upper incisor protrusion. Leaving children in such a condition would increase the likelihood of fractured upper incisors. The sample consisted of 13 males and 10 females.

A reduction was made with the face bow and two first permanent molar bands by age 9.4 years. A change in arch form by pressure on the upper incisors did the job. The orthopedic change was still quite dramatic as seen in the deciduous patients (see Fig. 9-14). The amount of mandibular growth however, was only 4.0 mm. in 1.7 years while in the deciduous, it was 6.0 mm. in 1.7 years. This made the child at age 5 preferable for the severe Class II high convexity problem. Larger samples are needed but this fits with data published by the author in 1960.

The final result at age 18.1, was again outstanding.

6. Sample # 6 and # 7 – Deciduous Open Bite and Mixed Open Bite compared (Fig. 9-16)

The Class II open bites were of interest particularly in view of the common practice of employing high pull off the face bow to alledgedly prevent the "wedge effect". However, **those fears are not justified** on the basis of the behavior of the mean of these two samples neither of which opened on the Facial Axis. Individuals however, opened but an equal number closed in order to produce a mean zero change.

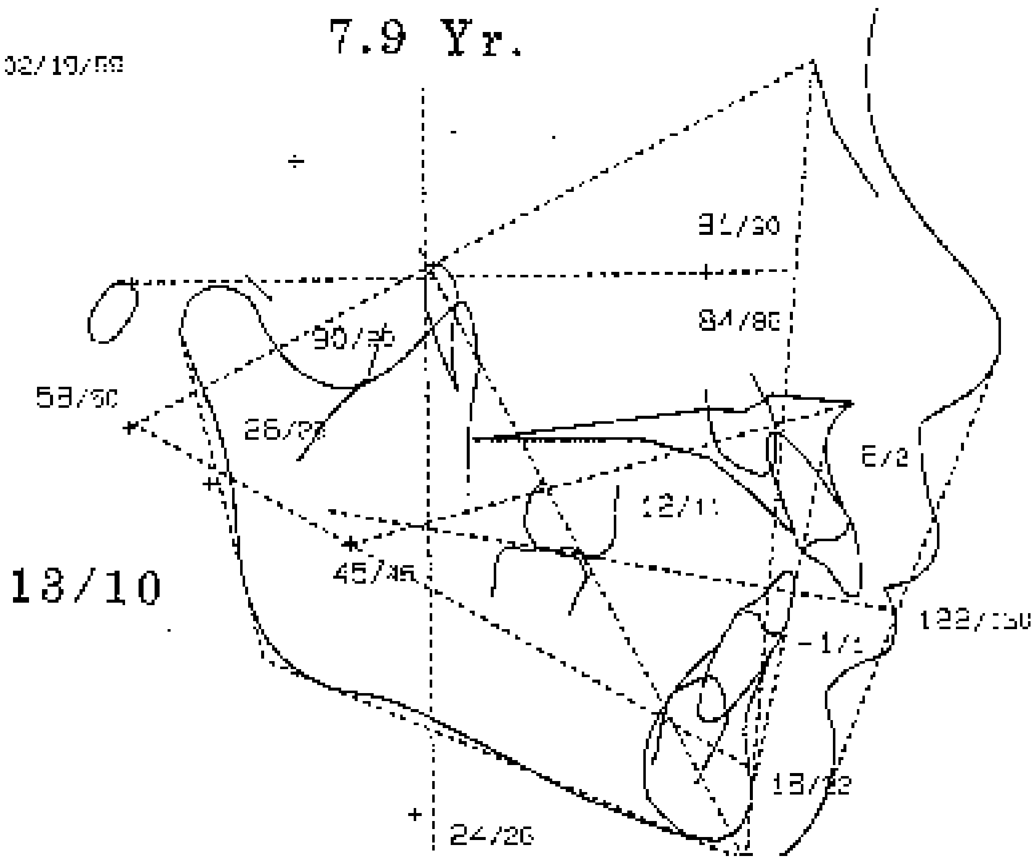
RMO[TM]

ETMIX1
RICKETTS
M (CA) Caucasian
AGE: 7.8
X: 12/10/89 - R: 02/19/89

TRACING

BEFORE TREATMENT

7.9 Yr.



SIGNIFICANT CONSIDERATIONS

CONDITION	REASON
Class II malocclusion	due to upper & lower molar
Severe Overjet	
Skeletal Class II	due to the mandible & maxilla
Adenoid blockage of the airway??	Probably not

FACIAL PATTERN: MESOFACIAL

R FACTORS	MEASURED VALUE		NORM		CLINICAL DEVIATION	
Interincisal Angle	121.8	dg	130.9	dg	-1.4	*
Convexity	5.8	mm	2.2	mm	1.8	*
Lower Facial Height	45.0	dg	45.0	dg	0.0	
A6 Molar Position to PTV	12.0	mm	10.9	mm	0.4	
B1 to A-Po Plane	-0.5	mm	1.0	mm	-0.6	
B1 Inclination to A Po	19.5	dg	22.0	dg	-0.5	
Facial Depth	84.4	dg	85.3	dg	-0.3	
Facial Axis	89.6	dg	90.0	dg	-0.1	
Maxillary Depth	90.6	dg	90.0	dg	0.2	
Mandibular Plane to F	23.6	dg	26.3	dg	-0.6	
Mandibular Arc	28.4	dg	25.6	dg	0.7	

Total mixed dentition Class II N=23 started age 7.9 years, 13 males, 10 females.

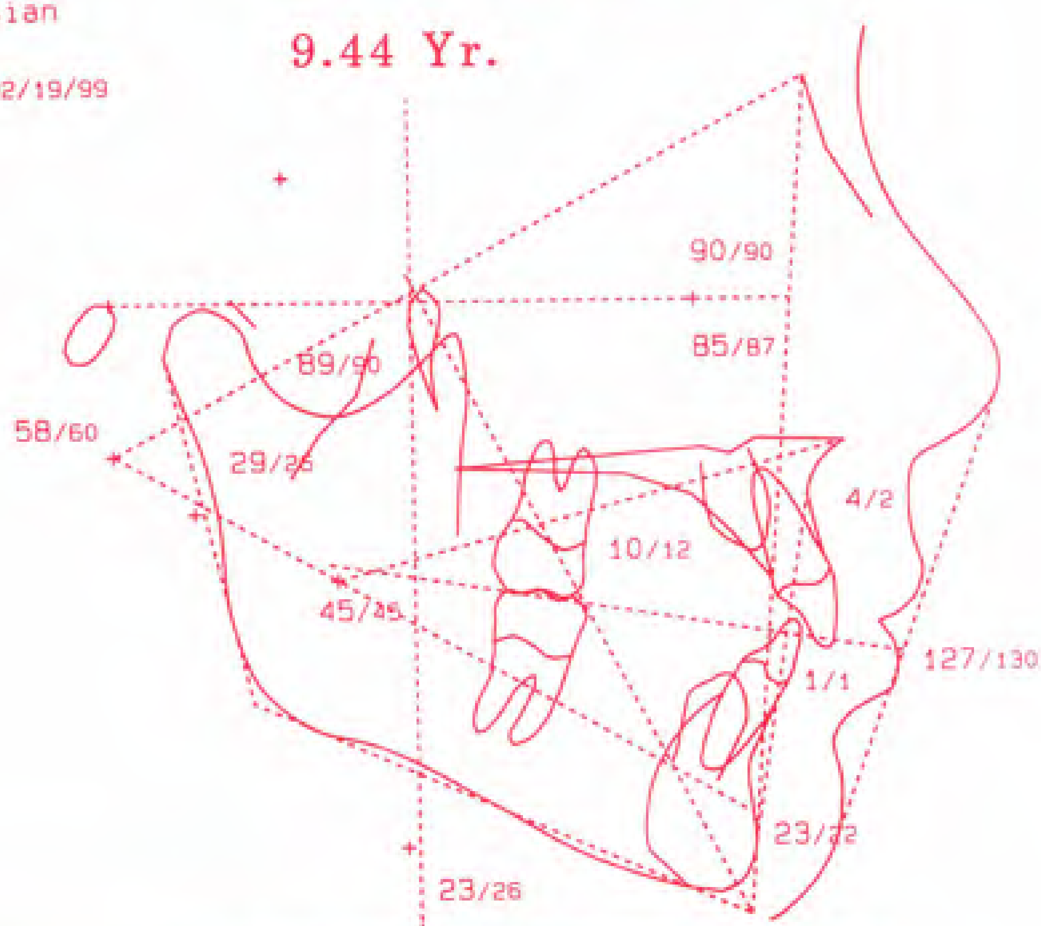
FIG. 9-15A

ETMIX2
RICKETTS
M (CA) Caucasian
AGE: 9.4
X: 12/10/98 - R: 02/19/99

TRACING

RMO™

9.44 Yr.

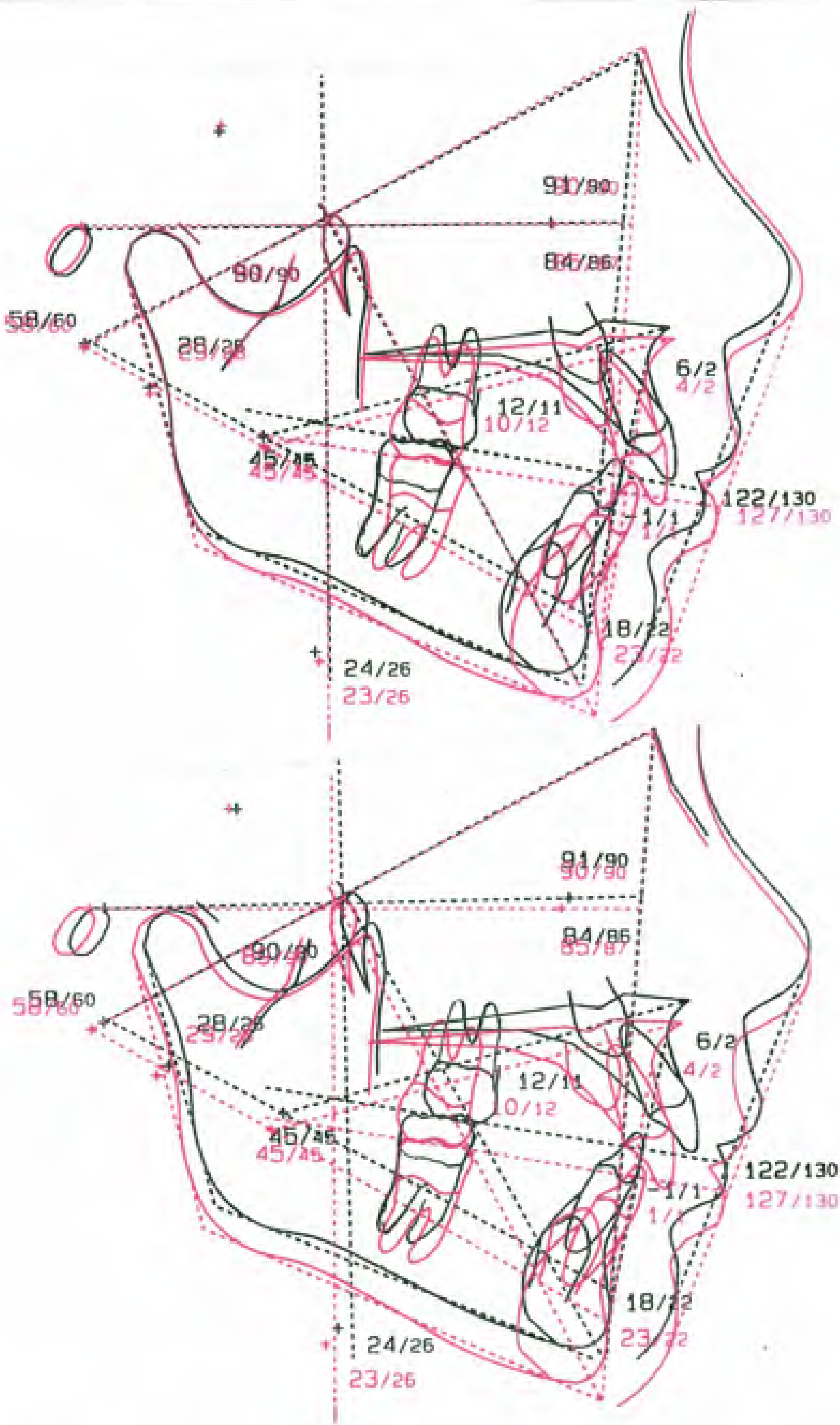


FACIAL PATTERN: MESOFACIAL

# FACTORS	MEASURED VALUE		NORM		CLINICAL DEVIATION
Interincisal Angle	127.2	dg	130.0	dg	-0.5
Convexity	3.9	mm	2.3	mm	0.8
Lower Facial Height	45.0	dg	45.0	dg	0.0
A6 Molar Position to PTV	9.9	mm	12.4	mm	-0.8
B1 to A-Po Plane	1.1	mm	1.0	mm	0.0
B1 Inclination to A-Po	22.8	dg	22.0	dg	0.2
Facial Depth	85.5	dg	86.7	dg	-0.4
Facial Axis	89.2	dg	90.0	dg	-0.2
Maxillary Depth	89.5	dg	90.0	dg	-0.2
Mandibular Plane to FH	23.5	dg	25.9	dg	-0.5
Mandibular Arc	29.0	dg	26.4	dg	0.7

Total mixed dentition group N=23 after major correction age 9.4 years.

FIG. 9-15B



Correction in Mixed cases started at age 7.9 to 9.4 – Position 1 and 2.

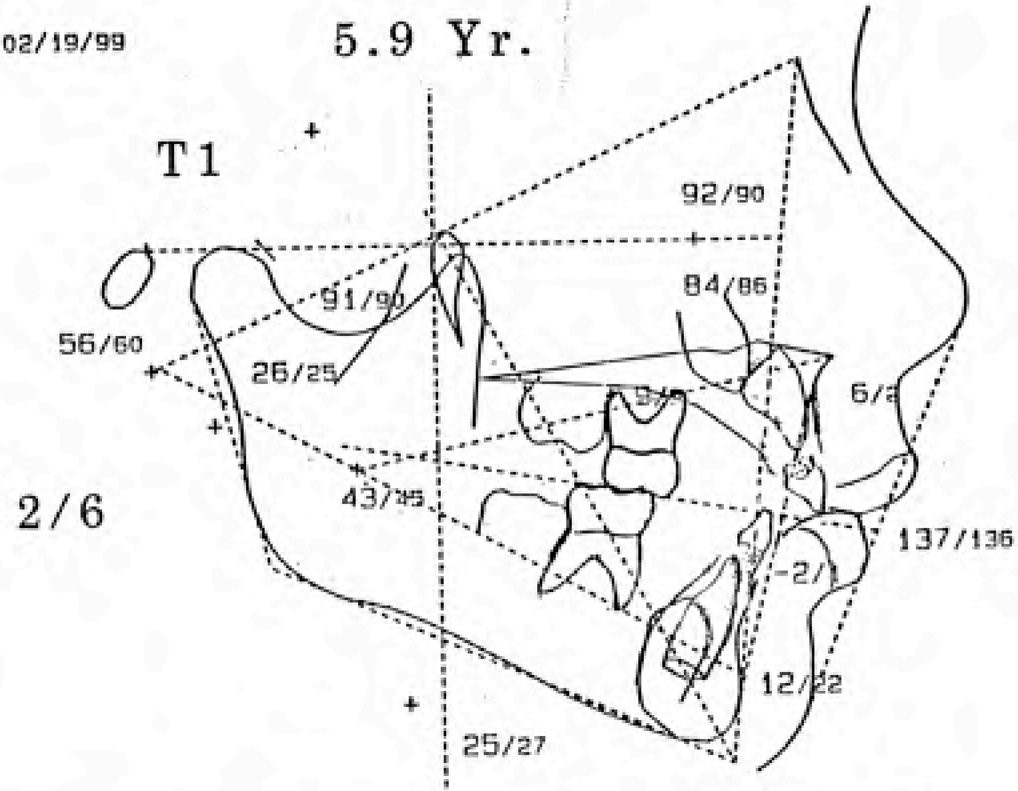
FIG. 9-15C

RMO™

ETDOPEN1
RICKETTS
M (CA) Caucasian
AGE: 5.9
X: 12/10/98 - R: 02/19/99

TRACING

BEFORE TREATMENT



SIGNIFICANT CONSIDERATIONS	
CONDITION	REASON
Severe Class II malocclusion	due to upper & lower molar
Mild Overjet	
Skeletal Class II	due to the mandible & maxilla
Adenoid blockage of the airway?	Probably not

FACIAL PATTERN: MILD BRACHYFACIAL

# FACTORS	MEASURED VALUE		NORM		CLINICAL DEVIATION	
Interincisal Angle	136.9	dg	136.3	dg	0.1	
Convexity	6.1	mm	2.4	mm	1.8	*
Lower Facial Height	43.4	dg	45.0	dg	-0.4	
A6 Molar Position to PTV	9.2	mm	8.9	mm	0.1	
B1 to A-Po Plane	-2.3	mm	1.0	mm	-1.4	*
B1 Inclination to A-Po	11.6	dg	22.0	dg	-2.6	**
Facial Depth	83.9	dg	85.6	dg	-0.6	
Facial Axis	90.9	dg	90.0	dg	0.3	
Maxillary Depth	91.6	dg	90.0	dg	0.5	
Mandibular Plane to FH	24.7	dg	26.9	dg	-0.5	
Mandibular Arc	26.2	dg	24.6	dg	0.4	

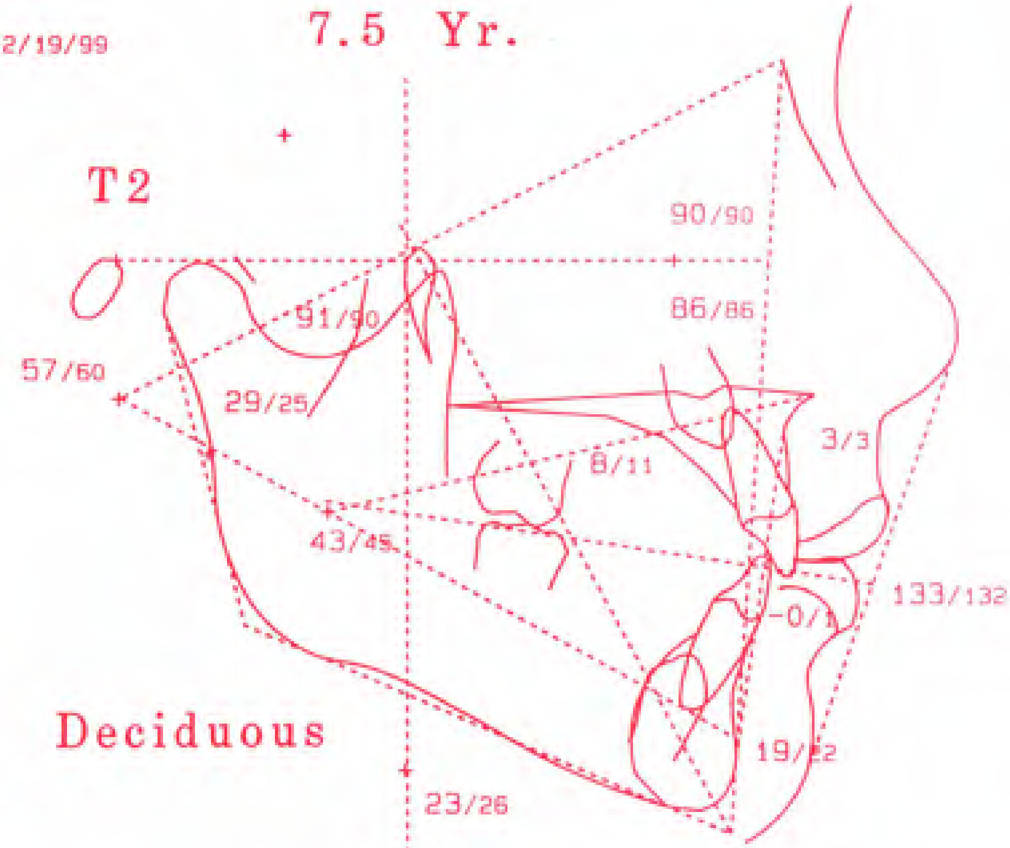
Deciduous open bite N=8, T1 age 5.9 years treated with only cervical traction on second deciduous molars.

FIG. 9-16A

ETDOPEN2
RICKETTS
M (CA) Caucasian
AGE: 7.5
X: 12/10/98 - R: 02/19/99

TRACING

RMO™



FACIAL PATTERN: MILD BRACHYFACIAL					
# FACTORS	MEASURED VALUE		NORM		CLINICAL DEVIATION
Interincisal Angle	133.4	dg	131.5	dg	0.3
Convexity	3.4	mm	2.5	mm	0.4
Lower Facial Height	43.1	dg	45.0	dg	-0.5
A6 Molar Position to PTV	8.1	mm	10.5	mm	-0.8
B1 to A-Po Plane	-0.1	mm	1.0	mm	-0.5
B1 Inclination to A-Po	18.7	dg	22.0	dg	-0.8
Facial Depth	86.1	dg	86.1	dg	0.0
Facial Axis	90.7	dg	90.0	dg	0.2
Maxillary Depth	90.0	dg	90.0	dg	0.0
Mandibular Plane to FH	23.4	dg	26.5	dg	-0.7
Mandibular Arc	28.7	dg	25.4	dg	0.8

Treated open bite deciduous Age 7.5

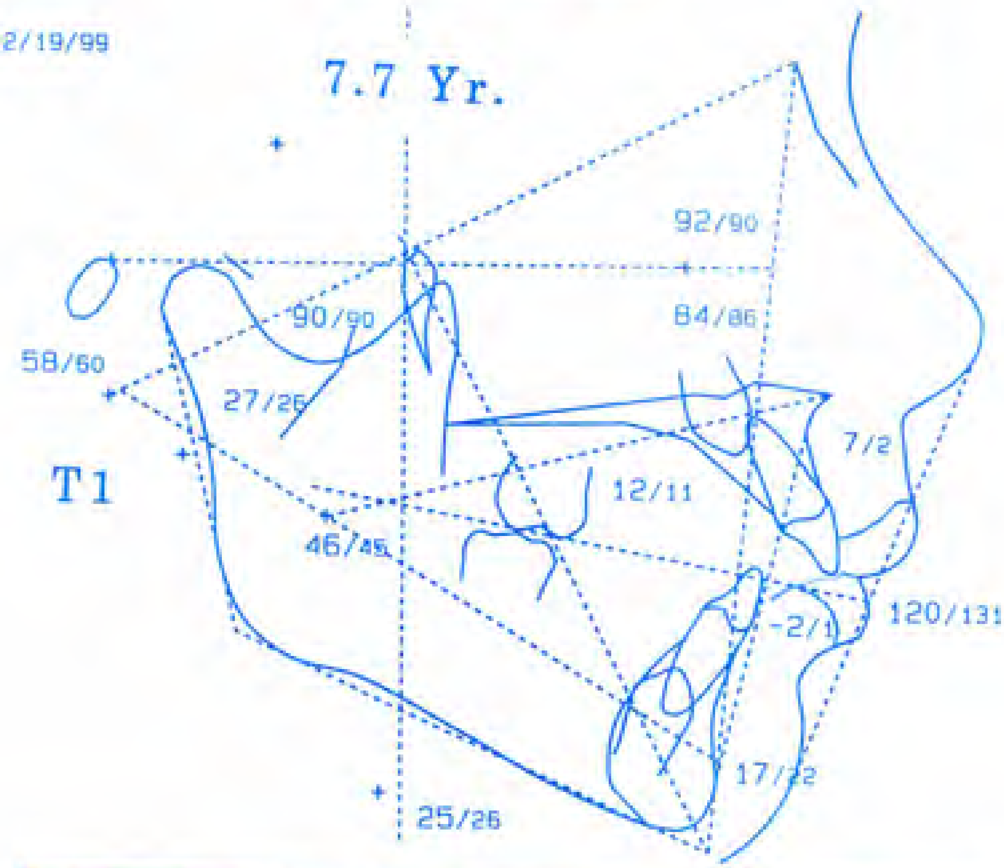
FIG. 9-16B

ETMOPEN1
RICKETTS
M (CA) Caucasian
AGE: 7.7
X: 12/10/98 - R: 02/19/99

TRACING

BEFORE TREATMENT

RMO™



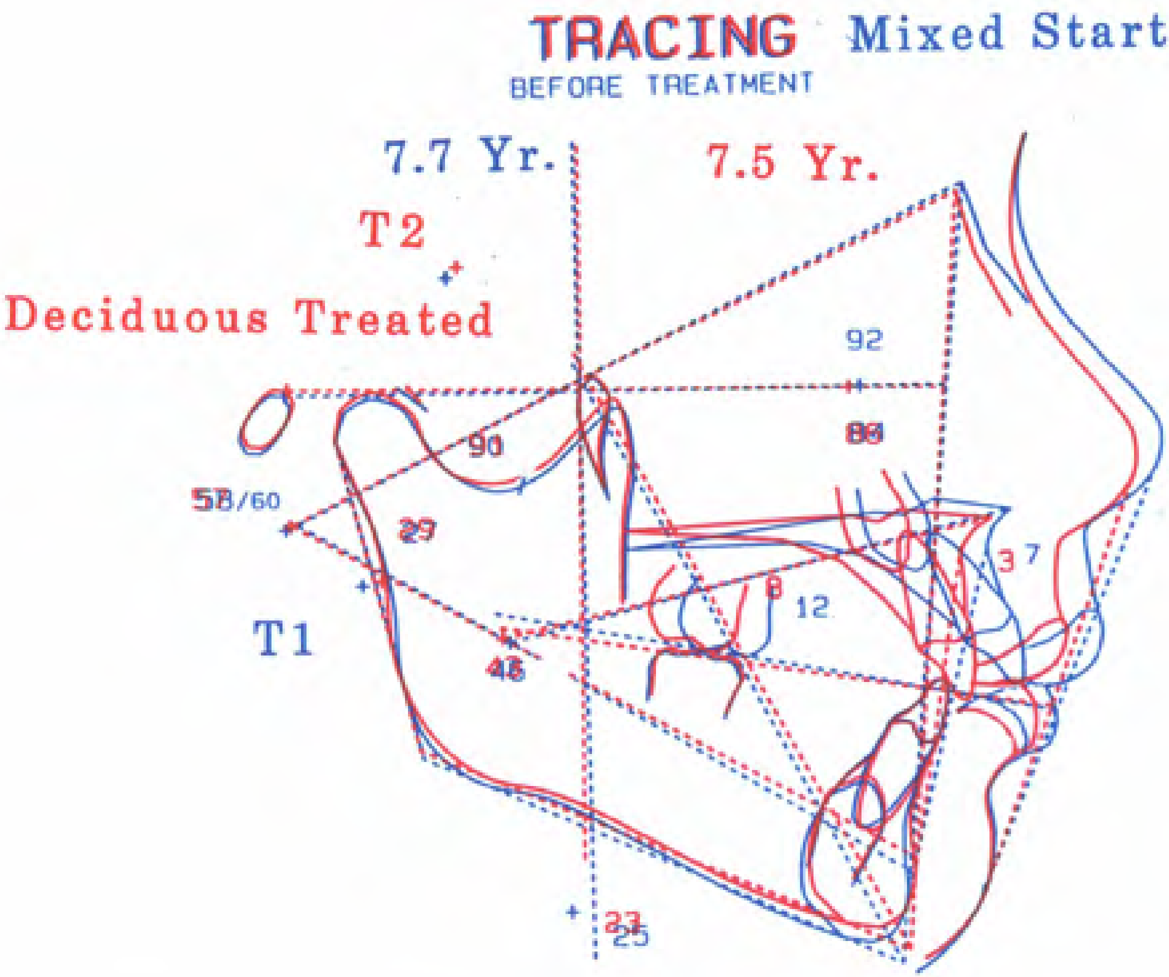
SIGNIFICANT CONSIDERATIONS	
CONDITION	REASON
Class II malocclusion	due to upper & lower molar
Severe Overjet	
Severe Skeletal Class II	due to the mandible & maxilla
Open Bite	
Adenoid blockage of the airway?	Probably not

FACIAL PATTERN: MESOFACIAL

# FACTORS	MEASURED VALUE		NORM		CLINICAL DEVIATION	
Interincisal Angle	119.8	dg	131.0	dg	-1.9	*
Convexity	6.8	mm	1.9	mm	2.4	**
Lower Facial Height	46.1	dg	45.0	dg	0.3	
A6 Molar Position to PTV	11.6	mm	10.7	mm	0.3	
B1 to A-Po Plane	-1.5	mm	1.0	mm	-1.1	*
B1 Inclination to A-Po	17.2	dg	22.0	dg	-1.2	*
Facial Depth	84.2	dg	86.2	dg	-0.6	
Facial Axis	89.7	dg	90.0	dg	-0.1	
Maxillary Depth	92.0	dg	90.0	dg	0.7	
Mandibular Plane to FH	24.6	dg	26.4	dg	-0.4	
Mandibular Arc	27.2	mm	25.5	mm	0.4	

Mixed dentition open bite Class II, age 7.7. Note severity increase from deciduous group.

FIG. 9-16C



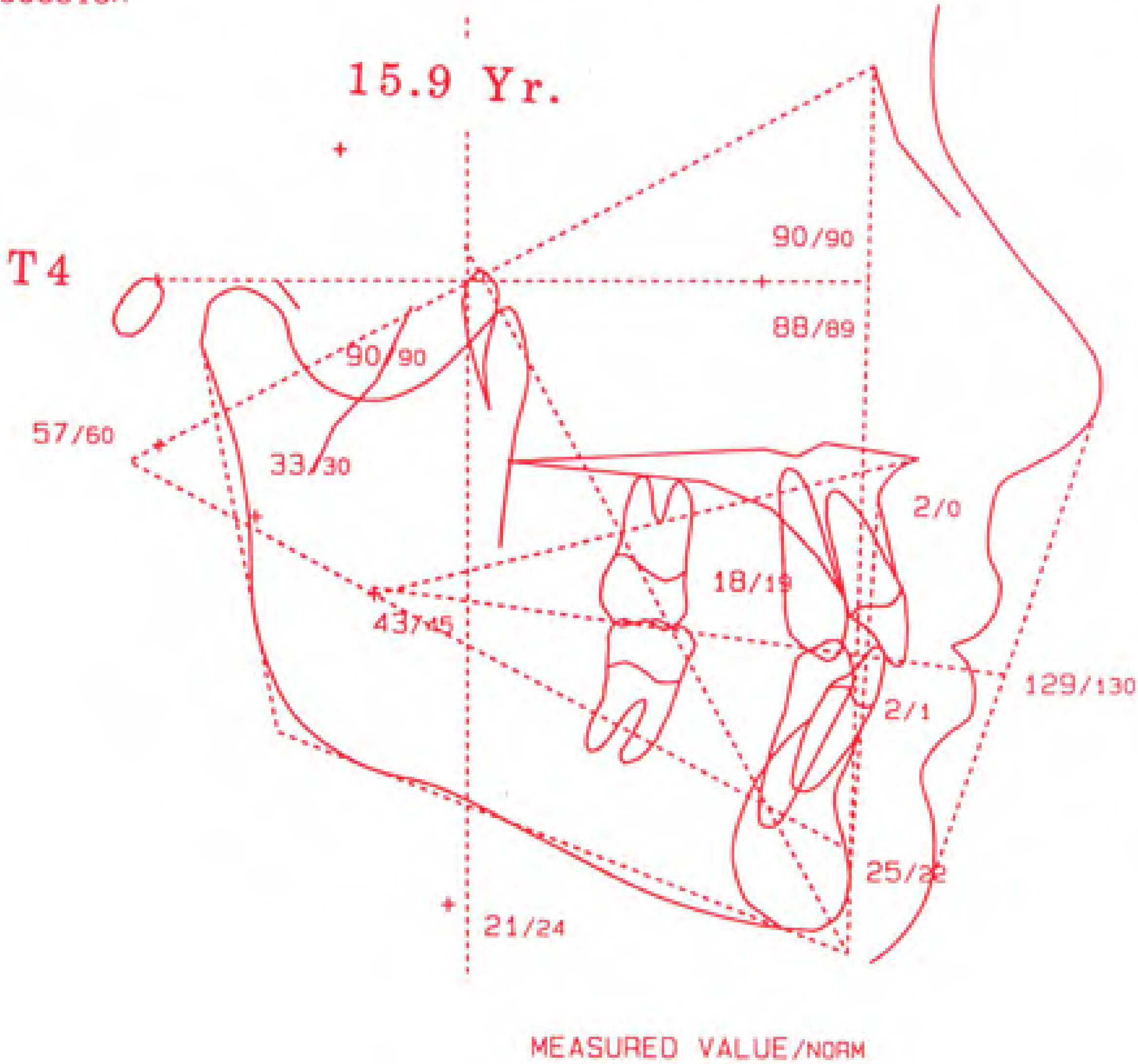
Comparison of treated Class II at deciduous phase (red) with untreated Class II at mixed dentition. Fig. 9-16B compared to 9-16C.

FIG. 9-16D

ETDOPEN4
RICKETTS
M (CA) Caucasian
AGE: 15.9

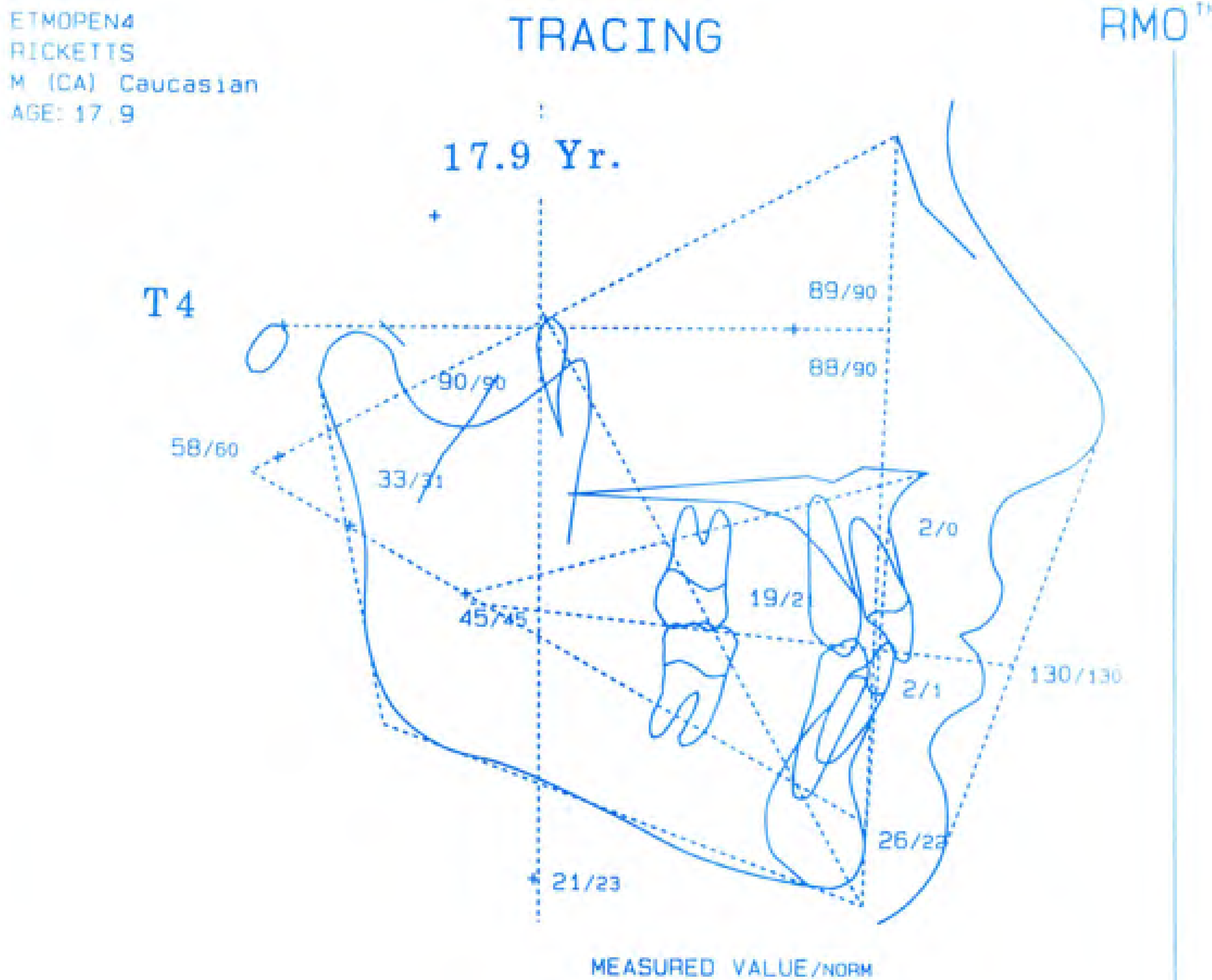
TRACING

RMO[1]



Retained open bite cases treated in deciduous stage.

FIG. 9-16E



T4 of Mixed group age 17.9 years.

FIG. 9-16F

The sample for the deciduous patient N=9 is small but the consistency of the childrens' behavior is not anecdotal. The "maxillary complex" was rotated downward and backward and the bite was nicely closed in 1.3 years or at age 7.5 (see Fig. 9-16).

The comparisons make a good experiment because the **deciduous first phase was completed before the mixed cases on average were started.** Thus a 7.5 year old sample treated can be compared to a 7.7 year untreated to show the theoretical difference of the Class II when cared for in the deciduous dentition!

Both the samples turned out equally good at 15.9 years and 17.9 years respectively (see Fig. 9-16).

VI COMPARISONS AT PHASES AND TYPES

The average open bites were started at age 6.9 and the deep bites almost a year later at age 7.7. The samples varied only slightly in time required for the first phase correction (or until progress films were taken). The mean time for all the major correction was about 18 months. The actual correction of the Class II took place in about 12 months.

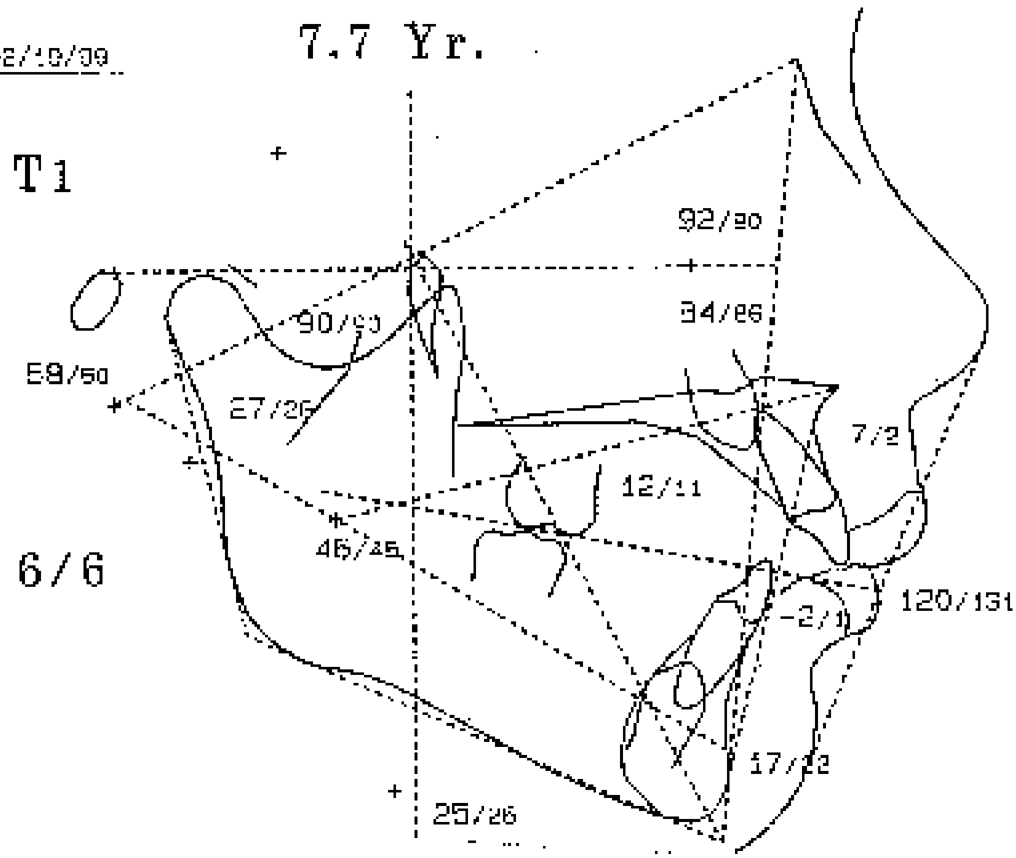
A comparison of the profiles of the original Deciduous Class II open bite at age 6.9 with the Mixed Open Bite comparison at age 7.7 showed the maxillary incisor position to be 4.5 m.m. more protrusive at the permanent incisor development. This suggested **earlier treatment (in the primary phase) required less movement for the correction (Fig. 9-17).** In other words, **waiting only made the condition worse** or more extreme. Ironically, as stated before, the open bite condition was corrected at age 7.5 and the mixed open bites were not started until 7.7 years (see Fig. 9-16).

RMO™

STMOPEN1
RICKETTS
M (CA) Caucasian
AGE: 7.7
X: 12/10/99 - R: 02/10/99

TRACING

BEFORE TREATMENT



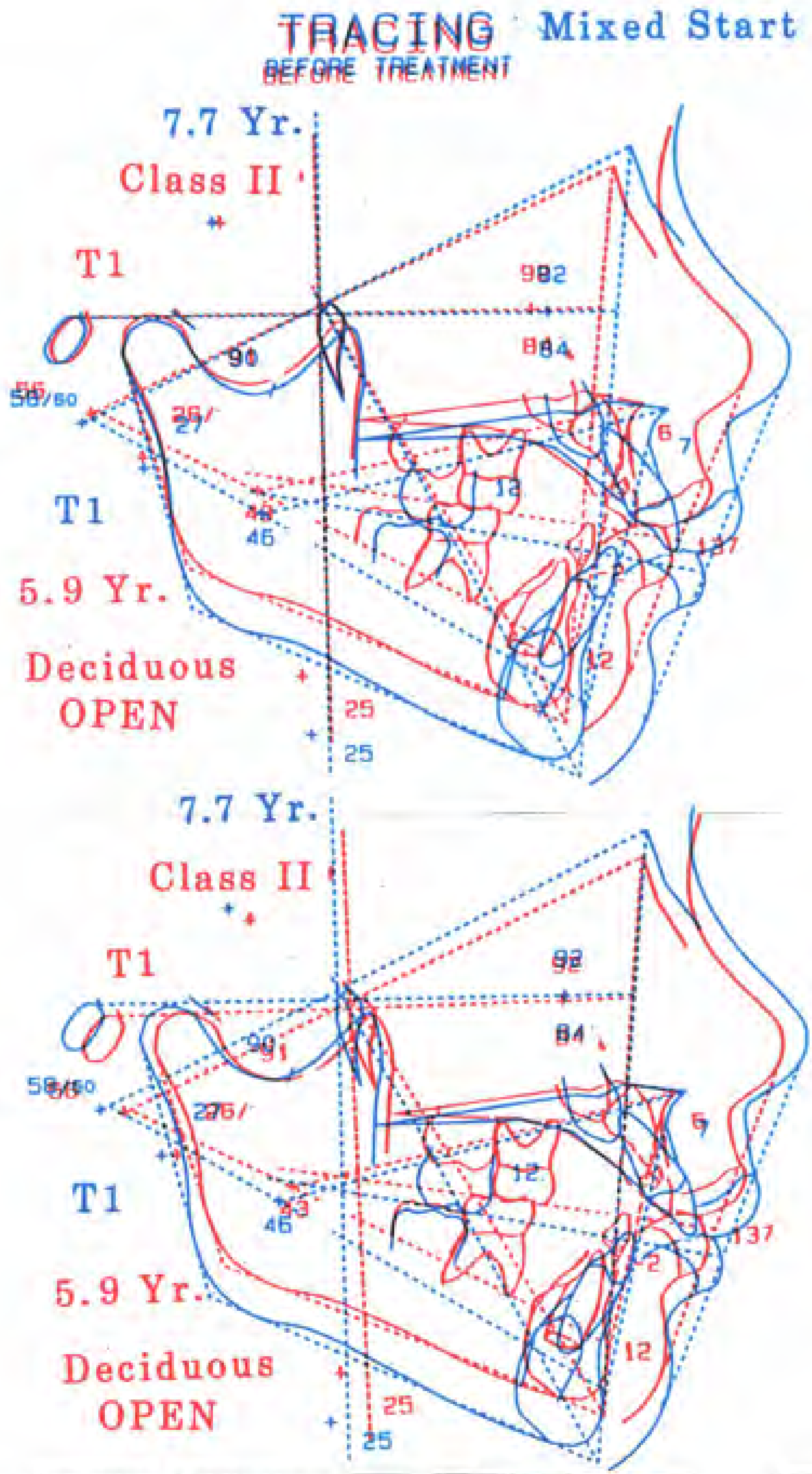
SIGNIFICANT CONSIDERATIONS	
CONDITION	REASON
Class II malocclusion	due to upper & lower molar
Severe Overjet	
Severe Skeletal Class II	due to the mandible & maxilla
Open Bite	
Adenoid blockage of the airway?	Probably not

FACIAL PATTERN: MESOFACIAL

# FACTORS	MEASURED VALUE	NORM	CLINICAL DEVIATION	
Interincisal Angle	119.8 dg	131.0 dg	-1.9	*
Convexity	5.8 mm	1.3 mm	2.4	**
Lower Facial Height	46.1 dg	45.0 dg	0.3	
A6 Molar Position to PTV	[illegible] mm	10.7 mm	0.3	
B1 to A Po Plane	-1.5 mm	1.0 mm	-1.3	*
B1 Inclination to A-Po	17.? dg	22.0 dg	-1.2	*
Facial Depth	84.2 dg	85.2 dg	-0.6	
Facial Axis	89.7 dg	90.0 dg	-0.1	
Maxillary Depth	[illegible] dg	90.0 dg	0.7	
Mandibular Plane to FH	24.0 dg	25.4 dg	-0.4	
Mandibular Arc	[illegible] dg	26.5 dg	[illegible]	

T1 Mixed dentition open bite. 6 males and 6 females.

FIG. 9-17A



Comparison of T1 Deciduous open bite to T1 mixed dentition.
Note increased severity by waiting.

FIG. 9-17B

The amount of maxillary basal alteration was similar whether the deciduous second as the permanent incisors erupted or first permanent molar was employed for anchorage.

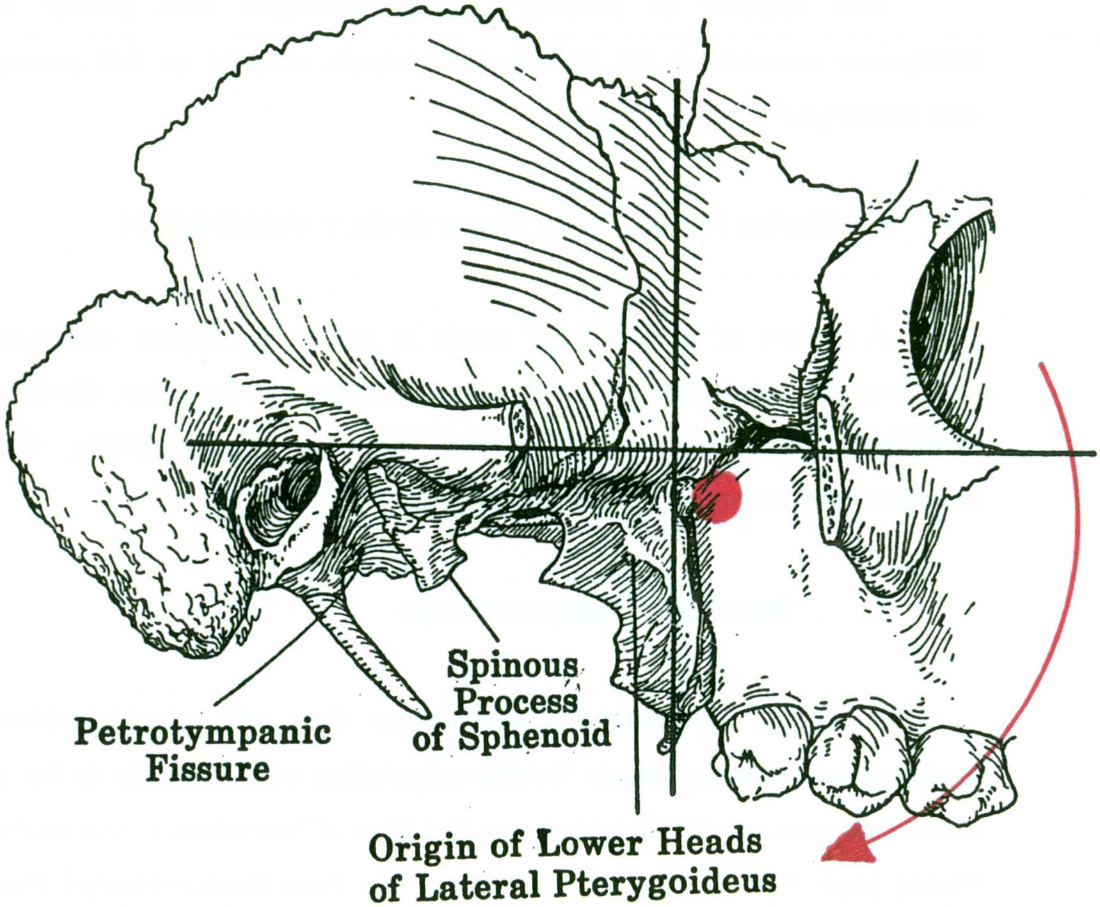
VII FINDINGS RESULTING FROM EARLY TREATMENT

A review of the findings leads to some interesting observations in the following six categories. These were maxillary orthopedics, dental movements (orthodontics), mandibular influences, temporal bone changes, occlusal plane behavior and esthetics of the soft tissue.

1. Maxillary Skeletal Change

It should be common knowledge that with normal development, a remarkable tendency exists for the angulation of the palate to be so stable to cranial references that it introduces the idea of "constancy" (particularly the BaN Plane) (see Pos. 2, Fig. 9-4A). The angle from Basion-Nasion Point A (Nasal Angle) also is highly regular in a series of untreated subjects. Point A may move forward very slightly but, often no more than a tracing error.

In the 1999 study, one consistent finding was "maxillary orthopedics". With cervical traction the palate was tipped downward and backward a mean of four degrees (4°). Further scrutiny showed that, as expected, the orbit was dropped slightly. Further the nasal bone tipped downward and backward. The Point A was reduced an average of 3 degrees during the first active phase. Point A was moved backward for all patients in both open bite and closed bite. **The maxillary complex was rotated near the apex of the body at the pterygopalatine fossa (Fig. 9-16).**



Drawing of sphenopalatine area showing central site of maxillary rotation with cervical traction.

FIG. 9-18

More movement was seen in open bite because of the freedom from interference from the lower arch (see Fig. 9-12). The mixed sample had 5° of backward positioning of Point A with a one degree (1°) reduction of the lower face height. The 10 year period still measures Point A to be reduced 5° in the group with open bite condition. The original BaNA was 67° and the final was 62°. This may suggest even further maxillary **remodeling** with later development (see Figs. 9-11to16).

It is most improbable, and often an error of selection of Point A, when it is found, to see an untreated child with a negative developing Point A. This assurance makes the findings of this study even more significant. A tipping of the palate and a backward movement of ANS and Point A is true orthopedics (skeletal alteration). The tipping of a palate without orthodontics is remarkably rare when related to BaN.

Detailed inspection of some of the subjects showed an increased suture space at the fronto-nasal suture and the fronto-zygomatic suture during the active treatment period.

2. Dental Change

The first molar was moved backward by two processes. It was moved together with the maxilla about 2 mm. Within the maxilla it was moved about 2 mm. for a total of 4.0 mm. on average in the first phase. In eighteen months the molar would have moved forward 1.5 mm. This meant a change of 5.5 mm. from its predicted position. The total distal movement of the upper molar would account for essentially 2/3 of the six mm. correction. However, the lower molar, the target tooth, moved distally sometimes even without a utility arch use which led to even a greater need for molar movement.

Because the palate was tipped and the maxilla was retracted the upper incisor in the open bites, developed into a normal overbite and overjet. In the deep bites In retrospect, more attention should have been given to lower incisor intrusion very early and came to be recommended.

3. Mandibular Change

Under normal conditions the closing "bend" in the Condylar Axis from the Corpus Axis is 0.6° per year. This would mean a 0.9° change in 18 months. In the Deciduous open bite sample **the closing was 3.0° in 18 months**. In addition **more vertical ramal growth was seen than would be forecasted** for that time period. Taken totally the bend was 2° or **double that of the controls. Greater bending** on the arc **favors a forward position of the chin** toward brachyfacial behavior. **On average the Facial Axis was not opened with cervical traction.**

4. Joint Behavior

Several composites confirm that from the temporal bone (Porion and the Glenoid cavity) moves backward 0.5 mm. per year from the Pterygoid Vertical or Pt Point. This would mean about 1.0 mm. in two years. However, in the treated patients during that period of cervical traction no posterior movement was evident. This matches observations in single patients and also the behavior in previous treated composites of a different group started at age 8.8 years and studied at age 13 (over a five year period) (see Fig. 9-8).

This measurement suggests that temporal bone alteration accounted for about 16% of the Class II correction or about one-sixth of the changes (during the correction).

5. Occlusal Plane Behavior (Position 5) (Vertical Changes)

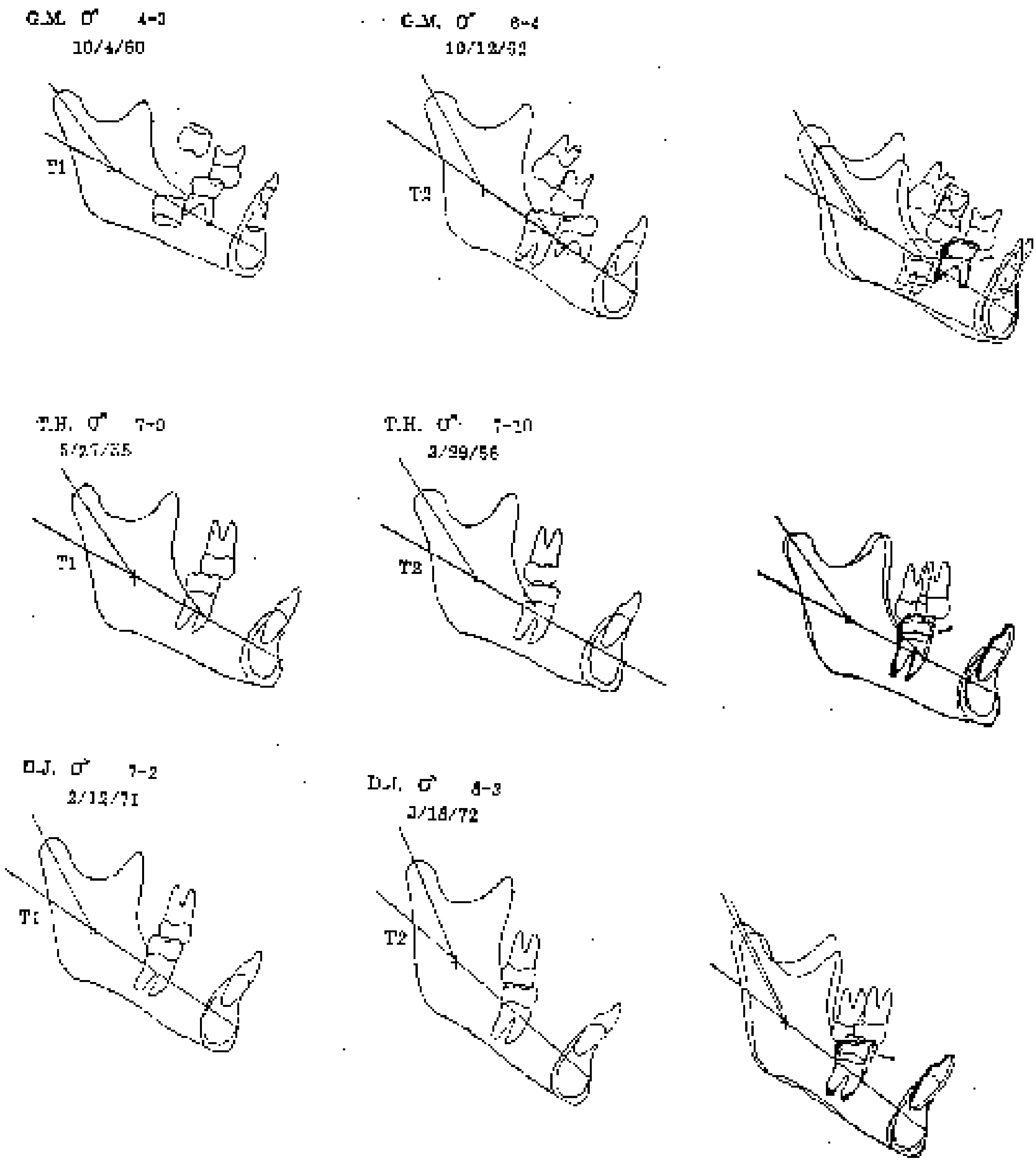
The True Buccal Occlusal Plane in the young Class II child tends to fall above XI Point. With cervical traction, the **occlusal plane is favorably influenced to lie below Xi Point** with cervical traction. While individual patients are seen to intrude the lower molar **(Fig. 9-19),** the mean behavior for this total sample showed no further eruption of the lower molar when cervical traction was being employed.

The molar correction as seen from the original Pterygoid Vertical oriented to Basion-Nasion showed 6.5 mm. reduction from its predicted position by age 18 years. Realistically about one half the change is upper molar distal movement and the remainder is mandibular growth with temporal bone influences.

6. Esthetics

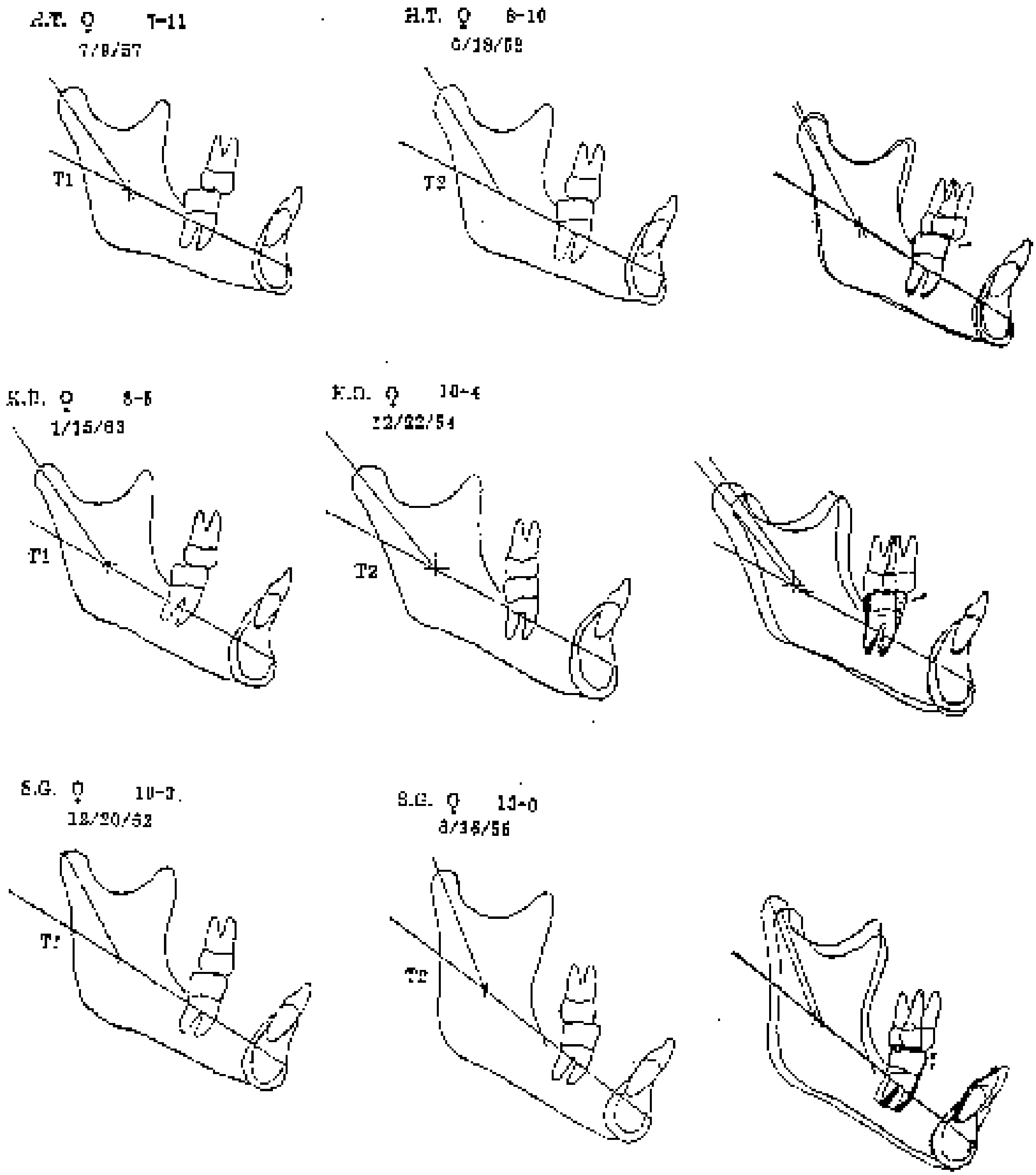
The normal nasal development reveals a concentric behavior and a **forward bend of the nasal bone** about 1 degree (1°) per year **(Fig. 9-20)**. The nose grows forward a remarkably consistent 1.0 mm. per year from the anterior nasal spine (see Fig. 9-4, 9-6 and 9-7). The upper lip thickens about 1.0 mm. each five years as measured from the labial surface of the upper incisor. The increase of the lower lip, from the interincisal point, and the thickness of the chin from the symphysis is similar to the soft tissue increase of the upper lip.

But with the treatment rendered with extraoral traction, the outline of the **nose crosses over the original contour. The nasal bone bends backward** with cervical traction. Without independent (orthodontic) retraction of the incisor the upper lip maintains its position relative to the upper incisor. This was shown in all the samples. Simultaneous with the correction of the incisors' relationship the lower lip followed the interincisal point upward and backward.



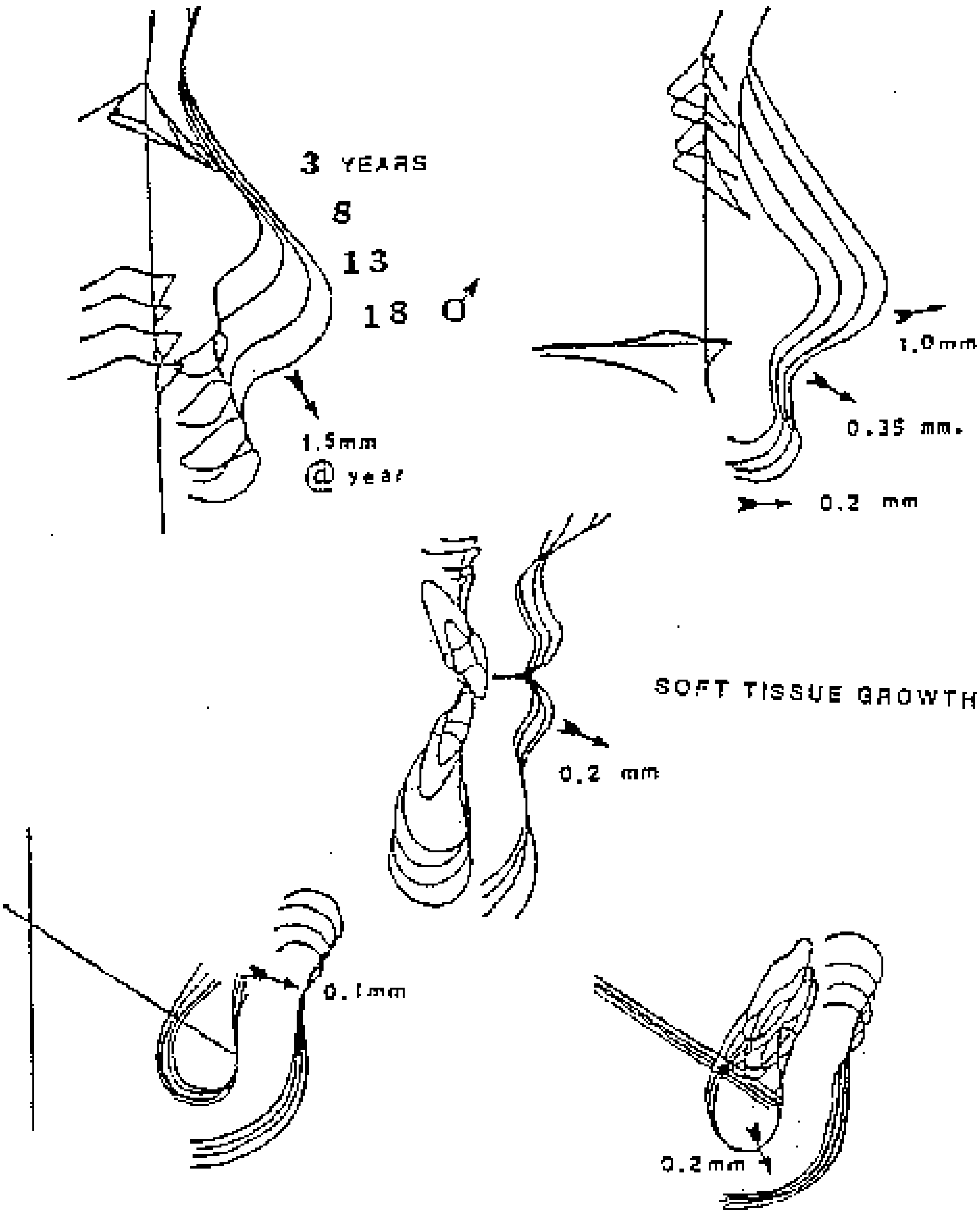
T1 and T2 and comparison on Position 4 of three children treated with cervical traction. Note the behavior of the lower molar from cervical traction on the upper molar.

FIG. 9-19A



Three more children showing intrusive action on lower molar during the first phase.

FIG. 9 –19B



Mean yearly growth changes in the soft tissue profile at ages 3, 8, 13 and 18 years.

FIG. 9-20

In the samples the facial convexity (A to Facial Plane) was corrected to "ideal" conditions. The lip protrusion relative to the E line was also at ideal objectives both for the early age of the children and again by maturity (age 18) (see Fig. 9-2).

VIII GROWTH AND ITS FORECASTING

This present manual of lectures is not concerned with forecasting. A two volume work is available on the details of that technique (*UNDERSTANDING THE VTO: Its Construction and Mechanics for Execution – Volume One and Volume Two*). Prior to considering the forecast in the composites and the eighteen patients later to be shown individually, some information should be acknowledged. There are five sobering conditions to wit:

1. Growth can be considered in amount from birth onward (Individuality is present at birth).
2. Growth from a zero starting point can be calculated from the cranial center reference (Cc on BaN).
3. Differences in the sexes can be seen already in the juvenile patient.
4. The original form and size is **the matrix of the individual** on which added growth is then plotted for forecasting.
5. Sexual cut-offs have been verified.

Because newborns differ in size, the zero starting point is the sensible reference. By age 6.9 years in eighty-three (N=83) untreated children, the facial axis was already 65 mm. By a growth age to 16.3 years the Axis (to Gn) was 107 mm. In the males to age 18 years, the mean is 112 mm. and the females about 103 mm.

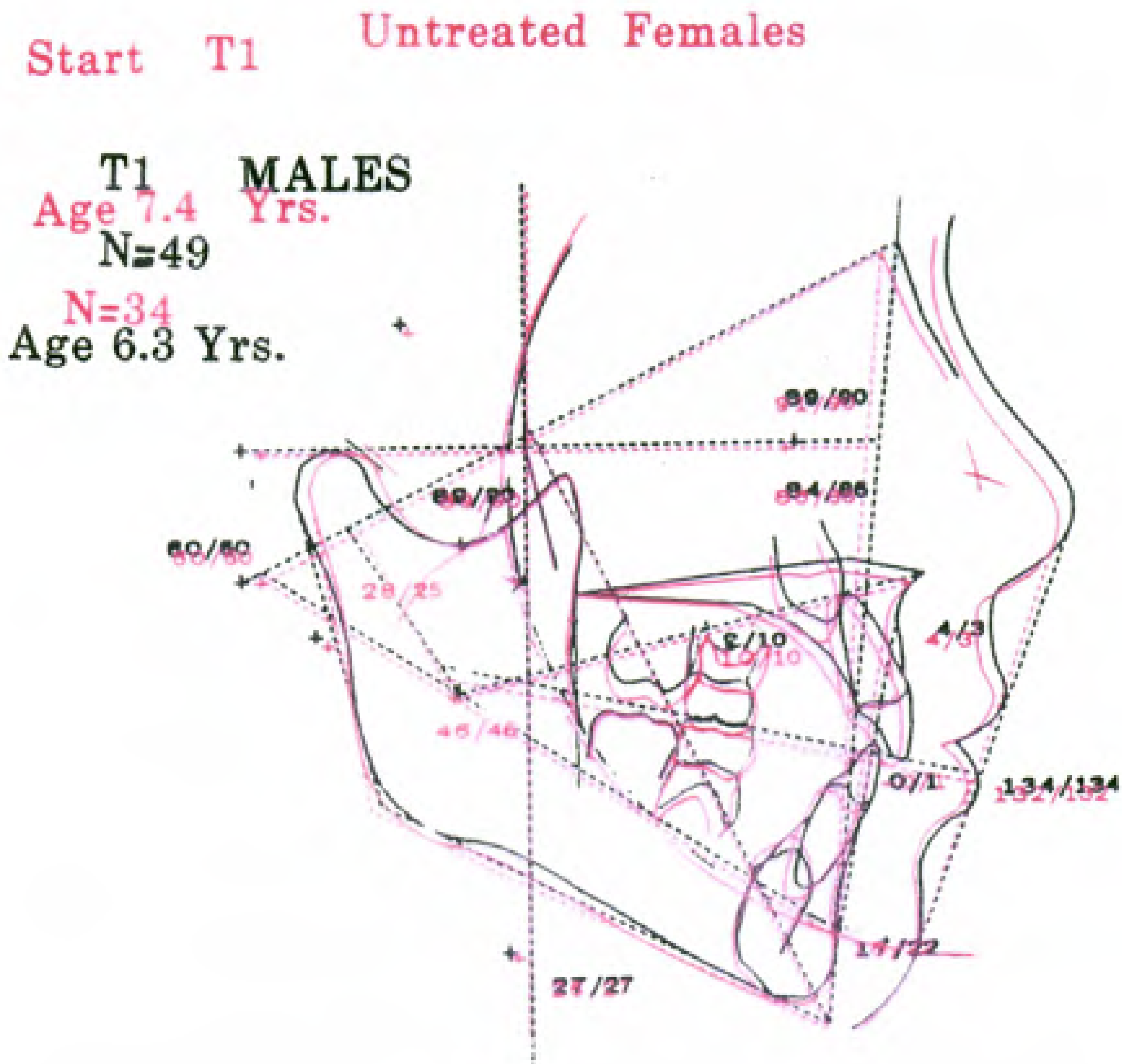
Sixty-five mm. (65 mm.) therefore represents roughly sixty-one percent (61%) of the total mandibular growth already present. This means that only 40 percent is to be added for the mandible after age 7. However, the cranial base from Co to N was 54 mm. at age 7 and 62 mm. at age 16. This means that only 13% remains to be predicted on the anterior cranial base. It shows that the cranial base develops earlier toward its ultimate state

In the 1990 study, 49 males and 34 females were composited at the time of the first headplates (or T1). To our surprise, the males at age 6.5 years were already larger than the females at age 7.4. This suggested that sexual dimorphism is present even before the mixed dentition age **(Fig. 9-21)**.

Work in the manual method of forecasting by trial and error led to a termination of mandibular growth in females somewhere between 14.5 and 15.0 years. Data collected in 1990 revealed that it was actually 14.6 years for a cut-off. However, the carpal index has shown that some females are essentially completed by age 11 years. The wrist plate is highly useful in the females. In the male, the cut-off found to work was 19.0 years.

The author is not impressed with the idea of timing treatment with the adolescent "spurt". First, the timing of spurting varies and some children never experience large spurts. In fact our data showed that the greatest growth increments occurred at the juvenile age from 5 to 7 years in both sexes.

Having abundant growth to secure the orthodontic result would seem to be at least as important as having a high velocity for the treatment itself.



Comparison of 49 males age 6.3 with 39 females at age 7.4 years. Note larger males even at one year younger age.

FIG. 9-21

IX TOTAL COMPOSITE FORECAST PREDICTION

A forecast of the total N=35 sample was made manually by the author using the current method. Cut-offs for the sexes were made for the construction of the forecast without treatment as follows:

The total sample was aged 7.2 years at Time 1.

For the cut-off at 14.8 for females

Thus, 7.2

= 7.6 growth years

Females N=18 x 18

136.8 total female growth years

For males cut-off 17.4

7.2

Male years = 10.2

Males N=17 x 17

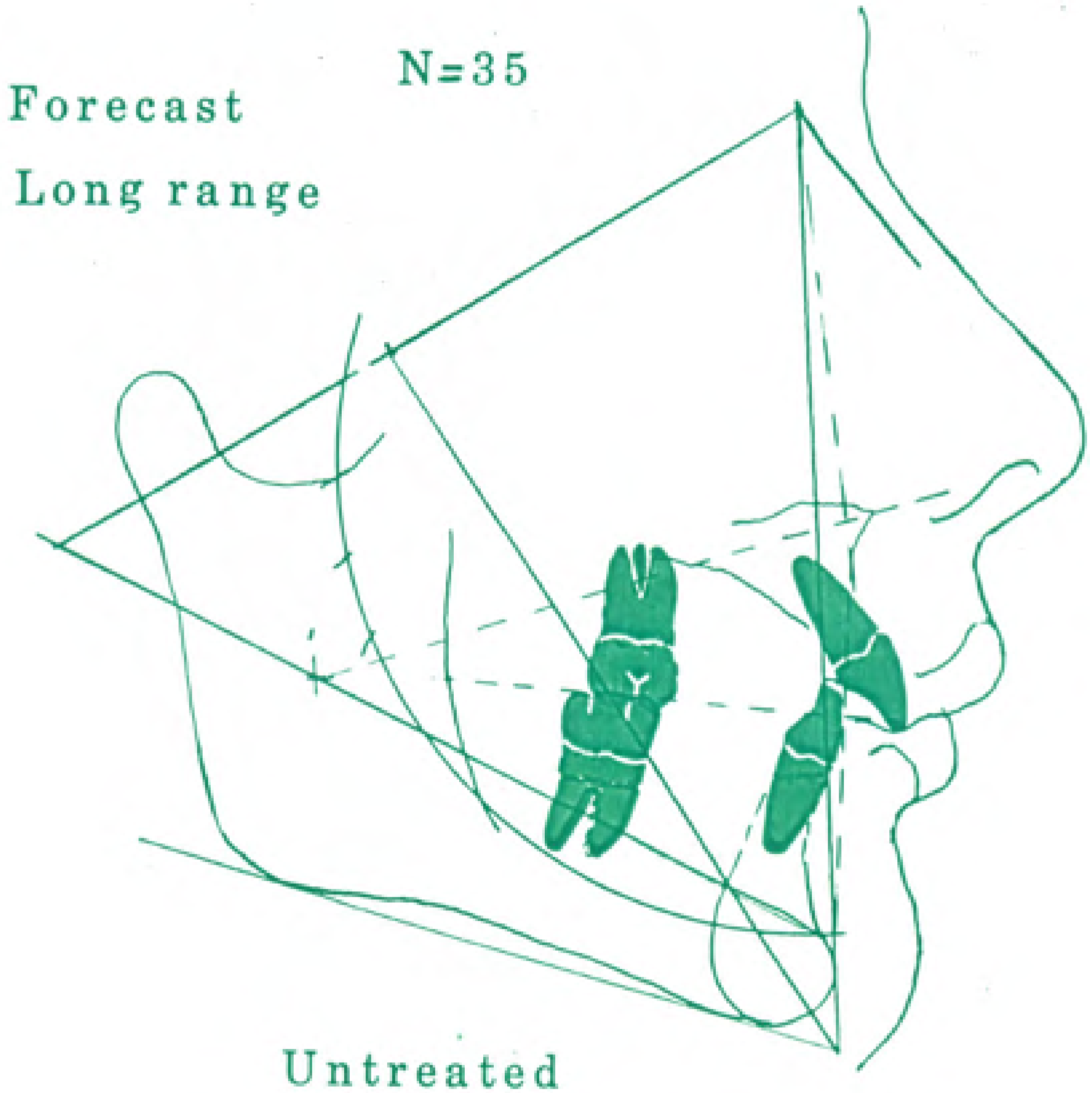
173.4 total male years

310.2

: N=35

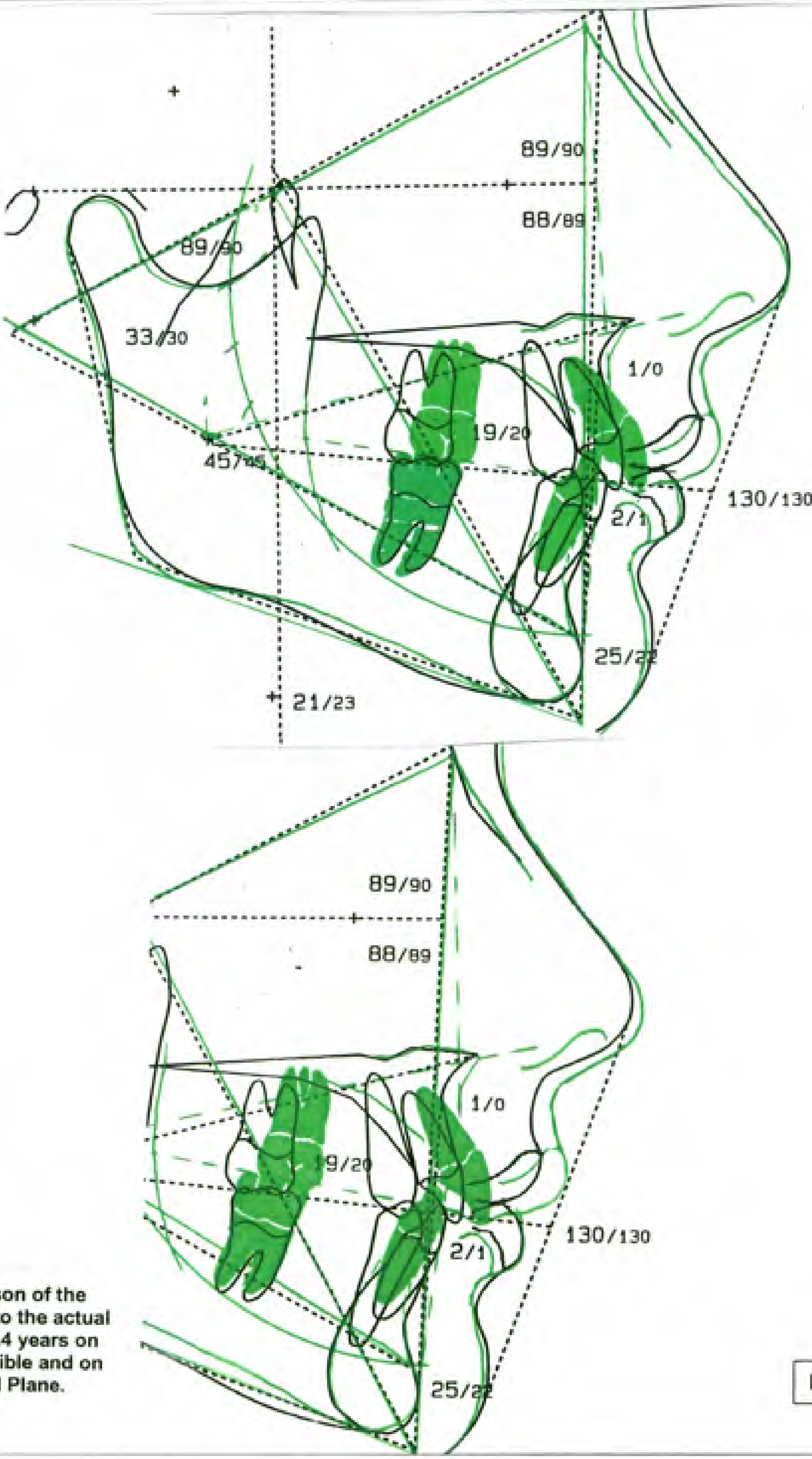
= 8.9 years growth for the forecast

Prediction of the result (non treated) showed a convexity reduction to 4.5 mm. with natural development. The actual with treatment was 1.0. This indicated a 3.5 mm. reduction from the therapy. The treatment appears to have opened the Facial Axis 1.0 degree **(Fig. 9-22)**. By superimposing on the Facial Plane, the total profile benefits are visualized (see Fig. 9-22).



Forecast to maturity of N=35 Class II as if non treated.

FIG. 9-22A



Comparison of the forecast to the actual at age 17.4 years on the mandible and on the Facial Plane.

FIG. 9-22B

X SUMMARY

The value and different methods of construction of a composite of cephalometrics data was discussed. The application of the computer with digitized points has been a valuable asset to continued clinical research. It has rendered in fact the state of the art knowledge for the new millinea.

Normal growth behavior was reviewed as a basis for comparison of treated patients. The method was tested and the findings were established and **verified twice**. The four position analysis was shown as a basic framework for growth or treatment analysis and was highly recommended to the profusion.

With the use of cervical traction, an orthopedic change was demonstrated beyond any question. This was proven in 1960, it was verified in 1974, but 40 years later, was reconfirmed still again but this time, in younger subjects started as early as three years of age in the deciduous stage.

Findings of patients started at the mean age of 5.9 in the deciduous condition and composites of children started at age 7 in the mixed dentition, showed irrefutable skeletal alteration.

The orthopedic changes seemed to include (1) the temporal bone to a minor degree, (2) the entire maxillary complex and (3) temporarily the growth of the mandible. These "orthopedic" changes accounted for much of the correction because tooth movements within the jaws were more minor.

Second phases were not required in many cases. When necessary, the patients were detailed for finishing at the permanent level – not retreated for unsuccessful correction or relapsed conditions. Open bites respond well. Deep bites may require intrusion of the lower incisors as the first step.

This lecture dealt with growth, growth forecasting and induced orthopedic changes. The beauty of this work is the follow up x-rays. These were taken later at maturity which is a rare opportunity for the student to experience.

MASTER COPY

ORTHODONTIC TREATMENT IN THE GROWING PATIENT

(Early Treatment)

VOLUME TWO

MECHANICS FOR DECIDUOUS AND MIXED DENTITIONS – ORTHODONTIC AND ORTHOPEDIC TREATMENT