FACIAL ART,
THE DIVINE PROPORTION AND
THE SCIENCE OF ESTHETICS

Esthetics, dealing with the sources and effects of art, is one of the main branches of philosophy. Esthetics involves the study of beauty and its psychological responses. Beauty is something which pleases and satisfies the senses. But, things are only considered truly beautiful when an inward emotional level of reaction is stimulated. This internal action is thought to be located in the primitive limbic level of the brain which contains the collective unconscious source of inherited instincts, according to Jung.

THE FUNCTION OF ART

Art is the product of consummate knowledge and skill demonstrated in the making or appreciation of beautiful things. Art is the expression of beauty and good taste. According to Ardrey, art has had a survival benefit anthropologically. The quartz hand axe was not especially strong but was beautiful and therefore was pursued and was a great value to be possessed. The earliest paintings reflected daring or death and the earliest figurines depicted pregnancy or “with life”. The survival benefit of art has been the stimulation of life. Art has been a weapon against the central focus of life, which is death. Thus, art has made life more worth striving for as stimulation to life has come from music, dancing, acting, and all things made beautiful or all things in nature which are beautiful.

Philosophy explores subjects at their early stages when things are not yet capable of being measured, and when they can only be reasoned about. But, when a subject can be measured or quantified, science takes over. Science is concerned with connected and organized truths rather than with loose, abstract ideas. Scientists arrange, classify and devise methods to discover new truths.

It may be wondered why we would dare to bring the heretofore subjective and philosophical subject of esthetics under the rigorous rules of science. This challenge is even greater because one aspect of the subject of esthetics involves personality.

We tend, however, to limit the concept of esthetics to physical beauty, structural harmony, equilibrium, unity or that wonderful quality termed “grace.” However, some physically unattractive people are spoken of as beautiful in terms of their character. Thus, the esthetic can not always be limited to physical form because the human face is remarkably expressive of moods. A strong personality may overcome what is otherwise structural imbalance by a developed capacity to cope with that endowed. Grotesque ugliness has been said to be the worst of human afflictions. These unfortunates repulse society at the roots of emotions.

In the context of facial esthetics, clinicians are called upon to properly design and correct the dental and jaw apparatus. The decision for most appropriate change in the whole face for the given individual in the past has been subjective and without a scientific basis. This situation leads directly to the need for science and an accumulation of knowledge of the possibilities of orthodontic-orthopedic treatment. You must know what an appliance can do before you can decide what to do with it. You must know the possibilities of surgery before planning alterations for a specific condition. Therefore, the problem is first the determi-
nation of what is wrong esthetically, followed by selection of the best detailed treatment alternatives for that individual. This is what we will call the diagnosis — prognosis — projection — treatment planning chain.

THE VALUE OF CLASSIFICATION

Stated simply, the process of classification functions for the breaking down of a conglomerate or a bewildering complexity into simple groups so that individual characteristics can be further handled in the mind by the clinician. Once a condition is classified, it can be abstracted and interpreted. The final determination of the patient’s needs and solutions and execution of treatment in the final analysis all become the practitioner’s art.

However, a clinician or scientist should guard against the underlying tendency to cloud a subject in art mystique. The more esoteric the knowledge is made or recondite it be considered, the more the danger of a cult presenting itself. Complication of the problem unnecessarily is deceitful to a patient. Clinicians can add to their knowledge and to their performance if their minds are open to the application of science. Scientific classification for esthetics would, therefore, be of profound benefit.

CURVE OF DISTRIBUTION AND IDEALISM

In descriptive science, the bell curve of distribution guarantees that all things in nature are complicated by variability (See Chapters 3 and 4). Three clinical procedures may be employed for the individual evaluation of facial esthetics, for mouth beauty and for dental harmony. The first choice is direct observation. The second is analysis of portrait-type photographs. The third, the most useful and informative, is the oriented cephalometric roentgenograph.

It is unfortunate that cephalometrics is not embraced by all clinicians, dentists, physicians and all concerned disciplines interested in esthetics. Cephalometrics is of great value to the understanding of cranio-facial-dental morphology because the external features are superimposed on the internal skeletal structure displayed in the X-ray plate. It has been said that “beauty is only skin deep” but that “ugly goes all the way to the bone” and it is quite true that the underlying matrix of bone is the limiting element in beauty.

If the statistician looks at the bell curve of distribution, he will often analyze it simply as the measure of central tendency and separate the data by the process of standard deviations. If the clinician visualizes the bell curve, a plus or minus of one standard deviation is usually considered a reasonable range of clinical normalcy in the clinical objective. The biologist, however, contemplates two standard deviations to be “a passable range.” Laymen may be perceptive and sense something wrong at any level, and most anyone will recognize physical faults at three standard deviations which take in the variability of almost the total population. Patients with values of more than three standard deviations from the mean are considered to be “freaks of nature.” They are out of the range of normal distribution, and should be dealt with as extremes (Fig. 6.1).

By considering distribution from an esthetic viewpoint, central tendencies can be observed by selection of conditions at or near the peak of the curve as “idealism.” In an arbitrary selection only a portion of one clinical deviation could
be considered the "desirable" range (Fig. 6.2). The next lopping off of an arbitrary area could be the "acceptable" range of clinical patients. To move beyond one standard deviation, dysplasia (imbalance and disharmony) is reached which approaches the "undesirable" level. These conditions require too much functional accommodation and compensation for function to be accomplished in a graceful manner, and usually these patients will be quite aware of a problem in morphology and function.

Beyond the level of undesirability are conditions which even the most uninformed layman would classify unusual or maybe "distasteful." In another sense, these conditions would be "ugly" because they are at the extreme ranges of distribution. Under any criterion, these are "unattractive," and even pathologically disposed in terms of functional and environmental impact on the tissues. These kinds of drastic conditions may be "repulsive" to the average person and serve as a challenge to the professions at large.

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**Fig. 6.1** There is a curve of distribution which is recognized in statistics that often is not correlated with beauty and ugliness. It would appear that the closer all structures are to the peak of the curve the greater the perfection. Variation from the peak might still display clinical beauty and even further dysplasias may be functionalistic but as the extremes are approached structures become incongruent and unpleasing.

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**Fig. 5.2** A conceptual way of expressing the same phenomenon shown in Fig. 6.1. The ideal would be the peak of the curve, the next group would be features that are desirable. The third group (C) are acceptable. But as (D) is approached the conditions are unacceptable and become pathologic at (E), ugly at (F) and repulsive in (G).
THE GOLDEN SECTION AND FIBONACCI NUMBERS IN THE BIOLOGY OF ESTHETICS

Sectioning of a line so that the smaller section is as proportional to the larger section as the larger portion is to the whole line is called the "Golden Section" (Fig. 6.3). If the small section is taken as a value of 1.0, the larger is 1.618 times the smaller and the smaller is 0.618 the length of the larger. This is called Phi (with Greek symbol $\phi$) and a series of these proportions we call a "golden progression" and the symbols $\phi^2$, $\phi^3$, $\phi^4$, $\phi^5$, are used to relate a geometrical phenomenon (Fig. 6.4).

Fig. 6.3 Demonstration of the method of obtaining the Golden Section with a compass and a straightedge.
Fig. 6.4 The shorter to the longer progressions represent an increase of 1.618. If the long section is represented as 1.0 then the shortest is 0.618 times the longer length.

### FIBONACCI SERIES

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| 1 / 1 = 1 | 55 / 34 = 1.6176   |
| 2 / 1 = 2 | 89 / 55 = 1.61818  |
| 3 / 2 = 1.5 | 144 / 89 = 1.61797 |
| 5 / 3 = 1.666 | 233 / 144 = 1.61805 |
| 8 / 5 = 1.6  | 377 / 233 = 1.61802 |
| 13 / 8 = 1.625 | 610 / 377 = 1.61803 |
| 21 / 13 = 1.615 | 937 / 610 = 1.61803 |
|              | 1597 / 987 = 1.61803 |

Table 6.1

When any number in a sequence is the sum of the two previous numbers, a progression is formed. Thus, in Table 6.1 is seen a progression.
After only nine additions, each succeeding number is 1.61803 times the previous number and so on to infinity, but it was 1.66 at the 3/5 proportion or after the fourth addition! These are called the Fibonacci numbers and this sequence is a geometric progression rather than the standard arithmetic increase (See Fig. 6.5).

Thus, we see in the golden section and Fibonacci numbers a convergence of geometry and mathematics. Further, a Phi relationship underlies the basic laws of growth in order to maintain structural proportion. Ironically, this proportion also has been found to be uniquely pleasing to the human psyche for beauty and harmony. The golden proportion thus forms a scientific foundation for the analysis of esthetics.

By construction of dividers with two intermediate pieces located at lengths in 1.0 to 1.618 proportion, an instrument was formed which, upon opening, will maintain the golden cut or divine proportion (Fig. 6.6).

\[ \Phi = \frac{\sqrt{5} + 1}{2} = 1.61803398875 \ldots \]

Fig. 6.5 The 1.618 progression constitutes a special increase or relationship providing a law in biology for function and growth. The relation is called Phi (\(\Phi\)). Units in that proportion are correspondingly given the symbol \(\phi\), \(\phi^2\), \(\phi^3\) in increases and Phi prime, \(\phi'\), \(\phi'^2\), \(\phi'^3\) etc. in decreases.
Fig. 6.6 The Golden Divider expands while maintaining the Divine Proportion.
Fig. 6.7 The Golden Proportion is found in body height, arm length and other factors such as the hand. It is also found in seashells and flowers representing the five-cornered pentagon.
A host of Phi relationships have been found all through nature; it is observed in the cosmos, in plants and animals and many divine proportions have been discovered in the human body and face (Fig. 6.7).

When the Phi relationships are used for the base and altitude of a rectangle, it forms the "golden rectangle" (Fig. 6.8).

When the base of a triangle is 1.0 and the sides of an equilateral triangle are formed at 1.618, it makes the "golden triangle," and it forms a 72° - 72° - 36° triangle (Fig. 6.9). Bisecting one base angle will cross the opposite side and divide that side into a golden section and form an identical but smaller golden triangle.

When a part is added to a given shape without changing that shape but increasing its size, the addition is called a "gnomon." Often, the word "gnomic" or "allometric" came to be used when a constant vertex was found for a growth expression in parts of the face or body.

The bisection of golden triangles can be made in a series. When a curve is used to connect the points on a series of these triangles, it will form an equiangular spiral or logarithmic spiral (Fig. 6.10). Not only do many seashells grow on this plan (Fig. 6.11) but also the typical human mandible in all races grows on this logarithmic spiral! (Fig. 6.12)

When two corners of a pentagon are connected and crossed by another line through two other points, the point of intersection will section the lines into the golden section (Fig. 6.13).Another line, when drawn from one point to the fifth point on the pentagon, will separate the original line into a smaller golden section. The center portion will be a "reciprocal" to the two sides. We have such reciprocals in the human face and body when it is beautiful and in harmony! These areas may also be thought of as "congruent" due to their fitting with either or both sides of the original mass.

![Fig. 6.8 The Golden Rectangle has an altitude of 1.0 and a base of 1.618. A method to obtain such a figure is to bisect the width of the square and with a compass mark off that radius E,C to arrive at point F.](image-url)
Fig. 6.9 The Golden Triangle is a 72-72-36 degree isosceles triangle. As one of the base angles is bisected, it sections the opposite line into a golden section. The golden triangle always will have a base of 1.0 and a length on each side of 1.618.
Evolutionary Significance

It is possible that the divine proportion has served as a strong point in natural selection down through the ages as nature tends to cast off the ugly and cull out the weak. There could have been an operative factor in that the most efficient arrangement was the most pleasing and most beautiful for the one doing the choosing. In propagation of the offspring the selection is usually made by the female of an animal species, including man.

The most beautiful applies to that which gives the highest degree of pleasure to the senses and suggests that the object of delight approximates or tends toward one's conception of "ideal." Thus, esthetics, beauty and art may fall into science as things can be measured and tend to lie on a statistical curve with the peak of the curve approximating the most ideal.

RESEARCH IN FACIAL AND BODY ESTHETICS

Four main groups of factors may be helpful in an order of importance and essence in the analysis of facial esthetics. The first factors are skeletal due to the dominance of the influence of the underlying bony structure. The second factors constitute the soft tissue investments. The third is dental or the tooth relations as they affect esthetics of the middle and lower face. The fourth and final concern is the personality type and patient attitude which may involve internal character.
Skeletal

The primary concern is with dimensions of the “skeletal pattern” of the face because this is the basis on which the dentition is housed or supported. Further, the relationship of the teeth is frequently determined by, or certainly influenced by, the developing skeleton. Therefore, the relationships of the skeletal basal bone of the upper and lower jaws is of concern in esthetics and paramount in orthopedic-orthodontics.

Variations in facial structures have been recognized since the beginning of dentistry, but the complexity of the cranial and facial parts has led to controversy concerning methods used of description for scientific investigation.
Fig. 6.12 Many scholars believe that the human mandible grows as a logarithmic spiral on the arc as shown in (A). As generated by the author it shows mandibular growth and the eruption of teeth. (B) Shows how closely this arc fits the curve of the logarithmic spiral.
Fig. 6.13 The pentagon is seen often in nature. The inside of it, when the ends are connected, forms a golden triangle which when crossed by the line AB is divided into the golden section with a smaller golden section in the middle (P-Q). Note A-P-Q are reverse golden sections also seen in faces.

Cephalometric Analysis

After development of the cephalometric procedure by B. Holly Broadbent in 1931 and the growth studies of Allan G. Brodie in 1940, it wasn’t until 1948 that William B. Downs established skeletal type differences as a basis for consideration for orthodontic diagnosis. Many cephalometric analyses have used the anterior cranial base as the main source of reference. However, for esthetic and orthopedic considerations, Downs’ work showed that the Frankfort plane was more useful, more appropriate, and more convenient for clinical correlation than other cranial planes. In the horizontal dimension, Downs described the relative protrusion of the mandible and secondarily related the maxilla to the facial plane in terms of basal structure.

With modern computerization, and with the use of skeletal Porion rather than the ear rod of the head holder, a cartesian coordinate can be established for the three dimensions — horizontal, vertical, and transverse — which may serve as a basis for typing (or classifying) of the skeletal patterns. Within these three dimensions or reference lines proportionality and symmetry may be dealt with (Fig. 6.14).

In the horizontal dimension, anthropologists often refer to the upper jaw or maxilla (jaw-gnathos) as “prognathism” because the lower jaw is often missing in fossil material. The orthodontist, however, has concentrated on the relative position of the chin or mandible. Normal lower jaws were considered mesognathic (meso- in the middle or intermediate). Retrognathic (behind) (Fig. 6.15A) are most often associated with facial convexity. The prognathic chin is typically seen with concavity to the profile (Fig. 6.15B).
Fig. 6.14 Natural objects in nature have congruity in three dimensions. A. Lateral, shows the horizontal line, the Frankfort plane, and a vertical through the base of the pterygoid plates. B. Frontal, shows the Frankfort plane going through the center of the two zygomatic arches and a midsagittal plane through the nasal septum. C. Vertex, a horizontal plane through the base of the pterygoid plates will show the symmetry of the mandible.

Esthetic problems are caused also by a small upper jaw complex. Very large size of the midface (see Fig. 6.15A) are additional factors to those of the short mandible in the production of facial convexity. Combinations of either moderately small upper or lower jaw size can produce a variety of facial forms.

In the vertical plane, the face may be long or short, dominantly influenced by the mandible (Fig. 6.16A & B).

Within all different types, there looms the problem of proportionality of the upper to the lower face. One atypical nasal and midface condition was labeled by Bimler as "microrhino dysplasia". In such cases, if the nasal capsule is small and underdeveloped, the nose itself is short and high as the nostrils face outward in "pug nosed" state. In this circumstance, the floor of the nose anteriorly fails to
Fig. 6.15 These faces represent incongruity. A. Retrogнатhic, the mandible is distorted and retruded in comparison to the maxilla with 18 mm. of facial convexity. B. Prognathic, the opposite extreme to A. Shows a concavity of 27 mm. The mandibular plane angles are 51 and 8 degrees respectively. The facial axis is 70 to 115 degrees respectively. (The normal should be 90 degrees.)
Fig. 6.16 Extremes in length of faces. A. Brachyfacial, a very short anterior facial height and very long posterior height. B. Dolicofacial, represents a short posterior facial height and long anterior facial height. The mandibular plane varies from -15 to +60 degrees respectively from the Frankfort plane. The facial axis varies from 111 to 64 degrees respectively. (The mean is 90 degrees.)
Fig. 6.17 These patients represent long and short denture heights. A. Shows the palate upward anteriorly as seen in micro-rhino dysplasia. B. Shows the palate canting downward anteriorly. The oral gnomon (or oral height) varies from 53 degrees to 32 degrees respectively. (The mean should be 45 to 46 degrees.)
Fig. 6.18 A. Represents a long face with an open bite with an oral height of 61 degrees. B. Represents a remarkable dental protrusion and a mild Class III tooth relationship. These demonstrate the effects of the oral environment on the production of a protrusive denture from loose flaccid lips (B), while (A) shows the open bite influence of the tongue in the presence of a long face.
Fig. 6.19 A. Shows a midline of the chin 13 mm to the left and a crossbite molar occlusion on the right. The patient was a Class III on the right and a Class II on the left in the malocclusion. The arrows represent length to the mandible. In (B) the mandibular midline is to the right and severe asymmetry is noted in the maxilla. Notice the effort of the teeth to compensate to the facial form in both cases.
Fig. 6.20 A computer composite of a pure sample of thirty caucasian males at age 22 years. The means of all of the summary measurements are represented in this ideal sample.

grow vertically (Fig. 6.17A). It is our theory that such conditions can be caused by prolonged thumb sucking dating back to infancy and can also be associated with breathing difficulties as well as being genetic in origin.

On the other hand, there are patients in which the nasal cavity appears to be pressing downward, seemingly elongating the midface and upper teeth against the lower denture base (Fig. 6.17B). Such patients, as an antithesis, may be termed “macrorhino dysplasia.”
When the nose is normal and the denture height is long, the imbalance is noted in the lower face (Fig. 6.18A). This has prompted some to term it a "long face syndrome". Bony conditions constitute extremes in terms of facial types and are of concern in the esthetics of the face as it is analyzed (Fig. 6.18B).

Finally, there is the esthetic and functional problem of asymmetry of the face, dominated by asymmetry in the mandible (Fig. 6.19A). There are also patients in which the maxilla and midface have not developed equally on both sides, which turns a nose to one side (Fig. 6.19B).

**Divine Proportion Analysis**

Computer composites of groups of subjects with normal occlusions from Caucasian, Oriental and South American populations were employed for analysis with the Divine Proportion principle. Samples were from Ricketts, from McNamara at the University of Michigan and from Sassouni who selected groups from the University of Pennsylvania and University of Iowa. The purest racial sample was from a national population from Peru, submitted by a Dra. Maria Castro (Fig. 6.20). Unfortunately, only laterals were available on this adult group of 30 subjects with all 32 teeth in occlusion. Another, but mixed, group of 30 was gathered from Brazil. A general agreement in the normal samples was observed in several relationships. Some of the Phi or "golden" relationships were as follows: (See Fig. 6.21).

1. Sella-Nasion length was golden to Sella-Basion length.
2. Nasion to Cranial Center length was golden to cranial center (CC) to the Point Articulare (Ar).
3. From Pterygoid vertical, the distance to Orbitale was golden to Glenoid Fossa Center.
4. Maxillary depth (ANS-PNS) was golden to the location of the border of the ramus posteriorly.
5. Maxillary depth was golden to Pharyngeal depth at the level of Point A.

Other relationships in the makeup are seen in Fig. 6.22.

6. The Condylar Axis (Co-Xi) was golden to the Corpus Axis (Xi-Pm).
7. Ramus height (R3 to R4) was golden to Ramus depth (at the narrowest point) R1 to R2 (in adults).
8. Facial Axis length (CC-GN) was golden to posterior facial height (CC-GO).
9. The upper facial axis dimension (CC to the ANS-Xi Line) was golden to the lower facial axis length (to GN).
10. From the PT vertical plane to the incisal edge of the lower central, the first molar was found in the golden proportion.

Further relationships in the vertical are seen in Fig. 6.23.

11. From Frankfort Horizontal plane to Point A, the denture height (to PM) was golden.
12. From lateral canthus of the eyes to the floor of the nasal cavity to the chin (Menton) was golden.
13. The lower incisal edge was golden in relation to A and Pm point!
Fig. 6.21 As the composite is broken down golden proportions are represented from Sella-Nasion to Sella-Basion; from Articulare to Cc (cranial center) to Nasion; from the glenoid cavity (Gl) to pterygoid vertical to the orbit (O) and from anterior nasal spine to posterior nasal spine to the depth of the ramus.
Fig. 6.22 (Above) The mandible was found to be golden in proportion from (Co) condyion to Xi point to protuberance menti (Pm). In this composite also the width of the ramus was golden to the height of the ramus. From the pterygoid vertical the denture length from incisor to the first molar was golden to the pterygoid vertical line. (Below) From Cc point a golden proportion was present to the angle of the mandible and to gnathion. In addition the distance Cc-Gn was cut from a line from Ans to Xi into a golden proportion.
Fig. 6.23 Vertical measurements from the composite seen in Fig. 6.21. (A) Golden proportions are from the Frankfort plane to point A to Pm; from the lateral canthus of the eye to the nasal floor to menton as seen in (B). (C) The lower incisor is golden at its incisal edge from point A to Pm. All of these measurements are quite useful in orthognathic surgery and orthodontics.

For the Frontal Sample, a composite was made from 82 normal occlusion patients from the Foundation for Orthodontic Research combined with adult data from the Broadbent studies (Fig. 6.24). The divine proportions seen in Fig. 6.25 were as follows:

1. Between the two orbits (Dacryon to Dacryon) the distance was golden to each orbit (or the nasal space between the orbits was a golden reciprocal to the eyes).
2. The height of the nasal cavity formed a golden rectangle with its width to the widest area (NC).
3. Between the two mandibular condyles at lateral articularare (AR), the width of the piriform aperture (Pia) was golden and reciprocal to the two sides.
4. The maxillary width (J-J) was golden to the lateral width of the face from nasal cavity to lateral articularare (Nc-Ar).
5. The total width of the mandible (Ar-Ar) was golden to the maxillary width (J-J).
6. The width of the lower molars (to the buccal groove) was golden to mandibular width (Ag-Ag).
The foregoing values proved to be excellent for planning surgery in adults and planning orthopedics for orthodontic treatment in both juvenile and adolescent children. (See Volume II of this work.)

**Soft Tissue**

It is understood that given a normal skeletal pattern, an additional variation in soft tissue may exist. This involves the long or short nose, full or thin lip or thick or thin investment tissue over the chin (See Figs. 6.15-6.18). All these factors add to a concern in facial esthetics. But, it is difficult to improve esthetics by altering soft tissue when the underlying bone or tooth position is at fault. For this reason, rhinoplasty involves the bones and cartilages in the nose and also orthodontics...
Fig. 6.25 These composites suggest certain divine proportions. A. The inter Dacryon distance (Da-\(\text{Da}\)) if taken as 1, is golden to the width of the orbit from Da to Z. B. The periorb aperture is golden to the distance to lateral articulare. The width of the maxilla (J-J) is golden to the distance from the nasal cavity (Nc) to lateral articulare (Az). C. The width of the molars is golden to the width of the mandible at AG.
Fig. 6.26 Three adult caucasian subjects representing degrees of lip protrusion as signified by a line from the nose to the chin. (A) A flat mouth with vertical teeth in a normal adult male. (B) The normal interincisal angle and lip relationships. (C) A 21-year-old female with slight protrusive denture. All three patients had 32 teeth and normal occlusion showing the variation in protrusive relationships in the normal curve.

may involve removal of teeth for alteration of facial structure for esthetic purposes and further may require skeletal surgery for the production of a more favorable skeletal matrix.

**Mouth Poise and the Esthetic Plane**

While the soft tissue of the profile had been cephalometrically considered, no classification was made until 1954 when the author researched esthetics and established some references. A simple line from the nose to the chin was employed and called the Esthetic Line (or “E” Line) which became popular. It was used to scientifically scrutinize both mouth harmony and lip balance. It supplied a method for determining relative protrusion of the mouth (Fig. 6.26A, B & C).

The lower lip position and contour was a primary concern because (1) the lower lip should dominate the mouth and (2) the lower lip curve is influenced by both the upper and lower incisors and (3) the upper lip is acted upon and influenced mostly by the upper teeth alone. Therefore, the lower lip reflected both arches and the upper was in turn related to the lower lip.
Pupil Plane

After discovering the descriptive value of the E plane, width of the mouth became a second concern by 1958. In order to assess relative mouth width, the eye level was employed as a horizontal reference and interpupil distance was used as a transverse reference. The dimension between the eye pupil centers and the width at the ala of the nose became the lateral and medial references for the assessment of mouth width.

On the average and seemingly the ideal, the corner of the mouth or Chiellion point was found to lie midway between the alar rim and pupils. There seemed to be a relationship between mouth width and dental arch form as wide mouths tended to be associated with wider arches in the first bicuspid area. However, mouth pursing in strain will alter this measurement and the mouth width is best considered at a relaxed mouth position.

Fig. 6.27 Represents fullness and flatness in the mouth in racial type, showing a Polynesian type compared to the Scandinavian type with more shallow cheek and flatter mouth. Illustrated from a Breck Shampoo advertisement.
Fig. 6.28 These points were selected for analysis on the soft tissue of the face and are explained in the text. Points used in the Divine Proportion: Tri is Trichion, Ts is Soft-tissue Temporals, Eb is Eyebrow, Da is Dacyron, Lc is Lateral Canthus, Zp is Cheek Prominence, Ln is the Lateral Nares, Al is the Ala of the nose, Ch is Cheilion, St is Stomion, M is Menton, uv and lv are upper and lower lip respectively.

**Cheek Plane**

By 1965, a third consideration, the mouth in animation and from oblique angles was realized to be necessary. In an attempt to scientifically evaluate the oblique perspective, the soft tissue of the cheek was employed. This was intended to assess the angle of the mouth (Cheilion) (Ch). A "Cheek Plane" was therefore improvised for additional concern in the profile. A line from the bulbous portion of the cheek downward and forward to the chin often passed through the corner of the mouth. In the profile view some prefer the edge of the lower lip to fall forward of the cheek plane into a balance halfway between the cheek plane and the esthetic line (See Fig. 6.26B).

Patients with higher cheekbones and stronger and more prominent faces would seem to accept a fuller mouth and more protrusive dentitions in order to remain in good esthetic harmony. In the patient with the shallow cheek, the flatter mouth seemed to fit well (Fig. 6.27).

Research in mouth and lip relations led to both a **functional** and an **esthetic** model in order to assess facial and dental equilibrium and beauty. Together with the work of Holdaway, Burstone, Steiner, Peck and Peck, Reidel, Wylie, DeLaat, Jacobson and others this constituted the state of the art until the late 1970's.
The Divine Proportion

During the 1970's, as stated before, the author extended research in facial esthetics following the Golden Section. Several points came to be employed for the total face for soft tissue analysis to be used as basic information for diagnosis and planning for surgery and oral orthopedics (Fig. 6.28). A racial and typal variety of ten photographic models from magazine advertisements was studied and the findings are shown in Tables 6.2 and 6.3. There was no statistical analysis due to lack of standardized photos.

Vertical Facial Analysis - (Length or Height)

In orthodontics and in maxillofacial surgery, the problems often center around the vertical dimensions (such as the long face with open bite or the short face with closed bite). By using the series of measurements, a fascinating series of divine proportions were discovered. Please remember the scale of Phi relationships as seen in Fig. 6.4.

First Vertical Consideration - The Lips

Our analysis for ideal proportions of the face starts with the mouth and lips but any structure may be employed for a beginning. The lip embrasure or point of touching at the midline is called Stomion (S). Taking the center of the cupids bow midway at upper vermilion border (uv) to Stomion (S) as a unit of 1.0, the lower vermilion border (lv) in beautiful mouths was Phi or 1.618 times the vertical dimension of the upper (Fig. 6.29). This means that the lower lip dominates (like a foundation for the support of the upper).

For lip study, photographs of 30 subjects (27 female and 3 male) were randomly selected from magazines and measured. The findings of the height of the upper to the lower lip were a proportion of 1.0 to 1.65 ± .07 with a range of 1.45 to 2.00. This made 70% fall between 1.57 and 1.73.

Second Vertical Consideration - The Mouth

The proportion extends into the mouth to the position of Stomion. Taking the distance to the alar rim of the nose (Al) to Stomion (upper lip length) as 1.0, the distance to soft tissue menton (M) was Phi (or 1.618) (Fig. 6.30A).

A reverse reciprocal dynamic balance was seen for the upper lip as it was Phi prime (or 0.618) to the length of the nose as measured from either medial or lateral canthus height (Lc). (Fig. 6.30B).

These findings suggested that the **nose length should be equal to the chin length**! The upper lip length is ideally reciprocal or congruent to the chin and the nose and sets between them, which reminds us geometrically of the cross sections of the pentagon (seen in Fig. 6.13).

Upper lip length at the height of the filtrum, or to the distance from the base of the columella, was golden to the total height of both lips (Uv-Lv) as 1.0, lip length was found to be Phi prime.

The presence of these relationships and the overlapping of complementary areas in the lips and mouth perhaps explain in part why so many men may break up the excessive lip length with a moustache, or wear a bushy moustache when the lip is short. It may also explain why women accentuate the lower lip with lipstick and give close attention to lip contours in their makeup.
### DIVINE PROPORTION STUDY
**Frontal - Transverse Dimensions**
**N 10 Photographic Models from Magazines**

<table>
<thead>
<tr>
<th>Factor Measurement</th>
<th>X Actual</th>
<th>Predicted $\Phi$ or $\Phi'$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. LN - LN</td>
<td>28.4</td>
<td>$\Phi = 45.9$ $\Phi^2 = 74.35$ $\Phi^3 = 120.30$</td>
</tr>
<tr>
<td>2. CH - CH</td>
<td>45.4</td>
<td>$\Phi' = 28.06$ $\Phi = 73.46$ $\Phi^2 = 118.85$</td>
</tr>
<tr>
<td>3. LC - LC</td>
<td>75.3</td>
<td>$\Phi' = 46.54$ $\Phi^2 = 28.76$ $\Phi = 121.83$</td>
</tr>
<tr>
<td>4. TS - TS</td>
<td>118.2</td>
<td>$\Phi' = 73.05$ $\Phi^2 = 45.14$ $\Phi = 27.90$</td>
</tr>
</tbody>
</table>

Prediction TS - TS from LN - LN = 98.25%
or 1.75% error (for mean values)
(and these photos about 80% actual)
Prediction CH - CH from LN - LN = 98.80%
Prediction LC - LC from LN - LN = 98.75%

*Table 6.2*

### VALUES IN DIVINE PROPORTION STUDY
**N 10 Photographic Models**

**x Measurement**

<table>
<thead>
<tr>
<th>Actual 1.618 Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. TR - M 144.3 + 89.18 - 55.12 + 34.06 - 21.05 = 144.30</td>
</tr>
<tr>
<td>2. LC - M 89.3 x 1.618 = 89.3 x 1.618 = 55.19</td>
</tr>
<tr>
<td>3. TR - AL 88.6 x 1.618 = 88.6 x 1.618 = 54.75</td>
</tr>
<tr>
<td>4. TR - LC 52.1 x 1.618 = 52.1 x 1.618 = 32.2</td>
</tr>
<tr>
<td>5. AL - M 54.5 x 1.618 = 54.5 x 1.618 = 33.68</td>
</tr>
<tr>
<td>6. LC - CH 55.6 x 1.618 = 55.6 x 1.618 = 34.36</td>
</tr>
<tr>
<td>7. CH - M 33.7 x 1.618 = 33.7 x 1.618 = 54.52</td>
</tr>
<tr>
<td>8. LC - AL 34.7 x 1.618 = 34.7 x 1.618 = 56.14</td>
</tr>
<tr>
<td>9. AL - CH 21.3 x 1.618 = 21.3 x 1.618 = 34.46</td>
</tr>
</tbody>
</table>

*Table 6.3*
Third Vertical Consideration - The Nose

The nose length in the foregoing was related to the chin but it is now considered relative to other parts of the face. By analyzing from the eyes (Lc) to the nose (Al) (as vertical nose length) and taken as a basic unit of 1.0, the distance from nose to chin (M) is Phi (or 1.618) (Fig. 6.31A).

When the divider is reversed, the same lengths will fit the eye to the mouth to the chin (Fig. 6.31B). This suggests again, as seen previously, that the length from the eye to the mouth should be equal to the nose to the chin for dynamic symmetry to exist!

Fourth Vertical Consideration - The Eyes

Research on the face led to the use of an anthropometric point Trichion (Tr) which is located at the junction of the facial fascia with the aponeurosis of the skeletal cap. It is revealed as a triangular shaped wrinkle upon elevating the eyebrows and is usually near the hair line in young people (See Fig. 6.28). The dimension from Trichion to Mentum represents total facial height (not total head length). It was found that, ideally, if the distance from Trichion to the eye was a unit of 1.0 the dimension from the eye to the chin was Phi or 1.618 (Fig. 6.32).

The reverse proportion shows that nose to the chin as a unit of 1.0 indicates that the nose to trichion is a Phi relationship (Fig. 6.33B). Just as was seen for the upper lip length as a reciprocal unit to nose and chin, the nose is seen as a congruent unit to the upper and lower face. This yields three nearly equal dimensions in the face: (1) the nose to the chin, (2) the eye to mouth and (3) the eye to trichion (Fig. 6.33).

Transverse Facial Analysis

Space between the eyes if taken as 1.0 is golden to the width of the eye which is 1.618, the nasal bridge width (Fig. 6.34A). The columella of the nose likewise forms a golden relationship with the nostrils (Fig. 6.34B).

Width analysis of the nose at the lateral nares (Ln) was taken as a unit of 1.0 (See Fig. 6.28). The mouth to Chielion (Ch) was 1.618 the nose or Phi (Fig. 6.35A). The inter Lc (lateral canthus) distance was Phi 2 to the nose and Phi to the mouth. The width of the face at the temple (Ts) at the eyebrow height (Eb) was Phi 3 to the nose and Phi 2 to the mouth and Phi to the eyes (Fig. 6.35B). Measurements on live subjects suggested a Phi prime relation at inter-Dacryon or the narrowest portion of the bridge of the nose (Fig. 6.35C) and a Phi relationship was suggested to the lateral canthus. This suggested nose width to equal eye width (from Dacryon to Lateral Canthus).

Horizontal Facial Analysis (Depth)

This constituted a triple study. First, a few ideal faces were measured to create the hypothesis. Secondly, horizontal relations on the normal cephalometric composites were measured. Thirdly, the lateral photos of 30 acceptable post orthodontic patients, blown up to life size, were measured.

It became apparent from the studies of facial depth that a terminal line for the face would fall near to the base of the tragus of the ear (Tra) as Leonardo Da Vinci had suggested (Fig. 6.36). The vertical relations described previously were still obtained in the lateral view. When three similar vertical dimensions mentioned before were used as a base of 1.0 (Tr-Lc, Lc-Ch and Al-M), the Phi location falling
Fig. 6.29 A. Shows the analysis of a face from a poster advertising the Milopa cosmetic company. Notice that the upper lip is golden to the lower lip. B. Notice that the length of the filtrum of the upper lip when taken as 1.0 is golden to the thickness of both lips. (Courtesy of Milopa/Mila d’Opiz Cosmetics, Switzerland)

close to the posterior margin of the “side burn” line would form golden rectangles. These golden rectangles in the lateral view were for the upper, middle and lower face when oriented to Frankfort Plane (Fig. 6.37). Because the orbit and meatus were not visible, a point 15mm. below the lateral canthus for Orbitale and one immediately above the tragus at the base of the corner of the ear, for the Frankfort plane, were selected.

By dropping a perpendicular line from the lateral canthus to the horizontal line, it showed nearly a ratio to a golden cut between tragus and nose prominence. On measurement, it was found to be in the 30 subjects 6.17 ± .024. The distance from tragus to canthus was a mean of 1.612. This distance should help the plastic surgeon in nose depth determination and help the orthopedic-orthodontic clinician in projecting plans for treatment.
Of greater concern to the orthodontist and prosthetic dentist was the view for antero-posterior position of the lips. Cephalometric work had suggested that Stomion lay on the golden section from Lateral Canthus (Lc) to nose tip (Pnn). Measurements showed in the 30 subjects that Stomion was .603 from the Canthus, but the standard deviation as high at .035. This extent of variation was thought to be due to two variables, first, the nose length and second, the dental protrusion. (Fig. 6.37).

**Cheek Location**

One aspect of maxillofacial surgery involves cheek augmentation and work around the eyes. The question arises regarding the exact location of, or amount of, proplast or material to be used to build up a cheek contour. By taking the

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**Fig. 6.30 A.** The same model is shown as in Fig. 6.29 shows that from the curve of the alar rim to stomion to menton is a golden proportion. In (B) notice that the divider turned upside down without alteration shows the distance from the nose to the lips is golden to the medial canthus of the eye. (Courtesy of Milopa/Mila d’Opiz Cosmetics, Switzerland)
Fig. 6.31 Left shows the golden relationship from the eye to the nose to the chin. Without extending the divider notice at right, the eye to the mouth to the chin is an inverse golden proportion. (Courtesy of Milopa/Mila d'Opiz Cosmetics, Switzerland)

Fig. 6.32 This model represents the golden proportion from trichion to the alar rim to the chin at left. At right, without extension of the divider, a proportion is seen from the trichion to the eye to the chin. These proportions are tests for harmony and dynamic balance in a face. (Courtesy of Milopa/Mila d'Opiz Cosmetics, Switzerland)
Fig. 6.33 (A) represents a summary of the preceding measurements. (B) represents a golden triangle constructed in the face with the nose tip at the center. (C) represents a golden triangle constructed from the eyes to trichion with its center in the middle of the forehead. (D) represents a construction of the golden triangle in the lower part of the face with its center at tip of lower lip.

eyebrow point (Eb) and the vertical nose length (Al) and forming a golden rectangle, the cheek prominence will be seen to lie on a golden section (Fig. 6.38A & B).

Findings of Lip Conditions

Mouth Disharmonies

Displeasing mouth harmony falls into two categories. As Calvin Case suggested in 1920, one is a mouth retrusion and the second is a mouth protrusion. In fact, Case said that the ideal fell midway between the protrusive and retrusive lips (Fig. 6.39A&B).
Lip Imbalances and Lip Incongruencies - Three Types

Lip Imbalances

The first type of lip problems (Fig. 6.40A, B & C) involved pure lip imbalance. The first (IA) is either or both lip size inadequacy in which the lip may also be thin and atrophic. A second type (IB) is aversion or the proverted upper lip (as the upper lip lies ahead of the lower lip when compared to the E line), when it should be more distal to the lower in that orientation. The third subdivision (IC) is eversion or the lower lip everted and rolled forward as commonly seen in pseudo Class III and cleft palate conditions. These may be called type IA, IB and IC for classification nomenclature.

Fig. 6.34 A. Shows that the inter Dacryon distance is golden to the outer canthus of the eye. B. One nostril is golden to the columnella of the nose plus the nostril of the opposite side. (Courtesy of Milopa/Mila d’Opiz Cosmetics, Switzerland)
Fig. 6.35 Horizontal divine proportions. (A) shows the width of the nose is golden to the width of the mouth (B) which in turn is golden to the width of the lateral canthus of the eyes (C) (just at the medial border of the lateral canthus). (Courtesy of Milopa/Mila d'Opiz Cosmetics, Switzerland)
Mentalis “Habits” or “Perversions”

The second group of conditions consisted of hypermentalitis activity (Fig. 6.41A, B & C). There are also three subdivisions within this category. First (IIA) is an incapacity of the lips making it mandatory for mentalis action and chin elevation to close the lips around and over a dental protrusion. The second type (IIB) is normal lips but a mentalis contraction caused by compensation for excessive lower face height. The final (IIC) is a combination or full manifestation of mentalis, seen often as severe lip strain due to lip closure around a protrusive denture when the face is also long or skeletal denture height is excessive, yielding a double mentalis hyperfunction causation.

Perioral Contractions

The last group of lip imbalances may be seen in combinations with, but may be independent of, mentalis muscle abnormality (Fig. 6.42A, B & C). These are perioral contractions seen in the sublabial area or in the nasal angular area of the upper lip. The first (IIIA) is lower lip sucking as the lower lip is sucked underneath the upper anterior teeth. The second (IIIB) is most important to T-M joint conditions and it is sublabial contraction. In this genetic condition the fibers of the depressor menti (or quadratus inferioris) are overactive to a point of suggested fibrosis. The dense part of the lower lip is forced against the incisor area and the deep crease is present between the chin and the lower lip (Labio-mental fold).

Fig. 6.36 Tracing of a photograph of a beautiful face of an adult female. Notice that the base of the tragus of the ear to the lateral canthus of the eye to the end of the nose represents a golden proportion. Notice further that stomion is golden to the nose and canthus of the eye. Not all beautiful faces show this proportion.
Fig. 6.37 A. Profile view showing subnasale, labia superioris, labia inferioris together with soft tissue pogonion and the nose at pronasale. B. A golden rectangle formed with center located just below the cheek prominence. C. Center of an upper facial rectangle was just above the eyebrow. D. The center of a lower rectangle is just below the corner of the mouth.
Fig. 6.38 Golden sections can be utilized to determine the proper cheek curve for augmentation in surgery. A golden section from the nose to the curve of the eyebrow will strike the lateralmost part of the cheek as seen at (A). The same dimension is seen in (B) where a golden rectangle can be established from the base of the curve of the eyebrow to the alar rim.

The final perioral condition is circumoral contraction. In this type, lips may be in good balance but there may be lip pursing with contraction around the mouth leaving lines or creases from the nose angled downward and outward (often a problem in aging of the face). It has been called the naso-labial fold, but the author has called it a caninus-triangularis furrow, as it runs along the contraction of that muscle union. It may often be associated with long-standing tongue thrust when seen in younger patients.
Fig. 6.39 (A) shows the esthetic line, the cheek line and the inter pupil lines. Analysis reveals protrusive lips with the wide mouth. (B) Represents a patient with a retrusive and narrow mouth revealed by the same planes of reference.
Fig. 6.40 Three types of lip imbalances. (A) is short upper and lower lips. (B) An aversion or proversion of the upper lip and a wide mouth. (C) is an eversion of the lower lip.
Fig. 6.41 Three types of Mentalis conditions. (A) The lips protrude beyond the E line and the mentalis is under strain due to a protrusive upper denture. (B) A bimaxillary protrusion of the teeth with even more severe lip strain and a micro-rhino dysplasia of the nose. (C) A protrusive denture but mainly due to a retrod lower jaw and a long face.
Fig. 6.42 Three types of paracral contraction. (A) The result of a lip sucking habit. (B) Sub-labial contraction with probably hypertrophy of the quadratus inferioris and the orbicularis oris. (C) Represents contraction in the sling of the caninus and triangularis.
DENTAL RELATIONS

The dentist has often been expected to deal only with the teeth. He is expected to achieve normal dental occlusions or produce normal or artificial dentures in functional and esthetic equilibrium. As long as skeletal and soft tissue conditions are within the range of one clinical deviation, the orthodontist or prosthetic dentist can usually balance out the denture by simply adjusting the teeth in conformity to the individual pattern.

But the "ideal" location of the denture and arrangement of the teeth has been controversial throughout the history of orthodontics, particularly before cephalometrics emerged. A direct association of lip relationships with denture relationships was needed. The most appropriate reference for the lower incisor became the APo Plane (See Fig. 6.20). The idealism of the lower incisor position to APo was first noticed by the author in 1949. Fifteen mixed dentition children, with beautiful normal occlusions, were found to have lower incisors averaging plus 1 mm. at 22 degrees to the APo Plane (Point A and Pogonion).

The APo line usefulness for measurement came to be reconfirmed as it was related in adults and post-treatment results in orthodontic patients. In patients with abnormal esthetics, it was shown that esthetic harmony and balance, as well as functional equilibrium, could be achieved with the establishment of the lower incisor in a range of position of 1 to 3 mm. ahead of the line with the normal overbite and overjet of 2 to 2.5 mm. and interincisal angles at 125 degrees to 130 degrees. When tooth relations were abnormal, the esthetics of the lips and mouth were affected even if the orthodontic-prosthetic result was stable.

In 1968, a "master" study was conducted with the computer in order to associate arch width with facial form. In the frontal view skeletal relations in the posterior denture base were registered by the jugal process of the maxilla (J) and the triradii eminence of the mandible (Ag) (See Fig. 6.24). The inter-molar width was also capable of mensuration according to skeletal type.

A more cogent relation of the denture for beauty, harmony, and balance resulted from two other findings. One was the close order the occlusal plane maintained to Xi Point. The second was the golden section method whereby the lower incisal tip was golden to the Point A and Pm point (Protuberance menti — not to be confused with Pogonion) (Fig. 6.43). Thus, with cephalometrics the denture was assessed in all three dimensions for esthetic balance and harmony and arch form for the best equilibrium (Fig. 6.44).

Teeth to Teeth Proportion

Findings from five different studies suggested the mean values of the normal teeth to be related as seen in Fig. 6.45A. Upon learning of extent of the other golden proportions in the face and body, it was natural to expect certain relations within the teeth and their arrangement. Immediately, a Phi relationship was found between the lower central incisor (at 5.5 mm.) and the upper central (8.9 mm.). The orthorule published by Dr. David Hamilton was consulted which bore out the data (Table 6.4). In addition, arch dimensions had been studied on the normal by the author and data on 107 long-term stable orthodontic cases were available from Dr. Gardner's studies which matched significantly (See Table 6.5). A third detailed study was conducted by Dr. Santos.
### Table 6.4

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<th>2. Exp.</th>
<th>3. All</th>
<th>4. Exp.</th>
<th>5. All</th>
<th>6. Exp.</th>
<th>7. All</th>
<th>8. Exp.</th>
<th>9. Incisor to molar</th>
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<td>-</td>
<td>-</td>
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<tr>
<td><strong>Extraction</strong></td>
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### Table 6.5

**Mean Arch Distances (mm) and Standard Deviations**

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<tr>
<th></th>
<th>Nonextraction Both Sexes</th>
<th>Nonextraction Male</th>
<th>Nonextraction Female</th>
<th>Nonextraction Class I</th>
<th>Nonextraction All Class I</th>
<th>Nonextraction Mixed Dentition</th>
<th>Nonextraction Permanent Dentition</th>
<th>Extraction</th>
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<tr>
<td></td>
<td>74 cases</td>
<td>26 cases</td>
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<td>56 cases</td>
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<td>29 cases</td>
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<table>
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<tr>
<th></th>
<th>1 All</th>
<th>2 Exp.</th>
<th>3 All</th>
<th>4 Exp.</th>
<th>5 All</th>
<th>6 Exp.</th>
<th>7 All</th>
<th>8 Exp.</th>
<th>9 Incisor to molar</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Canine</strong></td>
<td>25.78</td>
<td>±1.77</td>
<td>26.56</td>
<td>±1.60</td>
<td>27.16</td>
<td>±1.45</td>
<td>27.42</td>
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<td>27.75</td>
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<td></td>
<td>25.90</td>
<td>±1.48</td>
<td>26.04</td>
<td>±1.41</td>
<td>26.69</td>
<td>±1.27</td>
<td>27.92</td>
<td>±1.21</td>
<td>28.31</td>
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<tr>
<td>T1</td>
<td>25.50</td>
<td>±1.13</td>
<td>26.09</td>
<td>±1.69</td>
<td>26.33</td>
<td>±1.57</td>
<td>26.63</td>
<td>±1.52</td>
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<tr>
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<td>25.87</td>
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<td>26.44</td>
<td>±1.62</td>
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<td>±1.51</td>
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<td>±1.33</td>
<td>27.25</td>
<td>±1.51</td>
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<td>T5</td>
<td>25.33</td>
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<td>26.12</td>
<td>±1.51</td>
<td>26.66</td>
<td>±1.33</td>
<td>27.25</td>
<td>±1.51</td>
<td>28.35</td>
</tr>
</tbody>
</table>

| **1st Premolar**   | 40.06 | ±1.74  | 40.75 | ±1.74  | 40.79 | ±1.74  | 39.92 | ±1.74  | 40.17               |
|                    | 40.06 | ±1.74  | 40.75 | ±1.74  | 40.79 | ±1.74  | 39.92 | ±1.74  | 40.17               |
| T1                 | 40.50 | ±1.74  | 40.75 | ±1.74  | 40.79 | ±1.74  | 39.92 | ±1.74  | 40.17               |
| T2                 | 40.63 | ±1.74  | 40.75 | ±1.74  | 40.79 | ±1.74  | 39.92 | ±1.74  | 40.17               |
| T3                 | 40.59 | ±1.74  | 40.75 | ±1.74  | 40.79 | ±1.74  | 39.92 | ±1.74  | 40.17               |
| T4                 | 40.32 | ±1.74  | 40.75 | ±1.74  | 40.79 | ±1.74  | 39.92 | ±1.74  | 40.17               |
| T5                 | 40.87 | ±1.74  | 40.75 | ±1.74  | 40.79 | ±1.74  | 39.92 | ±1.74  | 40.17               |

| **2nd Premolar**   | 46.39 | ±2.09  | 46.96 | ±2.09  | 46.68 | ±2.09  | 46.40 | ±2.09  | 46.32               |
|                    | 46.96 | ±2.09  | 46.68 | ±2.09  | 46.40 | ±2.09  | 46.32 | ±2.09  | 46.32               |
| T1                 | 45.50 | ±2.09  | 46.68 | ±2.09  | 46.40 | ±2.09  | 46.32 | ±2.09  | 46.32               |
| T2                 | 45.37 | ±2.09  | 46.68 | ±2.09  | 46.40 | ±2.09  | 46.32 | ±2.09  | 46.32               |
| T3                 | 45.46 | ±2.09  | 46.68 | ±2.09  | 46.40 | ±2.09  | 46.32 | ±2.09  | 46.32               |
| T4                 | 45.87 | ±2.09  | 46.68 | ±2.09  | 46.40 | ±2.09  | 46.32 | ±2.09  | 46.32               |
| T5                 | 46.32 | ±2.09  | 46.68 | ±2.09  | 46.40 | ±2.09  | 46.32 | ±2.09  | 46.32               |

| **1st Molar**      | 52.86 | ±2.46  | 53.60 | ±2.46  | 53.42 | ±2.46  | 52.75 | ±2.46  | 52.75               |
|                    | 52.86 | ±2.46  | 53.60 | ±2.46  | 53.42 | ±2.46  | 52.75 | ±2.46  | 52.75               |
| T1                 | 52.23 | ±2.46  | 53.60 | ±2.46  | 53.42 | ±2.46  | 52.75 | ±2.46  | 52.75               |
| T2                 | 52.52 | ±2.46  | 53.60 | ±2.46  | 53.42 | ±2.46  | 52.75 | ±2.46  | 52.75               |
| T3                 | 52.80 | ±2.46  | 53.60 | ±2.46  | 53.42 | ±2.46  | 52.75 | ±2.46  | 52.75               |
| T4                 | 52.75 | ±2.46  | 53.60 | ±2.46  | 53.42 | ±2.46  | 52.75 | ±2.46  | 52.75               |
| T5                 | 52.75 | ±2.46  | 53.60 | ±2.46  | 53.42 | ±2.46  | 52.75 | ±2.46  | 52.75               |

| **6 to T**         | 23.74 | ±1.25  | 23.74 | ±1.25  | 23.74 | ±1.25  | 23.74 | ±1.25  | 23.74               |
|                    | 23.74 | ±1.25  | 23.74 | ±1.25  | 23.74 | ±1.25  | 23.74 | ±1.25  | 23.74               |
| T1                 | 23.74 | ±1.25  | 23.74 | ±1.25  | 23.74 | ±1.25  | 23.74 | ±1.25  | 23.74               |
| T2                 | 23.74 | ±1.25  | 23.74 | ±1.25  | 23.74 | ±1.25  | 23.74 | ±1.25  | 23.74               |
| T3                 | 23.74 | ±1.25  | 23.74 | ±1.25  | 23.74 | ±1.25  | 23.74 | ±1.25  | 23.74               |
| T4                 | 23.74 | ±1.25  | 23.74 | ±1.25  | 23.74 | ±1.25  | 23.74 | ±1.25  | 23.74               |
| T5                 | 23.74 | ±1.25  | 23.74 | ±1.25  | 23.74 | ±1.25  | 23.74 | ±1.25  | 23.74               |
The Phi sequence starting with the two lower central incisors goes to the upper central incisors Phi 2, to the distal of the upper lateral incisors (on the chord of the arc of the arch) Phi 3, to the buccal of the upper first or second premolar, depending on arch form. In the lower arch, a Phi relationship was found from the distal of the lower lateral incisors to the intercanine width at incisal tip of the upper arch. A further Phi 2 relationship was found from the second premolar to the width of the upper second molars. There was also the suggestion of a tendency for upper intercanine width to be harmonious with nasal width in the smile. Of further interest was the comparison of the normal arch forms to the golden triangle as shown in Fig. 6.43B.

Fig. 6.43 Denture height and facial depth is a consideration for diagnosis.
Fig. 6.44 Shows the width dimension particularly in the width from AG to AG or the antagonal tubercle (also called the trihedral eminence).

PERSONALITY

The final factor in esthetics, that of personality, may hardly be scientific because personality types are not clearly defined and tests are usually subjective. As a working hypothesis, three different types were considered. For want of more sophisticated terms, let us refer to them simply as (1) outgoing, (2) complacent and (3) reserved types. These are simply normal personalities with different qualities expressed in physical type and mental attitudes. We hesitate to refer to extroverted or introverted types because those terms possibly suggest abnormality.

One reason for typing to be considered is because some patients prefer a prominent denture with fullness to the mouth while others prefer a dominance
Fig. 6.45A Divine proportions in normal occlusions. Width as seen on the left shows lower incisor as golden to the upper incisor which is golden to the width across the upper laterals in the arch which is in turn golden to the width of the upper first bicuspids. Right, the four lower incisors are golden to the center of the cuspids which in turn is golden to the width of the upper second molars. Below, notice the width of the lower canines is golden to the width of the buccal grooves of the lower first molars.
of the chin with the mouth more recessed. Let us say that the outgoing type displays the “springtime” personality. This type uses the attractive denture to attract attention. Women like fullness of the mouth as a feature of youth.

The antithesis of the outgoing is the reserved type. Let us say, for want of better semantics, that this represents a “winter” personality. This type may be more egregious, and appear uninterested or bored by social affairs. They tend to conceal the denture, hide the teeth, and prefer to go unnoticed in a crowd. They may be highly selective in friends and not wish to attract undue attention without an invitation. They may prize the “cut of the chin” and resent a prominent denture as a more primitive form. They may appear negative, depressed or worrisome in attitude. Extraction of teeth and flattening of the mouth may be in keeping with this type’s self-image.

The even tempered or complacent personality falls into the range of central tendency. This patient is self-satisfied, flexible, adaptable and appreciative. Parenthetically, it is incumbent on the clinician to be able to identify the type and offer the alternatives to patients of different temperaments.

ESTHETICS CLINICALLY

In maxillo-facial orthopedics changes induced by growth alteration, by surgery, or by implant augmentation may affect the nose, cheeks and the chin. An additional fact is that the skeleton and denture form a basis for correct function. As skeletal and denture balance is achieved, improved esthetics therefore will be most likely. The lips are markedly influenced by the teeth.

Two terms come to mind regarding the subject of “denture balance.” First is adaptation and second is compensation. The soft tissue adapts. When teeth are positioned orthodontically or prosthetically, it is hoped that function will adapt to the new form. But teeth, during development, over a period of time, erupt and

Fig. 6.45B Notice that the normal arch almost fits the golden triangle, or a 72-72-36 degree triangle.
Fig. 6.46 An edentulous patient (A) was fitted with four different artificial dentures. (B) The lower incisor was placed "over the ridge". (C) The lower incisor was placed at plus one mm. (D) The lower incisor was placed at plus three mm. (E) A Class II, Div. 1 malocclusion was simulated.
drift to compensate in their positions for skeletal and muscular variation of the jaws. When excessive skeletal dysplasia is present, the demands for compensation may be too great and the capacity of nature to harmonize the teeth may be limited. Orthodontics, orthopedics or surgery are therefore required to correct the skeletal parts so that better muscle adaptation and function can occur as suggested by the work of Solow.

The lips and the surrounding perioral tissues are influenced directly by the underlying teeth. Reduction of dental protrusion to established objectives (towards the peak of the curve) produces a dramatic esthetic improvement.

A reversed situation of orthodontics was experimentally produced by the author and Dr. William Gambli. Artificial dentures were placed in standard position over the ridge, and in various protrusive positions and in states of Class II malocclusion. The lips as studied showed a wide variation dependent upon the type of prosthetic denture placed which proved the effects of the teeth on facial esthetics.

The consensus on showing the illustration seen in Fig. 6.46 to dental audiences was that the most pleasing balance was somewhere between plus 1 mm. and plus 3 mm. in protrusion. This fits the normal population samples studied. The unpleasing lip adaptation to Class II Division 1 was most obvious and even involved abnormal mandibular posturing.

CLINICAL IMPLICATIONS

The evolution of 40 years of studies in esthetics by the author is described in this chapter. Esthetics is a fundamental of dentistry. The psychologic well-being of a contemporary patient is at stake and can involve occlusion, comfort, security and above all self-image. While esthetics in the past has been considered totally subjective, much can be learned from the scientific approach offered in this chapter. By using cephalometrics, photographs and direct patient measurement conclusions regarding esthetics can be drawn. The golden divider has proven to be a valuable adjunct to treatment planning.

Esthetics involves the underlying skeletal pattern, the conditions of the dental occlusion or malocclusion and the soft tissue of the nose, lips and chin. Light reflection and refraction, harmony and morphology of the individual teeth are also quite important. Tooth arrangement subtly also includes the divine proportion.

There are, finally, personality types to consider in selecting esthetic values for the individual.

The possibilities of all kinds of treatment and further details for planning will be covered throughout these volumes.

The importance of the function of esthetics in clinical dentistry cannot be overstated. The underlying need is improvement, self-worth and self-esteem. This improvement of self-image is an important step toward happiness for the patient.