American Institute for Bioprogressive Education

THE LATEST STYLE IN THOUGHT AND ACTION IN ORTHODONTICS

by Dr. Robert M. Ricketts

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Welcome to the "Latest Style in Orthodontics"

The last ten years have, like past decades, given rise to new ideas and developments. Some of the new will characteristically drop by the wayside and only dent the mainstream. Other parts will have a lasting effect on the course of history.

Here are some thoughts of Robert Henri regarding movements.

> There is the new movement. There always has been the new movement and there always will be the new movement. It is strange that a thing which comes as regularly as clockwork should always be a surprise.
>
> In new movements the pendulum takes a great swing, charlatans crowd in, innocent apes follow, the masters make their successes and they make their mistakes as all pioneers must do. It is necessary to pierce to the core to get at the value of a movement and not be confused by its sensational exterior.

* *

> Every movement, every evidence of search is worthy of the consideration of the student.
>
> The student must look things squarely in the face, know them for what they are worth to him.
>
> Join no creed, but respect all for the truth that is in them.
>
> The battle of human evolution is going on.
>
> There must be investigations in all directions.
>
> Do not be afraid of new prophets or prophets that may be false.
>
> Go in and find out. The future is in your hands.

Robert Murray Ricketts

EVOLUTION OF PROGRESSIVE ORTHODONTIC TECHNOLOGY TO ITS PRESENT STATUS -- A RECAPITULATION

1950 -- A change was made from static diagnosis and planning to dynamic forecasting and objective designing. This movement resulted from cephalometrics combined with laminagraphy as an effort to utilize the contribution of growth in a deliberate manner (VTO).

-- A recognition was made of muscular resistance of the lower lip (E.R. case).

-- The possible effects of extra oral traction of the maxillary arch on the development of the lower arch was taken into account.

-- Many of the orthopedic principles of Arthur Steindler were applied to the jaws and the TMJ. Classification of joint pathosis was made, and the "Trauma Quadrangle" was described.

-- The first surgical cephalometric set-up was formulated (SVO).

-- The symphysis was studied with Dubrul, and Pogonion was accepted as a basal least changing reference.

1951 -- Rietan's "Initial Tissue Reaction" (hyalinization) was acknowledged as a factor in manipulation of teeth clinically. This started the movement toward lighter pressures.

-- Several departures were made from traditional edgewise practices. Experiments with bent loops in .021 X .021 gold basic wire were conducted to produce "work" by the appliance.

-- Efforts were made to reduce the effects of intermaxillary elastics on extrusion of the upper anteriors and tipping of the occlusal plane. These were factors inducing negative rotation of the mandible during treatment, which worsened the problem of correcting Class II.

-- Two parallel brackets were soldered experimentally on the band strips for all molars and the upper central incisors.

-- The "headcap" became a "neckstrap".

1952 -- A focus was made on finishing of the occlusion. Proper meshing of the lower and upper molars was imperative, and the key to both was the contact of the distal incline of the upper second premolar later labeled #14 in the normal occlusal scheme.

-- Lower incisor compensation to the facial pattern and to growth behavior was recognized by use of the APo plane of reference. Molar compensation was noted later.

-- Pogonion was reasoned to be a basic skeletal point, and Point B was found to be totally an alveolar point. Point A was more basal.

-- More continuous three-plane control forces were desired, and calculations of "forces" in appliances were started. This led to the acceptance of the "loop principle" for lighter and more continuous 4-dimensional control and efficiency.

-- "Tucking of the canines" was found to be a significant aid to prevention of over-expansion of canines. Traditional arch form was modified.

-- Cervical traction was applied to molars only.

1953 -- Research was conducted on milled "Siamese" brackets in gold material.

-- Cortical bone was recognized as a basic factor in anchorage application clinically. Cortical avoidance had long been established.

-- Anchorage difficulties were discovered from (1) round wires and (2) sliding mechanics.

-- Space for bands (and teeth) was created in a progressive manner, and with control of the location of space creation the idea of "progression" was born.

-- Proximal anchorage was rejected, particularly mesially and distally to the canines where the planes of force changed from horizontal to transverse directions in the arch wire.

-- Tubes were presoldered on band strips.

1954 -- Work with esthetics led to the application of the "E" line for evaluation of lip relations. The pupil planes and the cheek plane were added later.

1955 -- While suggestions had been made previously, movement of the midface basal structure was proven by the use of extra oral traction. This was in short term, but the maxilla could no longer be considered immutable.

-- Smaller band material and more delicate appliances were developed.

-- Tie-backs were made with "racket principle".

1956 -- Research was started with base metal preformed bands and siamese brackets. Canine and premolar forms were designed.

-- Elgiloy .019" X .019" was employed in .022" slots.

-- Smaller slots were desired for three-plane control with square wire. Experimentally .016" X .016" slots were employed.

-- Loop configurations were measured and torque forces were calculated.

1957 -- The idea of forecasting growth and "response" was published.

-- Work was completed on canine and premolar preformed bands. The .018" X .030" slot was designed for "piggyback" use.

1958 -- Much of the doctrine of Edgewise was questioned. Several functional problems were identified.

-- Uprighting of lower molars was made from depression and uprighting of lower canines as a primary movement.

-- Storey's work of 1952 was reviewed and applied, but pressures were found to be still excessive for protection of anchorage.

1959 -- The first fully preformed-preadjusted formulation was made, and a typodont was constructed for the American board examination.

-- A growth behavior study of five groups of subjects was presented. One group of N=50 Class I conditions and one group of N=50 Class II patients untreated were employed as controls. One N=50 group was treated with cervical traction, one with intra oral elastic traction, and a third with a combination of extra and intra oral

traction. Maxillary alteration was proven, and mandibular influence was hinted.

-- Three dimensional orthopedics was proven.

1960 -- Direct intrusion of teeth down their long axis was shown.

-- Frictionless mechanisms were sought.

-- The utility arch concept was developed.

-- Double and triple tubes were designed.

-- Head gear design was changed.

-- Many types of continuous wire forms were designed for production.

1962 -- Studies were made for sectional mechanics and anchorage values.

-- "Clinical Research" was promulgated, reporting on classification of tongue problems in Kraus and Reidel's "Visuas of Orthodontics".

-- A refocus was made on occlusal function and the joint.

-- The "new mechanics" were formulated into a system referred to as "Light Square Technique".

1963 -- Bjork's implant studies proved the mandibular plane could no longer be employed for longitudinal studies of lower arch behavior.

-- Blue Elgiloy .016" was revealed to show the best advantages, everything considered.

-- Procedures for intra oral regulation were described.

-- Work for the force values for "Frictionless Retraction Sections" was completed.

-- The quad helix appliance was perfected in .038" Blue Elgiloy size.

-- The "Doctrine of Possibility" was formulated with sixteen basic features.

-- Root rating scales were presented as guides for "pressure" calculations.

-- Sclerosis was evaluated at areas of resistance to a drag.

1964 -- Advanced Orthodontic Seminars were composed and started in Pacific Palisades, California.

1965 -- Normal contact stops were determined and the occlusogram scheme was described for ideal occlusal relations.

-- Xi point was discovered as an alternative for occlusal plane reference.

-- Pterygoid point (Pt) at the lower border of foramen rotundum was employed as a working center. This became the point for description of a new facial axis. Where Pt-Gn crossed the basicranial axis it became Cc, or Cranial Center.

-- A computer study was consummated on a prosthetic population for determination of the occlusal plane for the edentulous. It proved the value of the Frankfort plane to be far more useful than SN. SN for typing and longitudinal work was rejected.

-- Degenerative joint disease was described relative to development of the mandibular condyle, and clinical situations were described.

1966 -- The major computer study protocol was established, and longitudinal frontal and lateral headplates from 40 subjects were chosen for intensive investigation with 372 parameters. Time 1 and Time 2 lateral and frontal headplates were carefully traced. Measurements were placed on punch cards for processing.

1967 -- Changes were made in the biotemplate technique.

-- Bjork's implant cases were restudied, showing the validity of the original growth hypothesis of 1950.

-- The "crumbling pillars" of orthodontics was speculated upon, and a divorce from tradition was announced.

1968 -- Frontal and lateral composites led to the theory of the "Polar phenomenon".

-- Onomonic forms were discovered for the facial cavities as hypothetically keyed to neurotrophism.

-- A new orientation was achieved, as an "atlas" for

morphology and growth was established for the computer programs.

1969 -- The new comprehensive Computer Analysis was presented as families of measurements were selected from the welter of information.

-- The original Summary Analysis was selected.

-- The original four-position longitudinal analysis was proposed for the chin, maxilla, and upper and lower teeth determinism.

-- Eight changes were suggested for the orthodontic specialty as a whole for improved professional relations.

1970 -- The arcial growth of the mandible was discovered. Through the use of an arc long range forecasting was found to be feasible.

-- Full torque appliances were designed.

-- A new appreciation of lower arch anchorage and need for control of the occlusal plane for management of the lower incisor was recognized.

1972 -- An advanced seminar class relabeled the technique "Bioprogressive".

-- Lower third molar germectomy was proposed following the findings of prediction of space available by maturity.

-- Hundreds of patients were recalled for a post-treatment stability study (P.S.) with long-range changes to maturity, which also formed the basis for a reinvestigation of Angle's "Line of Occlusion".

1973 -- Long-term forecast studies were conducted, and story-boards were constructed for 35 long-range patients.

-- Eight Frankel cases were predicted in a Manchester, England meeting, and orthopedic changes in the mandible were present but found to be temporary.

-- Conflicts were evident regarding the role of the computer as a clinical aid.

-- Conflicts developed from the study of failures with mandibular surgical advancement in open bite cases.

1975 -- Arch depth was studied, and the typical dental arch was described as a biparameter catenary curve.

-- Psychologic problems were classified for aid in clinical screening.

-- Non-surgical squeeze treatment was described.

1976 -- Five types of general arch forms were determined to cover clinical situations. These were labeled pentamorphic arches and were found to be the same for both upper and lower in size and shape.

-- Phasing (or treatment timing) was organized for improved communications.

-- Staging was laid out as a planning matrix form. Four stages and eight steps formed the base.

-- The evolution of all basic appliances was reviewed.

-- Intermaxillary elastics were classified.

-- Sectional mechanics was re-emphasized.

1978 -- A "Fourth Dimension" formulation was proposed as a therapeutic ideal based on continued study of relapse tendencies.

1980 -- The "Golden Section" or "Divine Proportion" was realized as a basic law of growth and was reapplied to the face, head and body.

-- A refocus was made on biologic considerations for patients.

1981 -- Relapse studies in extraction cases were reported by Little.

-- Baumrind studies showed growth simulation by activator methods and a like stimulus with cervical traction. High pull off molars was found to inhibit vertical ramal growth.

-- Computer composites were studied from patients treated with several modalities.

1982 -- Work was completed on improving the Cromat appliance which became the Crickett.

1984 -- "Physiologic Centric" was revisited.

1985 -- Thames, St. Clair and Alexander made unfair conclusions regarding the accuracy of computer forecasts. Cutoffs in mandibular rotation were programmed and not recognized by these investigators.

-- Combined appliance reactions were studied.

1986 -- A lower removable corrector was designed.

1988 -- A consumation of occlusal studies was made. "Trimorphic" formulation was made for different facial and denture types.

1989 -- A protocol was devised for long-term growth and treatment studies.

1990 -- New findings were made for growth. Forecasting was good, but certain improvements followed. Boys were more than one year's growth larger than girls at the juvenile age. Cutoffs were confirmed for the sexes at 14.8 years for females and 19.0 for males. Many growth details were found.

1992 -- Minitaurus bands were designed.

-- The .017" X .017" wire was rounded on the corners for ease of application and identification.

-- Long range annual growth was computerized.

1993 -- A new light wire plier was designed for aid in loop construction and aid for intra-oral regulation.

THE BODY OF

BIOPROGRESSIVE PRINCIPLES

THAT MAKE UP

THE

RICKETTS PHILOSOPHY

THE BODY OF BIOPROGRESSIVE PRINCIPLES

1. Principle of unlocking of the malocclusion in stages.

2. Principle of application of optical pressure for tooth movement.

3. Principle of cortical anchorage and cortical avoidance.

4. Principle of simplicity of technique application.

5. Principle of efficiency with mechanisms.

6. Principle of Intra-oral Regulation (I.R.).

7. Principle of control of anchorage with priority of anchorage.

8. Principle of replacing "control" concept, with its immediate and continuous fixation of teeth -- with a concept of "order".

9. Principle of orthopedic alteration of skeletal structure and factors of general orthopedics applied.

10. Principle of induced change in the oral environment through the practice of orthopedics.

11. Principle of counter-acting the factors causing undesirable mandibular rotation.

12. Principle of setting up the lower denture first except in cleft palate and Class III.

13. Principle of "Prediction" or the VTO construction as a planning procedure.

14. Principle of over-correction of teeth and arch relations.

15. Principle of use of interrupted force.

16. Principle of application of sophisticated cephalometrics for planning and monitoring.

17. Principle of esthetic equilibrium through application of the esthetic line and the cheek planes.

18. Principle of selection of options based on possibilities, probabilities and feasibilities.

19. Principle of application of the forces of occlusion of the incline plane and the forces of eruption.

20. Principle of muscular anchorage and release of restricted muscle action.

21. Principle of control of the environment through myofunctional procedures.

22. Principle of anchorage and/or molar movements with vertical growth of the ramus.

23. Principle of band or bond height orientation to the marginal ridges.

24. Principle of designing optimal torque values for anchorage, treatment efficiency, overtreatment and provision against relapse.

25. Principle of an orthodontic ideal arch form as safety factor against post- treatment adjustment.

26. Principle of phasing of treatment.

27. Principle of adaptability and resourcefulness of one mind to all phases.

28. Principle of management of habit patterns and muscle problems.

29. Principle of avoidance of interproximal binding, selerosing restraints and the need for frictional override.

30. Principle of the use of lingual couplings and counter movements.

31. Principle of intrusion of teeth.

32. Principle of maximum prefabrication.

33. Principle of augmentation of intrusion of upper incisors by application of high pull applied between the central incisors.

34. Principle of preservation of root structure.

35. Principle of preservation of alveolar crest height, gingival height or clinical crown exposure.

36. Principle of the squeeze technique for surgical and non-surgical cases.

37. Principle of pain control for orthodontics through control of force and selection of appliances.

38. Principle of pain control for teeth, joints, muscles, fascia, nerves and periosteum through physical and physio- palliative and remedial.

39. Principle of pain control for parapsychological problems through esoteric procedures.

40. Principle of manicuring and recontouring.

41. Principle of composite resin buildup.

42. Principle of esthetic bleaching.

43. Principle of tooth reduction and reproximation.

44. Principle of psychologic motivation in children and adults.

45. Principle of adult therapy with a classification of different treatment rehabilitative types.

46. Principle of long term consideration in the planning of surgical cases.

47. Principle of implant augmentation for facial components.

48. Principle of the Polar Phenomenon.

49. Principle of apical mandibular growth and stabilization concept of mandibular anchorage.

50. Principle of application of long-range forecast for treatment planning and the optimizing objectives with the forecast in long-range - the FLO.

51. Principle of computer composites for determining characteristics of groups, monitoring and comparison of various orthodontic technique.

52. Principle of root rating scales for estimates of pressure application.

53. Principle of corticotomy for preservation of anchorage and ease of movement.

54. Principle of lower third molar enucleation of early removal of permanent lower second molars.

55. Principle of compliance with the line of occlusion.

56. Principle of emplacement and collocation of occlusion.

57. Principle of refinements of occlusal contacts - the occlusogram and the principle of stripodization.

58. Principles of three plane control and three order concepts throughout treatment.

59. Principle of singular arch form coordination and pentamorphic shapes to cover all but a few of orthodontic problems.

60. Principle of application of the golden section or divine proportion and Fibonacci numbers to facial structure, the skull and the teeth.

61. Principle of iatrogenicity of the temporomandibular joint.

62. Principle of coordination of banding and bonding.

63. Principle of application of the lingual friction lock tube of Wilson, and some of the modular components.

64. Principle of modified arch type and spring type appliances.

65. Principle of surgical relief for tight lips.

66. Principle of maximization of the bony chin surgery.

67. Principle of a physiologic centric.

68. Principle of nutritional and biologic support with the concept of food sensitivity and physiologic individuality.

69. Principle of optimization of the lingual approach for detailing.

70. Principle of maximum use of the computer "in house" or preferably a commercial laboratory.

RICKETTS PRINCIPLES FOR THE 1980s

1. First select procedures that will make a profit and still produce the highest quality possible.
2. Learn all methods - no single method is a panacea.
3. Select the most appropriate therapy for each case.
4. Know natural growth in general and growth mechanisms in particular.
5. Know and apply long-range forecasting because it affects the treatment plan.
6. Know orthopedic and orthodontic possibilities - otherwise you will plan defensively.
7. Start in deciduous and mixed dentition phases for best advantage of growth and orthopedic change.
8. Remove the hazards in the way of treatment.
9. Appreciate a cybernetic feedback in the planning process.
10. Employ the four-position procedure for determining the details of anchorage requirements.
11. Major anchorage in an intra-oral regime comes from cortical bone and muscle.
12. Transformo anchorage takes precedence over proximal anchorage.
13. Extra-oral anchorage has specific applications and benefits.
14. There is virtue in a staging sequence.
15. Utilize prefabrication as much as possible.
16. Treatment starts with an unlocking of the malocclusion.
17. Three-dimensional control of each tooth is preferable throughout treatment -- particularly in non-extraction.

18. Sequences or progressions follow in a hierarchical order.
19. Pre-torquing and preangulated formulas are selected according to facial and denture type.
20. Continuous force is most advantageous for tooth movements.
21. Intermittent heavier force may provide more orthopedic effect.
22. Frictionless techniques are more predictable and use less anchorage.
23. Slow palatal separation is superior to rapid palatal division.
24. Intrusion is the easiest movement.
25. Intermaxillary elastics are the most simple and useful form of arch correction.
26. Rotations should not be attempted until space is created.
27. The bite should be opened before retraction of upper anterior teeth is made.
28. Breaking up the arch (sectioning) shifts anchorages to favorable advantage.
29. Arch integration requires careful attention.
30. Full control is delayed until the ideal arch stage (Step 6).
31. Arch form is selected according to type.
32. Overtreatment is the rule.
33. Progressive withdrawal is as important as progressive entrance.
34. Metapositioning can always be expected.
35. Third molar problems should be solved and avoided.
36. Subtle growth changes occur in adulthood.
37. The condyle should be maintained in an alpha position.

THE DOCTRINE OF LIMITATIONS REVISITED

by Robert M. Ricketts, D.D.S., M.S.

INTRODUCTION

In 1969 in Part II of papers on professional and public relations in orthodontics, I listed 24 maxims or basic beliefs in orthodontics that we found no longer acceptable clinically.(1) That paper was written 32 years after my graduate education in which many of those dictums had been vigorously defended in our training. With years of research and clinical experience I was compelled to challenge that existing "Doctrine of Limitations" which had apparently grown out of the practices with the appliances in use in the 1930s and 1940s.(2),(3),(4) When these challenges were announced at a national meeting of the Angle Society in 1967, there was naturally some resentment and alarm.

Subsequently, during the 1970s, hundreds of patients, who had been treated with the newer methods, were recalled and studied in long range (up to ten years). The objective was to quantify and to check the stability and final results of the patients treated with the "new doctrine".(5) The interest of these studies was not only for stability. The testing of the newly discovered cranial growth of the mandible and anchorage concepts derived therefrom were also to be investigated.(6)

In the course of the 1980s the facial, skeletal and soft tissue structures came under scrutiny with the "divine proportions".(7) This was combined with routine cephalometrics for better planning of mandibular rotation, and an improvement in planning esthetics.(8)(9) In that decade the "pentamorphic arches" were also described,(10) together with findings suggesting at least three different new bracket and tube formulations (Proversion, Mesioversion and Retroversion) for clinical application in different types.(11)

In 1990 a large-scale study of 113 subjects was conducted on growth from the juvenile ages to maturity in both treated and untreated conditions. Forecasts were made of these patients, and the methods were tested and even further improved.(12)

Now, after another 20 years, the effort is made to "revisit" that era of the limitation doctrine in the light of current research and up-to-date information.

THE DOGMAS AND CURRENT VIEWPOINTS

These 24 unaccepted dogmas were ultimately increased to more than 30. Originally they were simply listed because prolonged discussion was not possible. Let us therefore revisit these aphorisms decreed to be false in 1969 and add to their discussion other newer concepts that have emerged since then.

CANON #1: THE GROWTH PATTERN IS ESTABLISHED BY THE FIRST YEAR AND THEREAFTER IS STABLE.

Discussion: Exception to that statement still stands. Brodie in 1941(13) had written on the growth pattern from the third month of life to the eighth year. Ten years later he showed that some patterns may grow more forward while others may grow more downward, but consistently in those directions.(14)

We found that quite often a remarkably accurate forecast was possible by as early as four years, but not at one year.(15) The forecast of one patient came rather close, starting at age two and one-half. However, age five or six is more preferable for the forecasting technique, but the original pattern is not just expanded. Much depends upon the technique used for assessing the growth pattern and the rendering of the forecast.

Additional comment: Linder-Aronson found a group of patients with respiratory obstruction to be backward divergent in the mandible but tended to recover after adenoidectomy.(16)

Facial growth patterns seem, therefore, to be influenced by a combination of genetic and environmental factors. One underlying phenomenon is that most of all animal morphology is probably related to electromagnetic fields and as long as these are maintained, the so-called pattern may be difficult to disrupt, sometimes even with surgery.

CANON #2: THE REST POSITION IS CONSTANT AND UNCHANGEABLE.

Discussion: Objection to that statement still stands. It was found in investigations in the 1940s(17) that the rest position was affected by the depth of the bite and after bite reduction the freeway space reduced by mandibular elevation at rest. It was later found in patients on whom a biotemplate was used for TM-joint cases, that in treatment the whole freeway space was filled, and almost always the establishment of a new rest position was witnessed. The ability to attain vertical increases in denture height is not a function of rest position. Clinically, some of the patients who have the greatest resistance to long-term opening of the bite are the deep-bite brachyfacial faces with wide freeway spaces. Some of those with the greatest tendency to rotate the mandible show very small freeway spaces in the beginning.

Additional comment: The fact that it changes does not mean that rest position does not have a remarkable value to the treatment of the TMJ condition. Vertical increases in facial height can be attained with neuromuscular override.

CANON #3: ORTHODONTICS IS LIMITED TO THE ALVEOLAR BONE.

Discussion: The concept of orthodontics at that time was concerned with the mandible and grew out of the early work with cephalometrics in 1938 in the treatment of only 26 cases.(18) Brodie, Downs, Goldstein and Myer showed noticeable mandibular rotation which "tended to return" but no long-range studies were made of that preliminary work. Neither the types of treatment nor the ages of the patients for the 1938 study were conducive to skeletal change but other modalities were later found to influence mandibular development.

We now find that the mandible is affected in short term both by mandibular posturing and very vigorous elastics, but in the long term (7 to 10 years) it differs very little from a forecast of its size and form without treatment.(19)

The alveolar process extends much higher than would be imagined and is certainly capable of extensive modification by moving of the teeth.

Additional comment: While long-term stimulation is doubted in the human, inhibition of the condyle has been suggested iatrogenically and as a result of prolonged clenching of the jaws as a primary factor.(20) This, together with the loss of teeth, is thought to possibly damage the growing cartilage on the condyle. When iatrogenic influences are experienced and are particularly compounded with hormonal changes in the females at puberty, as recently reported by Arnett,(21) condyle resorption ensues.

It was shown by Thames, Sinclair and Alexander in 1985(22) that high-pull headgear on the upper molar tipped the palate and tended to bring the upper incisors into inference with the lower incisors and rotated the mandible excessively. A full amount of recovery from a 7° rotation of the mandible (on the facial axis) is doubtful. Long-term records have not been made available for study after such treatment.

CANON #4: THE MAXILLA IS FIXED AND CANNOT BE ALTERED.

Discussion: This was a major issue at that time and still is currently. In 1957 and again in 1960 we reported a major study showing a statistically significant change in the whole palate in Class II treatment. Change was particularly noted at the deciduous dentition and the mixed dentition ages.(23)

The mid-maxillary suture can be widened. Cervical extra-oral traction is capable of tipping the whole palate backward and downward! Reverse headgear can move forward the position of the anterior nasal spine and Point A. The upper jaw has two maxillae, one on either side, and is supported by several intermediate bones connected with sutural ligaments. It stands ready to be affected by prolonged forces.

Additional comment: We listed 22 mistakes that clinicians may make in the use of extra-oral traction;(15) therefore, skeletal alteration is not made simply because someone may use extra-oral anchorage. The headgear must be used in the appropriate manner to produce these changes described.

CANON #5: THE GROWTH OF THE MANDIBLE IS NOT INFLUENCED BY TEETH.

Discussion: In the broadest concept, this statement is probably true. The mandible grows in harmony with an entire cranio-facial kinetic chain of muscle. However, as described in Canon 3, the position of the chin was proven to be influenced by the manipulation of the teeth. We may back away slightly from our objections to the mandible in long range as long as it is not damaged.

We have experienced patients with the loss of teeth leading to what appeared to be compression in the joint and flattening of the condyle with inhibition of vertical growth in the ramus.(20,24)

It was also shown by Baumrind in 1981(25) in a significant sample of patients treated with high-pull headgear that a statistically significant undergrowth in the vertical development of the ramus or posterior height mandibular growth was recorded.

Additional comment: In the sample studied in 1990, of the 83 patients without treatment and 50 patients with treatment (mostly with the Bioprogressive philosophy), the growth in form and size of the mandible was essentially identical. Only a few patients were followed in long range after posturing devices were used, however. This does not mean that iatrogenic factors are to be ignored, because patients with obvious joint disease were not included in the study.

All distal displacement was not found to be an inhibiting factor in the growth of the mandible, as some still claim. Growth turgor of the condyle, or the growth factor, generally overrides the oral conditions. However, when clenching and bruxism lead to cartilage damage, there is not always a full recovery. The picture is further confused because patients with fractured condyles, with restored normal function, have undergone condylar regeneration almost to normal size,(26) but the regaining of normal mandibular length was questioned in our experience with unilateral fractures.

CANON #6: MOLARS CANNOT BE MOVED DISTALLY.

Discussion: This belief resulted from studies with the edgewise mechanism in which arch-leveling and ideal arch form was attained followed by second-order bends and inter-maxillary elastics.(27) It was shown that the upper molar could be inhibited from its normal downward and forward course, but was not moved

backward. An opening rotation of the mandible, the tipping of the occlusal plane, some growth, and the forward displacement of the lower arch seemed to explain the changes.(28) The idea was promulgated that if the molar could not be moved backward with the edgewise mechanism, then it could not be accomplished by any technique.

Findings in younger patients treated with extra-oral traction, however, showed that the molar could indeed be moved downward and backward almost the full width of the molar in specific cases.(29) When, as explained in Canon #4, the entire maxilla was altered and the teeth moved in addition to that, the upper molar positively could be moved backward when related to cranial references. It becomes totally a matter of technique, therefore. With the usual full bracket hook-up and with the use of "straight wire proximal control" and elastics from the lower arch, distal movement is not dramatic.

Extra-oral traction directly to the molar with no additional arch wire causes maxillary rotation and is combined with transverse movements to alter the whole complex.

Sectional mechanics such as the Ricketts push coil utility section and "transforme anchorage" also can move the upper molar distally easily in adult cases.(11) The Wilson Bimetric arch assembly, by applying all the force of inter-maxillary elastics directly to the molar, also has proven effective in distalization of the upper molar.(30)

Additional comments: After treatment with the release of the traction forces, the maxilla in the growing patient will tend to rebound at different rates. The upper molar will again tend to erupt and erupt downward and forward but now in a normal pattern. Ultimately, it may arrive at the horizontal position similar to its starting distance from the pterygoid vertical. Data indicates that the upper molar moves forward 1 mm. per year in natural development.(31) Therefore, even if it is held in position for, say, a treatment period and a retention period over four years, there would therefore be a 4 mm. distalization of its probable position in the absence of treatment.

CANON #7: THE FIRST MOLAR ALWAYS MOVES FORWARD TO TAKE UP THE LEEWAY OF THE SECOND DECIDUOUS MOLARS.

Discussion: The upper first permanent molar at an early stage is highly adaptable to the aggregate growth and behavior of the mandible and of the forces of occlusion.(31) Therefore, there is a tendency for the upper molar to quickly adapt to the space made available by the loss of the upper second deciduous molar.

The lower arch, particularly as viewed from the arcial development, moves upward and forward as a unit, and with the loss of the deciduous second molar in the lower the first molar tips out

the first premolar and canine may drift distally from their usual course if given the opportunity.

Additional comment: One of the most remarkable findings clinically has been premolar and canine drift in all directions during Bioprogressive therapy. With utility arches, a form of transforme anchorage, employed with expansion nopositioning will witness the distalization of the premolars together with buccal movement without bracketing or banding. A change in the environment will lead to favorable response of the canines. Distalization of the premolars prior to eruption in the upper arch have been shown as long ago as 1943 by Kisternagen as a reversal of their normal downward and forward behavior. The forces of occlusion, once the teeth are locked into correct performance, will tend to mitigate the amount of drift during the growth phase.(32)

CANON #8: INTERCANINE WIDTH CANNOT BE PERMANENTLY INCREASED.

Discussion: Intercanine width as measured from the tip of the canine crowns shows a strong tendency to return to its original dimension.(33) However, in specific cases a successful increase of 5 mm. has been noted. Probably this consideration more than any other led the orthodontist to extract premolars in the hope that canines could be moved backward into a wider space in the arch. However, in a study by Gardner of 107 long-range orthodontic cases, more relapse was found in the extraction cases than in the non-extraction cases. Ironically it was not always a factor of beginning arch-length deficiency.

The real key to success clinically is not to overexpand for the individual patient. It is also to be mindful of the connection of the oral environment. Skeletal widening in the upper arch may carry the origin of some of the labial musculature laterally and reduce the pressure on the canines.

Additional comment: With lower inter-canine width limitation in mind, our Fourth Dimension program was designed to deliberately tuck the canines inward and lap the contact of the lower lateral slightly labially. In addition, we lap the mesial contact of the first premolar slightly buccally to the distal of the canine. This gives the lower canine a freedom to adjust during and after the retention process. Patients who appear to be quite crowded are therefore over-widened to create space to bring the incisors through to be placed in alignment labial to the canines, and the canines are narrowed in behind the anteriors in order to prevent relapse.

CANON #9: TEETH CANNOT BE INTRUDED, SO OVERBITE MUST BE CORRECTED BY EXTRUSION OF POSTERIOR TEETH.

Discussion: Many scholars claimed that intrusion of anterior teeth was impossible.(34). This was perhaps due to the fact that

proximal anchorage (proximal tooth engagement) via a reversed Curve of Spee was employed in the attempt to accomplish anterior intrusion. For instance, with the old straight-wire philosophy the lower incisor was activated for a depression movement from a canine that was already extruded. The old levelling technique was an accentuation of the Curve of Spee in the upper and use of an excessive reverse curve in the lower. This acted, consequently, to extrude the premolars. When the pull of inter-maxillary elastics was added to this arch levelling technique, additional extrusion of the lower molar occurred. The extrusion of the lower was so much that even some intrusion of the upper molar was recorded due to masticatory muscular resistance.

Therefore, at first it was declared that the orthodontist could not intrude the anterior teeth, particularly the lower incisors. Then it was said that you should not. The idea proclaimed so vigorously by Schudy(35) was that an intrusion of the lower incisor will tend to return and be a factor in the production of a long face. But the key to success of intrusion of anterior tooth lies in the production of proper inter-incisal angles and the attainment of proper function.

Additional comment: The ability to intrude has been demonstrated beyond any doubt. Upper incisors have been intruded almost the length of their roots. Upper second and third molars have been intruded likewise almost the length of their roots. Once intrusion is started in the lower incisors, they can actually be impacted. Any tooth can be intruded given a proper pressure and a continuous force.

Forces of eruption are apparently in a range of 0.3 gram per square millimeter of en-face root surface. Double that amount of force and the tooth will intrude.(36) Because roots are conical in shape and the periodontal membrane stretches, a compression within the whole socket will occur. Thus, the resorptive process will entirely surround the tooth. Rapid intrusion will occur when the pressure is at the proper grade and the action is continuous once the lamina dura has been eliminated.

CANON #10: EVEN IF TEETH ARE INTRUDED, THEY WILL ALWAYS RETURN.

Discussion: An upper molar moved backward will, with further growth and development, move forward again under natural developmental influences. Likewise, an incisor can be intruded to the level of the premolar, and then the canine can be intruded downward to that same level. With growth ultimately the lower incisor may erupt back up to its original level.

It makes a difference which occlusal plane is selected for the measurement of the intrusion process and also which part of the symphysis is used for evaluation. We employ the true buccal occlusal plane. It is related to the corpus axis of the mandible for the most sophisticated analysis.

As it turns out, intrusion is the easiest and the safest of any tooth movement. Its stability is totally related to function of the opposing teeth and the lips. It will return to function if overintruded.

Additional comment: Any tooth can be intruded and will stay when it is properly opposed by normal function. In the absence of function or the absence of the opposing tooth, a tooth will tend to extrude, which is a well-known principle in all of dentistry. The clinician today must make a choice whether to intrude incisors or extrude posteriors for the treatment of deep bite.

It can be demonstrated that the lower incisor is in supraversion erupted in deep bites in all classes of malocclusion. If that is true, it should be placed into its normal position relative to an unobstructed buccal plane. During Class II elastic traction the upper incisor is extruded when it actually should be intruded. In faces with gummy smiles the upper incisor unit can be intruded as a segment or the two centrals may be moved in one stage followed by the intrusion of the lateral incisors. No thinking orthodontist today will still insist that tooth intrusion is an impossibility.

CANON #11: THE APICES OF TEETH WILL BE DAMAGED IF MOVED.

Discussion: My objection to this statement still stands. However, any movement that produces pressure ischemia will produce a localized anoxia and be a primary factor in necrosis of cementum. In order to accomplish apical movements safely it is largely a matter of technique.

Vigorous movement against cortical bone should be avoided. Probably the most common site of root resorption is in the upper incisors in Class II, Division 2 cases when attempts are made to retract the roots through the palatal plate. Particularly in adults we therefore perform a corticotomy of the palatal bone to facilitate this movement. Light continuous forces, especially of the transforme variety with the utility arch, with .016" blue Elgiloy wire can move the lower incisors bodily with little or no damage to the apices.

With the movement to a smaller bracket of the .018" variety, and with the use of lighter pressures, a great change was shown from the type of root resorption witnessed with larger wires and vigorous treatment with the .022" bracket. In fact, the dearth of serious resorption has reached the point where it is no longer a threat or grave concern.

We still are particularly concerned with resorption in patients such as asthmatics or in those with respiratory problems, who may have a deficiency in the supply of oxygen through the normal integrity of the blood supply.

Additional comment: If movement of the apices of the roots is not advised, all that can be achieved in orthodontics is the uprighting of the crowns over the existing roots. It was such a philosophy that led to the plethora of extractions that prevailed in the orthodontic specialty from 1940 to 1970.

CANON #12: TOOTH APICES WILL RETURN IF "DISPLACED".

Discussion: Just as the other phases discussed in this writing, teeth will remain and even improve in their positions if proper function is established. The incline-plane action, the forces of eruption, the forces of growth, and the forces of the musculature are the "forces of occlusion" and are all factors in stability.

Additional comments: It was for this reason that we designed the concept of the "therapeutic ideal" as a principle of the Fourth Dimension formulations. Certain teeth require "over-treatment" in order to exercise the forces of occlusion or, as we say, be given the opportunity to "settle in". If proper function is not attained, or principles of arch form and treatment are violated the teeth may "settle out". The therapeutic ideal was a product of the study of post-treatment stability in patients.(37) It resulted in the establishment of the pentamorphic arch forms in the 1970s.

CANON #13: THE LOWER INCISORS MUST BE OVER BASAL BONE TO BE STABLE AND SHOULD NEVER BE MOVED FORWARD.

Discussion: This statement should be tempered greatly. In patients with lingually displaced lower incisors or in conditions in which the entire lower arch is retruded on its denture base (or on the body of the mandible) what are the alternatives when the lower incisors are not moved forward? They are the flat mouth, the receded denture, and quite often the deep bite associated with over-retraction of the lower anterior segment. This canon of belief emerged also as a result of experiences with the early edgewise philosophy.(3,4,27) A vigorous and rapid treatment led to moving teeth faster than the tissues could respond. In addition, bite opening by mandibular rotation increased the strain on the lips, which put pressure on the muscular containment apparatus on the labial. It is no wonder it broke down.

During treatment, while excessive pressure was being placed against the labial crest from the inside, an increased lip tension was provoked. The practice of "proximal control" and arch length increases by advancement from the molars or a continuous wire were factors which we learned to avoid.

Because "teeth-over-bone" was an established concept of prosthetic dentistry, it became immediately accepted. Thousands of patients were extracted due to the fact that the orthodontist felt that forward movement of the lower incisor was a dangerous

procedure with the older edgewise practice.

Additional comments: The advent of (1) the bumper plus (2) the shielding appliance of removal varieties, together with (3) the use of multiple loops to shield a gingiva from the pressure of the lower lip, and (4) bite opening without mandibular rotation, and finally (5) the advancement of lower incisors simultaneously with intrusion all contributed to the change in this concept.(38)

We have devised a lip-releasing operation aimed at the quadratus inferioris muscle where it attaches to a raphe in the center of the lower lip. Removal of a central band in the lower lip, together with stretching of the lower lip, resulted in some remarkable stability of patients who were treated with as much as 10 mm. forward movement of the lower incisors.

It should also be borne in mind that the "ridge" is actually the planum alveolare or the lingual cortical plate of the mandible. It is formed following the eruption of the teeth, and is guided by the influences of the muscles.(39) It has been seen to follow the forward movement of the lower incisor, and ultimately remodel in response to function.

CANON #14: RETRACTED ANTERIORS WILL RETURN IF PREMOLARS ARE EXTRACTED IN DOUBLE PROTRUSIONS DUE TO TONGUE ACTIVITY.

Discussion: This comment was frequently repeated by Brodie, who was a staunch advocate for non-extraction.(40) In some patients he was correct. On following double-protrusive extraction cases for many years, we found that certain cases did respond as Brodie suggested. These were often patients with loose flaccid lips, thick alveolar process, and large tongues. After retraction slight spaces opened up during the course of retention. And with further maturation, particularly in males, the whole denture displaced forward again very similar to its original state.

In other patients with thinner lips and smaller alveolar processes, and less time for growth after treatment, the reduction of the double protrusion not only held but sometimes crowded up.

Additional comment: These findings point to the wisdom of long-range forecasting when considering any extraction. It is also a matter of evaluation of lip competency as advocated some years ago by Rosen.(41) It is certainly much easier on the orthodontist and on the patient to treat Class I double protrusion cases with spaces by closing them up, holding the denture and awaiting future development. This is particularly true of the black race which often has large strong jaws, loose flaccid lips, and abundant alveolar process. It means prolonged active retention processes in these types. Treatment of severe double protrusion or severe crowding in Class I in adults with extraction is correct. Even in some of these types advancing genioplasty is an alternative to extraction.

CANON #15: PRINCIPLE ANCHORAGE COMES FROM THE PULL OF THE PERIODONTAL MEMBRANE.

Discussion: This was another concept promulgated by Brodie. It was found by histologists that bone resorption was a more rapid process than bone apposition. If this were so, bone resorption, being the most rapid, would leave more resistance (or anchorage) on the tension side. It was reasoned that the periodontal membrane was in this final analysis the structure which would therefore produce the anchorage.

However, as shown by Storey and his students in Melbourne in the 1950s and 1960s(42), within a matter of only eight minutes the periodontal ligament had stretched on the tension side, causing pressure of the root or against the bone of the socket. Earlier Reitan(43) had shown that moderate to heavy pressures produce a hyalinization-type of reaction in the compressed area. This site was incapable of resorption except by tilanking or rear action. Storey also observed this phenomenon and called it a cell-free area into which the interstitial fluids had been compressed and no biologic support of oxygen and nutrients nor cellular waste elimination could occur. Ricketts observed this phenomenon and likened it to the sclerotic changes that occur in bone under heavy force in joints. This observation became one of the basic principles of differential pressures for tooth movements.

It would appear that, despite histologic findings, bone resorption occurs at a faster pace than apposition, it is the rate of resorption that yields the resistance to tooth movement. Two considerations are of interest. First, about one gram per square millimeter in en-face root surface is in the range of an ideal force for production of tooth movements. If a large area of resistance is placed against a small area of resistance then the larger amount of surface-bearing area would be consequently under less pressure than the area intended to be affected. In fact, this is the principle of the canine retraction loops designed by Ricketts in the 1950s.(44)

Canines are to be moved distally with no more than 150 grams of initial force. As it is depleted down to zero, it yields an average of 75 grams throughout the life of an adjustment. This produces a maximum protection of the posterior anchorage and serves for greatest efficiency in moving the canine root.

The second proposition would be to use a force great enough to produce sclerotic changes on both sides such as a straight wire tieback. Therefore, one sclerotic area would be pitted against a second sclerotic area, and it would then be an uncontrolled matter as to which would give way first.

Additional comment: These theories in general apply to movement within the alveolar process and within the labial-lingual plates (or the trough). They are also altered by muscle forces,

the forces of occlusion, and compounded with the pull of intermaxillary elastics.

Orthodontics clinically is certainly a game of anchorage, and another two propositions exist. One is a reinforcement of anchorage by extra-oral or intra-oral plates such as Nance holding arches in which heavy forces can be hopefully continued. The second proposition is the reduction of the drag on anchorage or the lessening of the demands of the anchorage by moving fewer teeth at a time and in the kinder and more gentle manner.

CANON #16: TOE-HOLD POSITIONS PROVIDE THE BEST ANCHORAGE.

Discussion: If the pull of the peridontal ligament supplied the anchor, then tipping the lower molar backward would put the tooth in a position where the pull of the elastic would be more directly perpendicular to the peridontal ligament as a whole or parallel to the individual fiber. Further, it was suggested by histologists that by moving a tooth in one direction osteoid or pre-bone formation would be more resistant to resorption. Therefore Tweed, in particular, tipped the lower buccal segments posteriorly with second-order bends activated with Class III elastics. The elastics were subsequently reversed to Class II elastics, in which it was hoped that the occlusal plane would be altered less with less extrusion of the posterior teeth. Because a directional pull was used on J-hooks for the upper arch it was hoped that extrusion of the upper anterior portion of the arch would occur to a lesser degree. However, if the best anchorage comes from heavy bone, toe-holding between the alveolar plates or in the cancellous bone is not the best source of anchorage.

We therefore sought anchorage from the heavy plate of bone on the buccal from the second premolar distally in the mandible. The thickness of the buccal plate or the compact bone, also referred to as cortex bone, offers a great advantage. In the early 1950s, following the use of the ribbon arch, more anchorage was found from the use of only the lower first molar and lower incisors at the age of seven and eight than had been seen in the whole arch at the age of 12 or 13. Examination cephalometrically and directly (clinically) led to the conclusion that it was due to cortical anchorage as had been noted by Gilford as long ago as 1898(45). The resistance of the palatal plate of cortical bone lingual to the upper incisors was mentioned previously. Special note should be taken of the retraction of canines when the roots are tipped buccally or against the external cortex.

Additional comments: "Toe-holding" for the lower molars is probably a bad label. But if it be used it should receive more attention in the buccal-lingual direction than in the mesial-distal direction. Even when Tweed prepared cases, the lower molars were also torqued lingually, and hence the roots were inclined to the buccal under the thick cortical plate, which was not recognized at the time.

For intra-oral regimes, for space closure or for inter-maxillary traction, we try to situate resistant teeth behind cortical plates as much as possible. Accordingly, we avoid the cortical plates for teeth that are desired to be moved.(46)

CANON #17: MOVEMENT OF DECIDUOUS TEETH HAS NO EFFECT ON THE PERMANENT TEETH.

Discussion: Intra-oral regimes had been disappointing in the early 1920s. Angle, however, during his entire 50-year career up until 1930, always was an advocate of early treatment.(47) It is a well-known fact that the upper first permanent molar erupts as guided by the distal surface of the upper second deciduous molar. Therefore, wherever the second deciduous molar is positioned the upper first permanent molar will follow. Consequently, if a Class II condition exists in the deciduous dentition, the permanent molars will likewise erupt in a Class II position. If the deciduous second molar is corrected by extra-oral force by age five, the first molar will erupt Class I by age six or seven years. The first permanent molars by age seven should be in a locked Class I condition.

In 1950 our early work in cleft palate cases studied with tomography showed that with the use of the old .040" gold "W" appliance, the maxillary skeletal base was being altered in the transverse plane(48) and the permanent teeth were moved with the deciduous teeth were over-corrected. Still later, by 1954, we discovered that the anchorage supplied by the second deciduous molar, when treated with face bow and cervical traction, was sufficient to alter the entire midface structure, contrary to anyone's imagination at that time. Early treatment of Class II and Class III with extra-oral force therefore became a common practice.

Mandibular activation also may play a role in producing arch changes and changes in the oral environment to induce better cases for correction of the entire arch. Certainly if a cross-bite can be prevented in permanent dentition by correction of the deciduous crossbite with only three to four months of correction with our quad-helix appliance (with slight over-treatment recommended), the patient will have received a major service with very little cost and time.

Additional comments: From 1952 until about 1970 I was a member of a very popular study club made up of graduates of the University of Illinois and University of Washington called the "Illiwash Club". I treated many young patients and was continuously warned by other colleagues that one day I would have all these cases to "strap up" and "retreat" and that I would be sorry for having all those patients so long in my practice. The day for my sorrow never came. I went the other way -- to even younger ages. The good received for the time spent was more than justified, as far as I was concerned.

CANON #18: TEETH DO NOT INFLUENCE THE ESTHETICS OF THE LIPS.

Discussion: Protrusion of the upper incisors will cause the lip to thin. Retraction of the upper incisors will cause the upper lip to thicken. But there is not a one-to-one relationship between tooth movement and lip behavior.(49) When the retraction of the upper incisor is great enough, the position of the upper lip will change remarkably. It is also the upper incisor that determines the curve of the lower lip because the lower lip contains the upper incisor about 3 mm. on average. It is the lower incisor which determines the position of the sub-labial tissue in the area of soft tissue B Point.

Additional comments: Teeth have a direct bearing on esthetics. We made several artificial dentures in an edentulous patient simulating different malocclusions, and found a direct bearing on teeth and esthetics and function. Yet even a normal "bite" is no guarantee for optimal lip esthetics. This is another reason why long-range forecasts are needed for the best opportunity of ultimate lip balance and mouth harmony in the divine proportion.

CANON #19: NOTHING SHOULD BE DONE UNTIL THE PERMANENT TEETH ARE ERUPTED BECAUSE RETREATMENT WILL BE NEEDED.

Discussion: Many people took exception to early treatment, because they felt by waiting all the teeth could be manipulated at once and in a very short time. The question was, "Why get involved in years of early care when, by waiting, it could all be done in a year or so?" This was an argument when younger patients sought treatment in the graduate Orthodontic Department at the University of Illinois. When turned down there because of age alone, they went to the Pediatric Dental Department and received early care.

In my experience, in one out of four of even the most severe conditions, primary treatment when conducted properly was so satisfactory that secondary treatment would be hard to justify. It was particularly important in some Class III's. One out of four, on the other hand, would still need significant work later.(50)

After over-correction in the deciduous or mixed dentition the occlusion may develop to a satisfactory state with no further correction. Two out of four may require further treatment, but it is finishing treatment, not retreatment. It should not take more than nine to twelve months for this phase of detailing.

Additional comment: I always asked the question, what would I do if this was my child? I gave the parent the option of early treatment vs. late treatment. Almost invariably they would say, "Let's do it now. I don't want to just sit by and watch the condition worsen." It should be recognized that I used growth forecasts from the very start of my practice from 1951 on. I always have anticipated the form and size of the face. This had two

functions: first, I could be bold in my treatment regimes; and second, I could be more steadfast with an opinion, based on the expected growth to take place, and not "bail out" with extraction "midstream".

In observing more than 30 Class II, Division 1 patients in the 1950s over a period of 30 months with no treatment, the amount of maxillary incisor protrusion was seen to worsen 25%, which convinced me of the merits of earlier intervention.

In the 1980 study, however, untreated Class II's were studied in 17 Class II, Division 1 cases and 7 Class II, Division 2 cases, making a sample of 24. As these patients were followed for a mean period of eight years, the Class II at the molar slightly lessened but not the incisor relation.(12) The facial convexity was reduced only from 5 mm. to 4 mm., however. With the exception of two cases growth was not significant enough to overcome the Class II. Indeed, some patients went the other way, starting out as Class I and developing Class II conditions with growth. Therefore, the odds for improvement in occlusion by waiting are not significant, even though the maturation of the profile will mask the effects of the malocclusion esthetically, particularly in males.

CANON #20: MALOCCLUSION IS ONLY A GENETIC PROBLEM DUE TO SKELETAL MAKEUP.

Discussion: Two concepts are involved in this statement. The first is genetic endowment in the etiology of malocclusion. The second is the role the skeleton plays in the production of a malocclusion. It is true that the severe skeletal dysplasias make it very difficult for Nature to compensate for a mis-match in the size and position of the upper and lower jaws. Skull specimens in Nature, however, are found in which a compensation in eruption and function of the tongue and lips has been great enough to overcome both high and low convexities without orthodontic treatment.

However, findings reveal that the majority of malocclusions have no severe skeletal problems.

Additional comment: As shown by Conrad Lorenz,(51) muscle patterns are inherited also. Therefore, to a degree this canon might be more correct than is realized. It is possible we may inherit our swallowing, speech and lip action patterns!

However, thumb, tongue and lip habits firmly established are usually the sources of a relapse. This strongly suggests that they play an important part in the etiology of the malocclusion in the first place.

CANON #21: IT IS IMPOSSIBLE TO OBTAIN A DECENT OCCLUSION WITH EXTRACTION.

Discussion: This statement was heard from gnathologists. It is certainly no sin to extract premolar teeth when necessary. Very few trained orthodontists argue the cause of complete non-extraction of pre-molars. However, in the 1960s the popularity of the Crozat appliance among general practitioners was high. Many dentists who specialized in fixed prosthetics and the mounting of models on articulators took gross exception to many extraction cases they experienced. For this reason, we heard the statement that extraction ruined the occlusion. It took about five years for most of the followers of the Crozat method to get burned sufficiently to cause them to withdraw from the lure and panacea claimed by this and other removable appliance advocates.

Extraction is actually a conservative method in some patients, but it takes more time and more work and more sophistication to finish properly. It is easy to reach the illusion that the teeth have been straightened at an early stage in extraction treatment. But a good or ideal functional performance will not have been attained without careful finishing procedures. When finished properly, occlusal patterns are just as good with or without extraction. The width of the canines and their anterior-posterior positions and the excursion paths can be the same with or without extraction.

Additional comment: Proper incisal guidance, a proper wave of occlusal contact in mandibular motions, and muscle patterns are undetectable for a difference in extraction therapy when it is finished properly. I am afraid that some general practitioners are over-zealous in the condemnation of extraction. I also recommend special tubes for the second molars in all cases to position these teeth out of interference.

Now, in 1990, there seems to be a sort of consensus among the profession of around 20% extraction at the full dentition level, and more of course at the adult level. But in the younger patients many practitioners have reported a 10% or less extraction of premolars if the patient receives attention at the mixed or the deciduous dentition level. This is a far cry from the 90% extraction level of the Begg treatment and the 65%-75% extraction level of the Tweed followers of the 1960s.

CANON #22: THERE IS ALWAYS A RELAPSE OF OVERBITE IN EXTRACTION CASES.

Discussion: The basis for making this statement probably rested on two propositions. First, in the extraction for double protrusion or even extraction for crowding, as the anterior teeth are retracted and uprighted from positions tipped forward they tend to extrude. Since intrusion of the incisors was not recognized in the 1930s to the 1950s, extraction and space closure frequently

were associated with greater overlapping in the upper and lower teeth. This was often erroneously thought to be due to loss of vertical facial dimension.

Second, in order to care for these conditions, the arch wires had to be reversed for the Curve of Spee in the lower, and increased in the upper, which extruded the premolars and first molars. This gave rise to mandibular rotation in the course of treatment.(52)

Additional comment: As the mandible tended to rebound after treatment due to the force of the masticatory muscles, the bite would tend to close under this tension. In addition, the high inter-incisal angle (135°+) would permit the "bite" to settle all the way to the cingulum, and often crowd the lower anteriors with the deepening of the bite.

In some patients, but certainly not all, the rabbiting of the upper incisors in the absence of enough torque led to incisor or canine interference, and this combined with excessive mandibular rotation was thought to be a cause of distal displacement of the condyle and the development of clicking. Extraction per se was thus not a cause of this condition, because this can be produced in patients without extraction. Indeed, it may also happen as a result of natural causes.

It was for this reason that I advocated the treatment of the overbite by intrusion of teeth before the overjet is reduced! Literally all extraction cases other than direct open bites require intrusion before retraction, or certainly intrusion during the course of retraction. These therapies are common in the Bioprogressive philosophy.(54) It may take years of experience to understand and appreciate this discipline in orthodontic therapy.

CANON #23: THE GROWTH OF THE FACE IS SO COMPLICATED, IT IS UNPREDICTABLE.

Discussion: The publication of these canons of belief was in January of 1969 but they were formulated in 1967. In May of 1968 we presented the famous Blueback on Computerized Cephalometrics.(54) At that time, we were using a short-term forecast technique which used a two-year or a two-module period of time of growth only as a beginning matrix for the drawing of a treatment design. It was never presumed that this would be accurate in the long range, or more than three years. However, by using growth as a matrix and by superimposing the effects of treatment caused by a given appliance therapy, we could arrange the teeth according to the most desirable arrangement under the circumstances and set the objectives to be worked toward in treatment (the V.T.O.).(55)

While the whole thing was called a prediction, it really was only a prediction if the clinician would be able to execute a plan

to bring the changes about. It thus was more of a treatment planning tool.

We had become disenchanted with the use of Point Sella as a starting point. We had shifted from the Y axis to the Facial axis as measured from the Nasion-Nasion plane centered at the Pterygoid Point as the central area for growth and behavior analysis.

The findings of the original computer study, started in 1966, showed that the mandible bent more acutely during growth. It was obviously growing up some sort of a curve. After two years of searching -- by 1970 -- we determined that the arc of growth was on the radius of the distance from a new point (Point Eva) to Protuberance Mentl (Pm).(6) Point Eva was at the center of the base of the Coronoid Process. We further felt that it was probably the long leg of a logarithmic spiral. Therefore, for the first time, after 22 years of study, I felt we were capable of making true long-range forecasts of the mandible.

After several experiments concerning methods of relating the predicted mandible to the future face, we were able to devise something workable. Now, after almost another 20 years of attention to the method, even better procedures have resulted.

One problem all the way through the research was that we lacked the X-rays of long-term untreated subjects. We had some data based on trial and error in case after case of treated patients. But our statistics and proof to satisfy the scientific community were lacking. We had satisfied ourselves that a reasonable and practical accuracy was possible and feasible. When a prediction of a four-year-old boy can be made, which comes out almost as good as the tracing made of the same subject at age 35 (or over almost 30 years), even if it could only be done on only one person, that is a remarkable achievement.

We came to expect that kind of accuracy almost on a routine basis. However, an absolute prediction is unrealistic. In the hands of a person who is not making tracings on a regular basis, a 1 mm. error, or a 1° error, in tracing is generally conceded. If the error were on one side at Time 1, and on the other side at Time 2, then a 2 mm. tracing error itself is possible. Therefore, a 2 mm. error, just on the basis of the technique, must be the starting point.

We have tried to nail down clinicians on how they would react to the two following questions: (1) How close would you need to be in a forecast for planning on a practical basis (on say a 10-year basis)? (2) How large an error would it take to be misled by a forecast or to prescribe an erroneous treatment plan? So far the scientific community and the educators in orthodontics have not been forthcoming with any help in this regard.

Additional comment: There are five aspects to the making of a long-range forecast as it presently stands.(15) First is the

size and form of the mandible. Second is a forecast of the cranial base references. Third is the size, form and position of the maxilla. Fourth is the development of the occlusion or the position and location of the dentures. Fifth, and finally, is the forecast of the integumental profile. When it comes down to the real issue, it is the size, form and relationship of the jaws, the space available between the jaws and finally the limits by the muscles that determines the proper emplacement of the denture. Many of the details of growth and development in the face are therefore only of academic interest.

For routine clinical deliberation it comes down to the issue of vertical, horizontal and transverse dimensions of the space between the jaws and the relationship to the function and esthetics of the soft-tissue profile. I tested the more detailed features for values of long-range forecasting in 60 categories. Many clinicians may sense the virtue of treatment only on the basis of its short term and not realize the long-term implications.

The real truth is that growth is not only predictable in general, but in many situations it is almost absolutely predictable. Our efforts now are being directed at the misses when they occur, and finding if we can determine the clues to these misses when they occur. The accumulation of data and the statistics for these kinds of studies are presently being assembled. If we could go to Las Vegas with more than 75% odds, we would break their banks.

CANON #24: IT REALLY DOESN'T MAKE ANY DIFFERENCE WHAT APPLIANCE IS USED.

Discussion: Even in 1969 it was obvious to any careful cephalometric examiner that the results of treatment with various modalities produced different results. This I showed in 1960 by use of 100 patients as a control with a comparison of 50 patients treated with extra-oral traction compared to 50 treated with only intra-oral traction.(23) Greater growth on the Y axis was seen in the patients with the cervical traction. One of the suspected reasons even then was that excessive mandibular rotation could possibly be a growth-inhibiting factor in some of the patients. But we were far from making that speculation at that time.

However, certain questions may be asked with regard to the type of appliances used. One is its effect on skeletal structures orthopedically, which also includes bite opening by mandibular rotation. The second is the treatment effect on the maxilla or midface structures. Third is the effects on the emplacement of the dentures. A fourth is the effect on the soft tissue.

In the hundreds of patients in which forecasts of the mandible have been made after the use of mandibular posturing devices there has been no increase in the amount of growth forecast based on normal control samples. Also based on studies I reported in

1960(23), the maxilla could be altered with extra-oral traction when conducted properly in the Class II condition.

Baumrind in 1981(25) reported a study in which a control sample had been accumulated and recorded in the computer. He then compared patients treated with intra-oral (activator appliances), cervical headgear and high-pull headgear off the molars. To his shock, and which he could not explain, the patients treated with high-pull headgear experienced less ramal height development and mandibular growth than the normal controls. Also surprisingly, the patients treated with cervical traction had more vertical growth in the rami than the controls, and as much incremental growth in mandibular length as did those cases treated with activators. These were studied, however, only during the treatment experience.

In our study of 1990, treated patients in long range showed almost identical growth behavior in the mandible in size, form and position in the face as did the untreated sample. However, none of these patients received therapy which instigated a marked rotation of the mandible in the course of treatment with possible condyle compression resulting. It will be of interest to determine if patients treated with the Alexander technique and some of those treated with the pure Begg technique in the short periods of time will make a full growth recovery.

LATER EVENTS

In teaching some of these features which I called the Doctrine of Limitations, I was reminded of several others by students and colleagues, and the list grew to 30. I will mention only two more.

CANON #25: MYOFUNCTIONAL THERAPY HAS NO BENEFIT.

Discussion: The assumption was made by many orthodontists that simply correcting the teeth and achieving a better skeletal relationship was their only responsibility. In many patients correcting of the malocclusion will indeed induce normal function of the tongue, cause natural function of the lips to occur and invite normal function of the muscles of mastication. However, in others this may not occur.(56,57) It then becomes the job of the orthodontist (as an oral orthopedist) to either master certain physiotherapeutic techniques or seek the help of those engaged in the correction of oral physiology.

As said before, the mainstream and common type of orthodontic problems are not extreme skeletal problems although even minor skeletal dysplasias may be a complicating factor in treatment. This would suggest that the cause of the malocclusion and the cause of the relapse is due to a lack of proper function. Our idea in patient management is first to set up skeletal relations and to grossly correct the teeth. If, however, during the course of treatment, or at the end of treatment, the teeth don't seem to want

to go together there must be some obstruction. This requires oral physiologic regimen and not just mechano-therapy.

Additional comments: The current argument does not regard the place for myofunctional therapy. It is largely a matter of when and if. It is unreasonable to expect a child with an extremely high convexity to the face and a severe open-bite Class II malocclusion to achieve a full benefit from myofunctional therapy at that stage. A gross reduction of the malocclusion orthopedically, and waiting six months at least for the natural forces of occlusion to develop, is exercised first in our practice. If the oral malfunction still persists I consider it then time for myofunctional therapy.

Many patients after orthodontics has been completed and over-corrected will respond with no need for myofunctional therapy at all. On the other hand, if the orthodontist is not mindful of the oral, circum-oral and circumferential muscle chains, all acting in harmony, he is doomed to some sleepless nights.

CANON #26: SEVERE MALOCCLUSIONS IN ADULTS SHOULD BE TREATED WITH SURGERY.

Discussion: In the 1930s, mandibular setback surgery became popular for extreme Class III's. Thirty years later, after Tessier's work in craniofacial anomalies, plastic and oral surgeons were trained in the maxillary procedures as well as in a sagittal sectioning of the mandible. In the 1980s rigid fixation or screws and plates mostly replaced the older techniques of wiring of the segments after the surgical sectioning. With the number of trained surgeons available, and their willingness to do surgery for even minor amounts of movement, they have become very accessible particularly to the orthodontist committed to the doctrine of limitations.

The idea that was promulgated, therefore, was to set the mandibular teeth over the bridge, coordinate the upper arch form with the arch form of the lower, and ship the patient off to the surgeon for a mandiblar or a maxillary procedure or both. That kind of practice fit in very well with the limitation consciousness, and gave rise to the surgical boom of the 1980s.

Additional comments: There is no objection whatsoever to surgery when it is needed. However, it is not without risks. As of this date in 1990, in my travels around the world, I have had 26 deaths reported to me following Lefort surgery. However, these I have not documented. There always seemed to be some excuse for it. Only one of these was related to mandibular surgery. But children die in an ordinary adenoidectomy and tonsillectomy. The trauma and risks involved in maxillary surgery are several times more critical than in adenoidectomy alone. For this reason, we say that with contemporary orthodontic therapy, if it is an orthodontic problem, treat it with orthodontics. If it is a skeletal problem,

then consider orthognathic surgery. Advancing and reduction genioplasty is a good alternative to complete orthognathic risk,(56) and it can be performed as an "outpatient".

Some people are not comfortable with the prospects of jaw surgery. Others are incapable of undergoing the expense of it. Sometimes it becomes a matter of values. But the surgery is improving! It is my idea to prevent the majority of these surgical indications by early intervention in the first place.

SUMMARY

With the advent of the edgewise bracket and the ability to control all the teeth within an arch simultaneously, and with the addition of the romance of rapid treatment with second order bends and inter-maxillary elastics, and with the advocacy of a full complement of teeth, many orthodontists shifted to the delay of treatment and "control" with the edgewise appliance. However, many practicing with the original expansion techniques became dissatisfied with the results and looked for alternatives. Thus, in 1935 Tweed advocated extraction of premolars in many patients. In 1938 Brodie and the Illinois group suggested that orthodontics was limited to the alveolar process with the edgewise appliance. There was a further claim that the growth of the face was constant. Treatment was therefore "slowed down" and anchorage was "prepared". As a result, an orthodontist being trained in the late 1940s was faced with the mainstream of thinking of a limitation idea. This was followed by the concepts of Begg in which a host of extractions were employed almost to the extreme, and a return to rapid treatment was advocated.

After 20 years, and with better knowledge of cephalometrics and new parameters for the consideration of growth, and new appliances, exceptions were taken to that dogma in 1960. A revisit to those limitations indicated that 75% to 90% of all malocclusions were extracted. Even today some advocate surgery, even for the simplest kinds of orthodontic problems.

Summarized, these limitations consisted of seven major issues, which we now will shift to positive statements or to a doctrine of possibility or a more unbounded belief. They are placed in the following hierarchy:

ONE: Growth is predictable. Forecasts are well within a practical value for the long range, and a planning value in the short range given a specific modality of therapy. Third molar impactions are also predictable when the proper techniques are applied.

TWO: Skeletal change is possible. This is particularly true in the maxilla which is not only changeable, but is shown to be permanently stable after treatment. Short-range changes in the mandible are also possible, but these do not tend to

remain stable as present studies indicate.

THREE: Molars can be moved distally. Demonstrations have been made to indicate that when necessary the molar has been moved its full width posteriorly with extra-oral traction or slightly less with segmented or modular techniques. Even the lower molar can be held in check or moved distally from where it would have been had growth been the only expression.

FOUR: Teeth can be intruded. Teeth can be depressed in their sockets not a little but a lot. For so long we were hampered by techniques that did not permit us to exercise this possibility.

FIVE: The arch can be expanded. Expansion can be accomplished in the transverse and in the horizontal plane. Expansion does not necessarily mean forward movement of the lower incisor, because arches can be enlarged while the lower incisor is moved lingually. Again, it is a matter of technique.

SIX: The lower incisors and the entire lower arch can be moved forward. While this movement entails risks, expansion with intrusion and forward movement with intrusion sets the teeth into a deeper portion of the alveolus. The main issue is avoidance of pressure ischemia on the investment tissues.

SEVEN: Changes are possible in the oral environment. With orthopedics and some orthodontic treatment, a change in the environment will occur naturally, and teeth may drift into favorable positions. Myofunctional therapy and surgical lip release in the lower arch hold a great promise for permanent stability.

CONCLUSION

Time was when the orthodontist would pick up a set of hand-held casts and immediately ask the question, "Which teeth am I obliged to remove?" Extraction orders were written without the slightest provocation and forethought. This was followed later by the idea, "Yes, maybe some arch enlargement could be made, but then which jaw must be surgerized?"

Extraction will always be indicated and surgery has always had an important place, but the plea here is to study, plan and realize the possibilities with present modalities available. So the argument is not against extraction or surgery, but when and if it is necessary to use them.

The Doctrine of Possibility, therefore, requires a sophistication beyond the empiricism of the past. Through proper preparation, information processing, and technical competence in the newer methods, pessimism can be turned around. Worry, fear,

frustration and inhibition can be transposed into optimism, love of work, and service to mankind. Orthodontics can be made a source of joy and happiness to all concerned.

The goals have not changed. They still remain to be: optimal facial beauty, perfection in function, maximum of permanency and health of the tissue. All these goals should be accomplished with practicality, feasibility, efficiency and grace, and art in the technology. Good orthodontics can play an ever-increasingly important role in our modern society.

The idea is to first establish long-range goals to maturity, and on that set short-range objectives, and then go for it!

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ADVANTAGES OF A FORECAST TO MATURITY
OF YOUNG PATIENTS WITH MALOCCLUSIONS

[Five major categories with 57 specific applications]

I COMMUNICATION

II GROWTH AND ORTHOPEDIC OR SKELETAL ATTENTION

III GROWTH CONTRIBUTION POSSIBILITIES TO PERMANENT ORTHODONTIC CORRECTIONS

IV FOR USE AS BASIS FOR DETAILED PLANNING OF MECHANICS FOR ALL TYPES

V PROGNOSIS OF RETENTION PROBLEMS

I COMMUNICATION

A. To the patient and parent for:

1. Visualization of adulthood potentials
2. Their consideration of later size and form, for their decision-making relative to specific treatment presented at young age.
3. The idea that more is involved than just teeth
4. A confidence level in the clinician due to completeness and information base.
5. Help in deciding the best age or phase at which to start treatment.
6. To decide whether treatment will even be needed.

B. To the clinician for:

1. Prognosis of risks.
2. A new thought form for reference in selection of mechanics.
3. An image at maturity without treatment for consideration of skeletal, dental and soft tissue conditions which still need correction.
4. Confidence level of the practitioners in planning.
5. Information level on which to make judgments.
6. A framework for monitoring during the correction and after.
7. An aid for making the sale to the patient.
8. Practice enhancement -- puts the user ahead of competitors who are without it.

II GROWTH AND ORTHOPEDIC OR SKELETAL ATTENTION

A. Convexity management

1. Amount of skeletal maxillary reduction required (after natural growth contribution to convexity reduction or convexity worsening).
2. Amount of molar movement desired or molar movement to be combined with skeletal change.
3. Feedback for requirements of treatment in the lower arch.
4. Requirement for alveolar modification at Points A and B. (Both are affected by therapy.)

B. Concavity Management

1. Amount of maxillary skeletal advancement required for Class III.
2. Feedback for needed retraction of lower arch with progressive mandibular growth.
3. Amount of maxillary therapeutic advancement in certain Class II brachyfacial types. (Some become concave with treatment.)

C. Vertical Management

1. Determination of natural lower face height (denture height) for bite correction.
2. Amount of intrusion for deep bite.
3. Amount of extrusion for open bite.
4. Aid for torque formulas.
5. Determination of iatrogenic excessive mandibular rotation.

III GROWTH CONTRIBUTION TO ORTHODONTIC CORRECTION

A. Class I

1. Accommodation of expansion.
2. Amount of incisor advancement permissable.
3. Indications for amount of reduction needed with extraction.

B. Class II

1. Contribution of mandibular growth to correction of arches (both Division 1 and Division 2).
2. The amount of maxillary advancement needed in Class II, Division 2.
3. The amount of lower arch advancement permitted or required.
4. The amount of over-correction probably necessary.

C. Class III

1. Amount of maxillary incisor or arch advancement required.
2. The amount of reverse torque needed on upper incisor.
3. Prognosis of excessive mandibular growth.
4. Prognosis for delay for surgery of maxilla or mandible.
5. Determination of amount of mandibular rotation to be attempted.

D. All Types

1. Probable final arch form for all types
2. Torque Formulas for all types

a. Proveration

b. Neutroversion

c. Retroversion

3. Prevention of excessive overtreatment in specific patients.

IV FOR USE AS BASIS FOR DETAILED PLANNING OF MECHANICS, ALL TYPES

A. The Forecast to Maturity (FTM) as a framework for treatment designing.

B. Aid in constructing the Visualized Treatment Goal (VTG) (long range) for orthodontics and orthopedics.

C. Anchorage requirement determination for anchorage preparation, stabilization or slipping of molars permissable.

D. Denture emplacement for avoidance of flat mouths.

E. Denture emplacement for achievement of best esthetics at maturity.

F. Avoidance of retreatment.

G. Prognosis of ultimate posterior space for upper molars.

H. Prognosis of ultimate space for lower third molars with indication for germectomy.

I. Aid in determination for lower surgical lip release.

J. The long range as a feedback for short range decisions (VTO).

K. Aid in selection of a candidate for a "functional

appliance".

L. To set a target for planning emplacement of occlusion on more total basis.

M. For selection of patients for genial bony modification.

V PROGNOSIS OF RETENTION PROBLEMS

A. Treatment rebound expected.
(30% do not close down after treatment.)

B. Prognosis of bite relapse.
(open or closed)

C. Long term effect of tight lower lip.
(estimate of muscle adaptation)

D. Compensations required to prevent overuse of maxillary retainers and iatrogenic inducement of joint derangement.

E. The Forecast to Maturity as a diagnostic tool to determine abnormal growth behavior.

F. The long-range effects of continued pathologic growth.

G. The effects of asymmetry in mandibular growth behavior.

H. A framework for the reality of the mandibular advancing hypothesis.

THE PRESENT CIRCUMSTANCE OF THE TMJ

by Robert M. Ricketts, D.D.S., M.S.*

and Victor West, D.D.S., Ph.D., LL.D**

In the 1970s Ricketts identified seven different viewpoints, or schools of beliefs, regarding ettology, diagnosis and treatment of the TMJ.(1) They were listed as: [1] prosthetic, [2] mechanical, [3] biological, [4] holistic, [5] medico-surgical, [6] myomonitorial, and [7] orthopedic.

In the past decade a movement has been afoot to negate the various influences of occlusion as related to involvement within the TMJ. Interest has been precipitated perhaps by the amount of a court award to a patient. Possibly this was more on the basis of the orthodontist's disregard for the total welfare of the patient than with the joint per se. The result was that several workers joined ranks to produce a momentum toward complete indemnification of joint involvement with any dental procedure whatsoever. It further included any iatrogenic process on the craniomandibular articulation from any orthodontic procedure.

The Medico-Surgical Theory

In summary, this recent argument was precipitated from the medico-surgical viewpoint. This standpoint is identified, essentially as follows:

1. Neither occlusion nor malocclusion is a factor in joint disease.

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2. The loss of teeth has no bearing on the joint conditions.
3. The patient's psychological condition is the total cause.
4. Orthodontic treatment can have no iatrogenic effect on the joint.
5. No type of orthodontics has an effect on condyle or mandibular behavior in short term or long term.
6. While epidemiologic studies suggest the incidence of symptoms to be independent of occlusal relations, they conclude that malocclusion cannot be a factor.
7. The patients with symptoms are just as likely to get well without treatment as with occlusal correction.
8. No X-ray of the TMJ is trustworthy.
9. Condyles distally positioned in the fossa, identified as consistent with derangement, are of no significance. The original etiology somehow is a dysplasia of the disc or a primary disc displacement irrespective of condyle position.
10. Drugs are indicated to help a patient overcome pain or headaches and can be administered over long periods.
11. Any "splint" therapy is only placebo in action when successful in helping the patient.
12. All major problems should be corrected with surgery or by implants.

For the past fifty years Ricketts has been engaged in research concerning craniomandibular joint function, condyle growth, fossa development, degenerative aspects and the clinical management of

joint disorders. During that time he has diagnosed or treated an estimated six thousand patients with a wide variety of conditions of the joint together with thousands of routine orthodontic patients. All have been followed with oriented tomography, making up some 200,000 films examined. Many of the joint conditions as well as treated orthodontic cases have been studied a number of years after treatment. He started reporting the conditions identified in orientated laminagraphy of this joint in 1950. By 1953 Ricketts also suggested a classification of four functional conditions giving rise to specific symptoms and signs for consideration by the clinician; all joint pathosis was not alike. He recognized muscle problems as the cause from the start.(1) His arguments concerned the genesis of the primary muscle condition leading to a loss of mechanical homeostasis in this joint.

It would seem to the authors that some educators are advocating an abrigation of clinical responsibility for the diagnosis of the TMJ condition. However, as a result of our almost routine success of treatment clinically and with respect to the patients treated, as well as a responsibility to the thousands of students the authors have taught, it would seem that a position statement should be forthcoming.

The Orthopedic Viewpoint

Therefore, opposing arguments to that medico-surgical approach and those beliefs characterized by the orthopedic philosophy as advocated by Ricketts are stated essentially as follows:

1. The emplacement of occlusion itself can be a factor in

derangement in the joint. With normal occlusal relations present, a drift of the teeth and growth developmental problems can lead to derangement. This includes post-treatment retention after the orthodontic correction.

2. Conditions of facial morphology can be a factor in joint conditions because the joint is a part of a total facial complex. Asymmetrical condyle positions and morphology were identified in growing children with unilateral cleft palate conditions before 1950.

3. Malocclusions requiring functional accommodation can be a factor in production of disease states, particularly the Class II, Division 1. It makes a difference in the manner in which certain patients adapt to obtain function and parafunction, as all similar patients do not make the same accommodation.

4. Loss of posterior teeth has been associated with increased loading and abnormal compression in the TMJ both clinically(2) and experimentally.(3)

5. Malocclusion and missing teeth become a complication for the patient having a macrotraumatic injury to the joint.(4)

6. Local or systemic infections can invade the joint.(5)

7. The clinical picture may be one of traumatic arthritis as seen in other joints identified by overload in duration.(6)

8. Arthritic regression is typical of degenerative joint disease which almost routinely can be arrested with correct biotemplate treatment of occlusal conditions, improvement of the stabilizing role of muscle, and therapy for harmonizing the occlusion.

9. Psychologic factors are paramount, but the exact mechanisms for connection with the TMJ are usually not described by the medico-surgical school of thought. Psychologic stress can result in increased clenching patterns. Psychologic stress can also affect the body's immune system and weaken the resistance of the joint tissues to even normal functional loads.(7)

10. Arguments that patients will improve symptomatically on their own are made without explanation for either the cause or for the cessation of symptoms. Do these changes run the course of the disease? Are they due to a series of dystrophic remodelling? Do patients ultimately undergo muscle atrophy and dyskenesia which lessens the load? Is one disease transferred to another malady less evident to the patient and clinician? What is done for pain that may be present for years?

11. Certain types of orthodontic treatment have been found to be iatrogenic to joint conditions.(8) The particular type of orthodontic treatment can yield specific types of effects.

12. Theoretically orthodontics should improve joint conditions, not worsen them, or even result in the same frequency of involvement in the joint.(9)

13. While orthodontics can influence the joint behavior in a growing child, the genetic dominance seems to be reasserted unless overridden by an insult to the joint tissue and muscle.

14. Epidemiological studies are not acceptable unless valid and complete longitudinal records are available. A patient's

signs and symptoms are not adequate for an appraisal. Advanced degenerative processes have been observed without patient awareness.

15. Muscle and nerve analysis should be basic to any consideration of this joint because the TMJ function is not a part of the anti-gravity system of the body.

16. Cervical collars and Milwaukee braces not only inhibit growth but destroy the condyle as well.

17. The condition has been treated, and long-term success has been achieved by remedial biotemplate therapy. After initial success in some patients, subsequent poor occlusal reconstruction, planned from articulator mountings, re-instated the pathosis. Yet once more correction with the biotemplate achieved success in relieving the condition. This indicates that occlusal functions and mandibular posturing can be a primary factor in joint disturbance.

18. Scientific studies have established the normal condyle position and the normal range of variation.(10, 11) This provides a standard for comparison with the deranged and arthritic joint. Occlusal management done properly shows correction of the abnormal to normal conditions. This strongly suggests that occlusal conditions have a bearing on the joint health.

19. The innervation ratio to the muscles of mastication suggests a rapid response in muscle from a reflex arc located in the mesencephalic root of the fifth nerve.

20. The role of sensory input resulting from environmental factors

in neuromuscular activity may well suggest a similar role for stress in establishing a lowered threshhold for neuromuscular activity of the muscles associated with the TMJ.(12)

21. The teeth are a part of the body and one component of the stomatognathic system. In some patients the teeth wear, in others the teeth undergo trauma, and still others may show damage in fascial planes and musculature. Most have an involvement with muscle and finally cause some breakdown in the joint when propensity is experienced in that component.

22. Patients with severe Class III are observed to be generally free of disturbances in the joint. However, numerous cases with mild Class III, when efforts are made to gain incisor contact, will inadvertently retract the mandible into conditions of distal displacement of the condyle and derangement with clicking.

23. When vigorous Class III intermaxillary elastics are worn for cleft palate correction, patients have been observed to develop distal displacement and condyle jamming iatrogenically.

24. The habitual posture of the mandible and condyle was different from the normal in Class II and Class III.(13)

25. In the original reports of 1950 even the resting position of the condyle was proven to be affected by correction of deep bite and Class II.(14)

26. When some patients experience incisal interference during the treatment of Class II with intermaxillary elastics, the attempt to avoid trauma has been seen to produce distal

displacement and derangement. All such conditions indict the factors in occlusion as contributory to TMJ disease.

27. Different levels of X-ray sections can suggest different conditions and disc dislocation is not usually straight forward.

28. Perforations usually occur toward the lateral border, suggesting wear by occlusion. Central perforations are more suggestive of disc and cartilage pathosis primarily.

29. Cases with spasmodic luxation beyond the eminence have been corrected by occlusal adjustment only.

When isolated single cases are reported it is often considered anecdotal by the scientist. When two or three are seen his head is turned. When 30 are seen he now may consider it science.

Documentation for all 29 of these premises is available in not just one but in significant samples of patients. Each specific argument requires a separate discussion.

If these 29 premises and findings are untrue, Ricketts' career in this area, going back 30 years, has been an exercise in futility.

September 1992

THE
STABILIZATION AND GUIDANCE
OF METAPOSITIONING

By Robert M. Ricketts, D.D.S., M.S.

PART II - APPLICATION AND PRACTICE PROCEDURES

III. Principles of Retention

IV. Problems in Retention -- A Hierarchy of Risks

V. Techniques for Stabilization and Guidance

VI. Summary and Conclusions

Table II lists these factors in an organized manner.

PART II - APPLICATION AND PRACTICE PROCEDURES

III. Principles of Retention

A principle is a general truth that is essentially trustworthy, but not without exception. Several principles can be applied to the stabilization, guidance and maintenance of the occlusion after active full appliances are phased out in the treatment. These general truths or principles are as follows:

1. Retention should be taken seriously -- after detailed planning and difficult work during treatment the best assurances of perfection should be practiced.
2. Retentive procedures tax the orthodontist's utmost knowledge and skill.
3. Antagonism should be directed against the relapse tendencies after a restudy of the original model and the facial muscles.
4. Greatest final success starts with the set up for overtreatment and the Ricketts therapeutic ideal (Fourth Dimension Formulations) (Fig. 10A).
5. The older the patient the longer the need for stabilization.
6. Prolonged retention may be less objectionable that severe relapses of the occlusion.
7. It is most difficult to retain unfinished results.
8. Ultimate failure is assured if the causes of the malocclusion are not removed.
9. Continued respiratory problems with continued mouth breathing

pose a serious handicap to long term success.

10. Retention should receive attention in both arches, as they work against each other.
11. The sources of available retention support are the use of adjacent teeth, units of teeth, incline plane function, and extra oral force.
12. Progressive and guided release of the teeth from fixed appliances constitutes a proven procedure.
13. Removable retainers may lack compliance and will invite failure; therefore, fixed is best, particularly in the lower arch.
14. When organized into a system, a retention check-list procedure will save the clinician much time, grief and despair.
15. Stripping (interproximal reduction) with reproximation may be indicated and can be selectively practiced prior to, during, or after treatment.

A part of the diagnosis, in certain severely crowded conditions, is the indications for interproximal stripping. A common practice is to wait for the relapse to start before addressing the problem. Studies of significant samples with step-wise regression statistical analysis showed a hierarchy of factors to take into account, as follows:

1. larger than normal size of lower incisors;
2. recessive facial angles;
3. high oral gnomon angles;
4. high corpus axis angles (long face).

When these combine in one patient, stripping can be started during the treatment or at retention, rather than waiting for crowding to occur.

There already should have been a check list appointment for care of details of finishing with the step for idealization and arch coordination (see Tables I and II of Part I).

Beyond the ideal arch, beyond the straight wire, a further check for overtreatment in all aspects of the original condition is a further responsibility (Fig. 16B). It is best to review the original model even before retention and estimate the factors which need greatest attention in overtreatment. Traditionally, a partial removal of appliances and staging of finishing is actually the movement into retention (Fig. 16C).

When a routine is established, the best consistently superb results will be achieved.

There are eleven check procedures, as follows:

1. Oral hygiene - final instructions on brushing and the use of floss.
2. Caries check - cavitron, fluoridization and polishing for staining, and referral for operative work if necessary.
3. Periodontal checks with probing and recording if necessary (notably in adults).
4. Tooth modification (manicuring) and anatomical contouring of abnormal restorations if not corrected previously.
5. Self-image check with encouragement to the patient.
6. Retention records check.
7. Monitoring check (Four-Position Analysis).
8. Retention planning (from the original and progress records).
9. Mounting of certain cases on the articulator, particularly for positioner application.
10. Third molar and future growth prognosis.
11. Equilibration after six months of stabilization when indicated.

An important routine recommended to be practiced is the **retention records check.** A 1990 survey revealed that 52% of American orthodontic specialists fail to take final headplates. It is informative, practical, and it provides good protection in liability cases. In our practice, retention records include the following: models, intra oral photos, facial photos, frontal and lateral cephalometric head films, panoral films, and 20° oblique TMJ films (Tomographs or 20° to 25° oblique cephalometric films).

The special monitoring check is important. The four-position analysis supplies the most profound and sophisticated basis for assessing the growth and treatment changes and planning retention (see Fig. 2, Part I). With available cephalometric forecasts (to maturity), it is fruitful and informative to compare them to the condition at retention in order to deal with expected post-treatment behavior.

The third molars have long been controversial. Many seasoned clinicians are unwilling to risk the slightest possibility of crowding. Consequently a plethora of third molar extraction is practiced even after they have developed normally! Yet, all posterior teeth, including the third molar, contribute to vertical support of the mandible and the third molars fill out the normal Curve of Spee for maximum jaw integrity and should be maintained when space is available.

Expectations for Shifting of Teeth

The tendency for future shifting of teeth varies with each individual and is influenced by muscle and functional patterns. However, seven generalizations of drift seem to be most common, as

follows (Fig. 19):

A. Changes in the lower teeth from the corpus axis registered at Pm point (Position 4) (see Fig. 19).

1. The lower molars tend to drift mesially and upright if tipped distally, but not if tipped mesially.

2. A lower premolar may drift mesially or distally and lingually, but seldom buccally.

3. The lower canine and incisors tend to settle distally, but on occasion will drift forward in tongue-lip balance problems.

B. Changes in the upper teeth from the palatal plane registered at Ans (Position 3) (see Fig. 19).

4. The upper molar tends to drift mesially, tip mesially, and rotate forward around the palatal root.

5. The upper premolars tend to drift mesially and rotate forward on the buccal side and although they may drift distally, it is rare in Class I or Class II conditions.

6. The upper canines, when freed from lip pressure, tend to drift mesially in keeping with their axial inclination.

7. The upper incisors tend strongly to drift forward, unless inhibited by the lower lip. In very rare conditions, however, they may show bodily distal movement.

Importance of Post-Treatment Consultation

It is advisable to present to the parent and/or patient the results at a post-treatment consultation. The purpose is to "reveal the case", create patient good will, and move into formalized retention programs. In our opinion, contrary to custom, there should be an additional fee for this long-term service. This should include the prognosis and management programs for future care.

IV. PROBLEMS IN RETENTION -- A HIERARCHY OF RISKS

The review of a hierarchy of severity of problems occurring in relapse is of interest. Examination of the possible factors for failure in specific conditions may be meaningful to stabilization and guidance planning and to future operations.

Relapse tendencies appear in all three planes of space: the transverse, horizontal and vertical dimensions. The most plaguing problems experienced clinically are listed first, with less aggravating but nonetheless important conditions in sequential order. The major to the most minor in difficulty experienced were rated.

Rating of Retention Difficulties

1. Extraction site closure -- particularly in adults
   -- some diastemas

2. Cross-bite -- cleft palate surgery
   -- collapse of maxillary arch due to tongue posture
   -- long facial patterns

3. Open bite -- surgically advanced mandibles
   -- posterior open bite due to lateral tongue thrust
   -- anterior open bite in habitual type tongue
   -- continued chronic mouth breathing

4. Rotations -- all teeth when undertreated

5. Lateral incisor retrusion -- in both arches followed by reimbrication of anterior segments

6. Class III -- non surgically treated
   -- surgically treated with tongue problem

7. Class II -- undertreated
   -- iatrogenic conditions in joint
   -- mesial drift of maxillary arch
   -- distal drift of mandibular arch
   -- regressive growth patterns

8. Deep bite -- following straight wire levelling treatment and posterior extrusions

9. Return of overjet -- with protrusion of upper,
retrusion of lower,
or both in combination

10. Derangement -- distal displacement of condyle (TMJ)

V. TECHNIQUES FOR STABILIZATION AND GUIDANCE

The Standard Technique

It is emphasized again that the best preparation for future success in my experience has been overtreatment of all aspects of the malocclusion.

Throughout the past 40 years I have tried almost all types of "retainers". Experience has suggested that the most successful routine program, in the long run, is the Ricketts type maxillary appliance employed together with a fixed Ricketts lower premolar to premolar stabilizing bar, either with cemented bands or a bar which is bonded (Fig. 20).

Lower Fixed Premolar-to-Premolar

Arch integrity starts with the lower. For the lower, once crowding has started, it is folly to use a so-called lower Hawley type appliance which was originally designed to hold the anterior teeth backward. In tight lower arches, when the lower removable is left out by the patient for only a few nights, relapse may start, the appliance will no longer fit, and the patient may blame the orthodontist. The lower anterior teeth need to be held forward in all but a few cases, and therefore something fixed for

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10. Derangement -- distal displacement of condyle (TMJ)

significant periods of time is advantageous.

The fixed lower premolar-to-premolar bar forms a support for the anterior teeth to rest against. It is designed to help preserve the lower anterior segment of the therapeutic finish. The Ricketts lower premolar fixed retainer has three main features. It consists of a wrap or butt attachment to premolar bands, a rest for the lingual surface of the canines, and a labially stepped incisor curve (Fig. 31). The bar rests in the middle third of the lingual surface of the anterior segment. Its application is facilitated by preformed technique and adaptation.

The arguments for, advantages of, and techniques are listed as follows:

ARGUMENTS FOR THE LOWER FIRST PREMOLAR FIXED RETAINER IN PREFERENCE TO CANINE FIXATION

1. In a tight case, a lower cuspid-to-cuspid will tend to shift one way or the other and, therefore, the canine will move labially on one side and lingually on the other.

2. A deep bite tends to return as the lower six anteriors extrude. The lower 3-to-3 will not guard against this situation. In other words, it will not support the premolars vertically.

3. By employing the lower first premolars (or second premolars in extraction cases) for the retainer, the lower canines and incisors can be held downward and the overbite will be vertically supported.

4. By holding the premolar laterally and properly rotated, the arch form can be maintained. This kind of support not only holds the lower arch, but through forces of occlusion helps to hold the upper premolar width as well.

5. By holding the lower premolar buccally and upward, a good reference or target is established for the positioning of the upper canine.

6. By releasing the lower canines, they are freed to seek their own axial inclination and function. This is important because of their functional guiding influence on the mandible.

7. The lower premolar band is more acceptable esthetically than one on the canins. The patient will not request its removal nearly so quickly.

8. The lower premolar-to-premolar retainer is capable of adjustment and adaptation. Minor tooth movement can be accomplished by virtue of the slight resiliency of a longer retainer bar rather than for the canine to canine.

9. When the two lower canines are connected through a lingual bar, there is the possibility of loss of some proprioception and possible functional stimulation. The canines are very important perceptive teeth, and this is another consideration.

10. The lower premolar-to-premolar retainer lends itself to direct construction in the mouth and immediate placement at band or bond removal.

11. The preformed retainer bar prevents time-consuming and expensive laboratory procedures.

12. It saves chair-side time by direct freehand soldering fabrication.

13. It is provided in sizes suitable for most arches: a kit is supplied.

14. It is constructed in .038" or .036" blue Elgiloy for maximum properties of adaptability and stability.

TECHNIQUE FOR RICKETTS FIRST PREMOLAR-TO-PREMOLAR RETAINER
(Fig. 22)

A. Premolar bands should be well adapted and tapped to place;
B. Mark mesial embrasure with wax marking pencil (to spot the retainer blank and provide soldering line);
C. Select closest fit of preformed size of the lingual of the four incisors plus extension across the canines to first premolars;
D. Make necessary minor alterations with three-pronged beak plier;
E. Carefully remove bands to prevent their distortion;
F. Adapt universal solder to retainer bar;

G. Orient the band and bar in freehand "eye ball" operation parallel to occlusal margin of the band in the spot marked;
H. Solder, making sure that solder does not flow into embrasure or up the wire to the level of the marginal ridge or canine;
I. Clean with vulcanite bur on the inside of the band to remove oxides;
J. Fit in the mouth and recheck for length and position on opposite side --mentally record relation of bar to opposite premolar;
K. Orient in the same manner as before and flash the other side;
L. Clean and polish with Berlew wheels or steel brush;
M. Recheck and refit slightly, if necessary;
N. Cement with affluence of glass ionomer cement. This may be worn for two to ten years!

MODIFICATION FROM STANDARD FIRST PREMOLAR RETENTION

MODIFICATION FOR LOWER SECOND PREMOLARS:

The lower second premolar is wider at the mesial margin. In contact with the canine, the lingual cusp extends lingually and provides a margin to which a retainer can be soldered in a butt joint (See Fig. 21). Procedure:

A. Select retainer bar as before.
B. Cut ends at proper length for butt joint.
C. Adapt ends carefully to embrasure or mesial aspect of lingual cusp of second premolar.
D. Mark, orient and flash as before.
E. Recheck, clean, polish and cement as before.

MODIFICATION FOR CANINE-TO-CANINE

In excessive caries of the premolar when shorter retention periods are planned, the canines may be used. Procedure:

A. Select length as before.
B. Fit canine preformed blanks.
C. Cut premolar extensions off (or they can be left for support).
D. Adapt, mark, orient, solder, recheck, and cement as before.

NOTE: The canine-to-canine, being shorter, reduces the flexibility of adjustment and may be more difficult to freehand solder.

Ricketts Upper

For the maxillary teeth, this guidance appliance consists of three components: the palatal U plate, the anterior return wire and the quarter clasp on the last molar (see Fig. 20B). The palatal plate, with or without a slight incline plane, is consistent with the progressive philosophy.

Plate Adjustments

The concept of relief at certain sites around the teeth by trimming for the guidance of maxillary teeth with further eruption in the metapositioning process has been most difficult to communicate and teach.

The distal aspect of the gingival margins of the molars and premolars is reduced on the appliance to promote their distal rotational metapositioning and to invite further distal rotation and locking of the molars by antagonizing only the mesiolingual surface (Fig. 23). The cervical margins of the appliance for the canines and incisors are altered by trimming according to the individual need.

Please note: It is not until after active treatment that relief for the upper laterals is provided. In our fourth dimension bracket formulation no "step-in" is made for the lateral incisors because of the need for overtreatment and the labially protected positioning of the lower lateral (see Figs. 18, 20, and 22). Very slight trimming on the palatal plate of the appliance permits the upper lateral incisors, with function against the fixed lower to adjust on their own as well as a very modest step placed on the anterior wire if so desired.

The Anterior Return Wire

The return wire emerges between the canine and the lateral incisor which keeps the canine positioned to its proper relation to the lower first premolar which is its target (Fig. 24).

The Hawley retainer, employed by many traditional orthodontists, has a wire extended between the canine and first premolar which tends to move the canine forward and break the clear buccal occlusion sought in treatment (see Fig. 24). Placement of a wire in the small space mesial to the canine takes advantage of the natural shape of the distal of the upper lateral incisor.

The anterior return wire is capable of five principal adjustments (see Fig. 7, Part I). First, like any labial wire it can receive first-order steps for position or rotation of the incisors. Second, it provides the means of a rotational control of the canines in either direction by a clasp action on the distal, or a mesial tuck in the labial section. Third, the anterior wire may be shortened or tightened for space closure by making vertical steps mesial to the canines. Fourth, the bend can be made gingivally and palatally when there is a need for "lingual root torque" control while if lingual crown movement is desired the step can be made incisally. Fifth, a tightening or loosening of the appliance can be made directly at the embrasure between the lateral and the canine (see Fig. 23).

The Ball Clasp

The ball clasp (or end stop), is used often for the second molar only. It is extended to the distal quarter of the buccal surface to help keep the molar rotated distally. When a long clasp is continued around to the mesial of the molar it will tend to rotate the molar mesially (in the wrong direction). The clasp helps close the spaces.

stabilize the appliance during eating, give better comfort and elicit better cooperation by the patient (see Fig. 23).

Timing

The upper guidance appliance is worn full time in the beginning, even for eating. It is removed only for cleaning during the first six months. After that period of settling, the whole denture should be freed to move anteriorly as mandibular growth continues. The appliance usually is worn at night only after the first six months to one year, and then can be worn as indicated by behavior.

Over-retention of the upper arch is thought, in rare cases, to contribute to posteriorly displaced condyles and joint derangement (see Fig. 18, Part I).

Low interincisal angles (123° to 128°) seem to permit the mandible greater freedom for its mandibular function.

The upper return arm can be used for a "fold-in" elastic for intraoral traction in case of relapse tendencies of complete arch relation.

Other Forms of Retention

(1) Hawley retainers may be employed in a poorly treated upper arch and when large amounts of space are desired.

(2) If the conditions of the teeth are protrusive at the end of active treatment or if better lip containment is desired, upper and lower "splint retainers" may be employed (see Fig. 25). Splint retainers are inside-outside acrylic appliances which can be adjusted and molded (with care) (Fig. 25). They transfer lip pressure to the teeth. They are worn at night only but must be worn every night without exception. In order for compensation to occur in double

protrusions, they are worn for a minimum of two years. They should be understood before being used.

(5) When the upper arch has not been sufficiently overtreated, a Kloehn type face bow, well adapted to the teeth, may be used as an active type retainer.

(6) A molar-to-molar retention bar in either arch may be employed. In the maxillary a first molar-to-first molar is adapted in the palatal vault for maintenance of a anterior crossbite. In the mandibular the fixed lower lingual may be carefully adapted to the premolars, canines, and incisors for retention against severely tight lower lip conditions and for the use of light elastics to the upper.

(5) When a slightly unfavorable change of the lower incisors is encountered, a lower lingual removable may be a choice; two types of appliances may be used. The first is a lingual acrylic with a connecting bar to which springs are attached (Fig. 26). This is called a BLC, (B) denoting a lower, (L) lingual, and (C) corrector.

(6) The second choice for the lower is the Ricketts modification of the Crozat which is called a Crickett (Fig. 27).

(7) The crickett can be employed on the upper, fashioned with a buccal bar and hook extended at the canine from the molar clasps, for receiving light Class II elastics. This will hold the molars in Class I locked position (see Fig. 27).

(8) Another modification for maintenance of the treated Class II is the old .045" Z arch (like the dental portion of the face bow for cervical traction) with soldered hooks for elastics. Inter-maxillary elastics can be employed from a crickett, lingual arch, or splint retainer on the lower.

(9) Another appliance is the positioner when the set-up is correct (Fig. 28A and Fig. 28B). While it may be an active appliance in the beginning it can also be employed for prolonged periods as a retainer. It will also, like the splint retainer, have an effect over time for further retraction of the denture from lip pressure.

(10) Bands and spurs or more contemporary light braided wires can be bonded for space maintenance for undertreated rotations.

(11) We have also in extraction patients used simple ligature ties between teeth or made in figure-eight form.

(12) When mild recession is present we have also placed a lip bumper slightly away from the gingiva and witnessed regrowth of the gingiva (Fig. 29).

(13) In conditions of pericoronitis of the lower third molar which interfere with function, the flap is removed with electrocautery (see Fig. 29).

(14) Equilibration can lead to better patient comfort and better stability. The occlusogram may serve as a guide for this finishing process (Fig. 30).

SUMMARY AND CONCLUSIONS

1. Certain semantics or descriptions for better communication regarding true relapse, metapositioning, metamorphosis and other post-treatment changes are offered for consideration.
2. Stabilization should be planned -- the beginning model should be reviewed and both arches given attention.
3. The etiologic factors that produced the malocclusion tend to reproduce it later, and must be guarded against if not removed.

4. The most difficult retention occurs in poorly treated or undertreated patients in which appliances were removed too early. Patients treated rapidly tend to relapse quickly.

5. Success starts with a good workable treatment plan.

6. Success relates to the selection of the original appliance and its placement with the best chance being offered by the Fourth Dimension Plus formulations and the therapeutic ideal finish.

7. Teeth corrected during eruption need less retention. An adult requires three to four times longer retention than those patients treated in the mixed dentition.

8. Our best long-term success has been found with the Ricketts type upper appliance and for the lower a fixed premolar-to-premolar bar.

9. Overtreatment of all factors is suggested for best insurance.

10. The seven forces of occlusion need to be understood in order to obtain ultimate best results.

11. A clue to future retention problems comes during the treatment when the arches are difficult to "couple" or when function does not seem to utilize the forces of the incline planes.

12. The lower arch is the primary target -- it erupts first and is the medium over which the upper is molded in development, and to which the upper modifies in retention except in cleft palate conditions, or some severe Class III cases.

13. The features and details of the therapeutic ideal were developed for specific reasons in order to ward off relapse tendencies; hence, the fourth dimension: time or the future.

14. The entire musculature with neuromuscular feedback is nature's

final retainer.

15. Third molars can be a significant problem.

16. A variety of guiding type appliances may be used, but before appliances are placed the logic for their use should be examined.

17. Organized check-lists and systemized plans insure the best success.

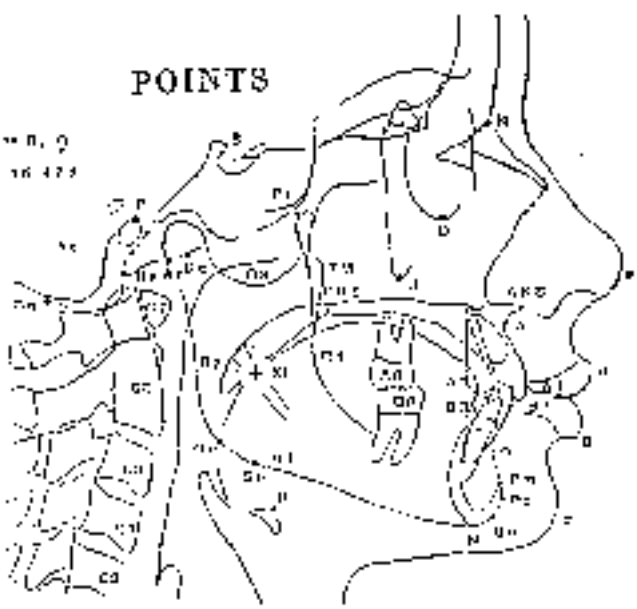
18. Before fixed appliances are fully removed, partial removal with controlled space management yields best success.

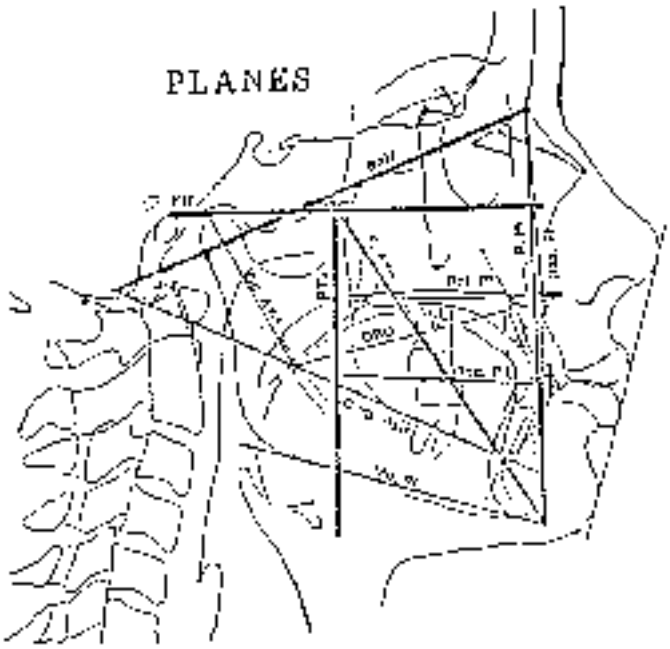
19. To prevent relapse in very crowded conditions it may be best to retain slightly excessive space in the arch.

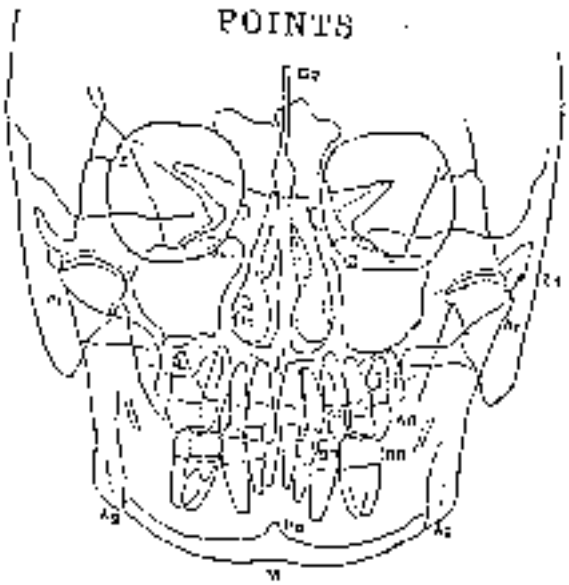
20. A hierarchy of difficulty in retention problems was offered.

21. Stabilization problems tax the utmost knowledge and skill of the clinician, and may present greater difficulties and more time than the active treatment itself.

22. Probably separate fees should be established for retention and maintenance programs in the future, rather than the orthodontist simply dismissing the patient.







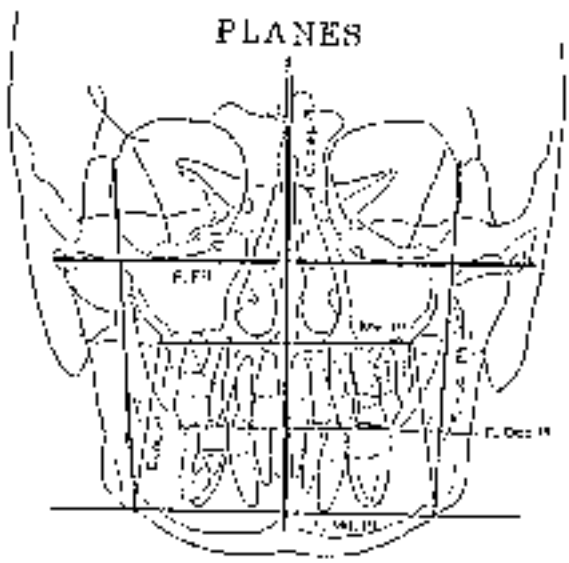


Figure 7A-A Notice the labeling of the various points and planes.

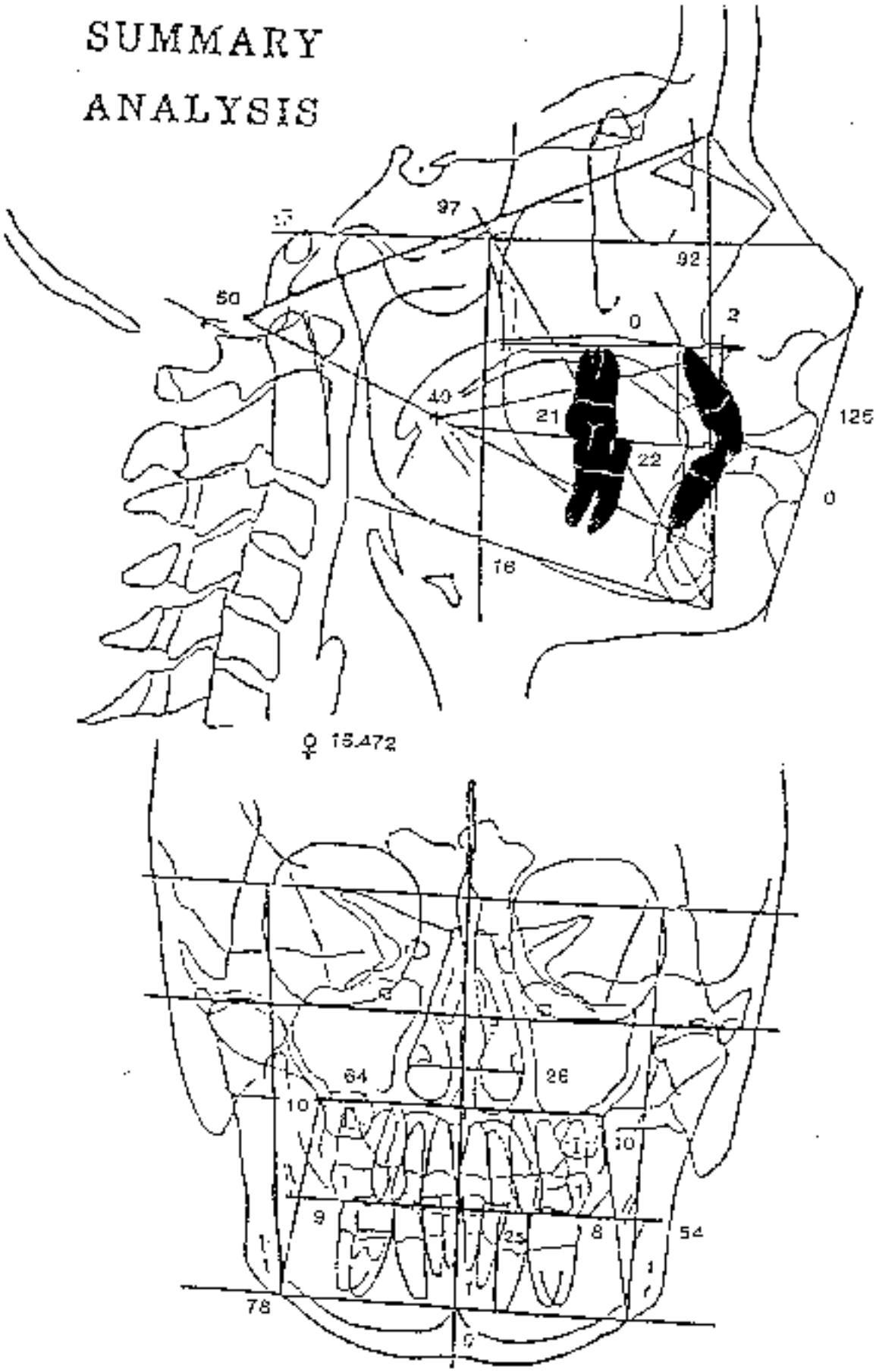
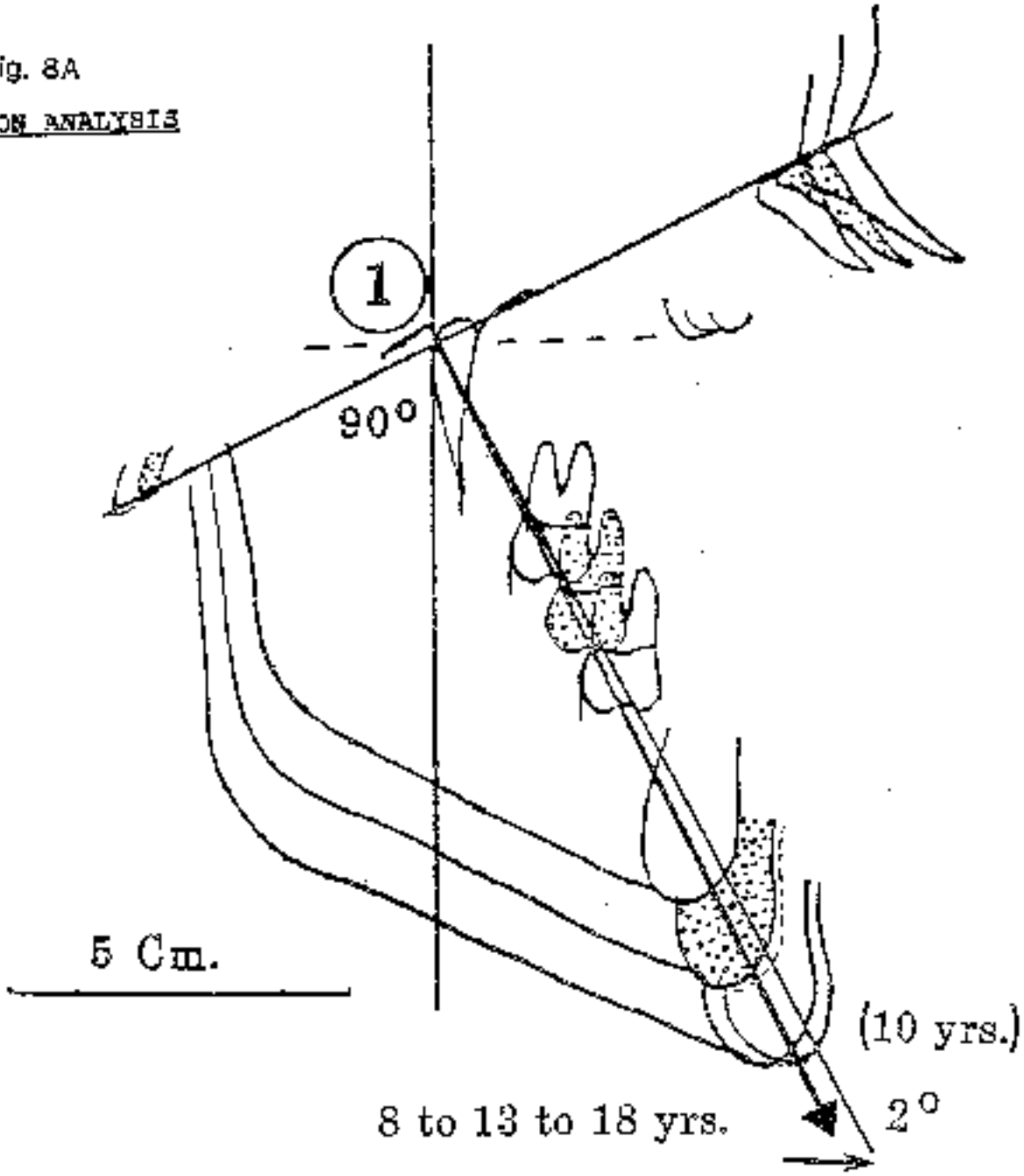


Figure 73 The Summary Analysis is shown with eleven measurements in the lateral and twelve measurements in the frontal. These have become the new standard.

Fig. 8A

POSITION ANALYSIS



Position 1 shows the downward and forward position of the chin (1990 findings show that it moves forward slightly).

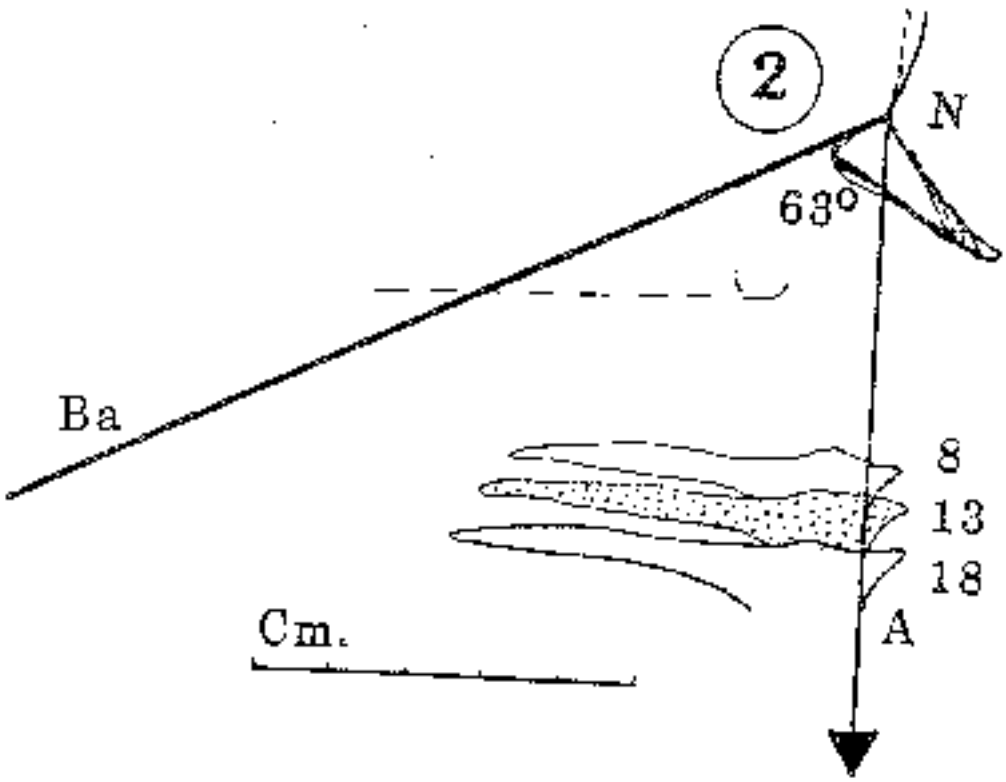
POSITION 1

Factor: Facial Axis - Basion-Nasion at CC (Pt-Gn Crossing)

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

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

Amount: 2.5 mm. each year, or 10 mm. each 4 years. C.D. ± 0.5 mm. each year.



Position 2 shows the palate to drop essentially straight downward from Basion-Nasion to Point A.

POSITION 2

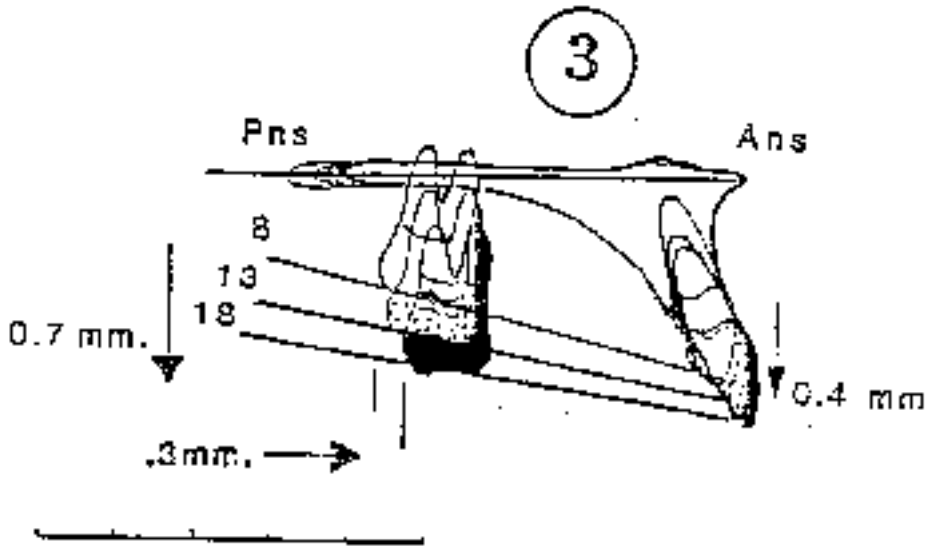
Factor: Basion-Nasion at Nasion

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

Change Values: Direction: 0° Standard Variation ± 1.0
Very rare cases slightly -

Amount: For ANS Vertical, 1.15 each year.
S.D. = ± 0.25 each year.

Fig. 68



Position 3 shows the forward migration of the denture.

POSITION 3

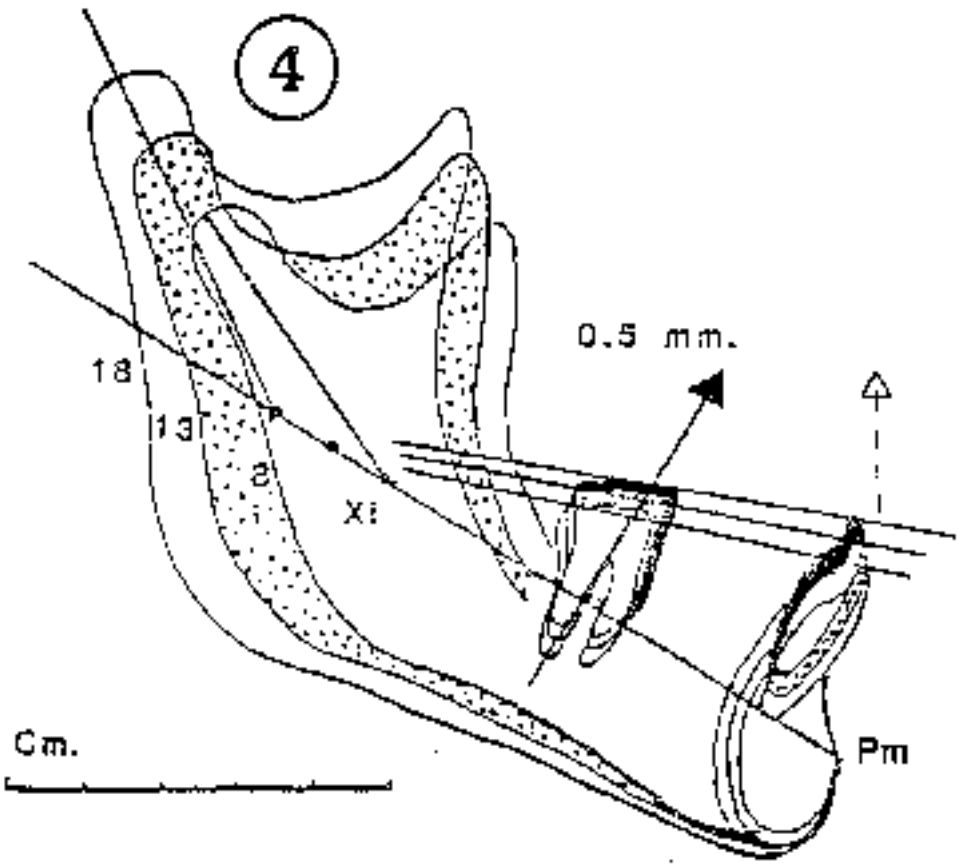
Factor: Palatal Plane (ANS-PNS) at ANS
For Reading of Incisor - Molar + Occlusal Plane

Function: Indicator for Maxillary Denture Change

Change Values: Forward: 0.3 mm. each year. C.D. ± 0.1 mm.
Occlusal Plane - crops at molar area
0.6° each year, i.e. 3° at 5 years,
6° at 10 years

$\frac{6}{}$ = 0.7 mm./yr. $\frac{1}{}$ = 0.4 mm./yr.

Fig. 8 C



Position 4 shows the lower first molar to erupt straight upward from the original corpus axis. The occlusal plane tends to remain level. The lower incisor erupts slightly upward and backward from Pm. Notice the gradual bending of the mandible.

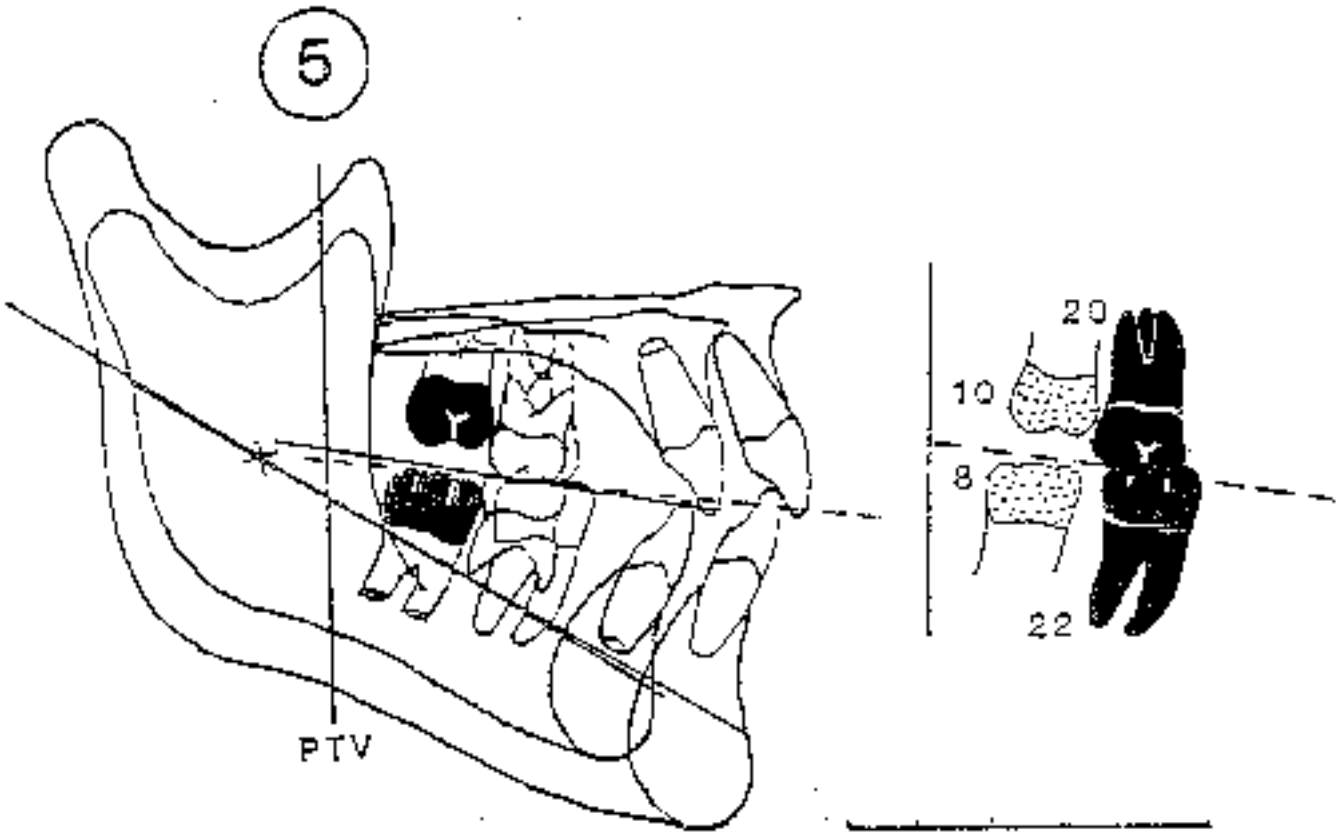
POSITION 4

Factor: True Occlusal Plane to Corpus Axis at PM point

Function: Indicator for Change in Lower Denture

Change Values: 0° change in Occlusal Plane
Eruption from Corpus Axis 0.5 mm. each year.
Lower Incisor = 3.0 mm.

Fig. 8 D



N73 Untreated 46/27
M F
6.7 Yrs. to 18.4

POSITION 5

Factor: Pterygoid Vertical Plane at Crossing of Buccal Occlusal Plane

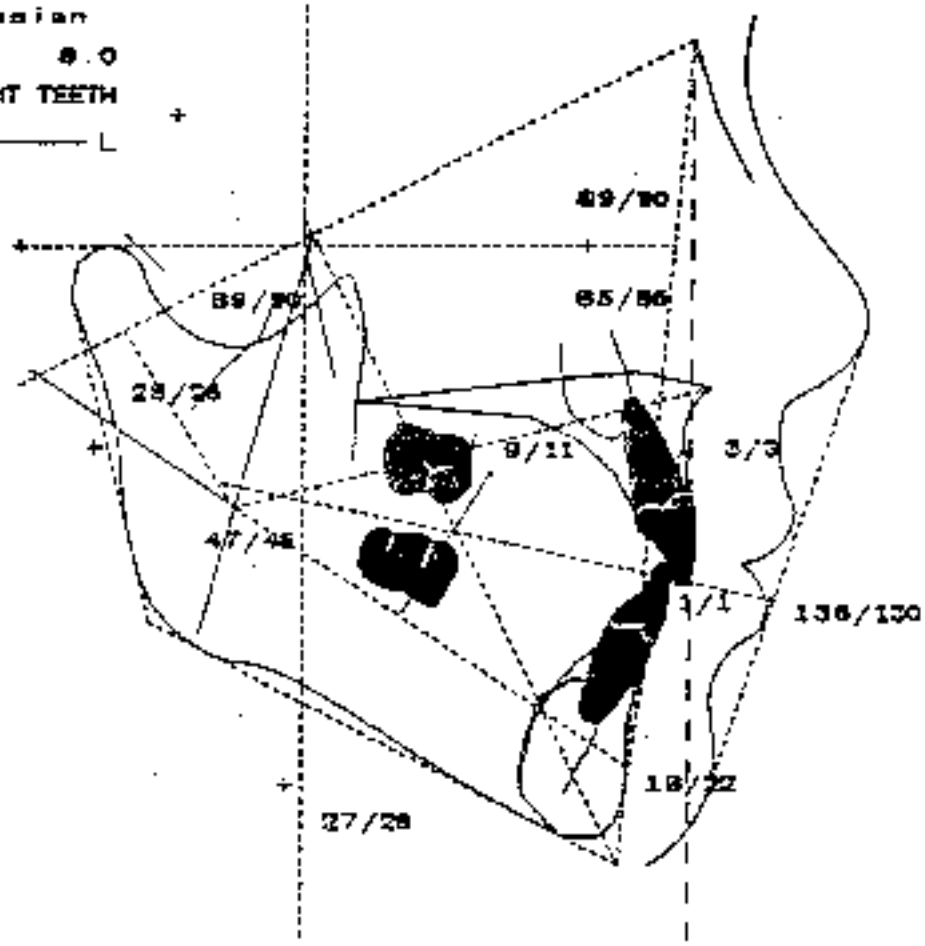
Function: Indicator for relative position of molars from a terminal reference

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. 8 E

ARCIAL PRE TX NORMAL
RICKETTS/CHRISTIE
11/20/90
M (CA) Caucasian
AGE(YRS) 6.0
MISSING PERMANENT TEETH
R — L

BEFORE



N 28
18/10

Age 6.3

SIGNIFICANT CONSIDERATIONS

Figure 1CA Shows a sample of 28 children with normal occlusion

A

FACIAL PATTERN: MESOFACIAL

# FACTORS	MEASURED VALUE		NORM		CLINICAL DEVIATION	
Interincisal Angle	135.7	dg	130.0	dg	1.0	*
Convexity	3.3	mm	3.0	mm	0.2	
Lower Facial Height	46.5	dg	45.0	dg	0.6	
A6 Molar Position to PTV	8.8	mm	11.0	mm	-0.7	
61 to A-Po Plane	0.5	mm	1.0	mm	-0.2	
61 Inclination to A-Po	18.1	dg	22.0	dg	-1.9	*
Facial Depth	86.0	dg	86.3	dg	0.4	
Facial Axis	89.4	dg	90.0	dg	-0.2	
Mandibular Plane to Ft	29.9	dg	26.9	dg	0.1	
Mandibular Arc	24.8	dg	25.7	dg	-0.2	
Maxillary Depth	88.8	dg	90.0	dg	-0.4	

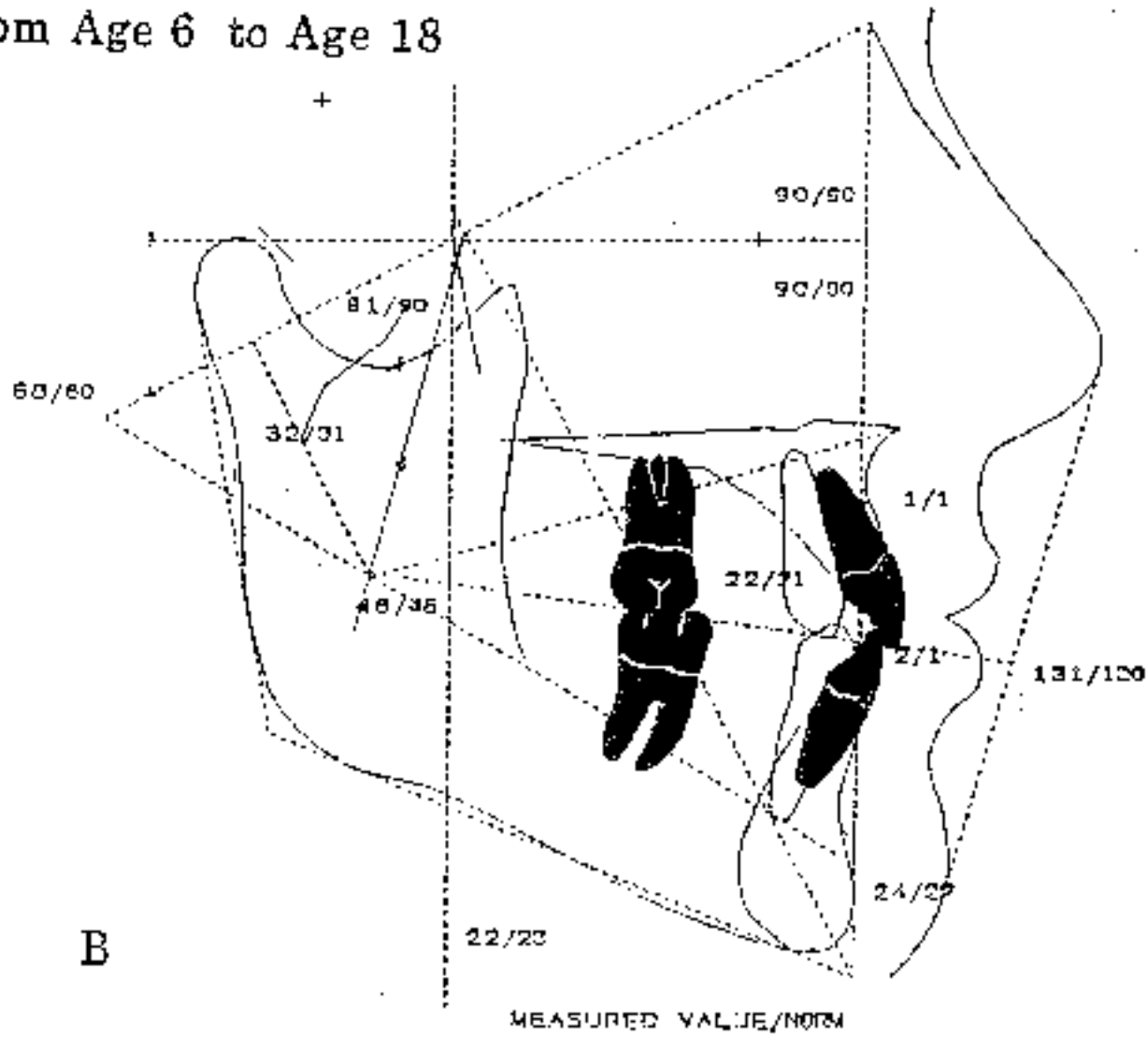


Figure 10b (19 boys and 10 girls in a composite at age 6). Ten years later the figures are still in quite good agreement with the program on the computer.

N 28

18/10

Age 6.3

C

Growth

10.32 yrs.

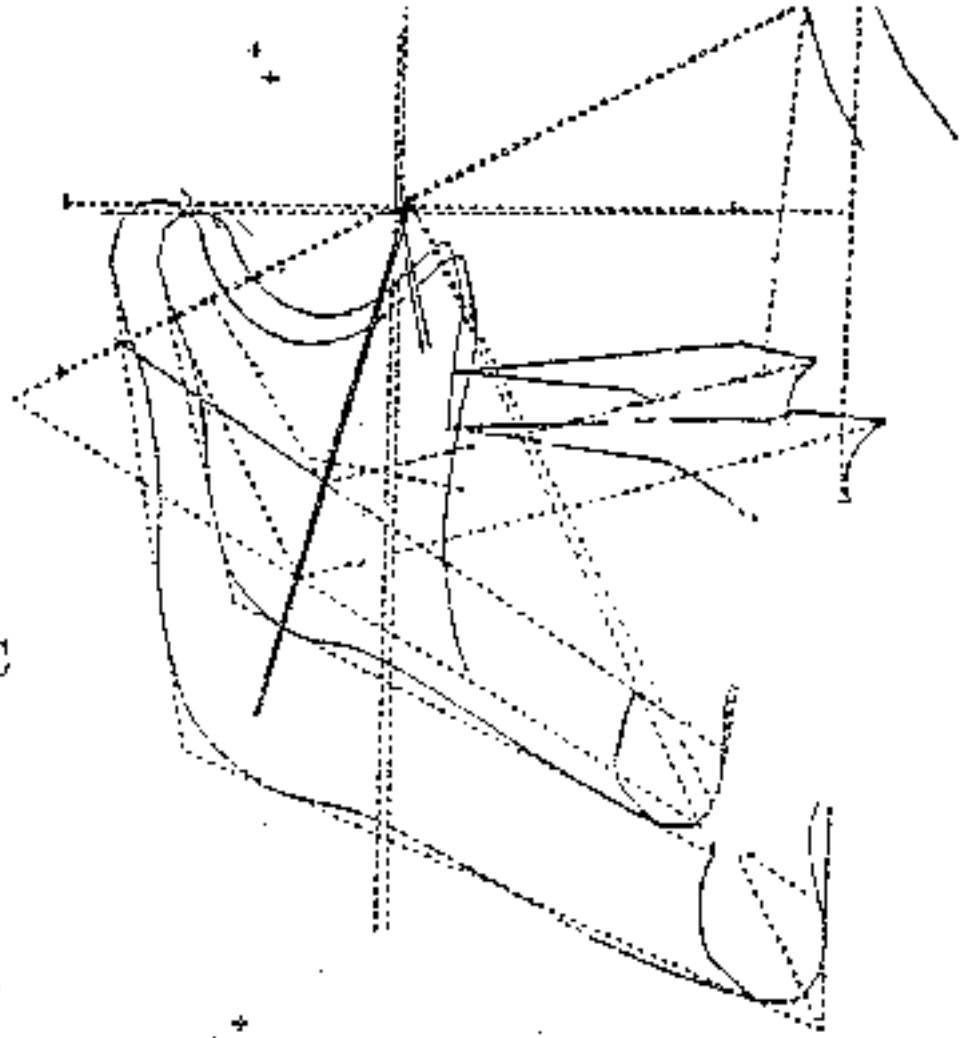


Figure 10C
Figure 10D

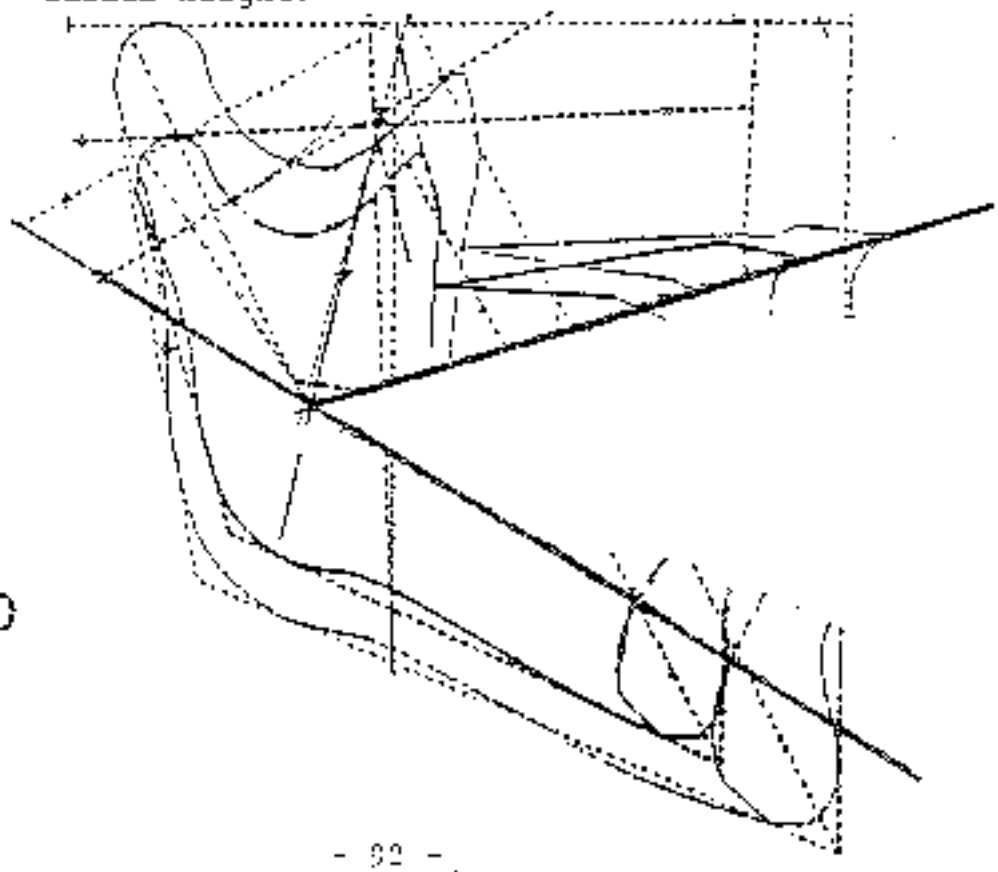
In C, notice the slight forward shift of the chin 1° to 2° in 10 years. In D, notice the almost absolute constancy of the oral gnomon, or lower facial height.

N 28

18/10

Age 16.6

D



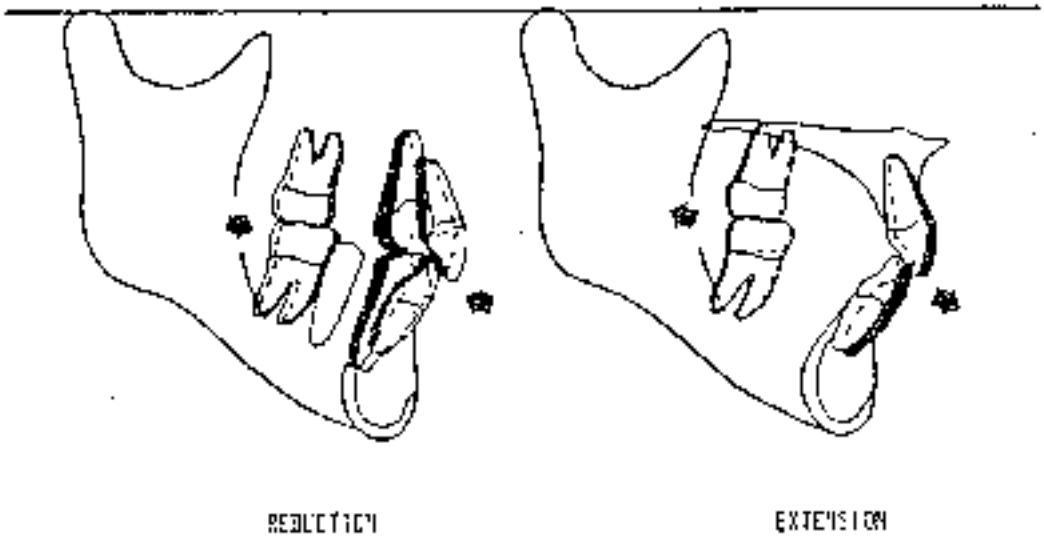
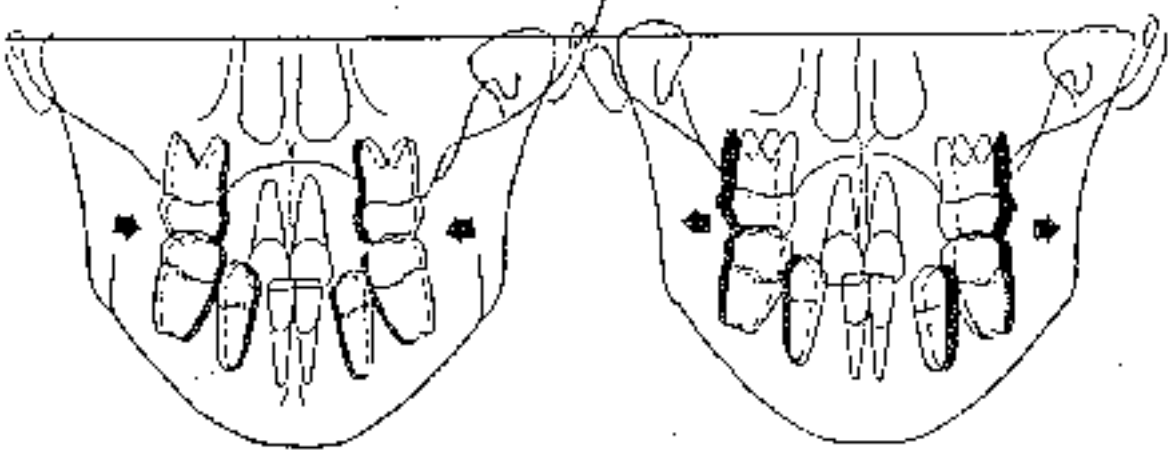
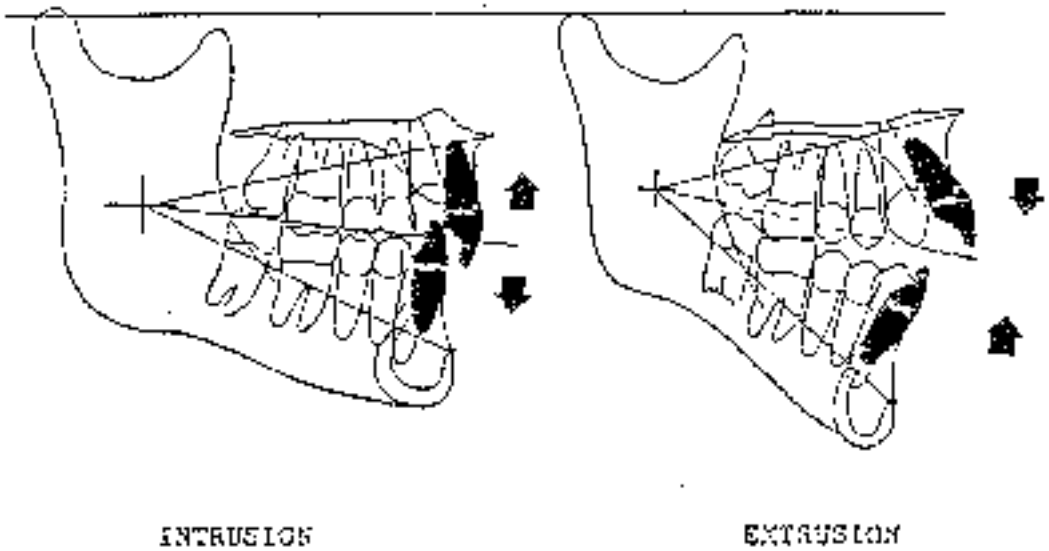


Figure 11 Above: introduction of a new terminology for communication of movement of the teeth in sagittal orientation.



Center: In frontal orientation, for semantic purposes, "contraction" and "expansion" may be limited to the transverse plane.



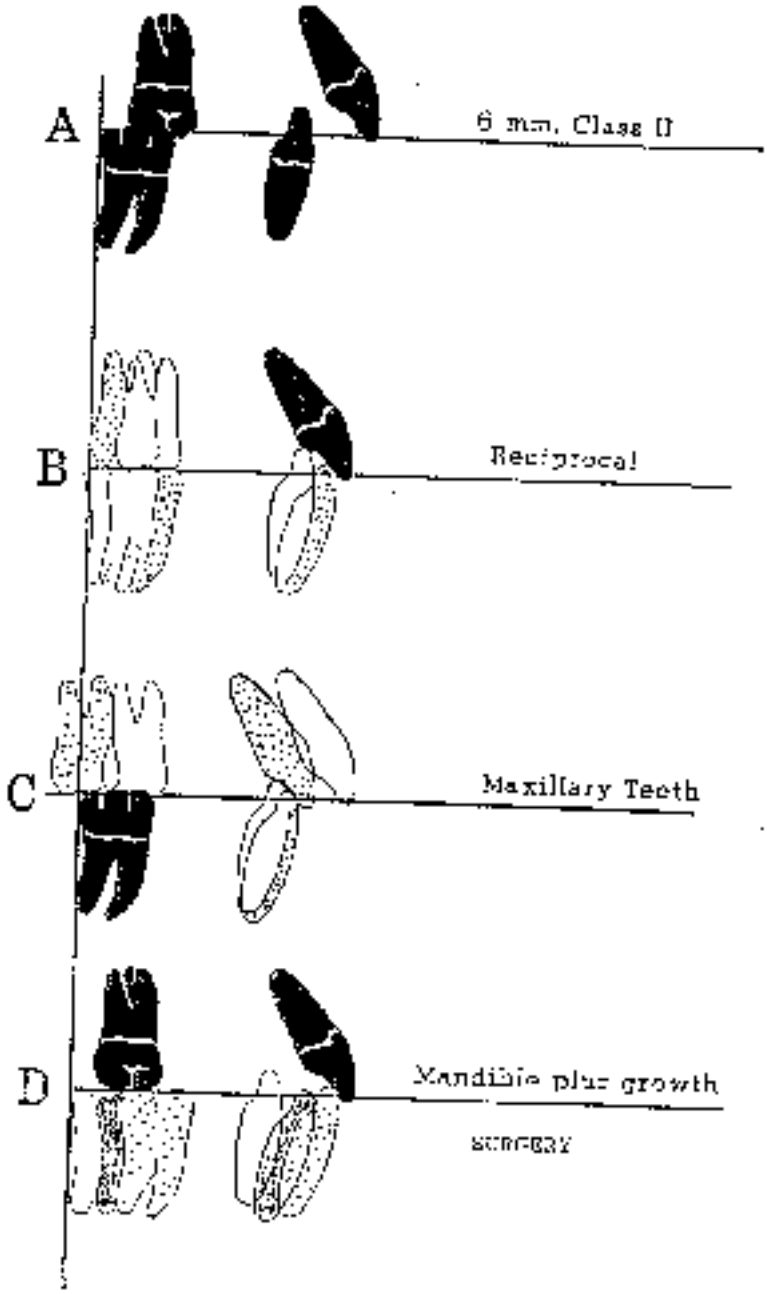


Figure 13

"A" shows the traditional 6 mm. Class II, and in this depiction a Class II, Division 1.
"B" shows a reciprocal change in the denture with a forward positioning of the upper molar and backward movement of the upper. The lower incisor has been advanced and intruded.
"C" -- Note the primary movement of the maxillary teeth with enough intrusion and protrusion to satisfy arch length in the lower and to clear space to move the incisors backward without interference.
"D" -- Note that the upper arch has been stabilised and (1) the lower molar has been moved forward, or (2) the arch is moved forward with growth, or (3) the jaw is moved forward with surgery.

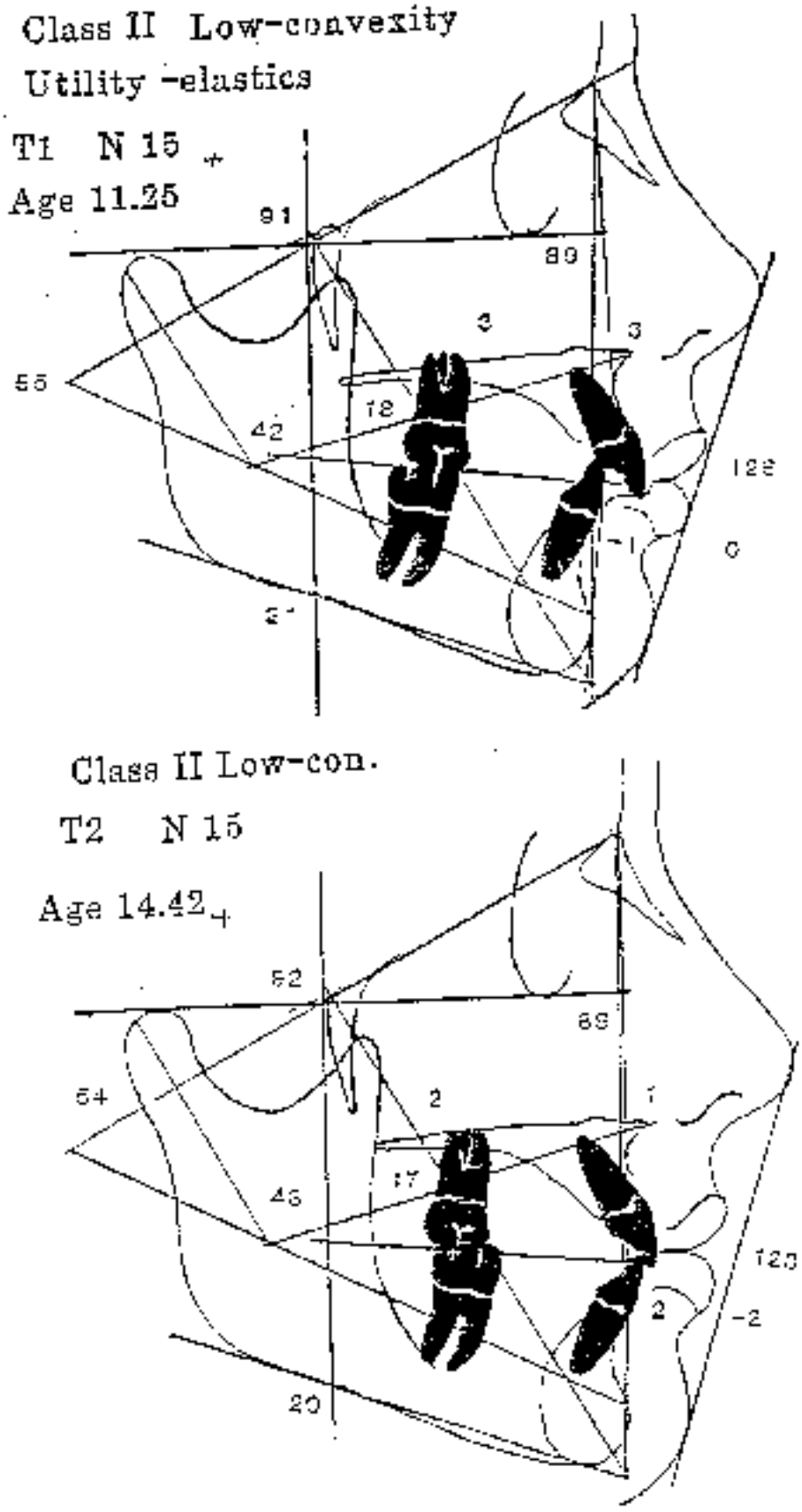


Fig. 14A

A low-convexity Class II deep bite sample of 15 children started at age 11 in which only utility arches and inter-maxillary elastics were employed. T1 is compared to T2.

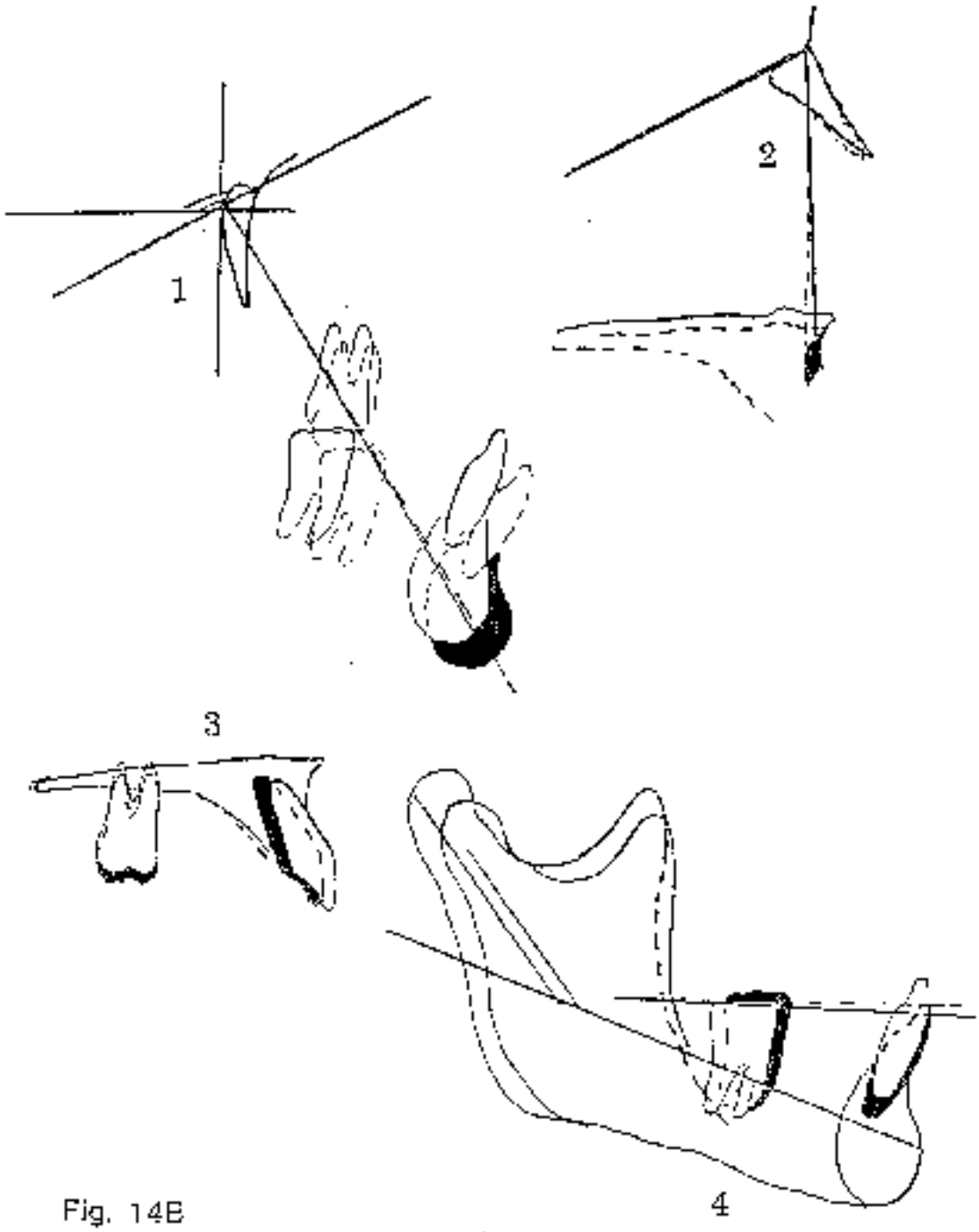


Fig. 14B

Notice the nice arrangement of teeth and the low inter-incisal angle deliberately developed for this type. This was a Proversion type of formula.
In Position 1 notice that the chin was moved slightly forward. In Position 2 the maxilla has been moved backward slightly. In Position 3 the upper incisor has been intruded and retracted. In Position 4 the lower incisor has been intruded and slightly protracted, and the lower molar has been moved forward about 2 mm.

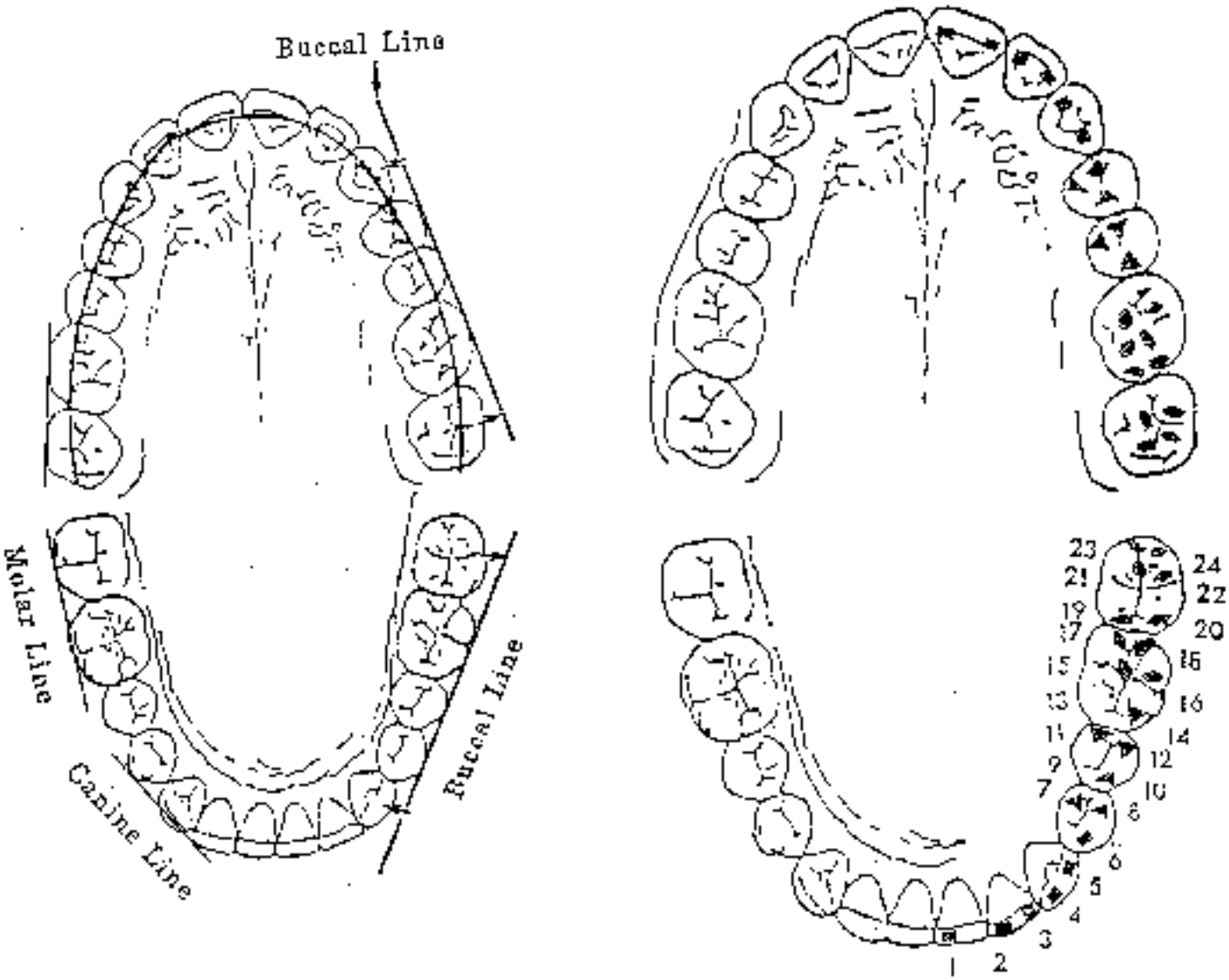


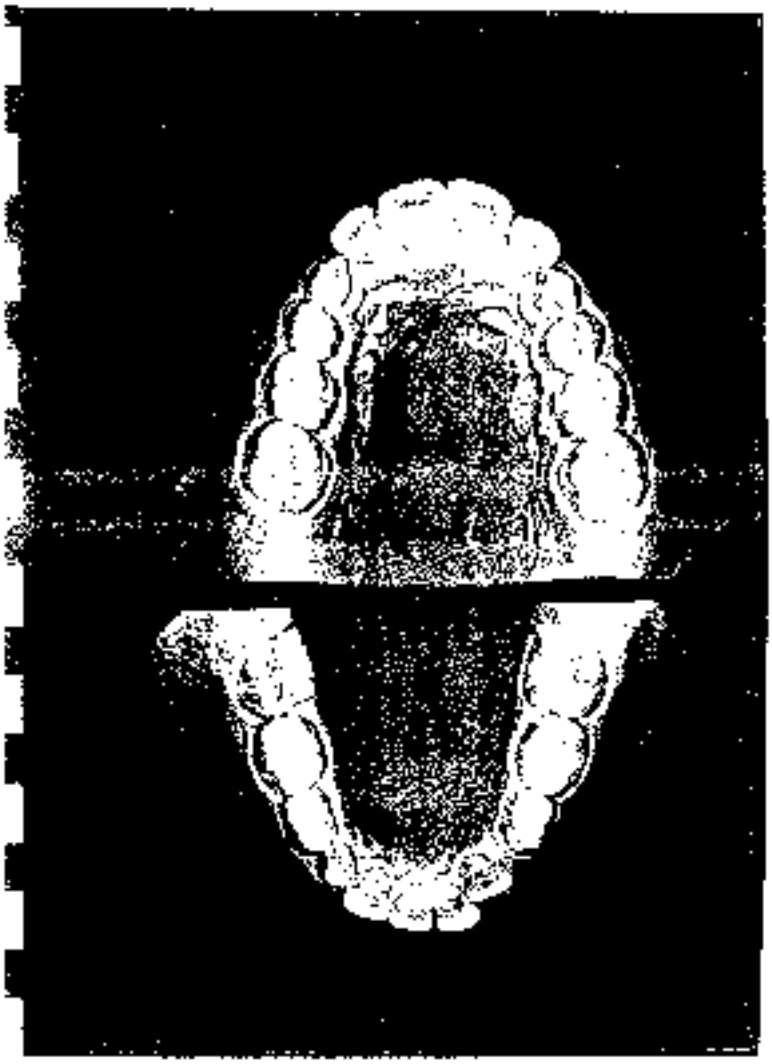
Figure 13 Three lines may be formed in the mind in finishing.

The contact steps may be checked for perfection.

IMPERATIVES IN COMMUNICATION

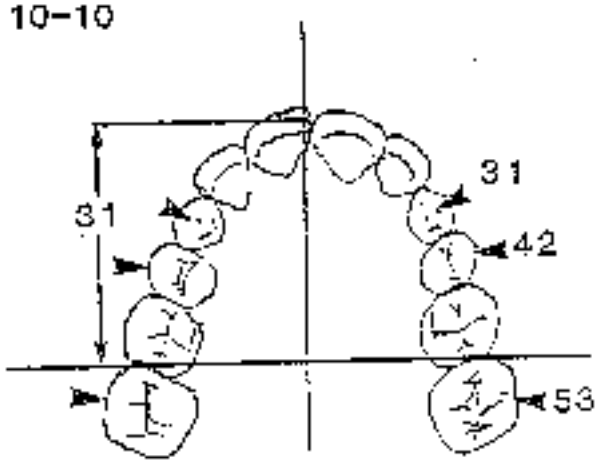
1. Model Conversion
2. Summary Analysis
3. Comprehensive Analysis
4. Divine Proportion Analysis
5. TMJ Imaging
6. Polar Growth
7. Summary Monitoring Analysis (5)
8. Arcial Mandibular Projection
9. Possibilities (Short Range)
10. Possibilities (Long Range)
11. Designing with the Cybernetic Circle
12. Anchorage Staging

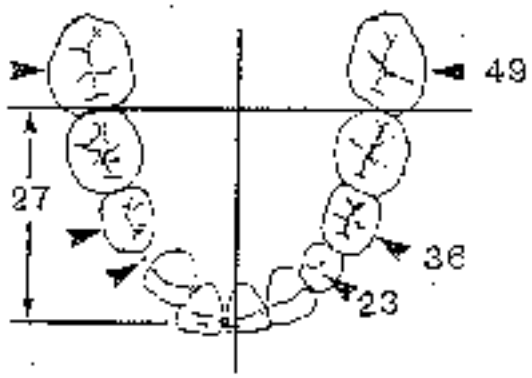
MODEL CONVERSION

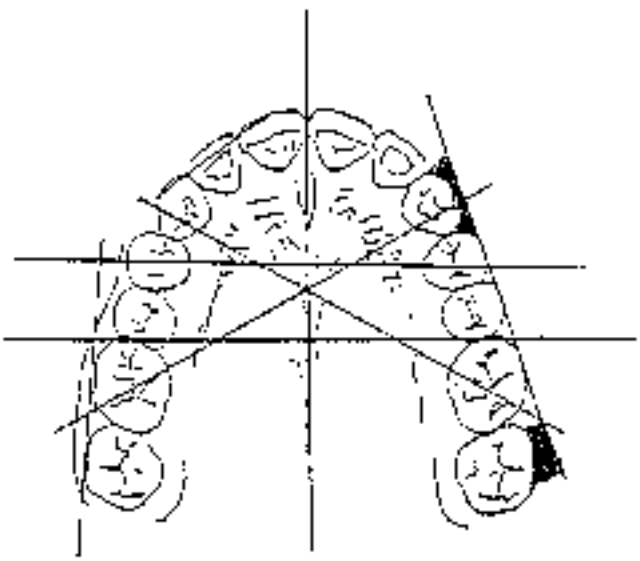


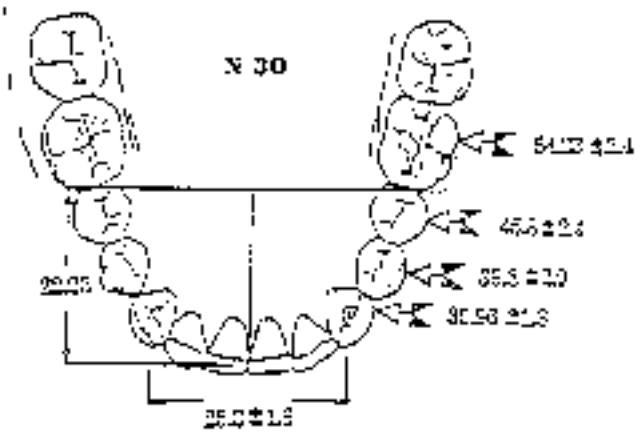
H.W.

10-10

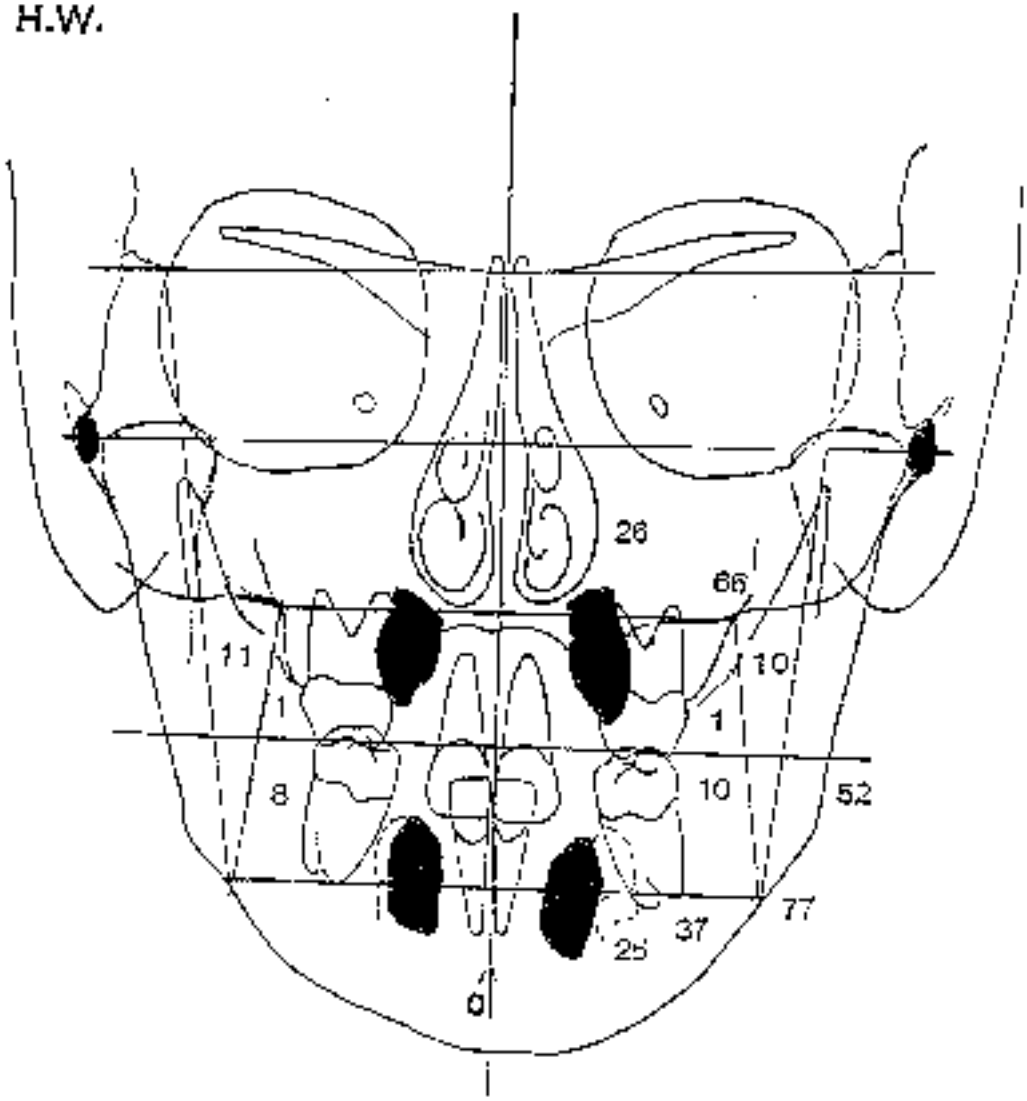




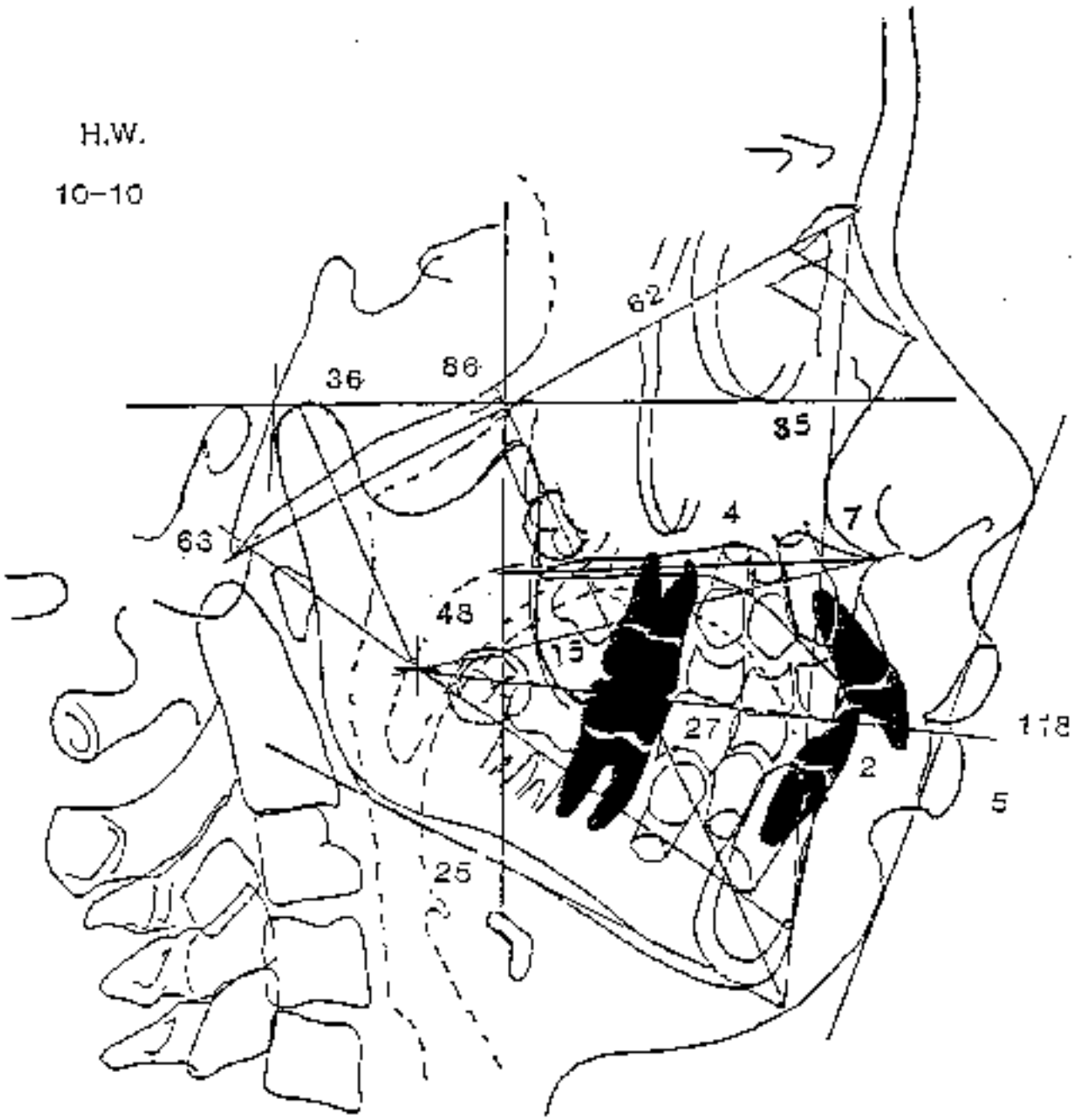




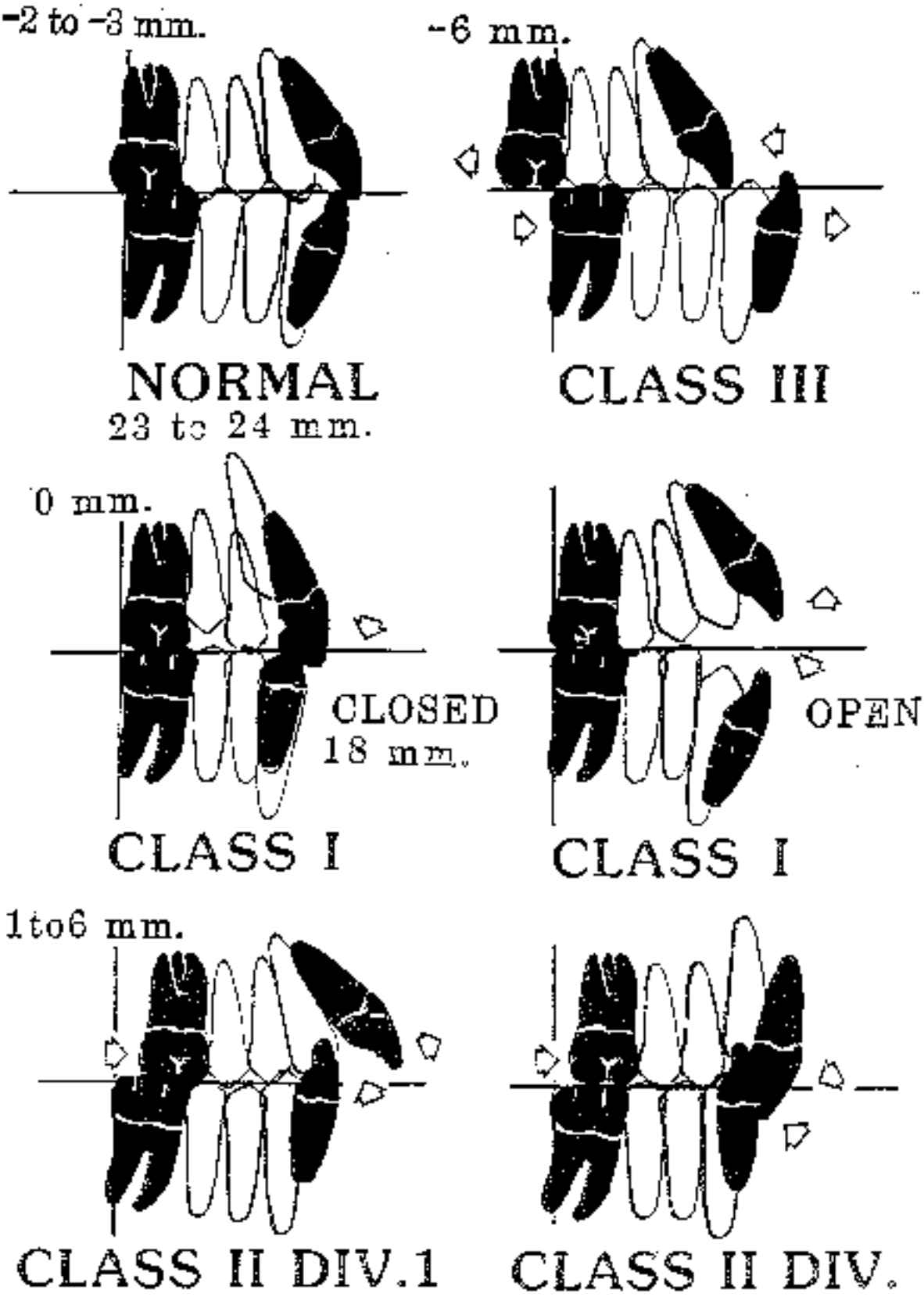
H.W.



BEGINNING

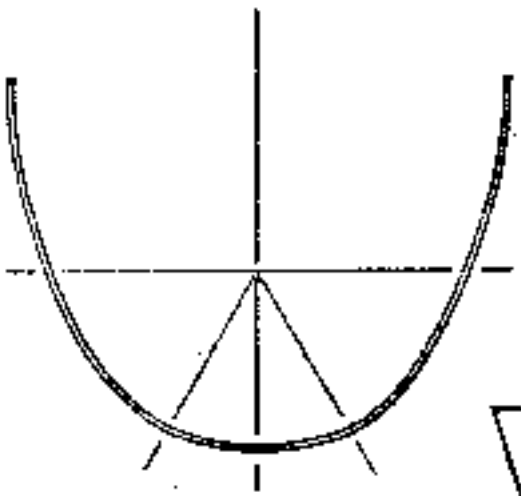


BEGINNING

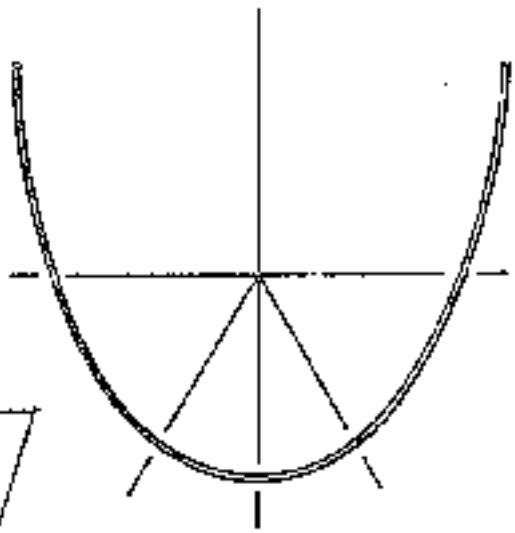

-2 to -3 mm.
-6 mm.
NORMAL
CLASS III
23 to 24 mm.
0 mm.
CLOSED
18 mm.
OPEN
CLASS I
CLASS I
1to6 mm.
CLASS II DIV.1
CLASS II DIV. 2

Arch Selector

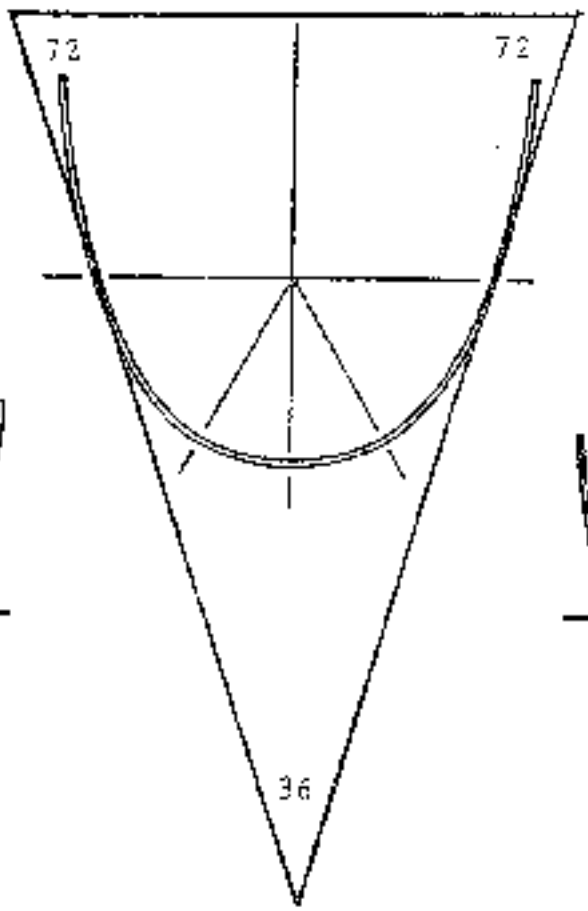
OVOID



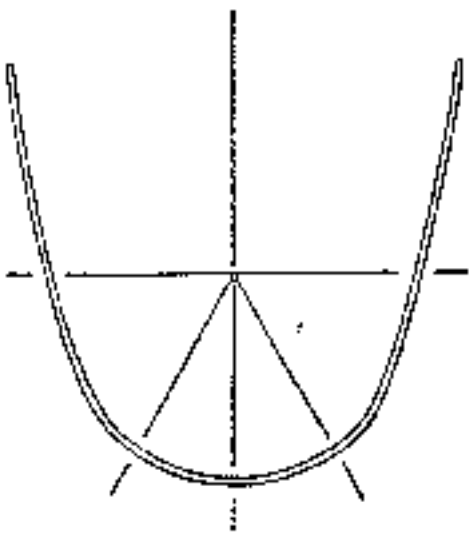
TAPERED



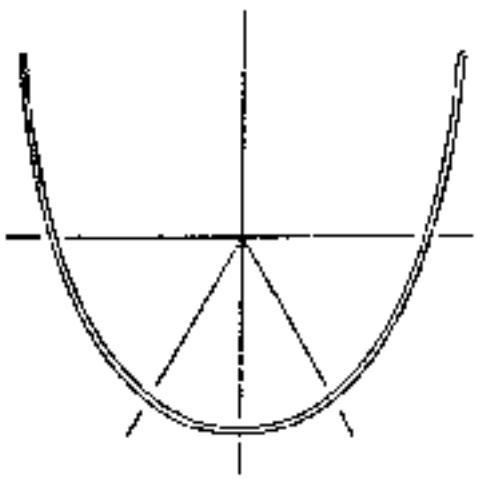
NORMAL

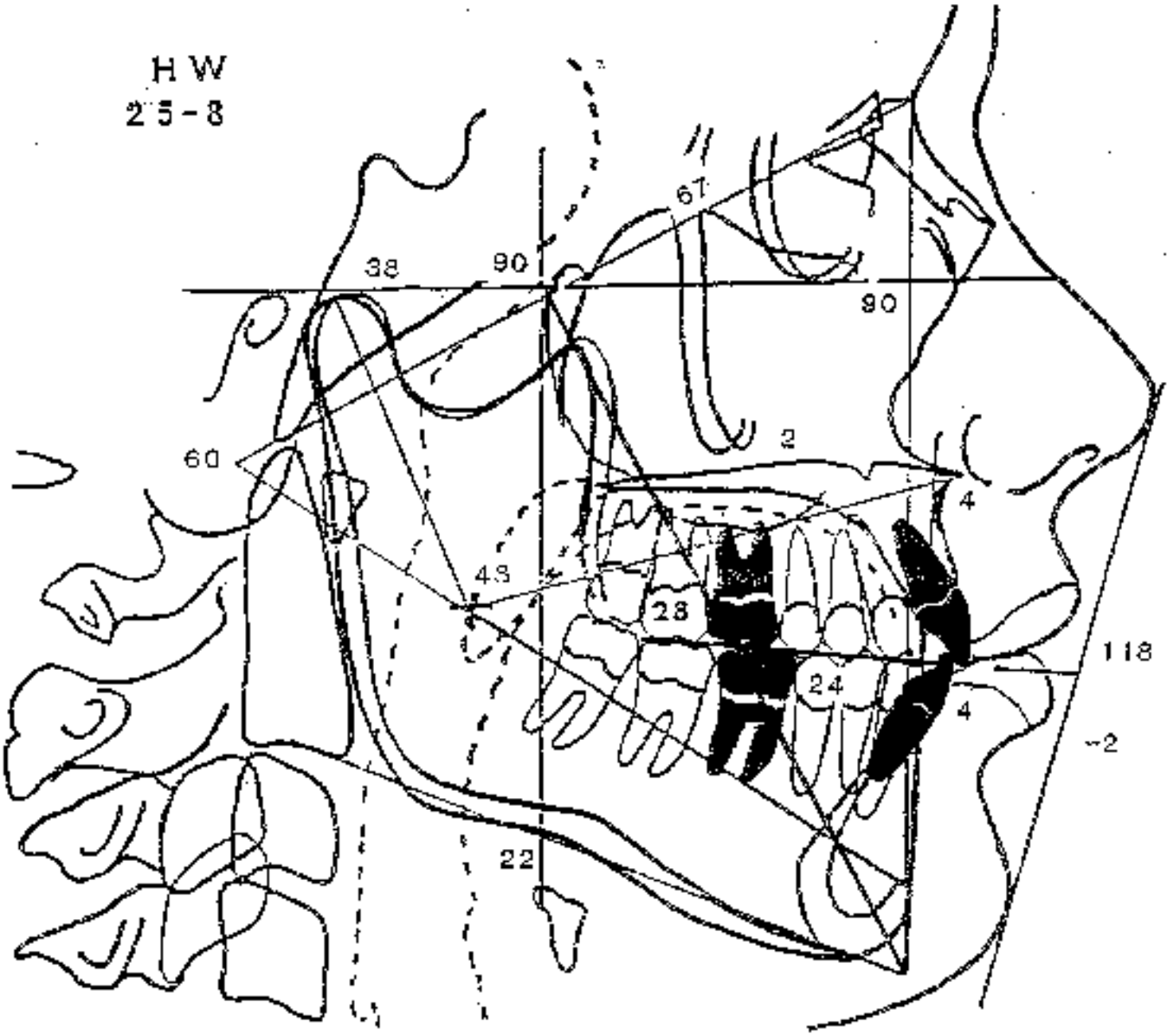


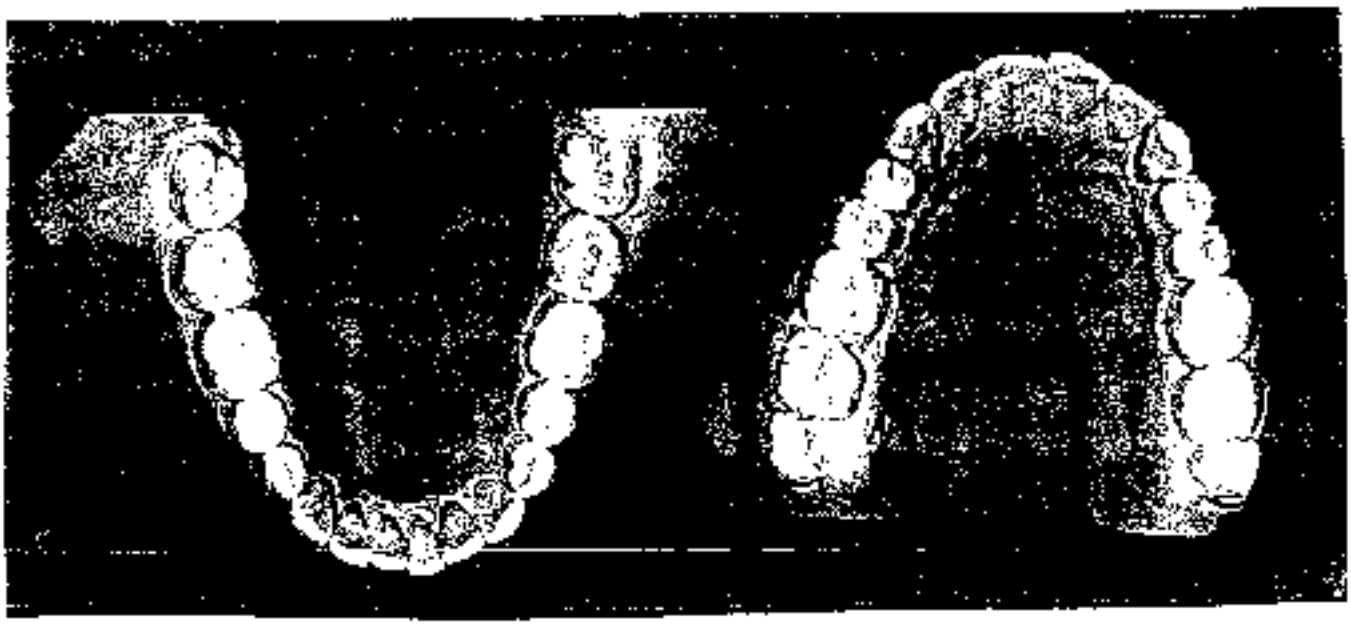
NARROW OVOID

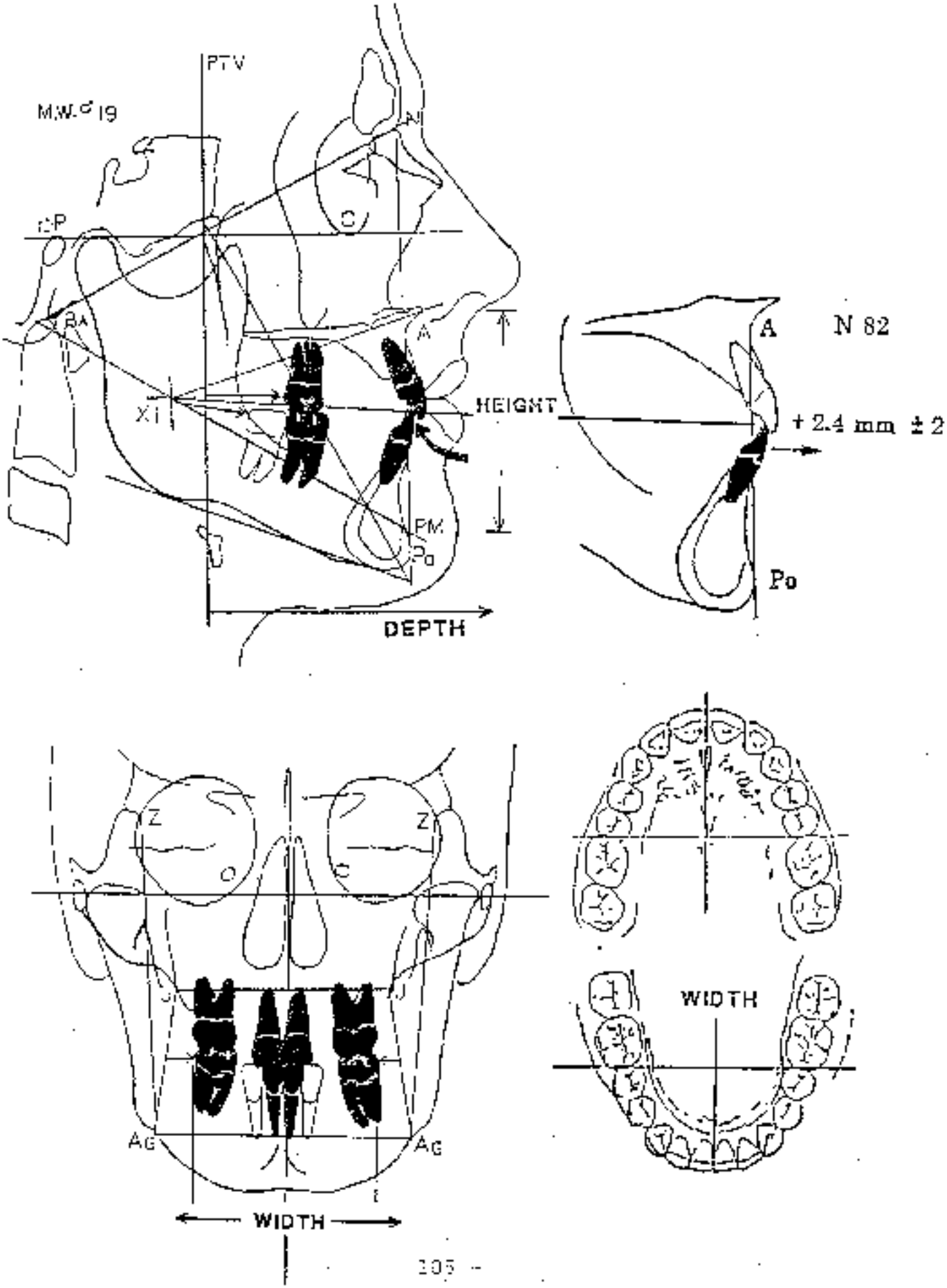


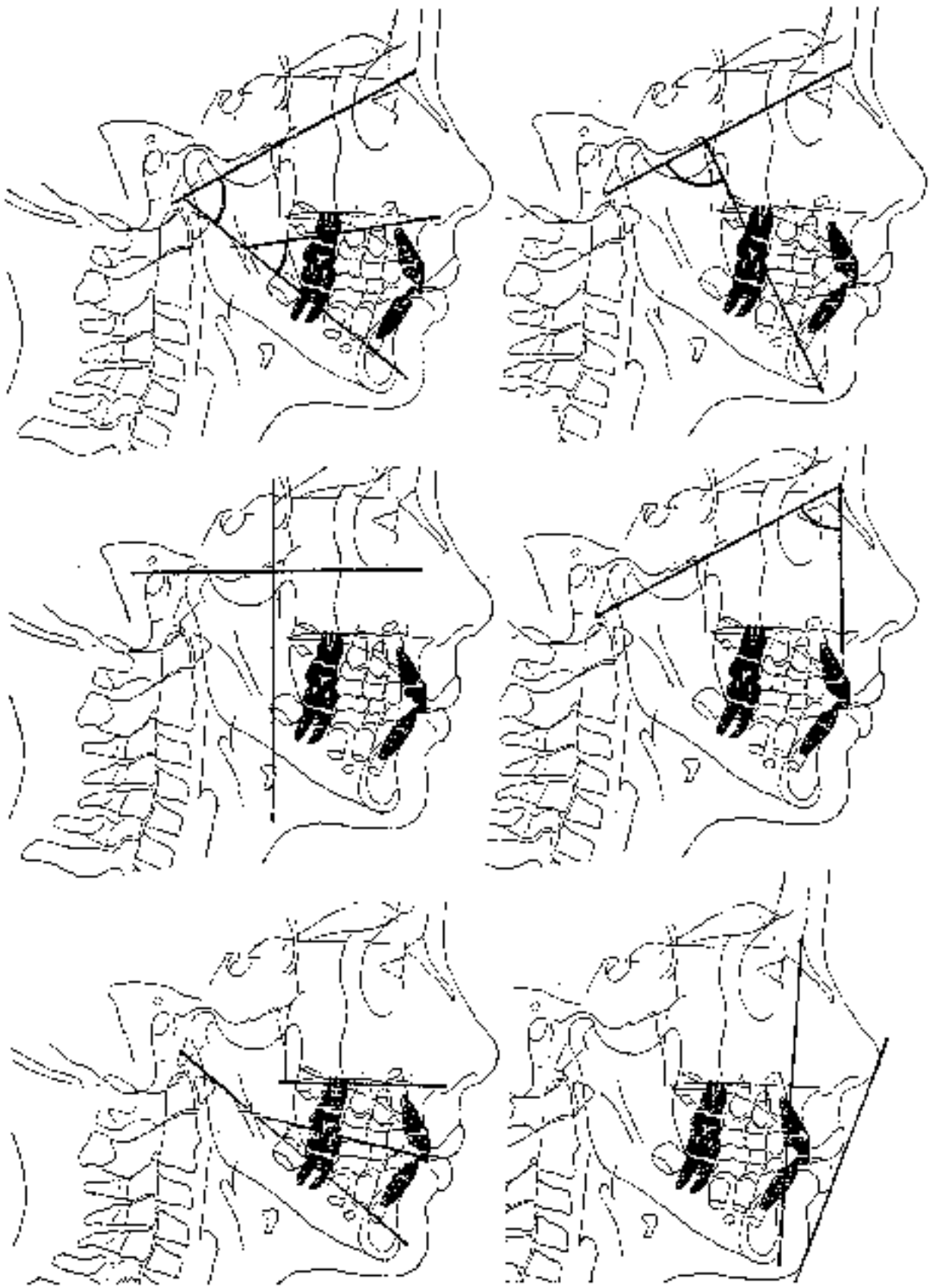
NARROW TAPERED

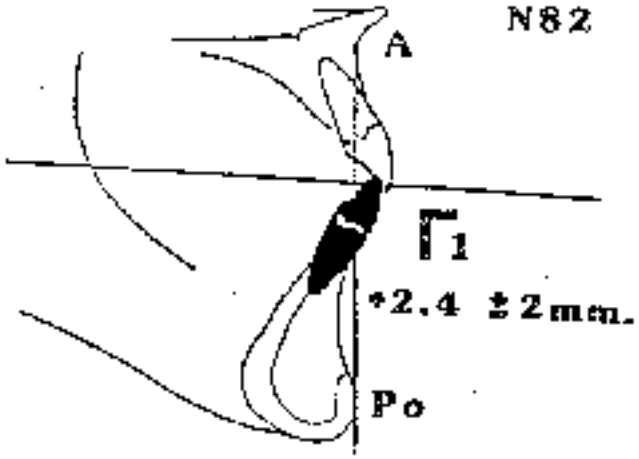



H W
25-8
67
38
90
90
60
2
4
48
28
118
24
4
-2
22



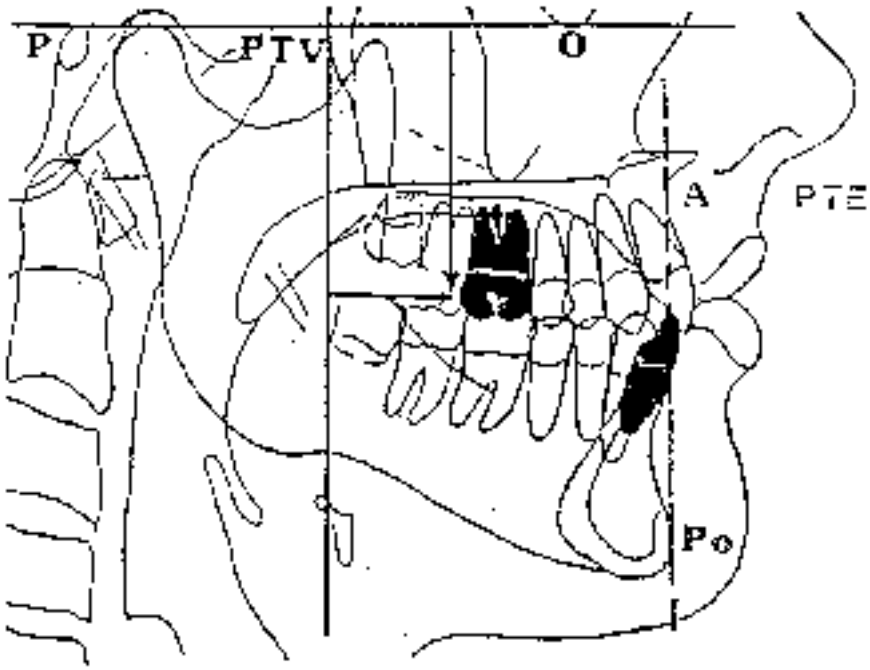

PTV
M.W.G 19
N
S
P
Ba
A
Xi
HEIGHT
PM
Po
DEPTH
A
N 82
+ 2.4 mm ± 2
Po
Z
Z
O
O
J
J
AG
AG
WIDTH
WIDTH



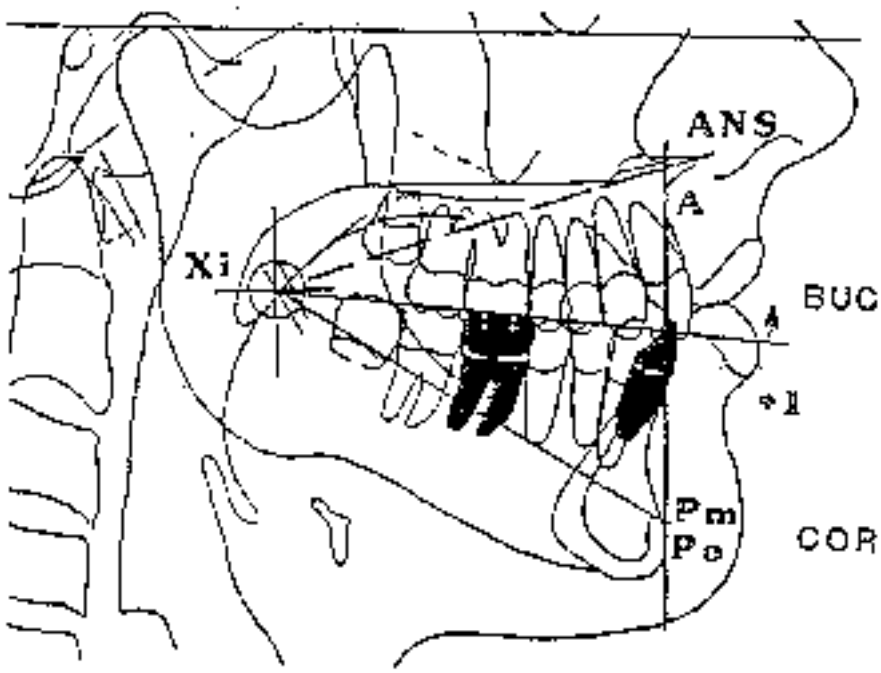


PARAMETERS FOR TEETH ASSESMENT

APo Plane



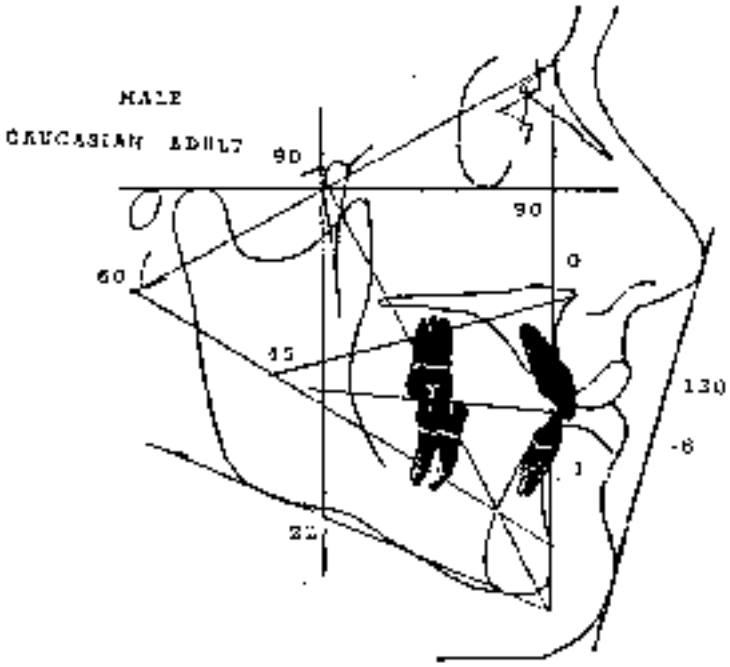
PTERYGOID VERTICAL

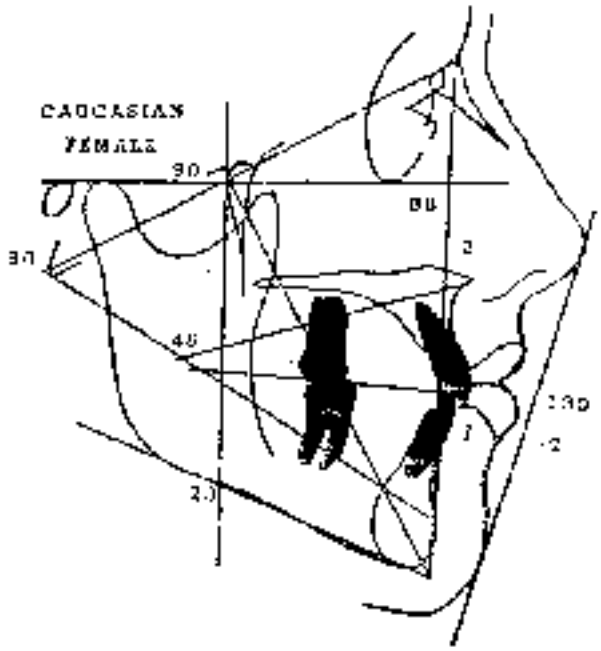


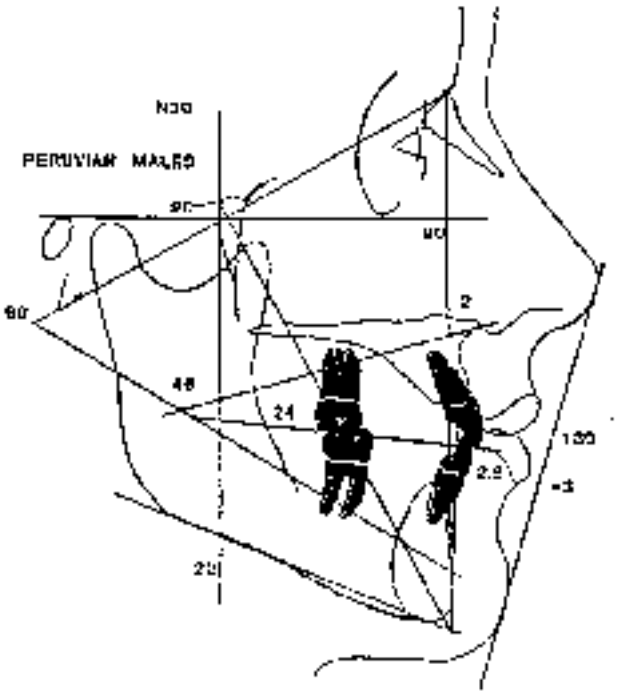
Xi POINT

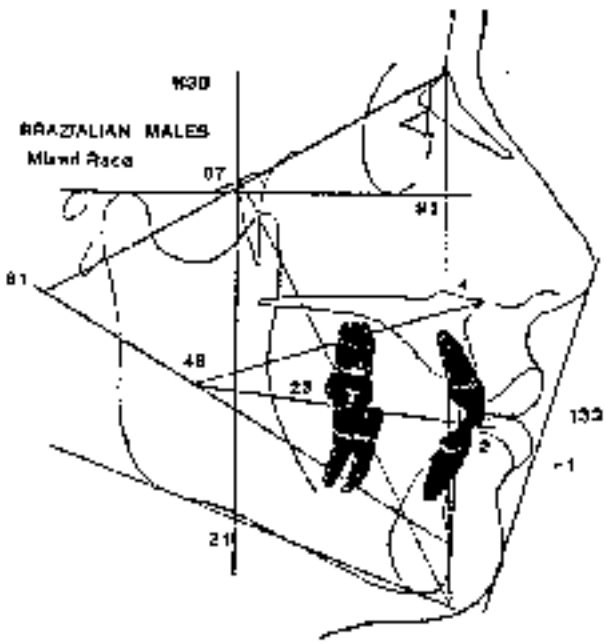
BUCCAL OCCLUSAL PLANE

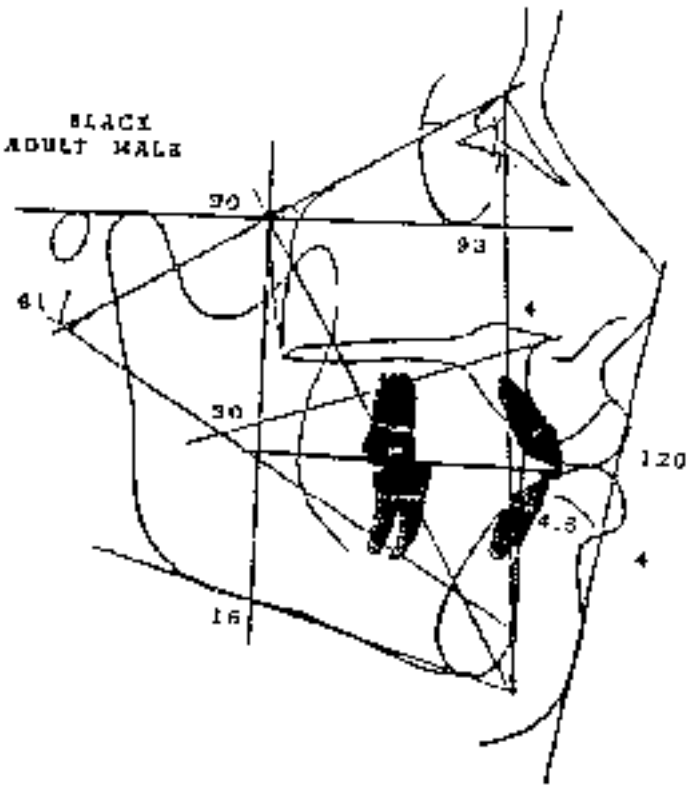
CORPUS AXIS

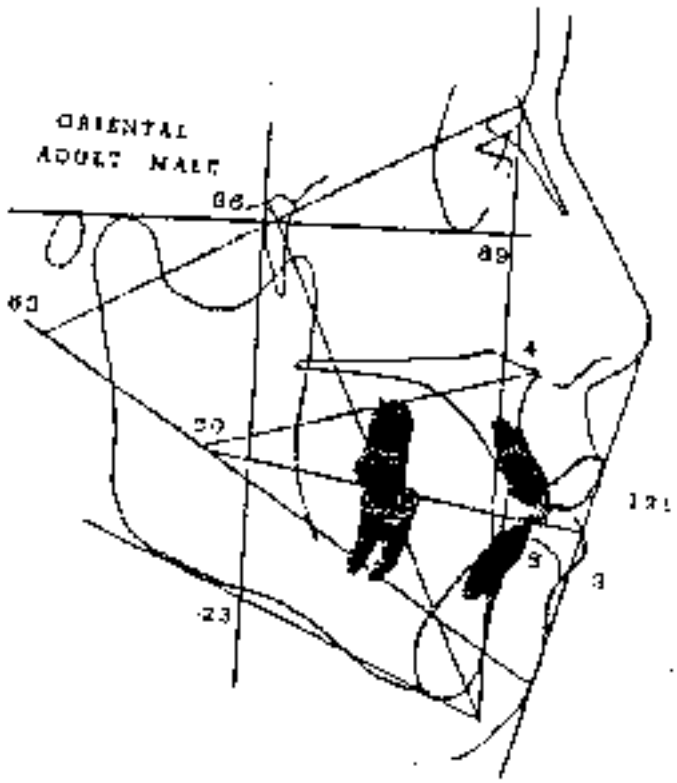

MALE
CAUCASIAN ADULT
90
90
0
60
45
130
-6
1
22

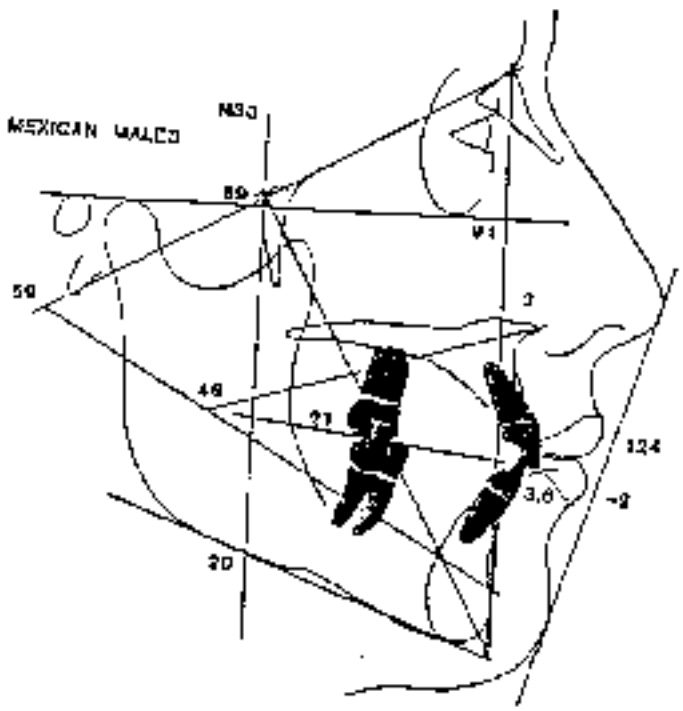

CAUCASIAN
FEMALE
90
88
2
80
48
130
-2
1
20

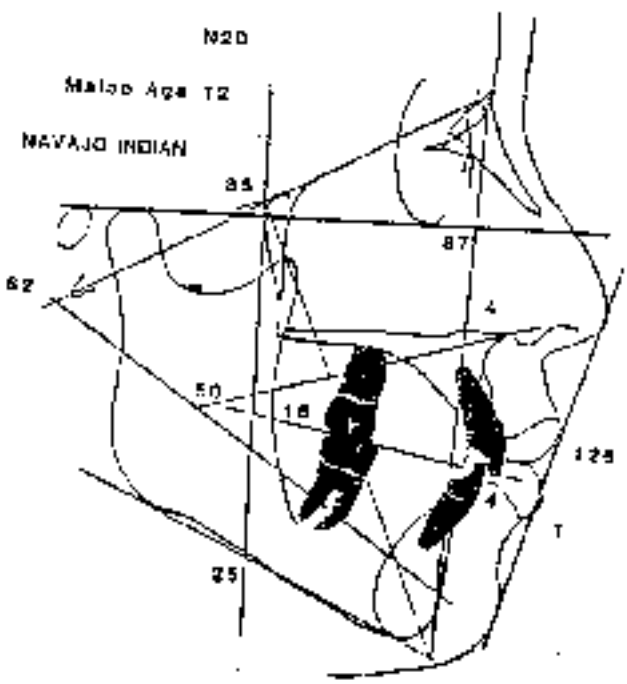

N30
PERUVIAN MALES
90
90
2
80
48
24
130
2.9
-3
25


N30
BRAZILIAN MALES
Mixed Race
87
83
4
81
48
28
132
2
-1
21

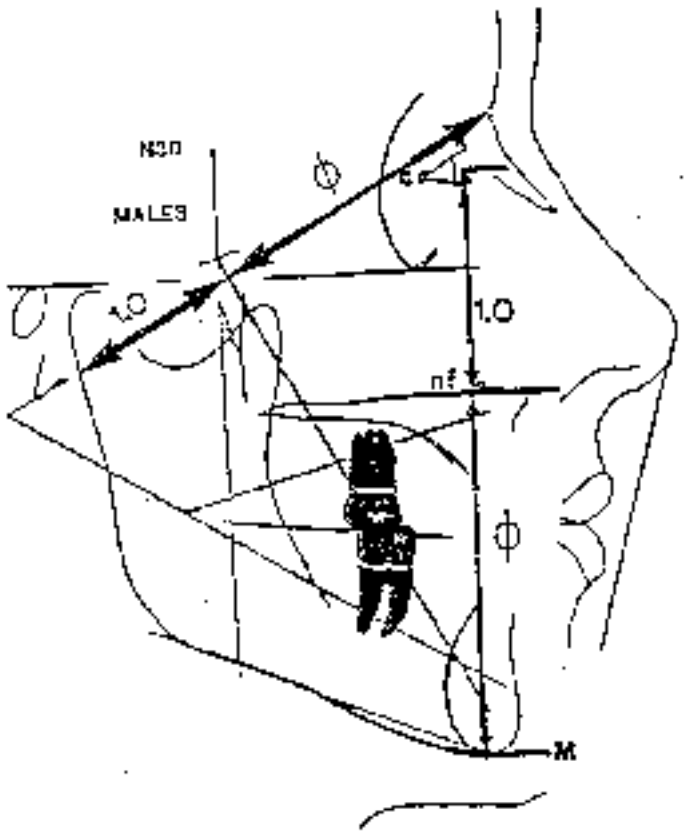

BLACK
ADULT MALE
90
93
81
4
30
120
4.8
4
16

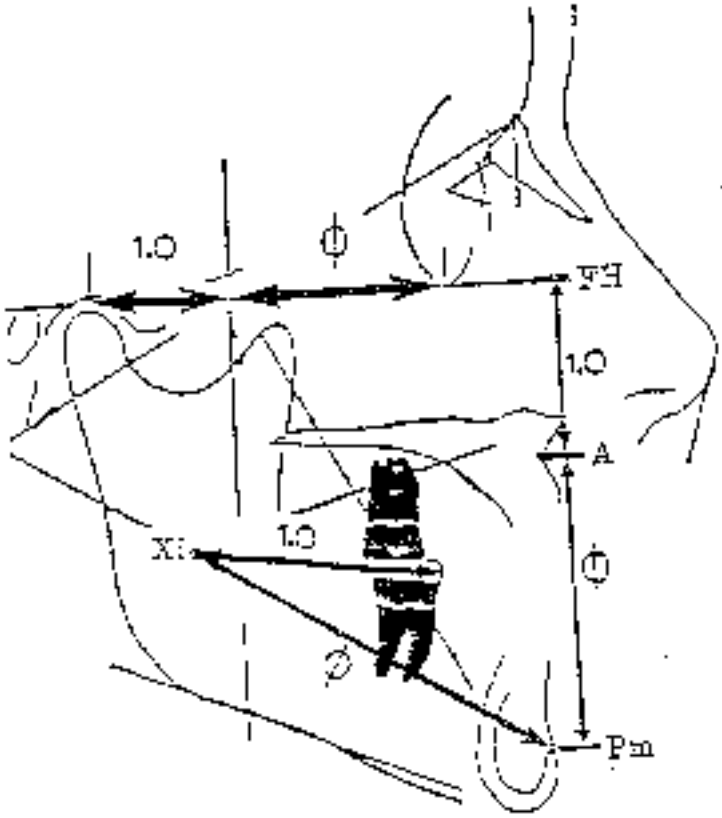

ORIENTAL
ADULT MALE
86
89
60
4
50
3
3
23

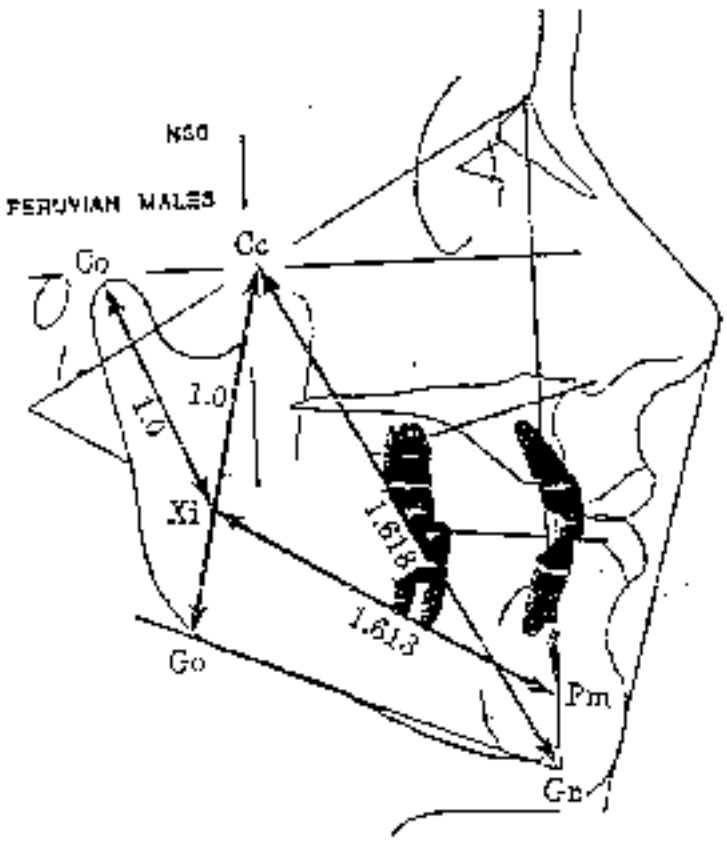

MEXICAN MALES
N90
89
91
58
3
46
21
124
3.6
-2
20

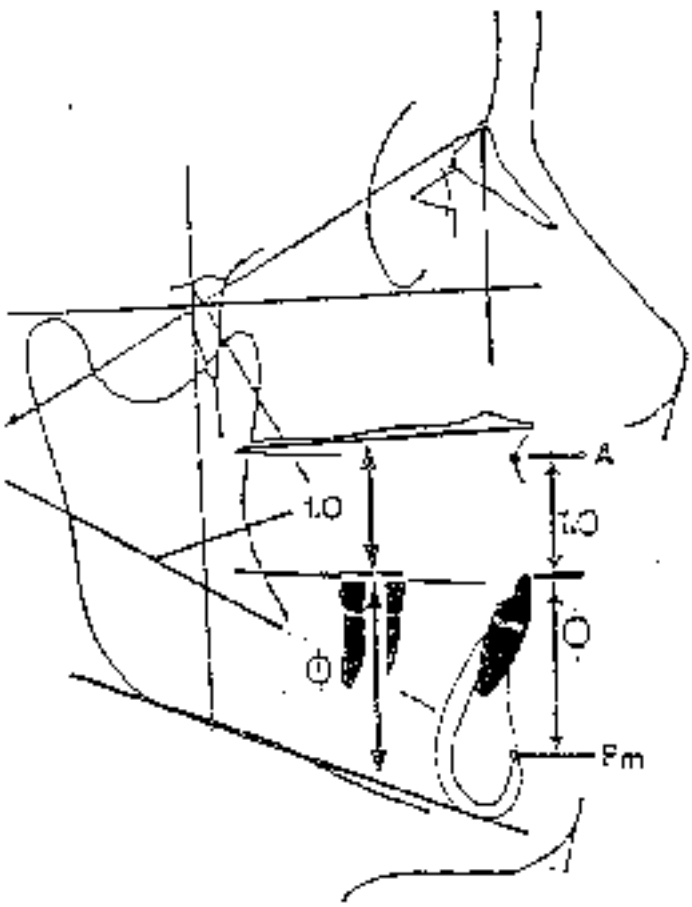

N20
Males Age 12
NAVAJO INDIAN
85
87
62
4
50
18
125
4
1
25

DIVINE PROPORTION

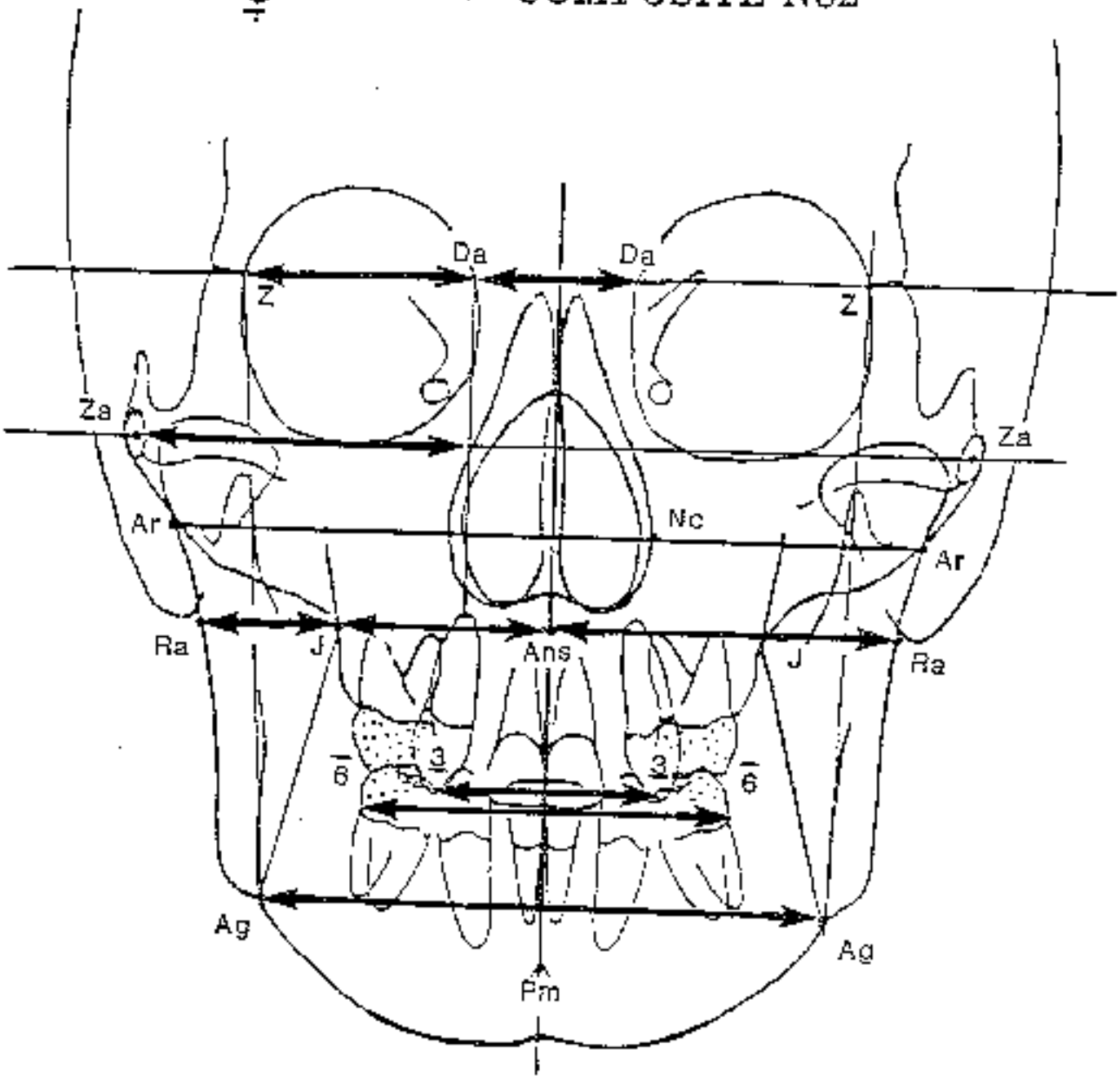


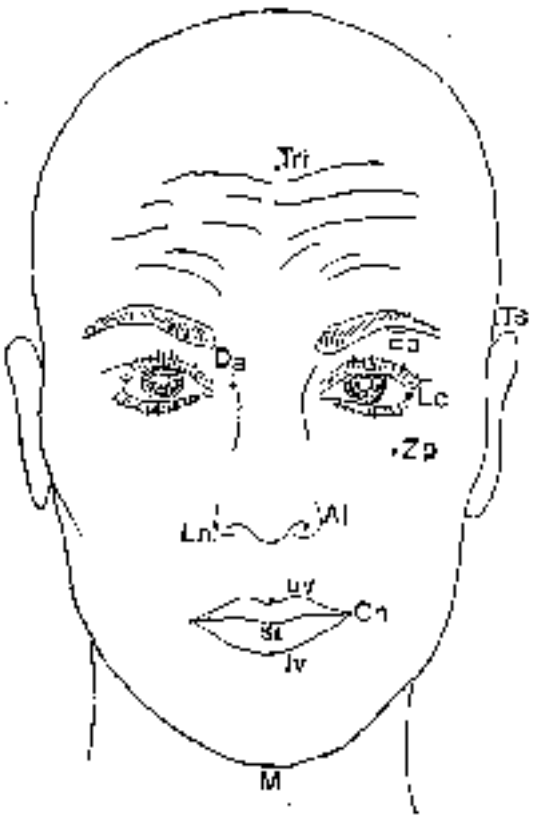


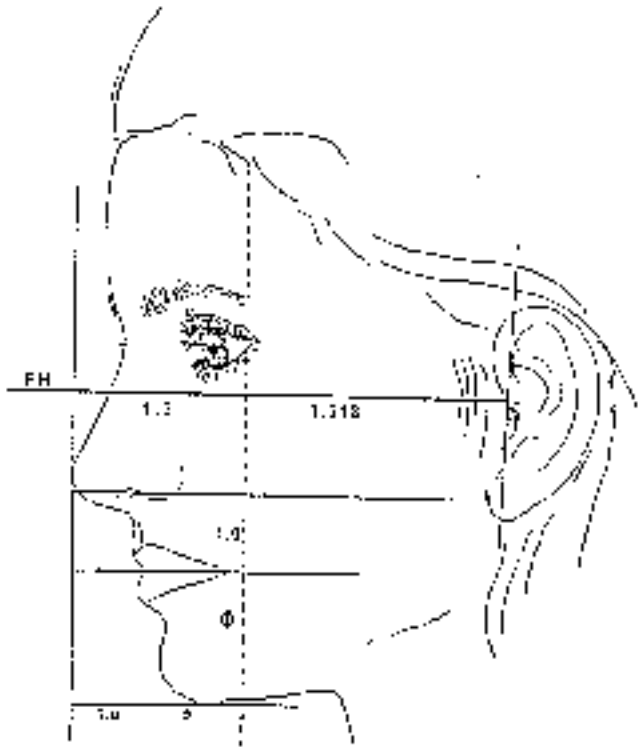


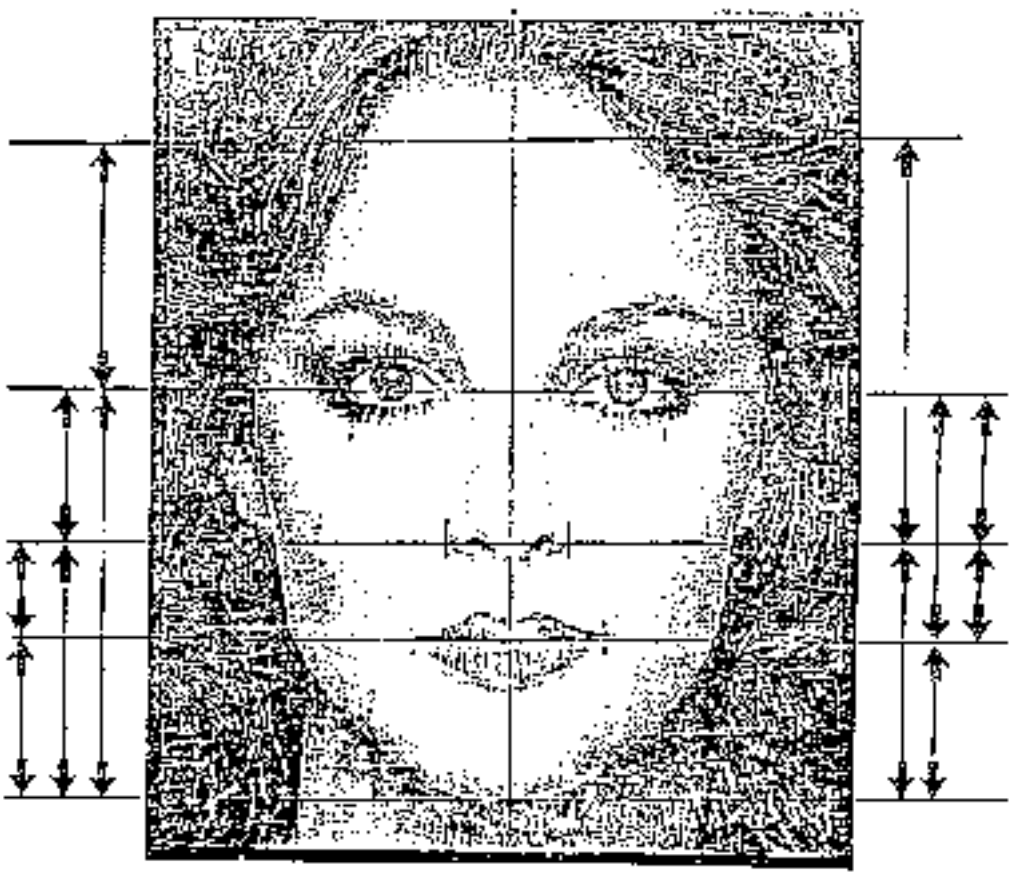


♀ ADULT COMPOSITE N82




Tri
Ts
Da
Ec
Lc
Zp
Ls
Al
Cn
M


FH



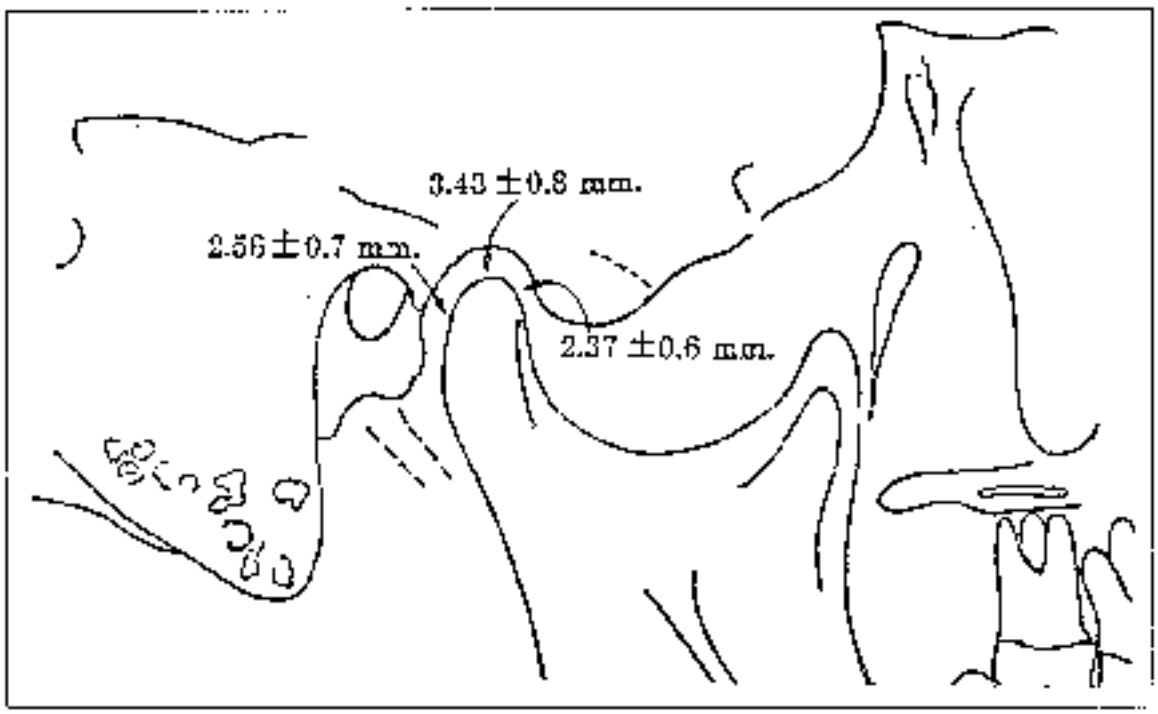
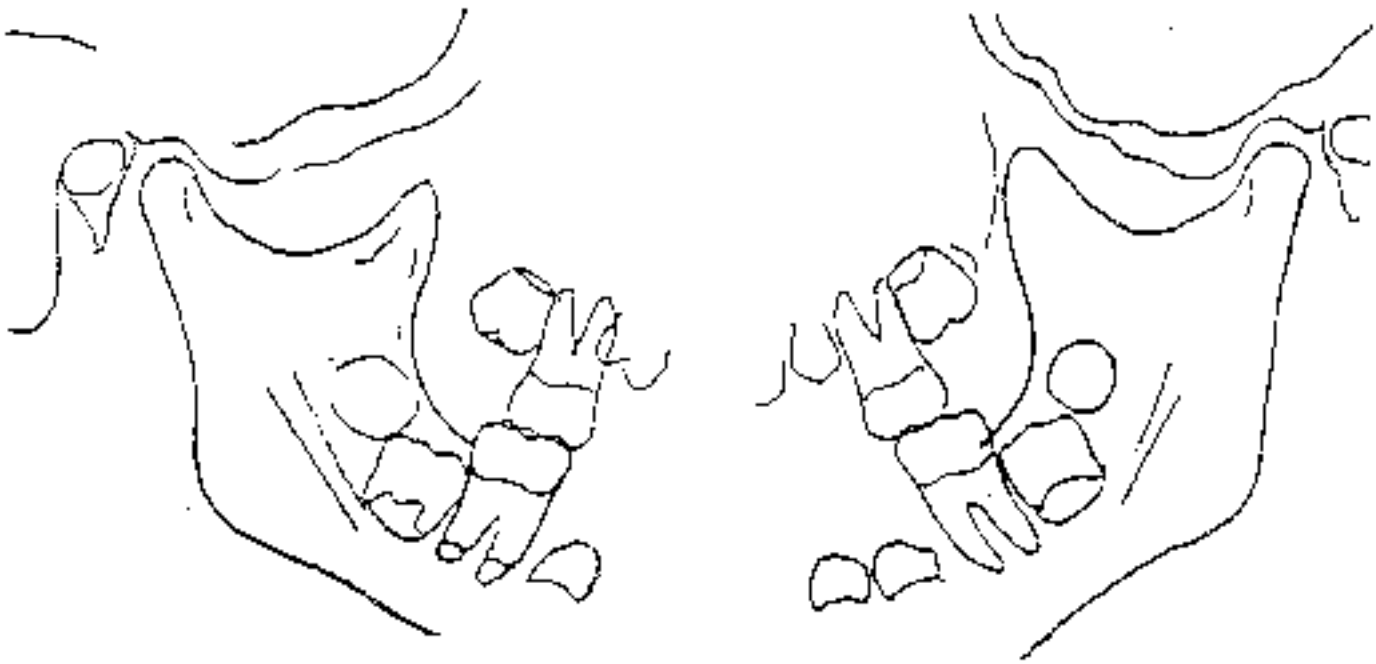
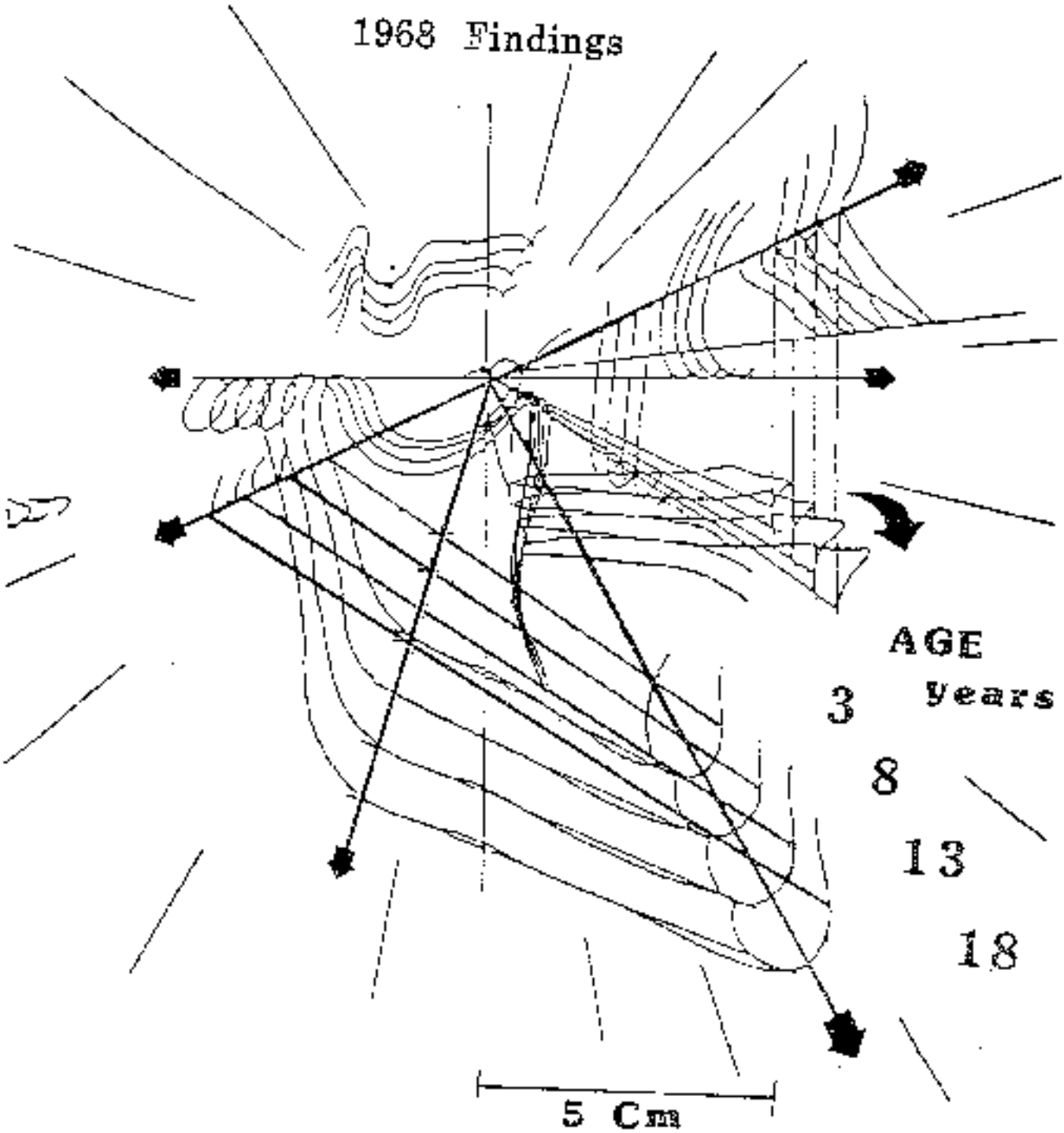
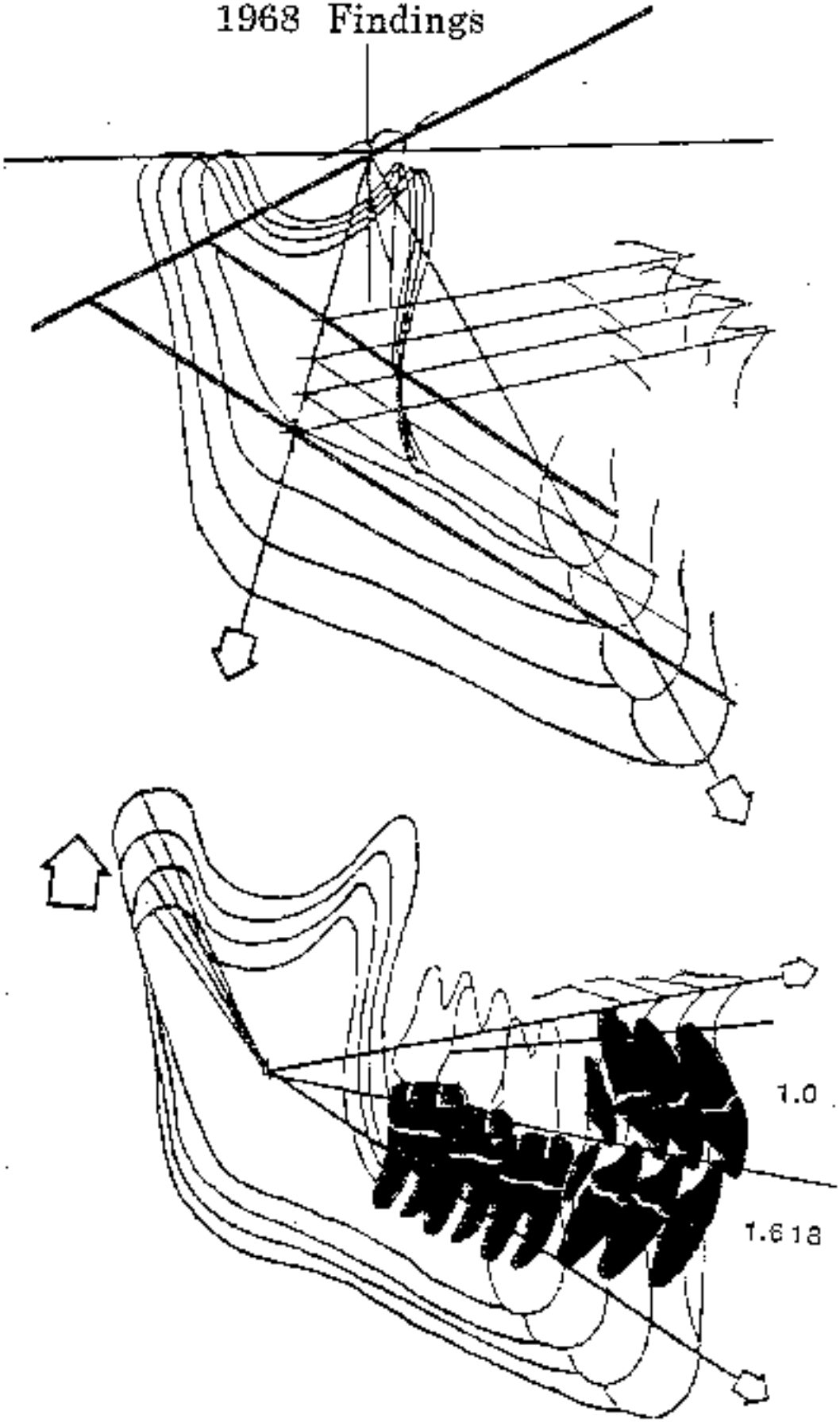


Fig. 18.50 The accepted control normal in 20° oblique image. Conclusions when previous study was combined with Dumas et al. in 1983. Note 2.37, 3.43, and 2.56 mm. respectively. Standard deviations were 0.6, 0.8 and 0.7 mm.




1968 Findings
AGE
Years
3
8
13
18
5 Cm

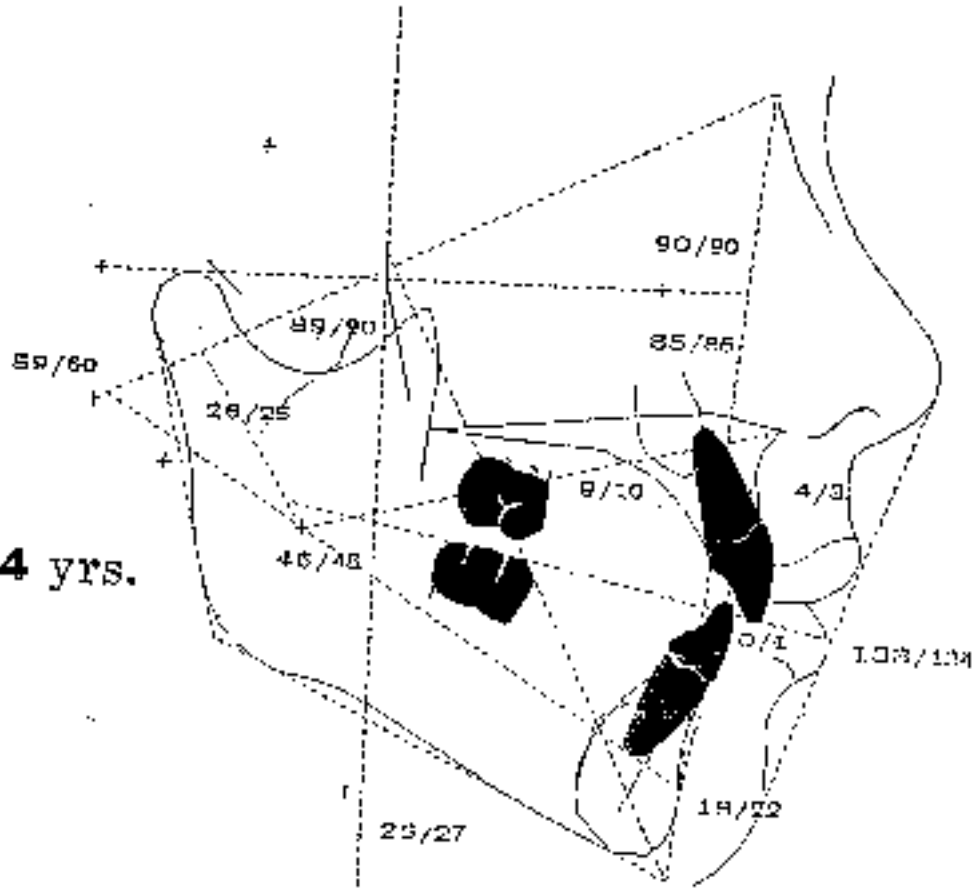
1968 Findings



N 73
non

46/27

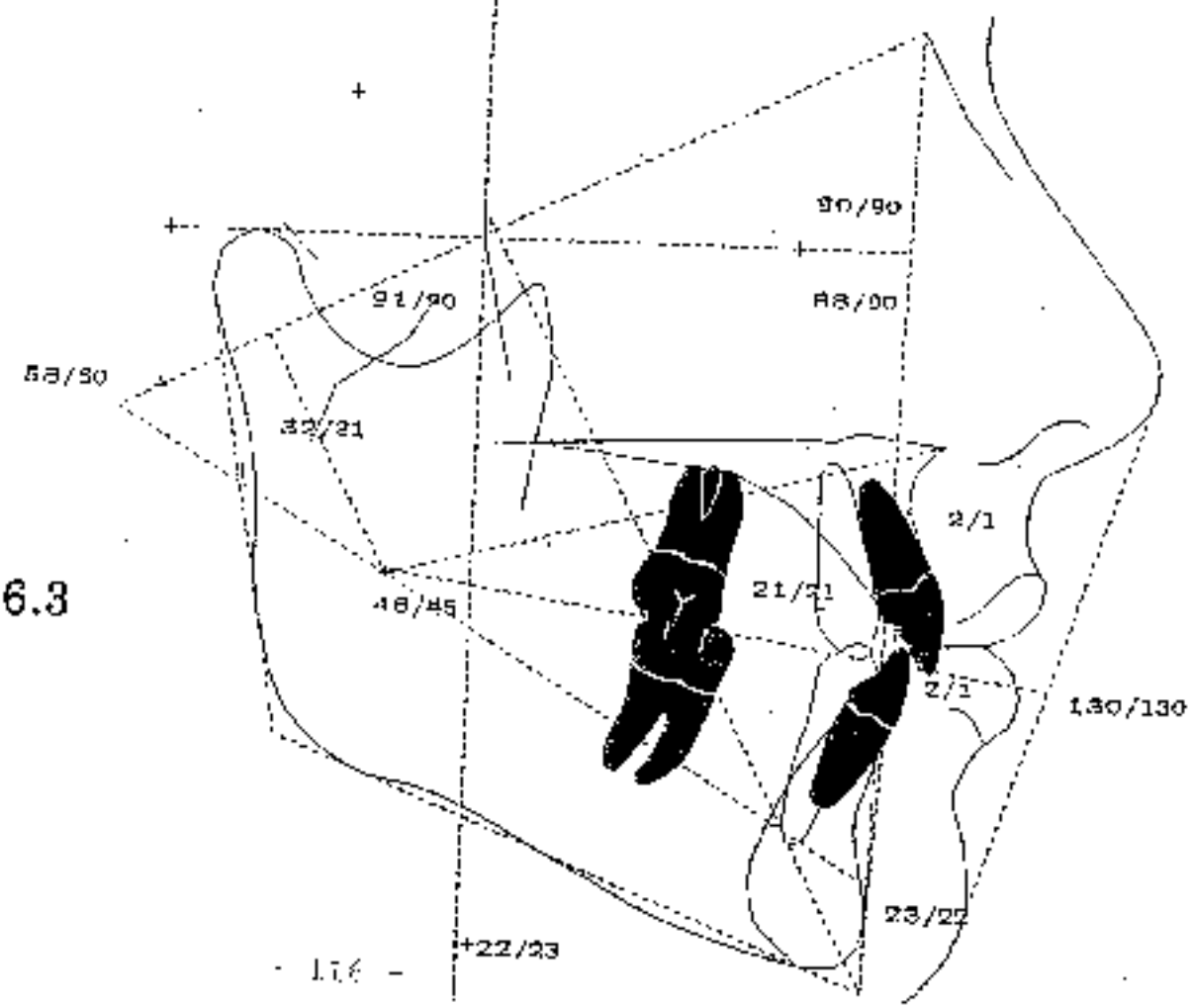
Age 6.64 yrs.

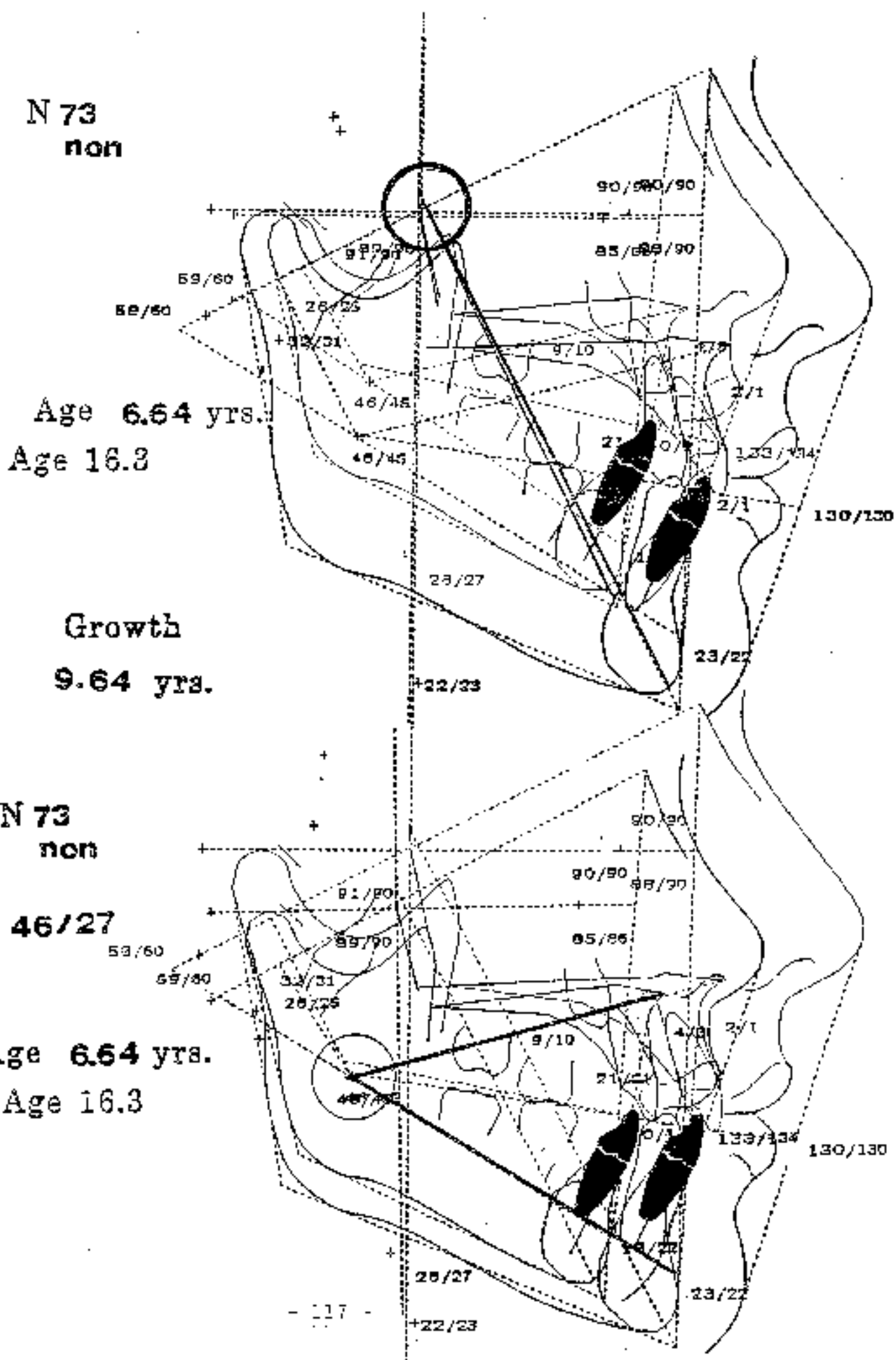


Growth

9.64 yrs.

Age 16.3



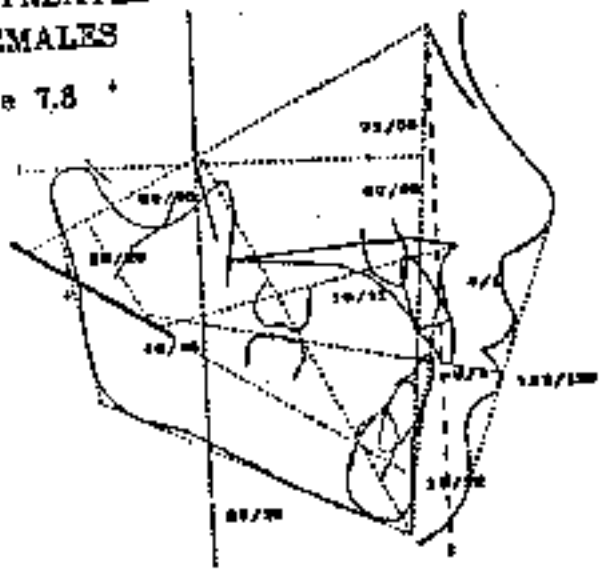

N 73
non
Age 6.64 yrs.
Age 16.3
Growth
9.64 yrs.
N 73
non
46/27
Age 6.64 yrs.
Age 16.3

T1 N54

UNTREATED

FEMALES

Age 7.8

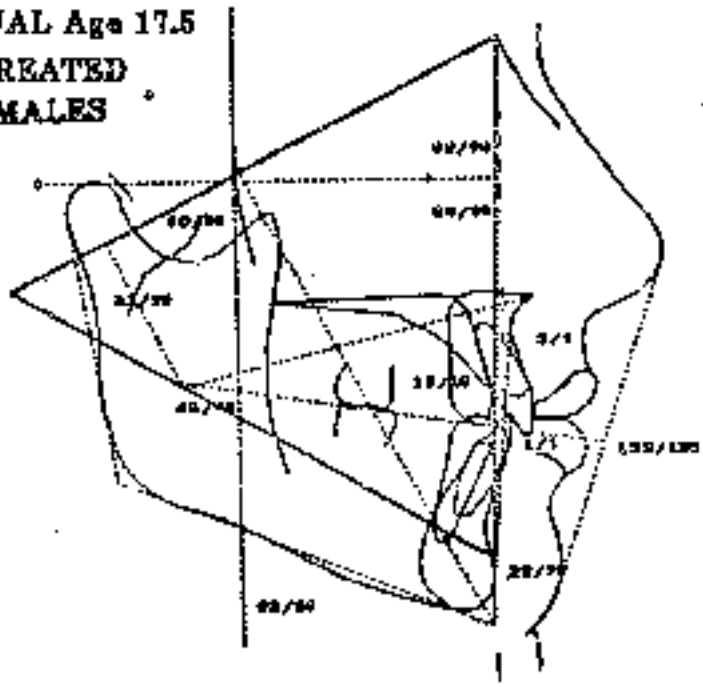


T2

ACTUAL Age 17.5

UNTREATED

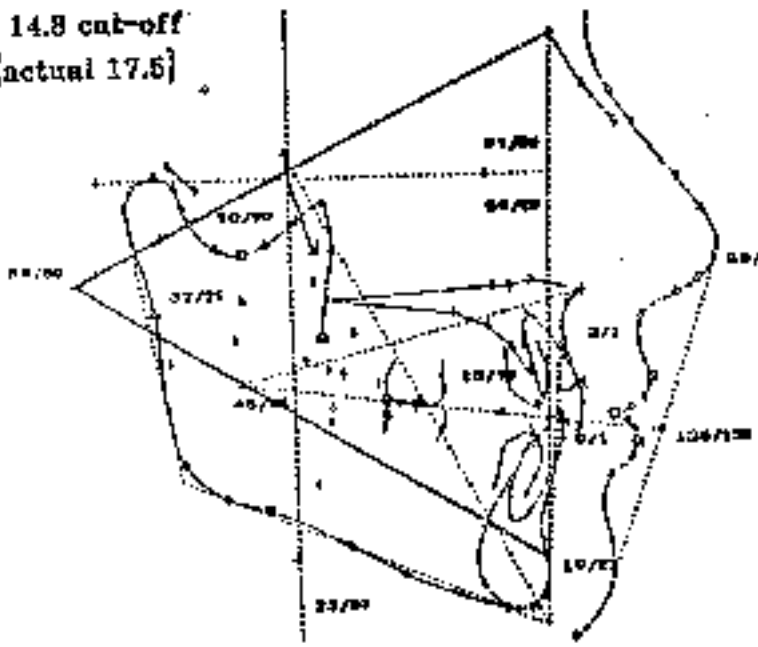
FEMALES

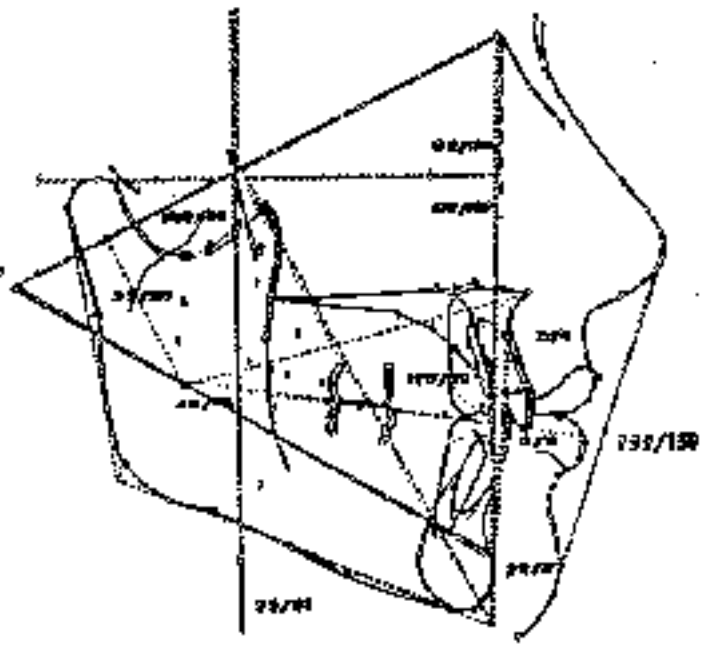


FORECASTS

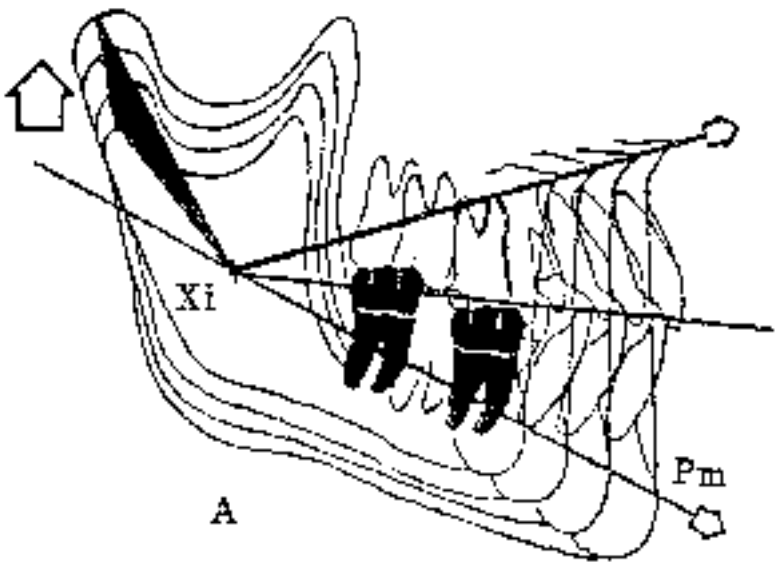
to 14.8 cut-off

(actual 17.5)

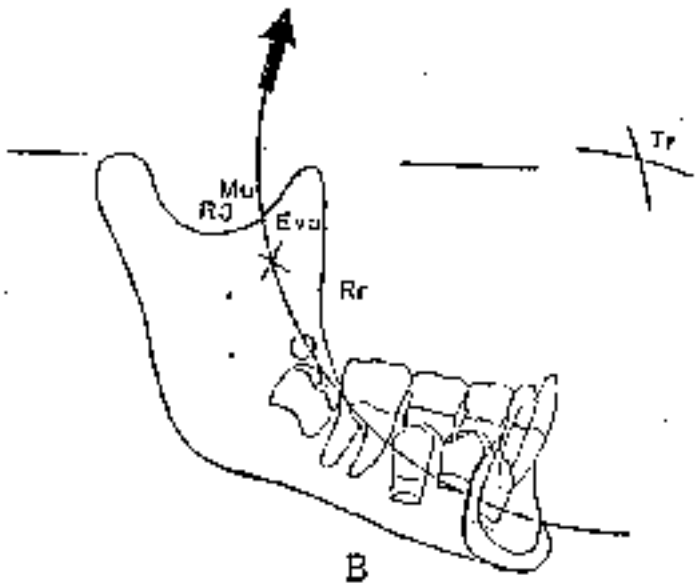




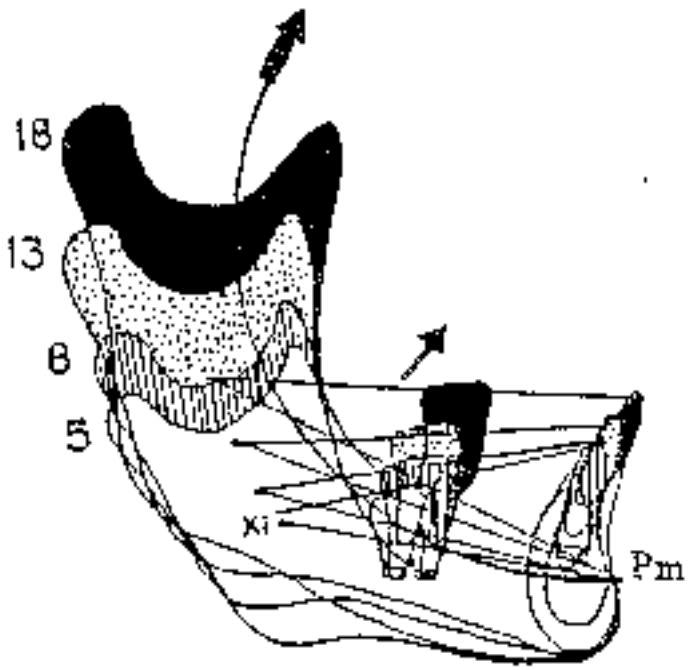
ARCIAL GROWTH



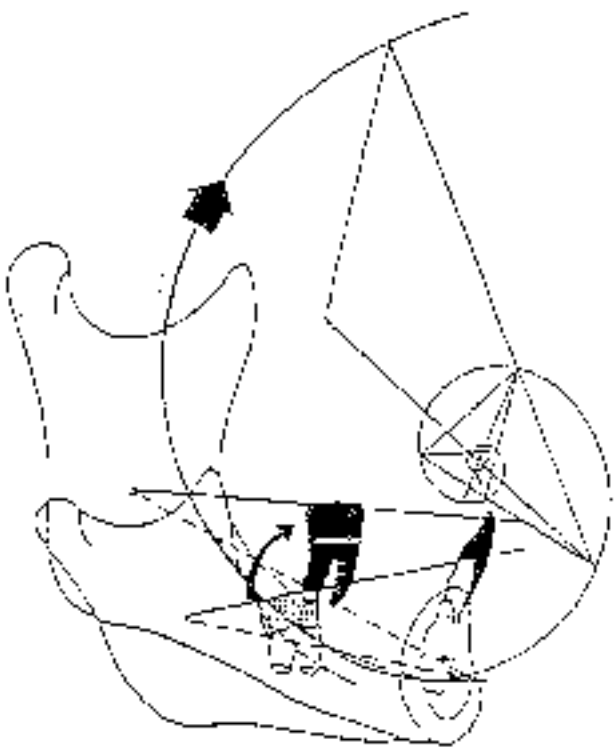
A



B

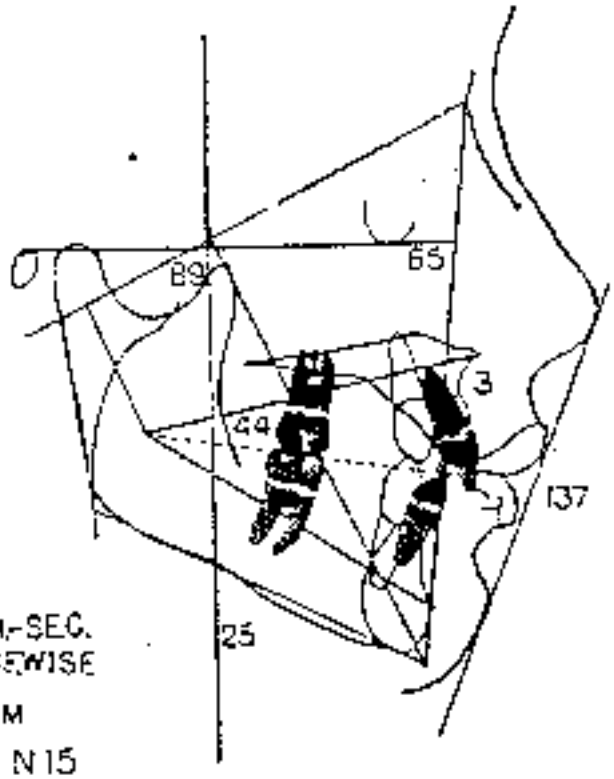


C

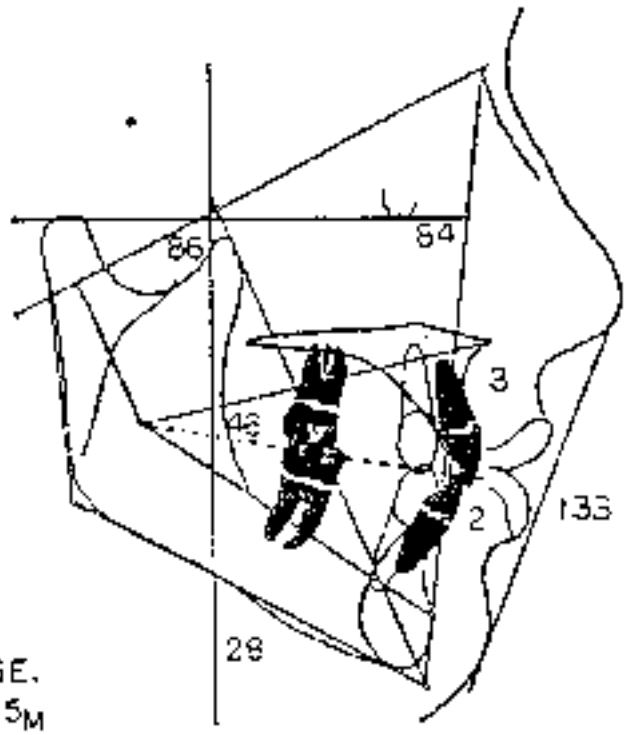


D

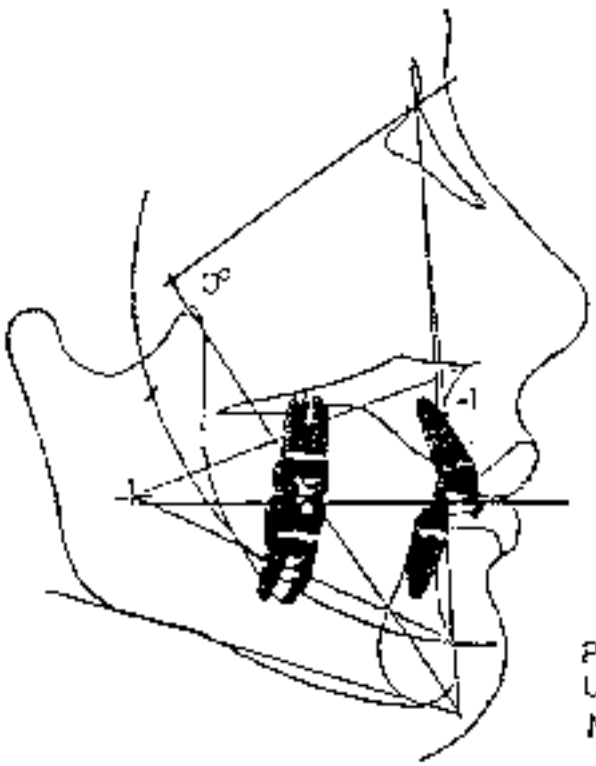
Damaging effects of bite opening on mandibular rotation

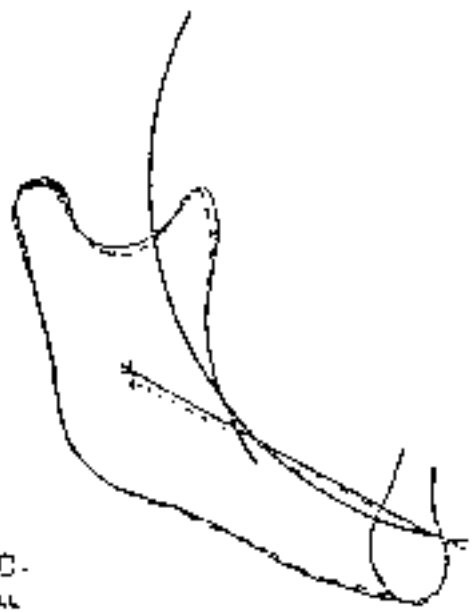


T1
CL II
PRIM.-SEC.
EDGEWISE
$11_Y\,4_M$
N 15

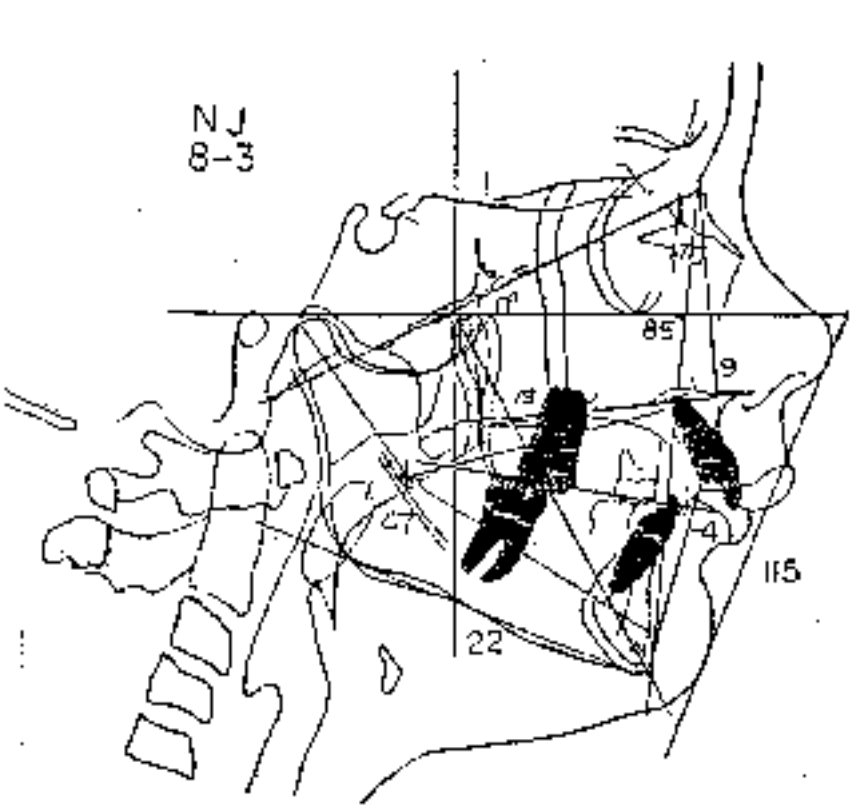


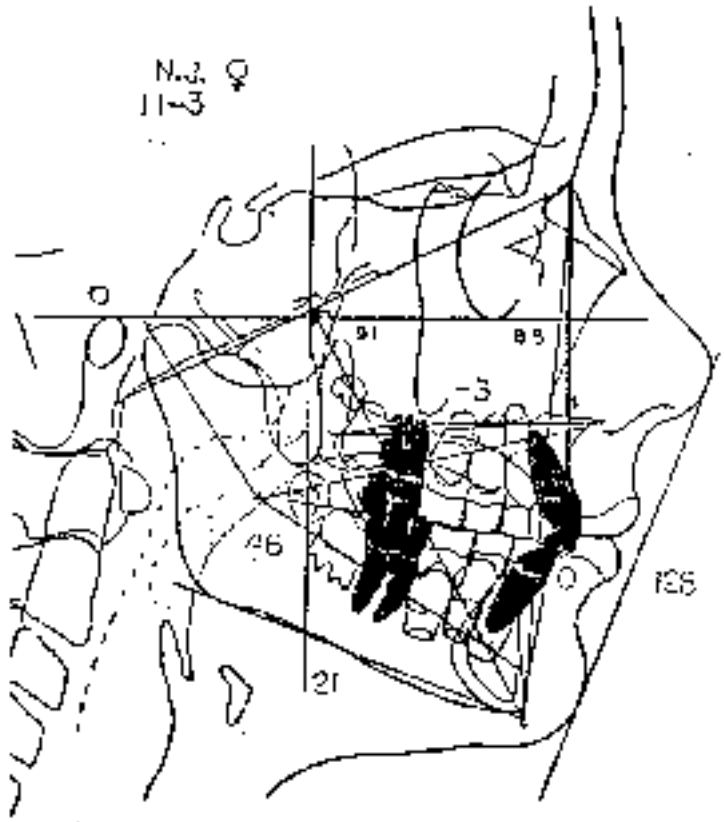
T2
EDGE.
$13_Y\,5_M$

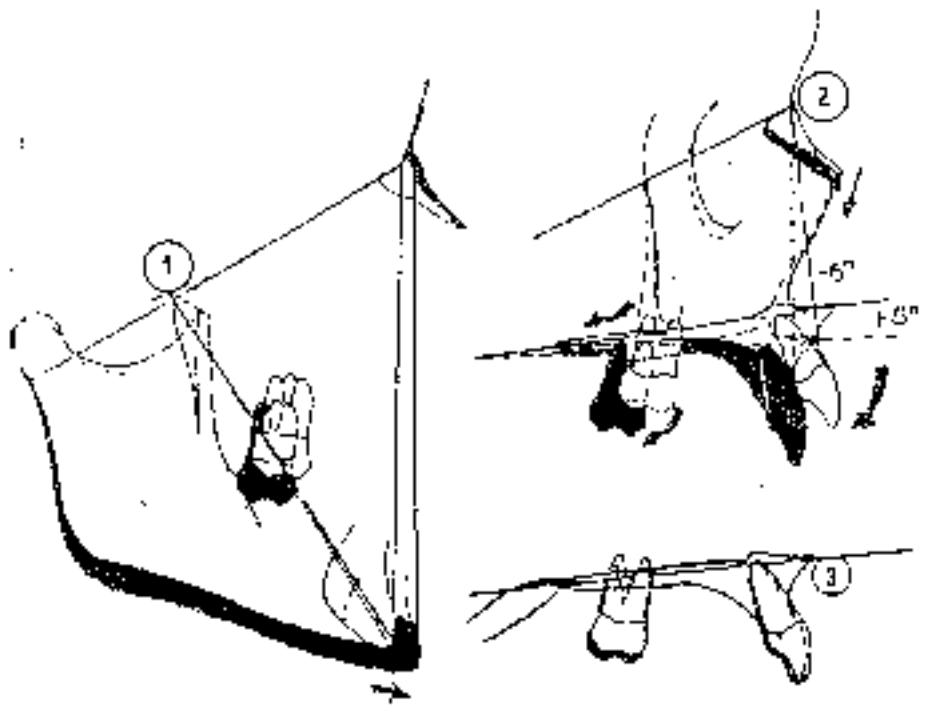


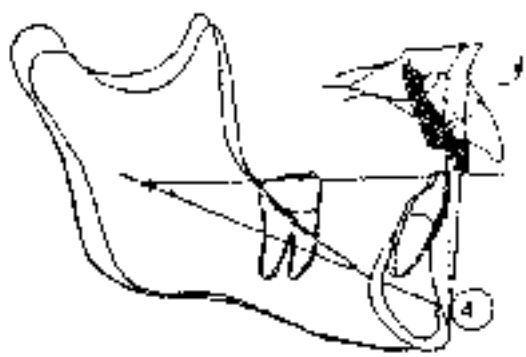


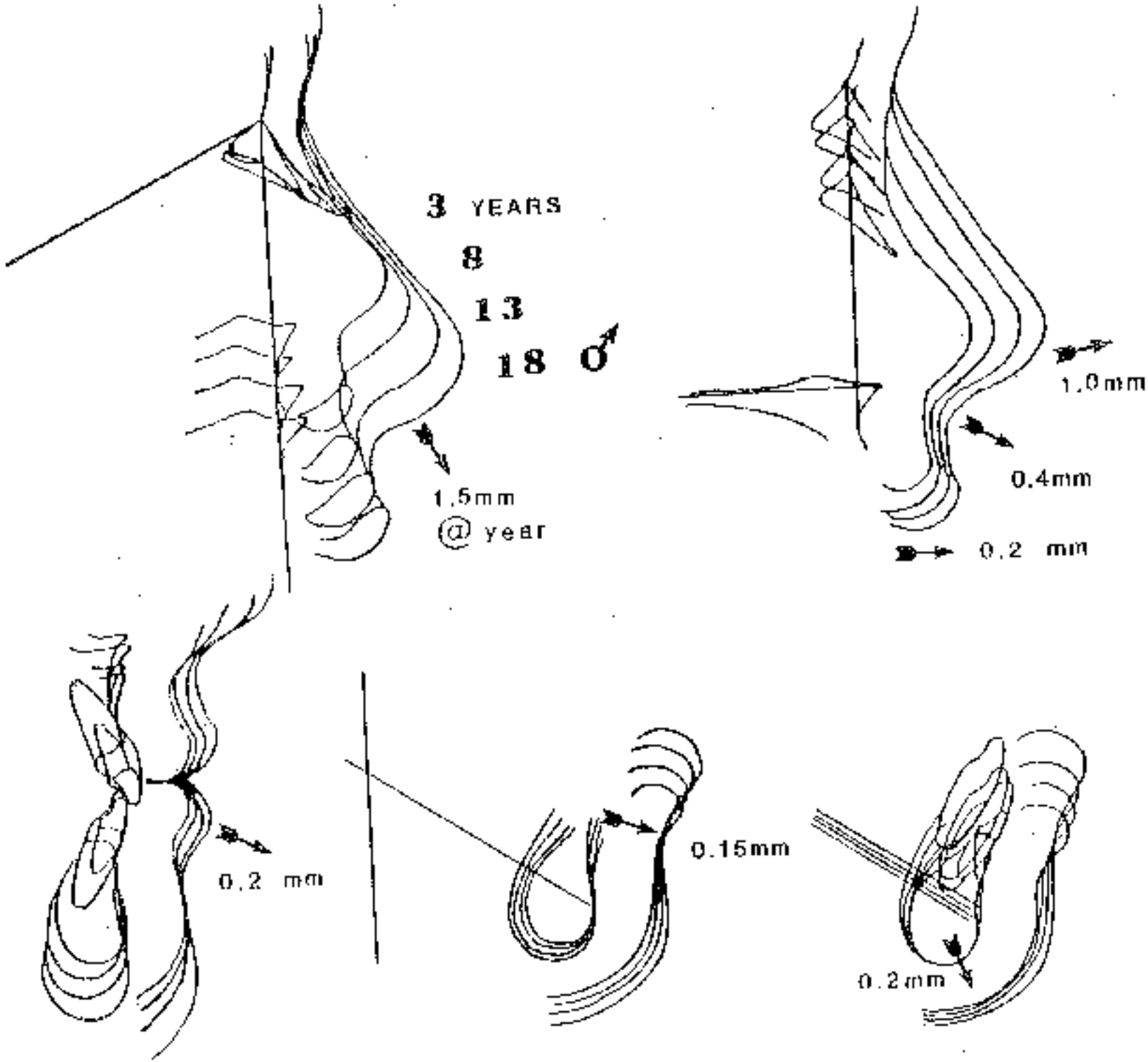
PREC-
Uprt
N 15

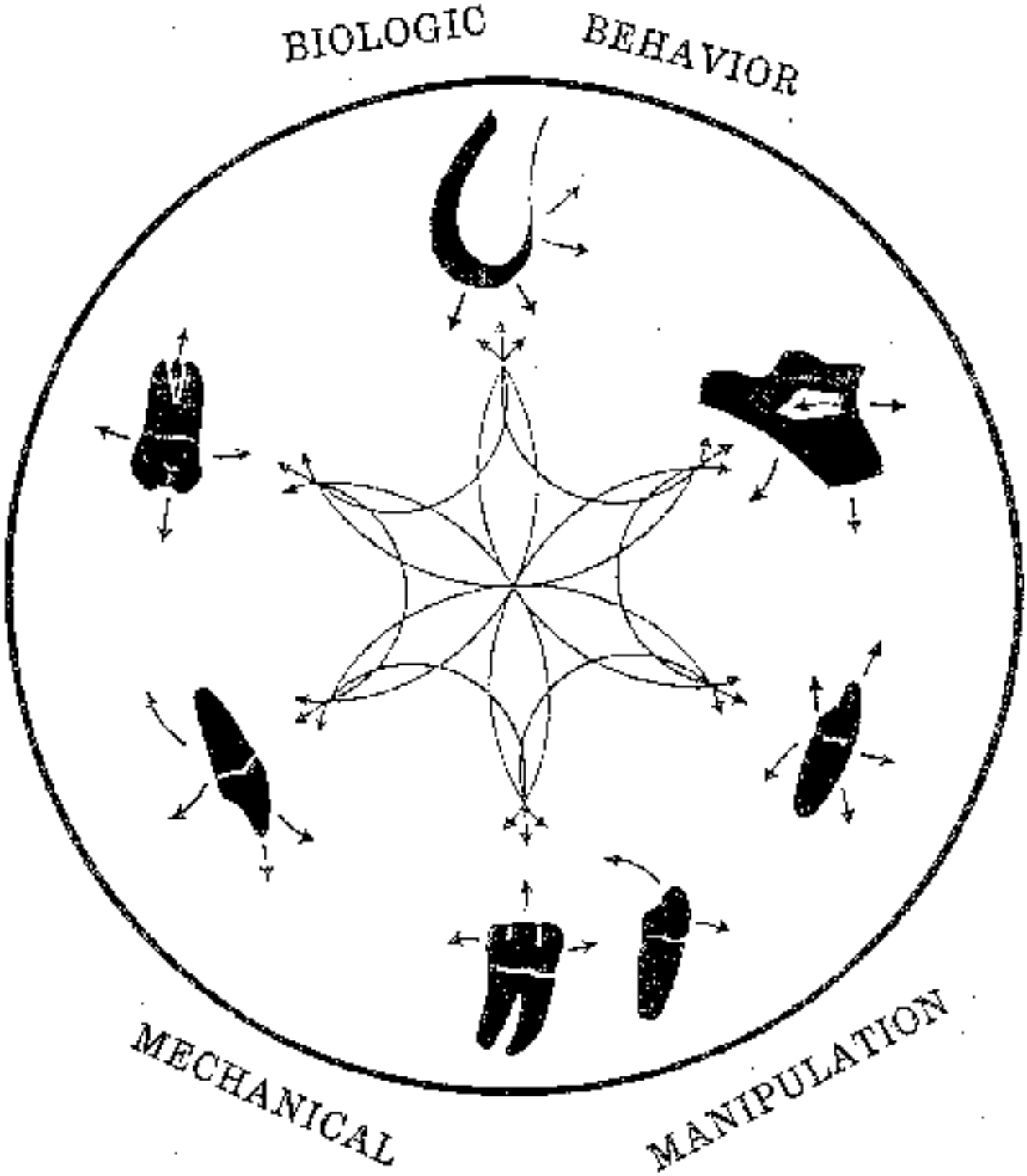

N J
8-3
85
9
115
22


N.J. ♀
11-3
91
85
-3
46
0
128
21


1
2
-6°
+6°
3


4


3 YEARS
8
13
18 ♂
1.5mm
@ year
1.0mm
0.4mm
0.2 mm
0.2 mm
0.15mm
0.2mm



CYBERNETIC CIRCLE

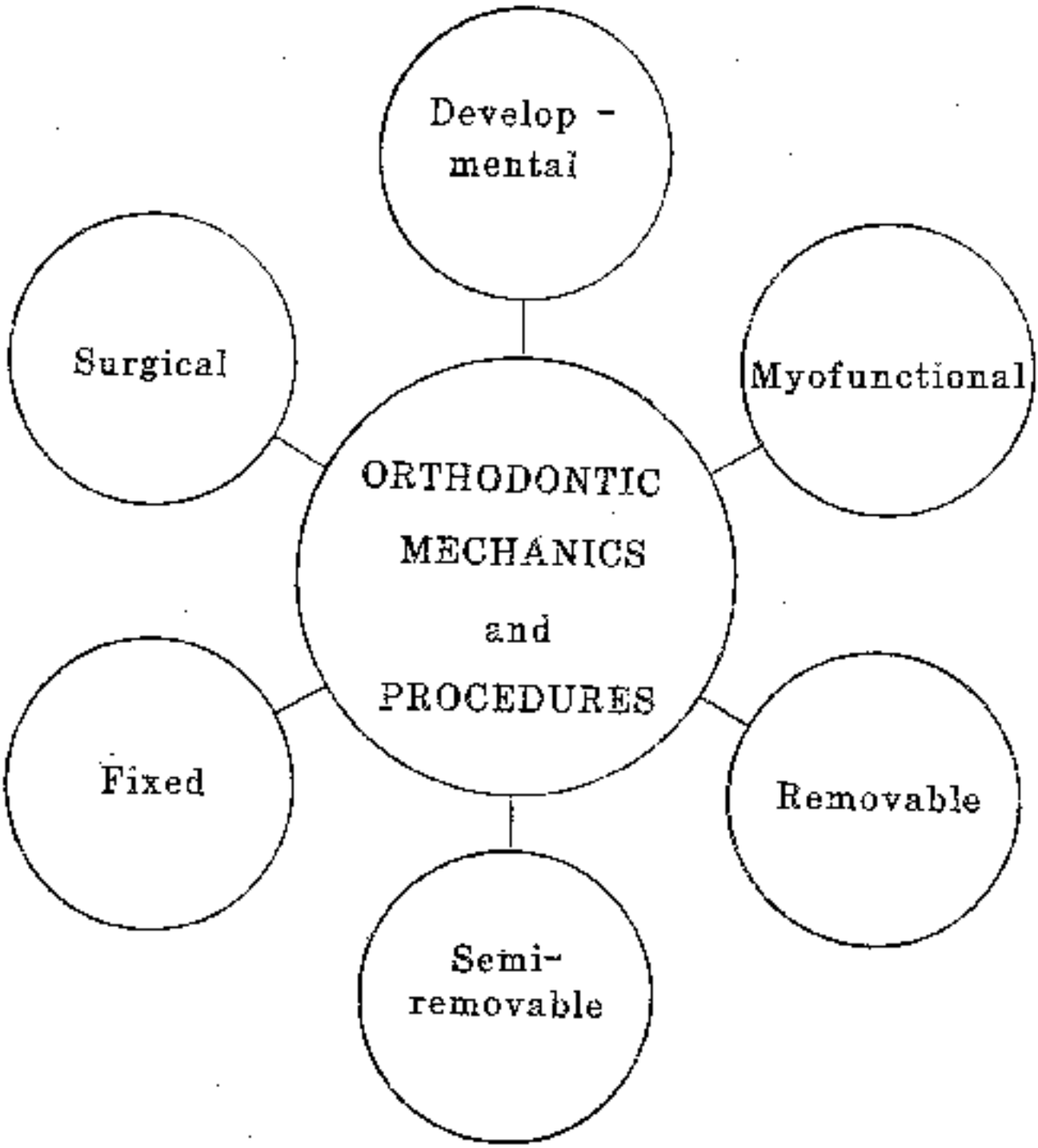
FOR PLANNING

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. Integration and Torquing 6. Idealization and Co-ordination
IV	COMPLETING	7. Finishing and Over-treatment 8. Retention and Stabilization

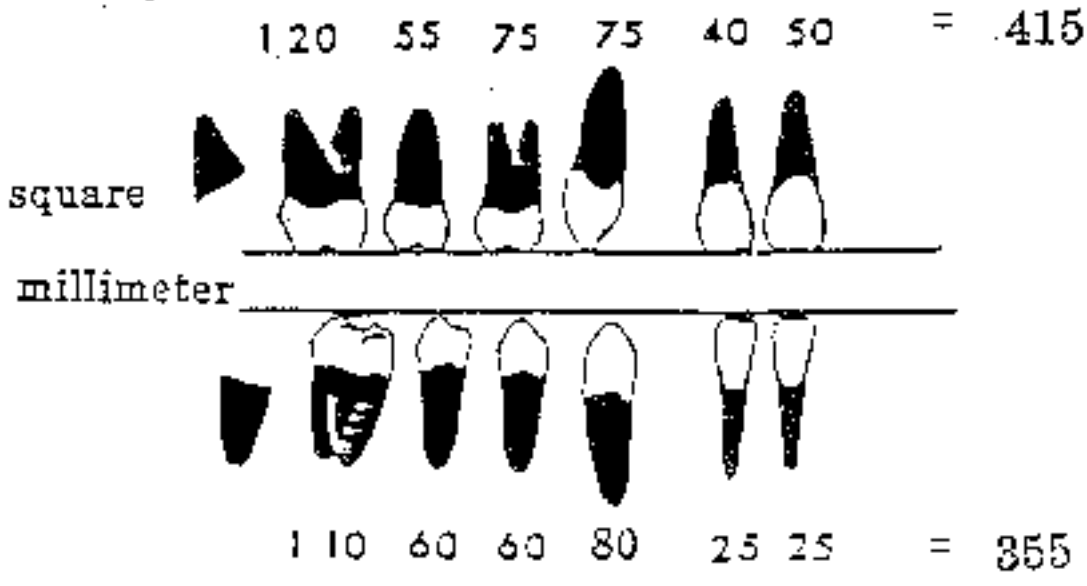
IMPERATIVES IN CONTEMPORARY MECHANICS

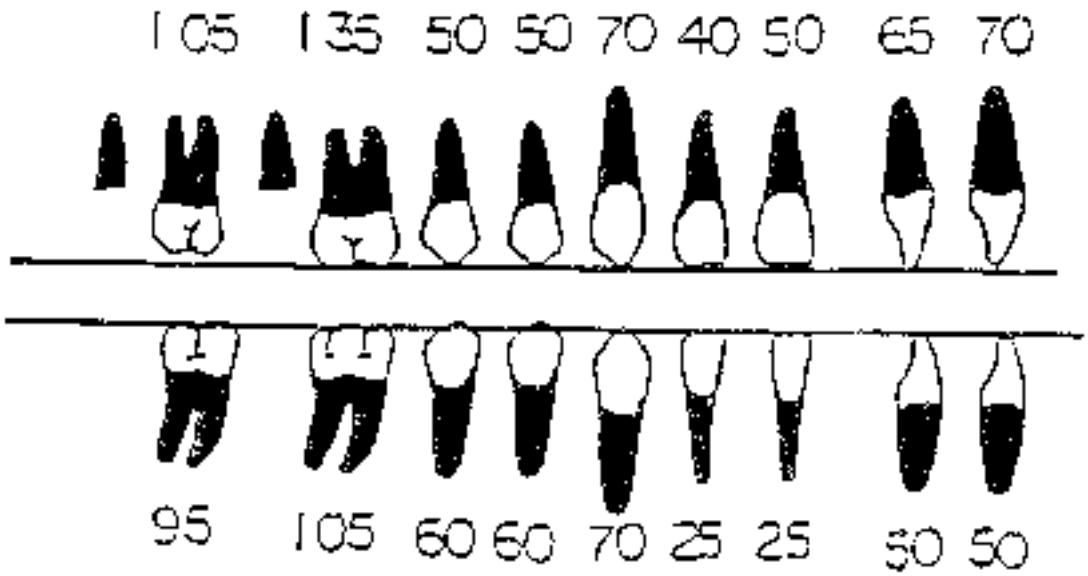
1. Extra-oral Traction
2. Quad Helix
3. Utility Arches
4. Sectional Therapy
5. Retraction Sections
6. Straight Line Approaches
7. Bumper (shielding)
8. Lower Lingual Modalities
9. Crickett
10. Mandibular Posturing
11. Intermaxillary Traction
12. Anterior Intrusion
13. Squeeze Techniques
14. Myofunctional Procedures

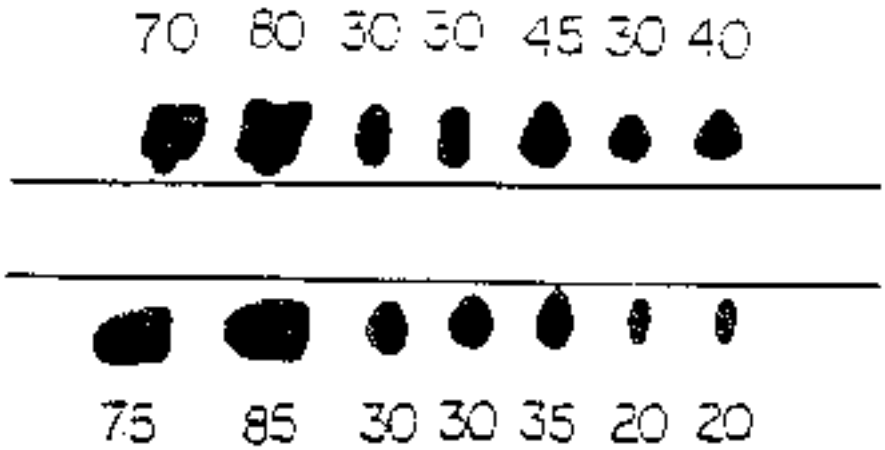

Develop - mental
Surgical
Myofunctional
ORTHODONTIC MECHANICS and PROCEDURES
Fixed
Removable
Semi- removable

RATING SCALE FOR ROOTS

mm^2







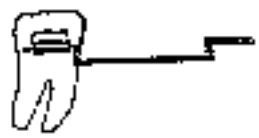
CAPACITY OF BLUE ELGILOY WIRE

(A)

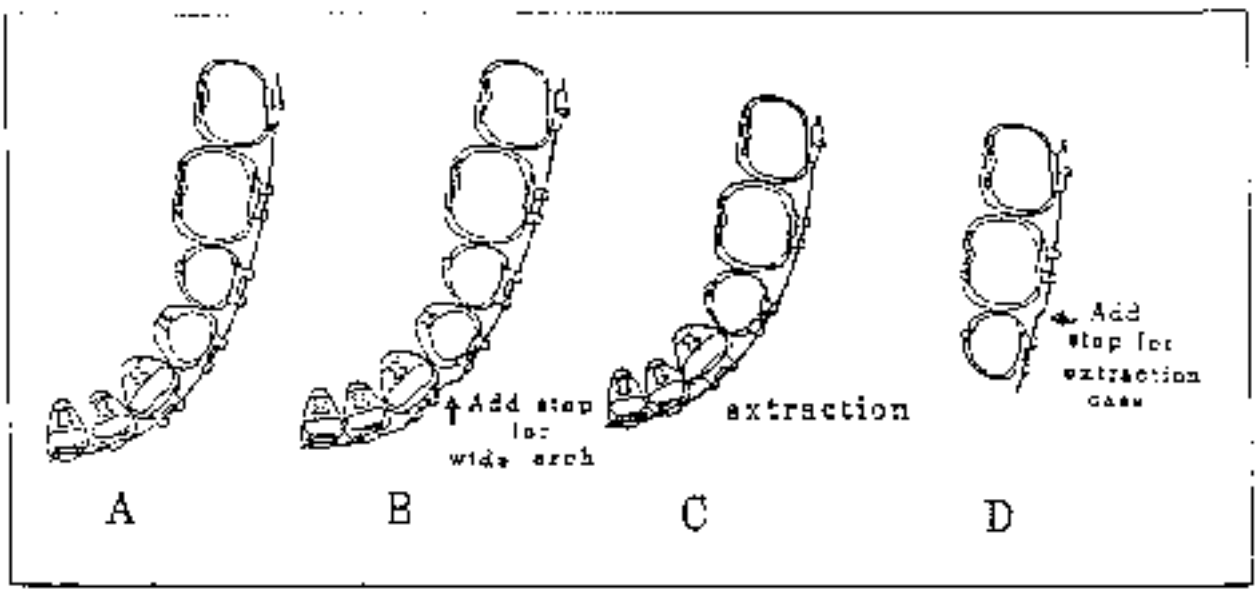
CONCLUSION: Around 2,000 grams

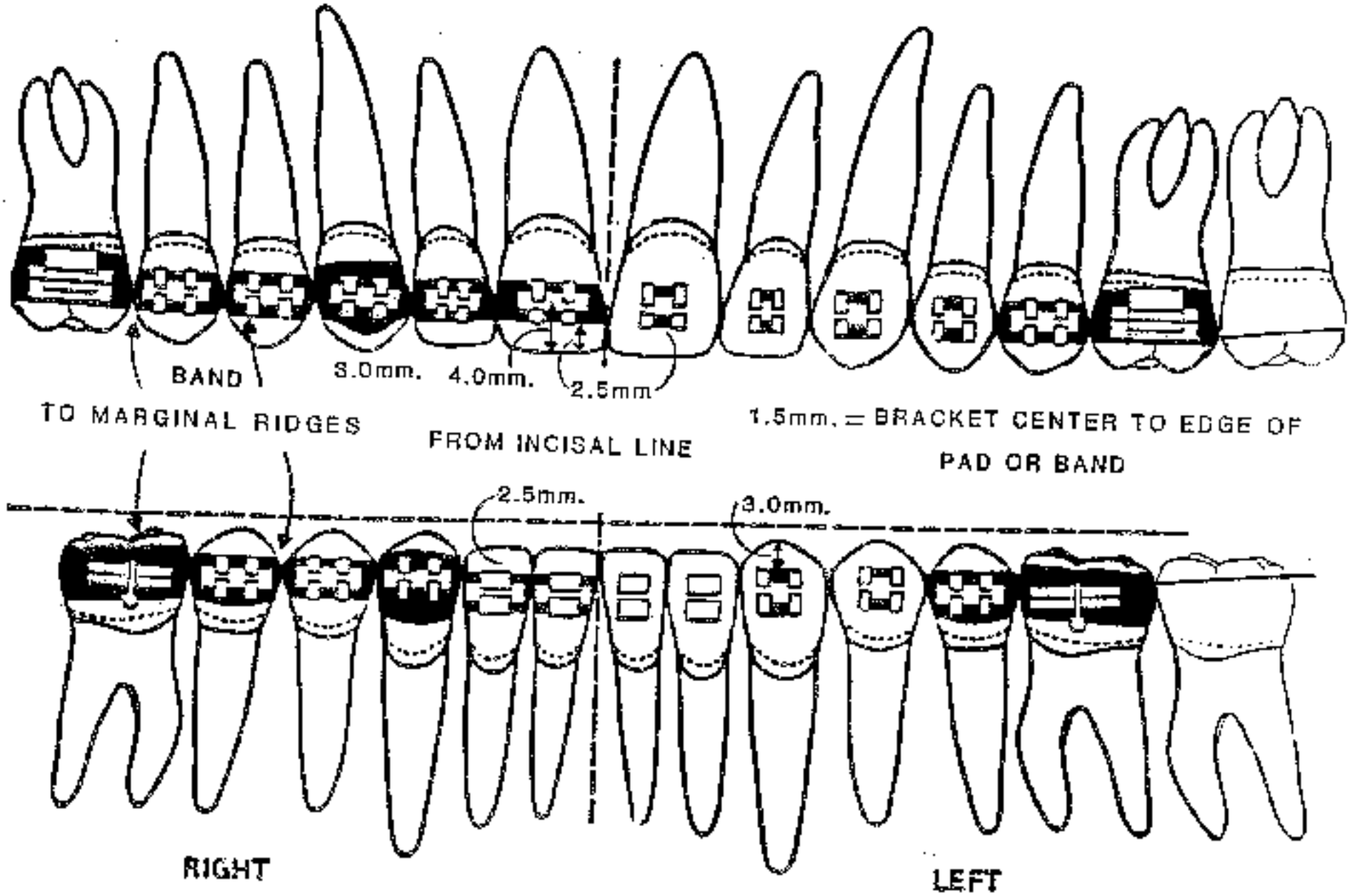
.016 2

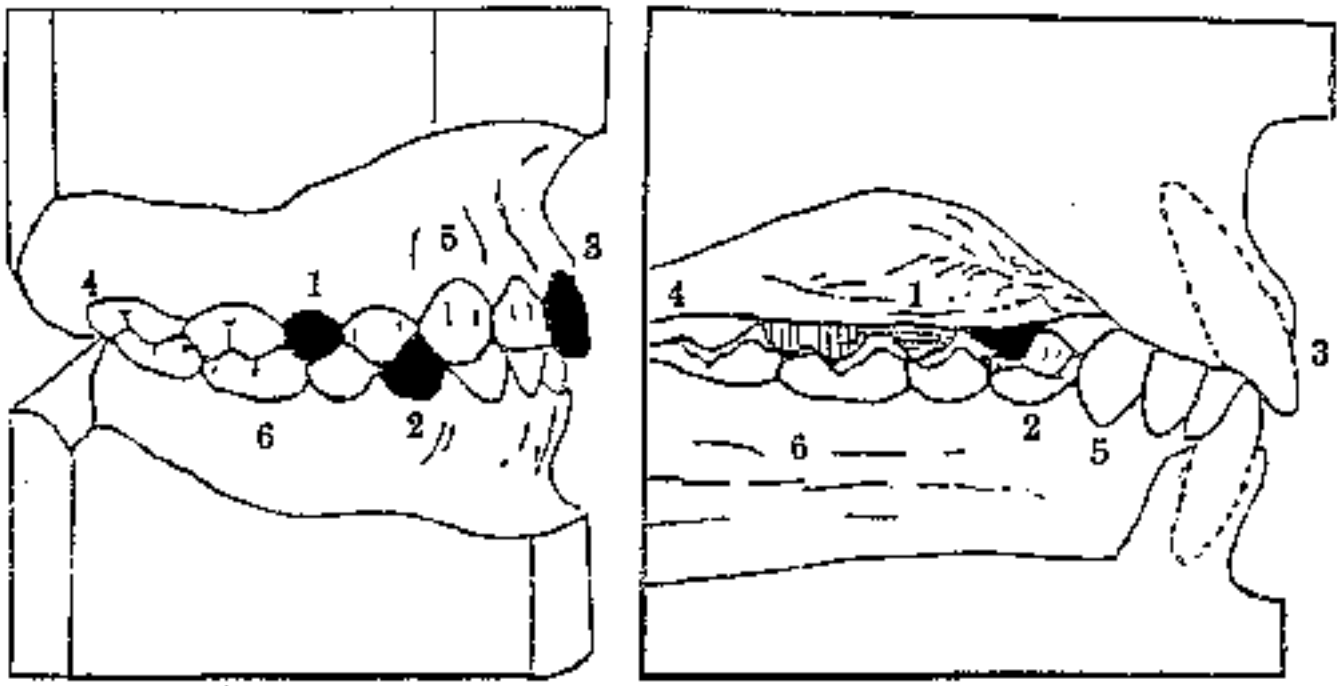
LENGTH	FORCE OF BENDING
@ 30mm	+ 70 grams
@ 25mm	+ 80 grams
@ 20mm	+ 100 grams
@ 10mm	+ 200 grams
@ 5mm	+ 400 grams
@ 4mm	+ 500 grams
@ 3mm	+ 600 grams

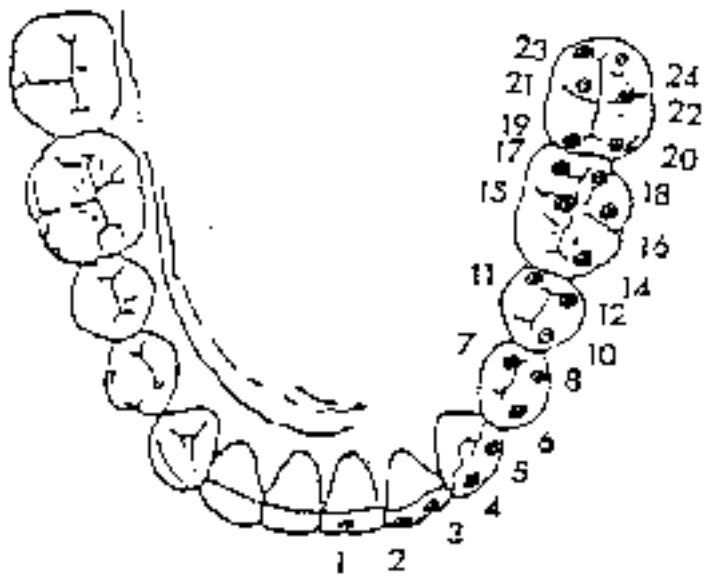


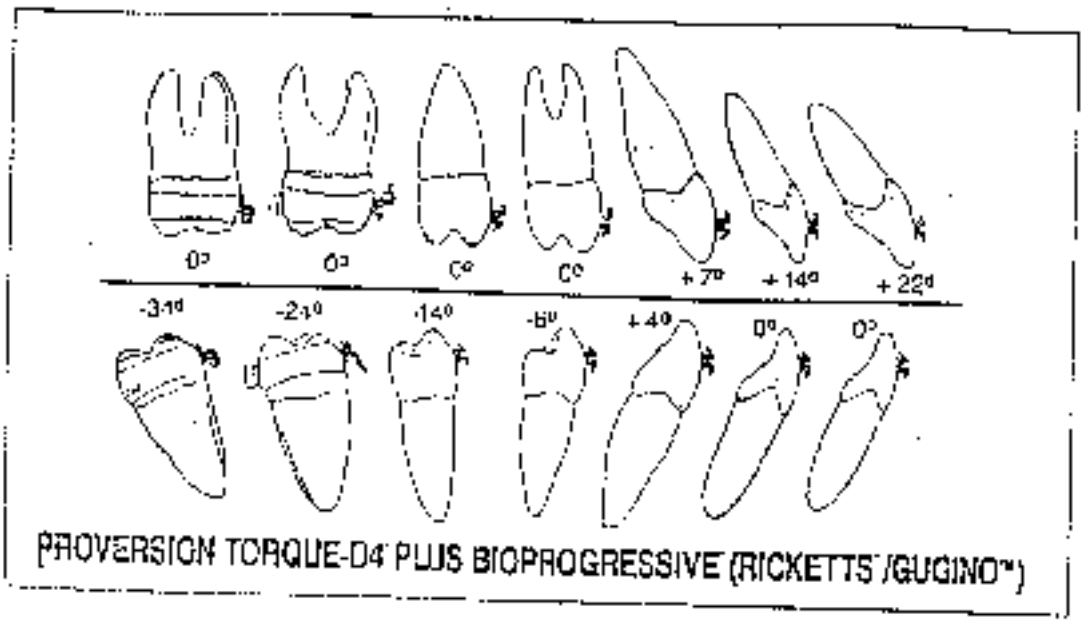
VALUES ROUNDED OFF FOR CLINICAL ESTIMATES IN THE MOUTH



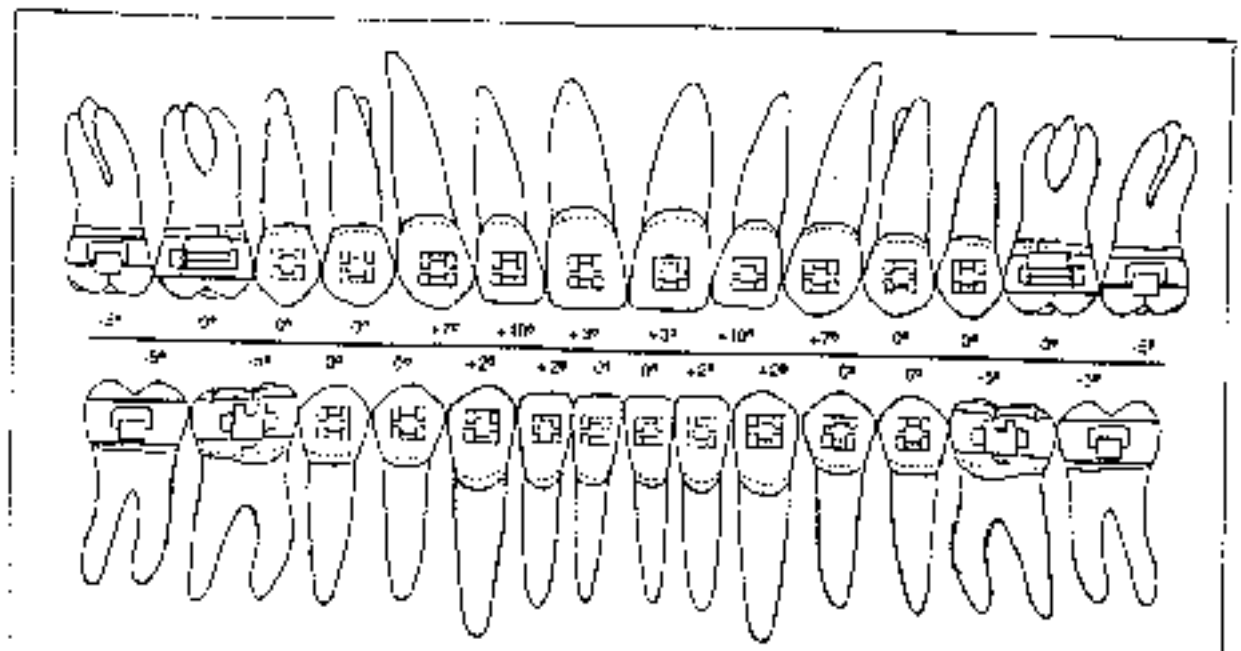

BAND
3.0mm.
4.0mm.
2.5mm
TO MARGINAL RIDGES
FROM INCISAL LINE
1.5mm. = BRACKET CENTER TO EDGE OF PAD OR BAND
2.5mm.
3.0mm.
RIGHT
LEFT


4
1
5
3
6
2
4
1
3
6
2
5

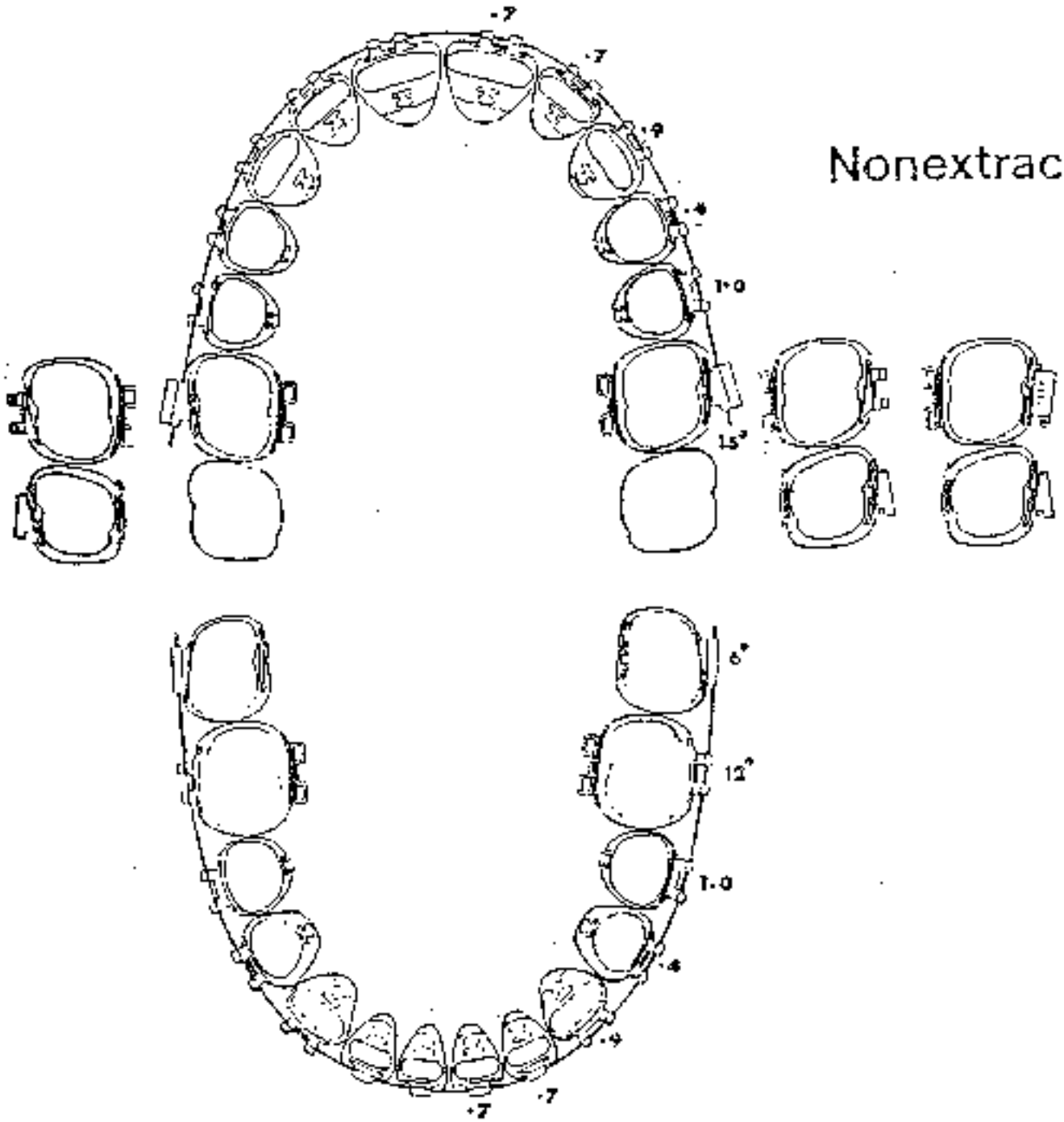

23
21
19
17
15
11
7
24
22
20
18
16
14
12
10
8
6
5
4
3
1
2



PROVERSION TORQUE-D4 PLUS BIOPROGRESSIVE (RICKETTS'/GUGINO™)



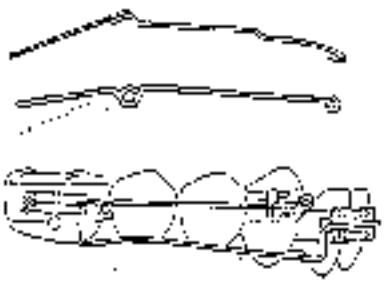
RMO ANGULATION-D4 PLUS BIOPROGRESSIVE (RICKETTS'/GUGINO)


Nonextraction

three dimensional cuspid control

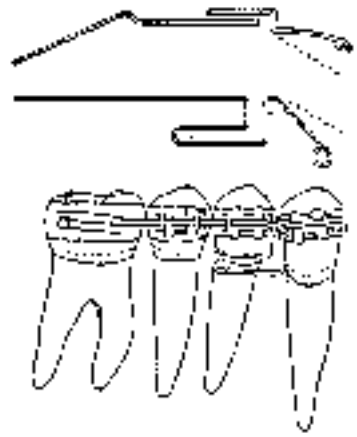
SECTIONALIZED FEATURES

INTRUSION



A. For intrusion of the lower cuspids to the level of the previously intruded lower incisors in bite opening, a .016 x .016 blue ELGILOY sectional arch wire with a 45 degree helical tip back loop is utilized in conjunction with the utility arch.

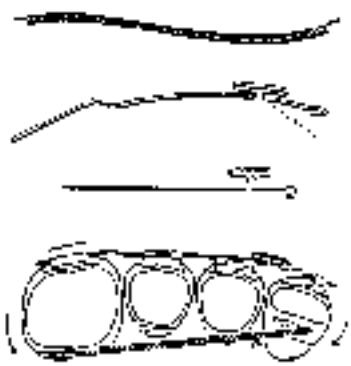
B. A light elastic thread is tied from the cuspid bracket to a small hole in the utility arch (made with an interproximal bur). This allows the cuspid to seek its easiest route of intrusion to the level of the previously intruded incisors.



C. The horizontal helical looped sectional arch allows cuspid intrusion and uprighting as a function of its wide range and combination action.

C. A Fraget elastic thread from the molar distal-lingual hook to mesial-lingual cuspid rotating cleat allows counter rotation of both molars and cuspids. All reciprocal rotations in the buccal segment are met with Fraget elastic thread in order to minimize over correction of rotations.

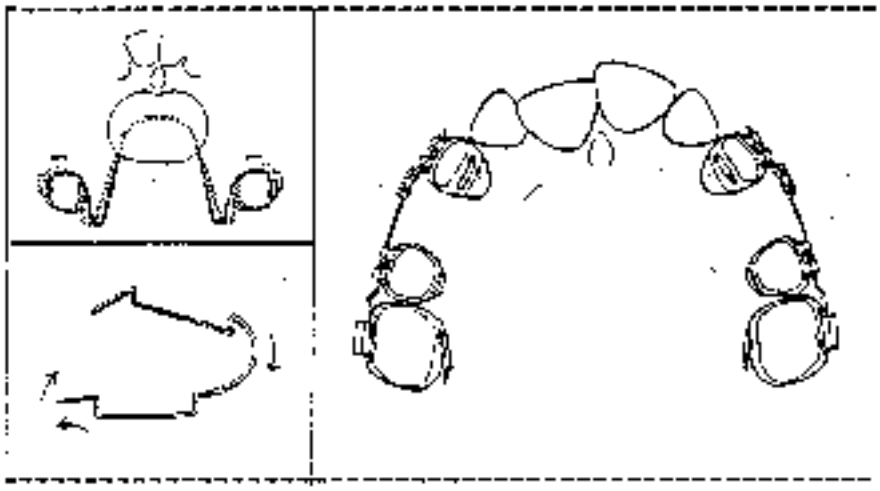
H. Double horizontal "T" loops (.016 x .016 ELGILOY) on each side of the cuspids are effective in leveling and rotational control.



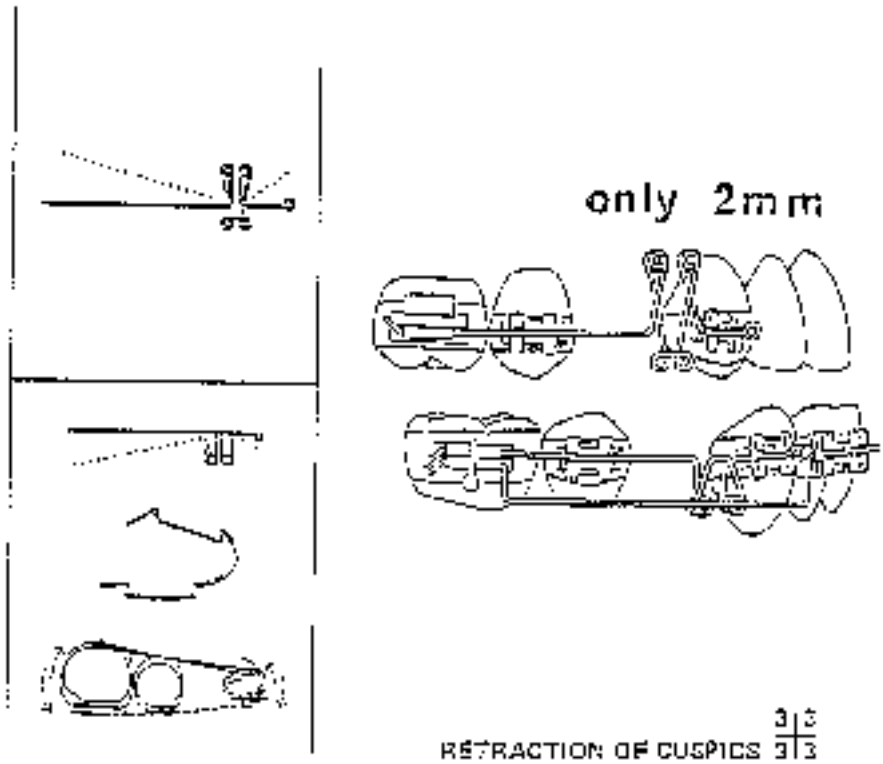
I. Cuspid rotational correction is supplemented by a horizontal "T" looped sectional arch and Fraget elastic thread.

ROTATION

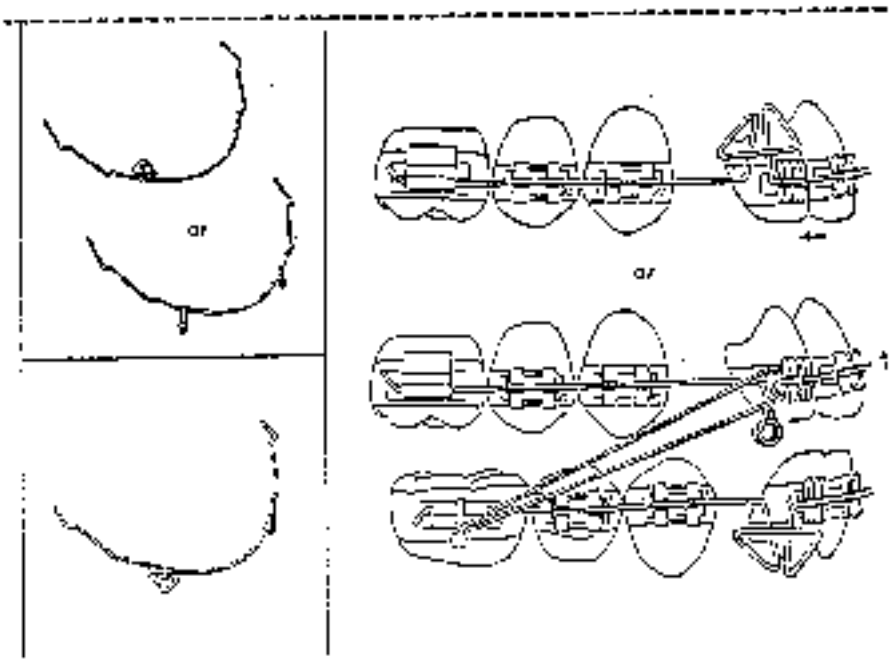
sequence of mechanics in class I extraction cases



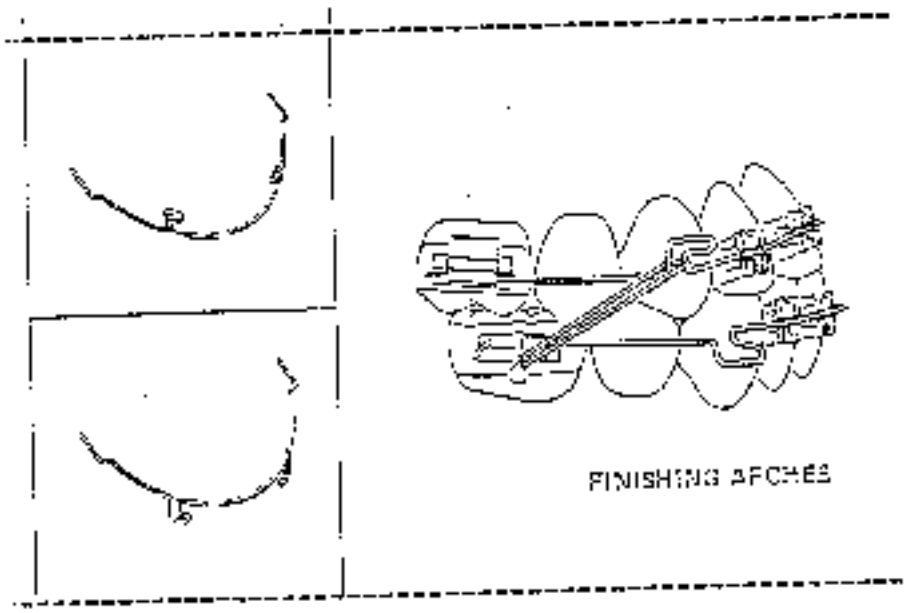
STABILIZATION OF THE UPPER AND LOWER MOLAR ANCHORAGE



RETRACTION OF CUSPICS $\frac{3|3}{3|3}$ WITH SECTIONAL SPRINGS



RETRACTION AND CONSOLIDATION
OF THE UPPER AND LOWER INCISORS



FINISHING ARCHES

'47

Second order bends

'60 –'70

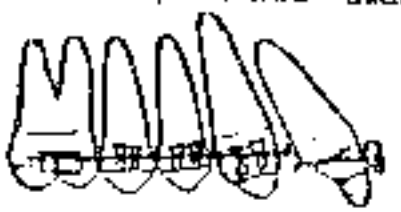
Free straight section

'50

Straight square wire –sliding hooks

'80
*

Pushcoil open utility section



'55

Straight Section

'85

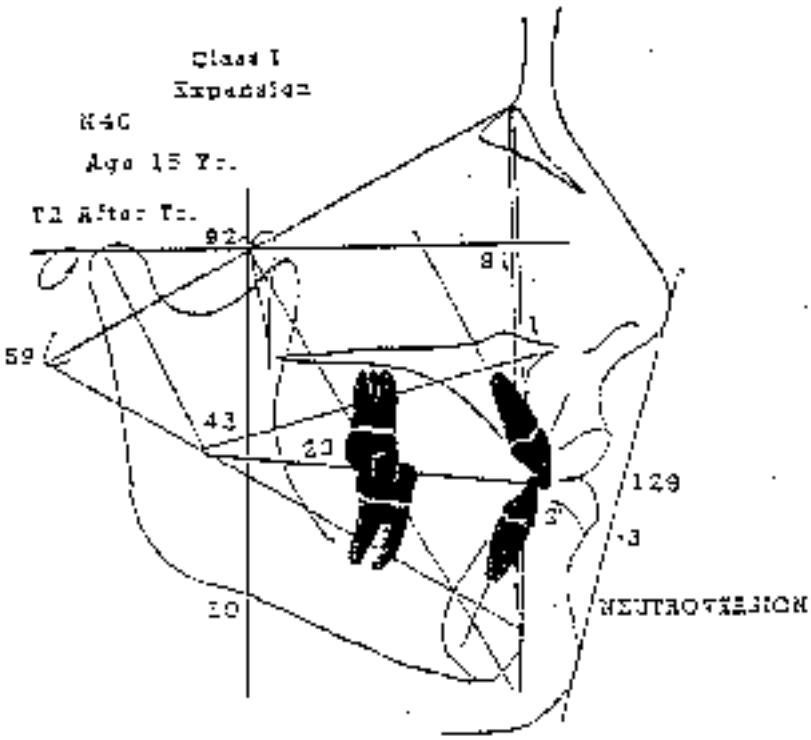
Double open utility section

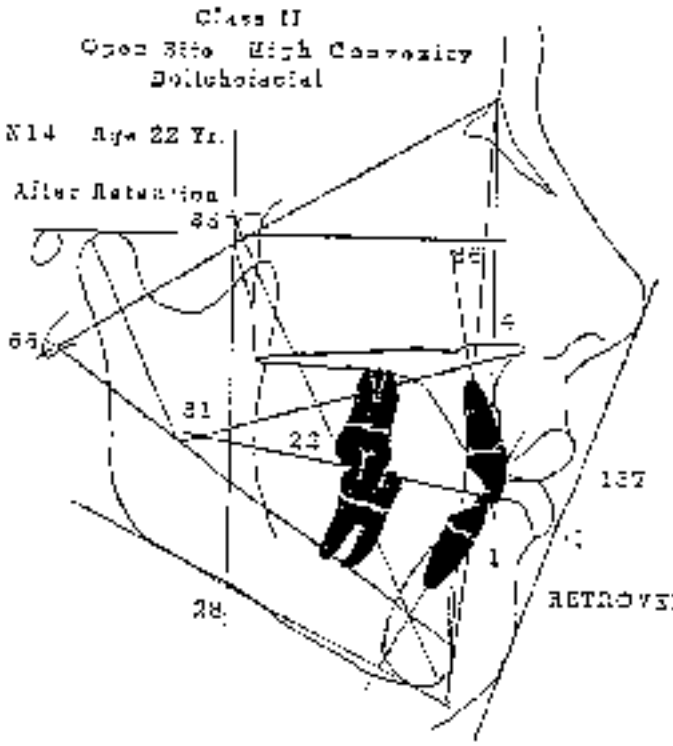
'70

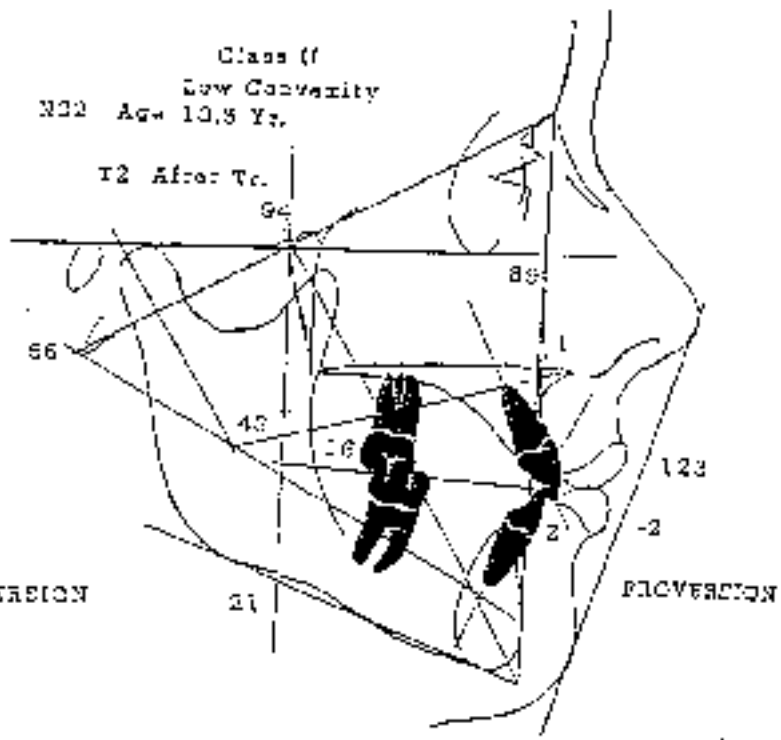
Utility section bypass

'88

Z utility section


Class I
Expansion
N4C
Age 15 Yr.
T2 After Tc.
92
8
1
59
43
23
129
2
-3
10
NEUTROVERSION


Class II
Open Bite High Convexity
Dolichofacial
N14 Age 22 Yr.
After Retention
88
66
4
31
23
137
1
28
RETROVERSION


Class II
Low Convexity
N32 Age 10,5 Yr.
T2 After Tc.
94
89
66
1
43
16
123
2
-2
21
PROVERSION

¶ *There are moments in our lives, there are moments in a day, when we seem to see beyond the usual. Such are the moments of our greatest happiness. Such are the moments of our greatest wisdom. If one could but recall his vision by some sort of sign. It was in this hope that the arts were invented. Sign-posts on the way to what may be. Sign-posts toward greater knowledge.*

ROBERT HENRI

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