VOLUME 28 | NUMBER 2 | SUMMER 2017

International Journal of Orthodontics

Published Quarterly by the
International Association for Orthodontics

Unraveling the mystery of facial beauty and its biologic significance ... *Update 2017*

In this Issue:

- Current Perspectives on Craniofacial Pain and Temporomandibular Disorders
- Virtues of Double Arch Mechanics and "U" Bend Spring in Straight Wire Appliance
- Skeletal Types: Key to Unraveling the Mystery of Facial Beauty and Its Biologic Significance - Update 2017
- Management of Bilateral Ectopically Blocked-out Canine and Posterior Cross- Bite
- Cervical Disc Prolapse among Orthodontists: A Professional Hazard
- Fabrication of Pre-Formed Acrylic Removable Retainer for Instant Retention
- Treatment of Bilateral Multiple Impacted Teeth with Efficient Mechanics
- Steel Template for Bonding a Lingual Retainer
- Surgery-First Approach in Redefining Treatment of Severe Asymmetric Class III Dentofacial Deformity: A Case Report

Visit the IAO online at www.iaortho.org

This article has been peer reviewed.

Skeletal Types: Key to Unraveling the Mystery of Facial Beauty and Its Biologic Significance - Update 2017

By Yosh Jefferson, DMD, MAGD, IBO

Abstract: *Great advances have been made in the area of functional appliance therapy and orthognathic surgery. Our ability to make real and perceivable changes in the human face has revolutionized the breadth and care that our profession can provide for our patients. In the vast majority of cases, treatments for facial esthetics, temporomandibular disorder, sleep apnea, cranio-mandibular pain, and many other medical issues demand that the patients' maxilla and mandible be treated to their proper shape and ideal position. To date, there are no definite guidelines as to what constitutes ideal facial-skeletal position for the maxilla and the mandible. Without establishing universal criteria that apply to all individuals regardless of race, sex, age, and other variables, accurate diagnosis and treatment can never be certain or comfortably achieved. The criteria for establishing ideal position of the maxilla and the mandible must be based on facial esthetics, maximizing healthy temporomandibular joints, upper airway respiration, and physiologic harmony. Just as Dr. Edward Angle firmly established criteria for ideal dental occlusion and developed a universally-accepted dental classification system, it is necessary for our profession now to establish firm criteria for ideal skeletal position of the maxilla and the mandible and to develop a universally accepted facial-skeletal classification system.*

Clarification of terminologies: Currently, there appears to be tremendous confusion in delineating dental problems from skeletal problems. They are two separate entities, and they must be evaluated separately and distinctly from each other. The following terms are proposed to prevent confusion and unintentional merging of the two. **Orthodontic** applies to the correction of dental problems, whereas **orthopedic** applies to the correction of skeletal problems. **Occlusion** and **malocclusion** describe the way the maxillary and the mandibular teeth relate to each other. **Position** and **malposition** describe the way the maxillary and mandibular skeletal components relate to the cranial base. Whereas malposition describes the abnormal position of the maxilla and/or the mandible, **malformation** describes the abnormal shapes of the maxilla and the mandible, i.e. the maxilla is malformed when it is constricted and has a high and narrow palatal vault. **Retrusive** and **protrusive** describe the posterior and anterior position of dentitions, whereas **retrognathic** and **prognathic** describe the posterior and anterior position of the maxilla and/or the mandible relative to the cranial base. **Open-bite** and **deep-bite** describe the vertical height relationship of the dentition; **long** and **short** describe the vertical height of the lower half of the facial-skeletal structures relative to the upper half of the face. These terms are used because they are directly related to "long" face and "short" face syndrome. Finally and more importantly, **Class** refers to dental classifications which include dental Class I, Class II, and Class III whereas **Type** refers to skeletal classifications such as skeletal Type I, Type II, and Type III. These distinctions must be made so that in discussing dental and skeletal abnormalities, one will not be confused with the other.

Introduction

When using the term "deep bites," are we speaking of dental deep bites, skeletal deep bites, or a combination of both? It is not only important but absolutely essential to make these distinctions in treating orthodontic patients with this and other skeletal problems. In fact, the treatment of skeletal abnormalities has greater esthetic and physiologic impact on the patient than the treatment of dental abnormalities. Even to this day, there appears to be ambiguity and confusion in delineating dental and skeletal problems. Many practitioners assume that the maxillary/mandibular A-P position always coincides with the dental A-P position; that Dental Class II always coincides with Skeletal Type II, and that Dental Class III always coincides with Skeletal Type III. This unintentional merging of these two distinct problems, as if they were conjoined Siamese twins, may have occurred in the early years of our profession because diagnostic assessments were not as sophisticated. Also, since the ability to make changes in the craniofacial structure was limited prior to functional orthodontics and orthognathic surgery, facial-skeletal diagnosis and treatment were rarely considered or emphasized. With the advent of these treatment modalities, face and health-focused cephalometric measurements are not only necessary but mandatory. It must be stressed that skeletal assessments do not always coincide with dental assessments. Malacic & Markovic[1] found that not all skeletal malpositions coincided with dental malocclusions. There are patients, for instance, who have Skeletal Type III with a Class I dental, and Skeletal Type I with a Dental Class II. These are just a few of many such examples. In reality, it is almost always advantageous to correct the skeletal abnormalities first, and then treat the dental malocclusions. As will be discussed in greater details later, more and more research and studies have shown the enormous impact proper shape and positioning of the facial-skeletal structures can have on facial esthetics, healthy TM joints, proper upper airway respiration, and overall health and well-being. At this juncture, I will state with absolute conviction and without hesitation: "Beautiful face is synonymous with health!" Functional appliance therapy makes real and profound changes to the

facial-skeletal structures. Plastic surgery and even orthognathic surgery, to a certain extent, often make superficial changes to the face. Functional appliance therapy can do what no superficial surgeries can do: it can enhance health and maximize quality of life. Treating to enhance facial esthetics via functional appliance therapy will oftentimes create what I call a positive "biologic domino" effect where multitude of medical issues alleviate. In the past, cephalometric measurements were almost entirely dental-focused. Now, more than ever, we need to be face and health-focused. We need face and health-focused cephalometric measurements. The Jefferson Cephalometric Analysis and the Jefferson Skeletal Classification are proposed here for that purpose.

Once we establish that dental and skeletal problems are separate and distinct from each other, then we must firmly establish normal or ideal from the abnormal. Without this knowledge, there is no definitive line separating normal from abnormal conditions. This can create a diagnostic nightmare. For instance, how can practitioners correct dental malocclusions if there is no agreement as to what is considered ideal occlusion? In 1899, Angle[2] clearly described and illustrated this. Previous to his landmark publication, many practitioners did not really know for sure. They were essentially treating blindly with oftentimes unacceptable results. Furthermore, various types of abnormal occlusions were described in vague terms, which added to the confusion. By defining ideal dental conditions and classifying the various malocclusions in a neat and efficient manner, Angle helped to crystallize once and for all how to diagnose the various types of malocclusions and how to achieve normalcy in dental occlusion.

Over 100 years later, we are faced with a similar situation with respect to skeletal problems. There is still no definitive agreement as to what constitutes normal or ideal facial-skeletal position. Without this information, many practitioners continue to disregard them. Worse yet, practitioners, with little appreciation for skeletal abnormalities, may inadvertently reposition the maxilla and/or the mandible further away from the ideal while treating orthodontic patients. This can result in severe consequences to the patients.[3] Rather than improve the human condition, this may adversely affect the patients' facial appearance and health.

The orthodontic profession is now very cognizant of the benefits of functional appliance therapy. This therapy, along with orthognathic surgery, has enabled us to change the size, shape, and position of the maxilla and the mandible. It has allowed our profession to help our patients far beyond the narrow confines of the oral cavity. This ability to correct facial-skeletal abnormalities can only help to break our self-imposed image as mere "tooth" doctors and elevate our profession to that of "real" doctors. However, in order for us to help our patients correctly and effectively, we must firmly establish a universal standard for ideal facial-skeletal position.

Currently, there are literature discussions and cephalometric analyses that deal with the assessment of normal facial-skeletal position.[4-10] To date, none appear to be universally accepted because they are vague, complicated, and sometimes contradictory. Furthermore, almost all of these cephalometric analyses have different values for different populations depending on race, age, sex, etc. Too often, many authors feel that facial bone structures and facial features are genetically influenced and diverse. They believe, for example, that Caucasian standards do not apply to Blacks, and vice versa.[11-18] If this were to be true, then it would be a formidable task to establish ideal facial-skeletal position for every single segment of the human population. Furthermore, the constant intermingling between the different races and cultures makes this task even more difficult, if not impossible.

Currently, there are two diametrically opposite treatment philosophies in orthodontics. These two treatment philosophies are based on two opposing theories on the cause of dental malocclusions and facial abnormalities. The first camp believes that the shape and size of the mouth, as well as normal and abnormal facial features are genetically controlled. It is their view that the shape and size of the mouth and abnormal facial features cannot be changed. Orthodontic practitioners who believe this extract teeth to make room in crooked, crowded dentitions. They often treat malocclusions using the "four bicuspid extraction technique." The second camp believes that abnormal size and shape of the mouth, and abnormal facial features are caused by environmental factors. These orthodontic practitioners believe they can change the size and shape of the mouth, as well as change the position of the maxilla and the mandible. They can use expansion appliances to widen the mouth to make room for crooked, crowded dentitions. They also use various functional appliances to move the maxilla and the mandible to their more ideal positions which can enhance facial esthetics and health. They treat malocclusions and facial abnormalities using the "functional, non-extraction technique." This author is aligned with the second camp's philosophy. It is my strong belief that almost all physical abnormalities, especially the extreme ones, are environmentally induced and should be corrected as closely as possible to the biological standard that is esthetically pleasing and physiologically healthy. As will be explained further, all creatures (including humans) are genetically encoded to develop towards the Divine Proportion. This proportion is universal and directly impacts esthetics and biological health. Because of environmental factors, most living creatures deviate from the ideal. In a perfect world, free of negative environmental factors, all living organisms, including humans, will develop normally and ideally. These negative environmental factors include but are not limited to, modern processed foods, pollution, toxins, allergens, extreme climatic conditions, stress, etc. I will establish a universal standard for ideal facial skeletal position based on the premises mentioned. A universal standard for ideal facial esthetics/facial- skeletal position can be established if practitioners and scholars emphasize common characteristics rather than differences. Realistically, when the anatomy of the human head and face is analyzed, superficial surface distinctions such as facial features, skin color, and hair essentially have nothing to do with the differences. Compared to the overall genetic make-up and the physical architecture of the human body and face, any differences are so insignificant that they may be considered almost non-existent.

Based on clinical and cephalometric observations of esthetic, biologic, and physiologic characteristics common to the

human race, I have been able to establish a universal standard for normal or ideal skeletal position of the maxilla and the mandible. The Jefferson Archial Analysis effectively assesses facial-skeletal problems. It is a modified and much abbreviated version of the Sassouni Archial Analysis. The establishment of a skeletal classification system somewhat analogous to Angle's dental classification was necessary to describe the many forms of skeletal malposition that became apparent when using the Jefferson Archial Analysis.

By treating patients toward ideal skeletal position, many benefits can be observed. These benefits include improved facial esthetics, enhanced TMJ health, improved nasal and pharyngeal respiration, and improved physiologic harmony. Physiologic harmony includes alleviation of severe and chronic headaches, mouth breathing, otitis media, myofascial pain, etc. Treating to ideal facial-skeletal position can also alleviate ADD/hyperactivity, increase IQs, increase academic performance, and maximize growth and development. How the face has such an impact to all this will be explained later. In essence, **the criteria used to establish ideal skeletal position of the maxilla and the mandible relative to the cranial base is that it enhanced facial esthetics, improved TM joint health and upper airway respiration, and improved physiologic harmony**.

Universality of the Human Race and Human Face

All living creatures - including man - are intimately connected to a biologic phenomenon known as Divine Proportion.[19-21] We are all genetically encoded to develop into this ideal shape and form for many reasons. Ricketts[22] notes that biologists and morphologists understand this, and they speak in terms of "laws." When the human body develops to this Divine Proportion, it upholds the first law of "conservation of energy," which means that there is maximum performance with minimum effort. It also upholds the second law of "conservation of tissue," which means that a minimum amount of cells and materials are employed to perform the needed task. To put it bluntly, any individuals who conform to this Divine Proportion are biologically and physiologically arranged to be profoundly efficient and healthy.

Thornhill and Gangestad[23] stated that ideal physical development such as facial and body bilateral symmetry is necessary for many animals, including humans, to be attractive, healthy, strong, and resistant to diseases and parasites. Leary and Allendorf[24] stated that environmental stress is often associated with abnormal development. They cite, for example, grunion *(Leuresthes tenuis)*, a marine fish which exhibited increasing pectoral fin ray asymmetry with exposure to increased concentration of DDT during development. A high incidence of asymmetrical development of fish was found in waters around industrial centers.[25] Rats subjected to a variety of environmental stresses during pregnancy produced greater incidence of abnormally- developed offspring than the control group.[26] The nuclear explosion in Chernobyl produced significantly higher incidence of physical defects in new-born animals and humans. In our own practice, we see evidence of long face syndrome which may be attributed to natural and man-made allergens. It is environmental factors, not genetic, that cause abnormal facial and body developments. Symmetry is important, but symmetry is only a subset of Divine Proportion. Living organisms, including humans, can be symmetrical, but may not necessarily be Divinely Proportioned. If living organisms are Divinely Proportioned, then they are symmetrical as well.

Divine Proportion

As described by Ricketts in his article, esthetic appreciation of shapes and forms was first described by Phidias, a Greek sculptor. He noticed an ordered relationship of spatially-related parts in nature, later defined as divine or golden proportion, that are instinctively appreciated as being beautiful. Ricketts credits Filius Bonacci as the most renowned advocate of the numerical value of the divine proportion. He traveled extensively around the Mediterranean coast meeting with many merchants and learning about their systems of doing arithmetic. He learned of the Arabic numerical system and the Fibonacci numerical series. In 1202, he wrote the *Liber Abaci* (*Book of Abacus* or *Book of Calculation*) which popularized Hindu–Arabic numerals and the Fibonacci numerical series in Europe. He posed a mathematical question involving the multiplication rate of rabbit population. He surmised that the multiplication rate of rabbits would not increase in an ordinary geometric progression. Instead, the rabbit population level would reach a point where each new addition multiplied at precisely 1.618 times the previous number, and this ratio of added population continued on into infinity. This number, 1.618, applies to all living organisms as well as non-living matters in motion such as sound waves, ocean waves, and galaxies. For example, an egg once fertilized will multiply and divide until it reaches a point where each succeeding number of cells will be exactly 1.618 the number of previous cells. For whatever reason, there appears to be a mysterious and biologic significance to the number 1.618. I have often wondered about the relationship between the Fibonacci numerical series and the numerical number of the Divine Proportion. One day it dawned on me that the Fibonacci numerical series is the "action," and the number 1.618 is the final result or the product.

The knowledge of Divine Proportion was well known to Leonardo Da Vinci. There is no greater example of this anywhere than his famous drawing, *Human Figure in a Circle,*

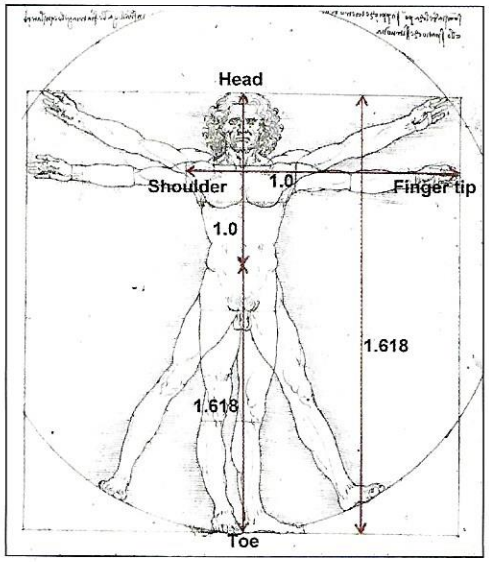

Figure 1: Divine Proportion seen in Da Vinci's human figure

Illustrating Proportions, 1485-90. As illustrated in Figure 1, if the distance from the top of the head to the umbilicus is 1, then the distance from the umbilicus to the toe is 1.618. Also, if the distance from the right shoulder to the tip of the left finger is 1, then the total height of the human body (head to toe) is 1.618. These are just a few of limitless numbers of examples that can be found.

The human face must also conform to the Divine Proportion in order for it to be biologically efficient and viable. Figure 2 shows some of the vertical relationships of the face that must conform to this ideal. For example, if the distance from LN (lateral side of the nose) to ME (soft tissue menton) is 1, then the distance from LN to TRI (Trichion-beginning of forehead wrinkling when one lifts the eyebrow) is 1.618. Also, if the distance from CH (Cheilion-corner of the mouth) to ME is 1, then the distance from LC (lateral canthus of the eyes) to CH is 1.618.

Figure 3 shows a few transverse relationships of the face that must conform to the Divine Proportion. For example, if the distance between LN is 1, then the distance between CH is 1.618. The distance between LC is 1.618 squared, and the distance between the temporal soft tissues of the level of the eyebrow is 1.618 cubed or 4.236.

Figure 4 shows that the external dimension of the head must also conform to the Divine Proportion. Ideally, if the distance from LCHK (lateral border of the cheeks) is 1, then the distance from TH (top of the head) to ME (soft tissue menton) should be 1.618. The divine proportion is universal and applies to all individuals, regardless of race, age, sex, geographic, and cultural variabilities.

Facial form and balance is directly related to Divine Proportion. Figure 5 shows a beautiful face of a female model. Because the model is bald, external measurements of her face were easily obtained. If the width of her face from cheek to cheek is 1, then the length of her head from the top of her head to the bottom of her chin is 1.618. The external configuration of her face conformed to the Divine Proportion. If the length of the face is longer than 1.618, then the patient will have long face syndrome. If the length of the face is shorter than 1.618, then the face will have a short face syndrome.

Practical application of the Divine Proportion in treating patients toward enhanced facial esthetics was demonstrated by Mack.[27] In essence, treating patients toward this ideal spatial relationship can improve facial appearance. For example, in patients with short face syndrome where the lower facial height is skeletally short, he was able to improve their facial appearance dramatically by increasing the lower facial height closer in line with the divine proportion.

The concept of Divine Proportion lends support to my contention that a universal standard for ideal skeletal position is not only possible, but necessary. Necessary because all creatures including humans are genetically predisposed to develop toward ideal proportion. As noted earlier, development toward ideal proportion maximizes efficiency and health. As will be explained later, faces that do not conform to the Divine Proportion not only have esthetic problems, but physiologic problems as well.

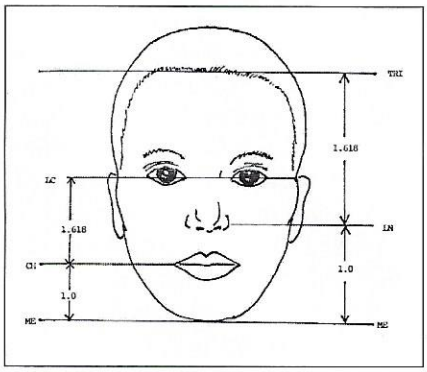

Figure 2: Divine Proportion of the face, vertical relationship

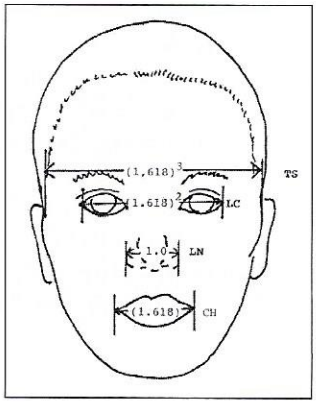

Figure 3: Divine Proportion of the face, transverse relationship

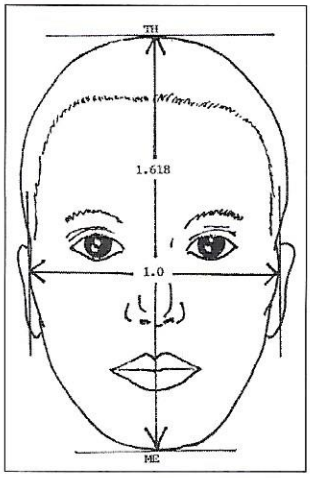

Figure 4: Divine Proportion of the face, external relationship

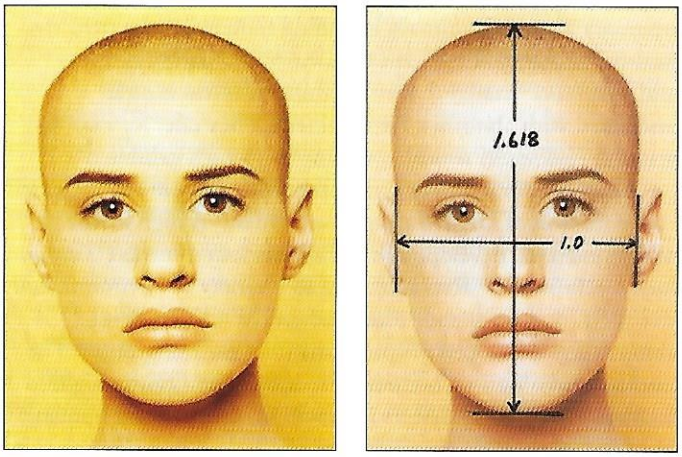

Figure 5: The external measurements of this beautiful female model's face conformed to the Divine Proportion. *Photograph by Francesca Sorrenti. Photographs by permission of Mademoiselle Magazine.*

Facial esthetics

The position of the underlying bone has a direct impact on facial appearance. If positioned ideally, it should enhance facial esthetics. Numerous articles in the literature have attempted to define facial beauty or esthetics. Too often, many scholars feel that facial beauty is subjective and culturally influenced,[11-18] and there are different facial beauty standards for different races, age, sex, etc. This type of thinking creates an impossible task of establishing a universal standard for ideal skeletal position, as well as a universal standard for ideal facial esthetics. As mentioned earlier, due to the ever-increasing incidence of mixed race marriages where the offsprings are multi-racial, using different esthetic standards depending on a particular race becomes extremely complicated. Today, there is an absolute need to establish a universal standard for facial beauty that applies to every human being on this planet. By ignoring superficial differences such as skin color, hair texture, etc. and by comparing unique characteristics that are common to the human face, a universal standard for ideal esthetics/facial-skeletal position can be established.

Facial beauty is directly related to Divine Proportion. Because Divine Proportion is universal, then it stands to reason that the standard for facial beauty can also be universal. The appreciation for beauty is also genetically controlled. The capacity to select and to seek out beauty is instinctive, and as Ricketts states, "This level of perception is not in the cognitive part of the brain, but is thought to be located within the subconscious or primitive portion of the brain referred to as the reptilian complex or the limbic system." This has enormous social implication. For example, in seeking out potential mates, all living creatures, including humans, seek out those that arouse the senses to an emotional level of pleasure. In other words, there is an instinctive drive to seek out mates that are ideally proportioned. In so doing, we subconsciously seek out mates that are maximally healthy and vigorous to insure survival for ourselves and our offsprings. Many researchers propose that sexual selection favors those facial and body traits that physically advertise their strength, high reproductive capacity, and resistance to micro and macro parasites.[28-30]

Many studies have shown the universality of facial beauty. For instance, there is a high degree of agreement among examiners when assessing facial attractiveness from photographs.[31-33] A number of recent cross-cultural researchers have shown that the bases for judging facial attractiveness were consistent across cultural lines.[34-41] They showed that racially and ethnically diverse faces possessed similar facial features that were deemed desirable and attractive, regardless of the racial and cultural background of the face being judged and regardless of the racial and cultural background of the perceiver.

Langlois et al,[42] Samuels & Ewy,[43] and Shapiro et al[44] were able to show that babies as young as three months can distinguish between attractive and unattractive faces. Because babies at this age are deemed too young to be substantially exposed to cultural standards of beauty, these studies indicate an innate ability of all human individuals to appreciate facial form and balance that have universal appeal. The attractiveness of the face has everything to do with facial balance and harmony, and nothing to do with race, age, sex, etc.

Figures 6, 7, and 8 show various types of facial profiles that can be found in the general population and in all parts of the world. If a poll were taken by the general population as to which facial profile would be considered the most attractive, the vast majority would select face F. As I lectured nationally and internationally on facial beauty, I would show these facial images on the screen and ask the course participants which face from A to F was the most attractive to them. Almost 100% of the time, they would select face F. This classic profile is universal and is not limited to any single race, age, or sex. Profile F is universally accepted as being the most beautiful. All orthodontic practitioners, plastic surgeons, orthognathic surgeons, and other healthcare professionals should strive to treat their patients to this universally accepted facial profile.

To emphasize the universality of facial beauty, please analyze Figure 9. The face to the left has universal appeal and would be universally accepted as being truly beautiful. What is amazing is that this face is not of a real individual but a computerized composite picture of four beautiful models which is shown to the right.

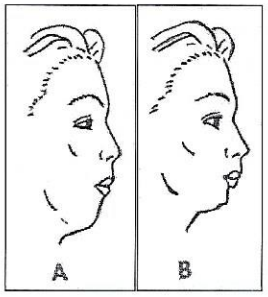

Figure 6

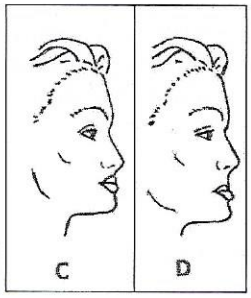

Figure 7

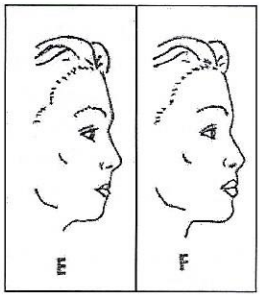

Figure 8

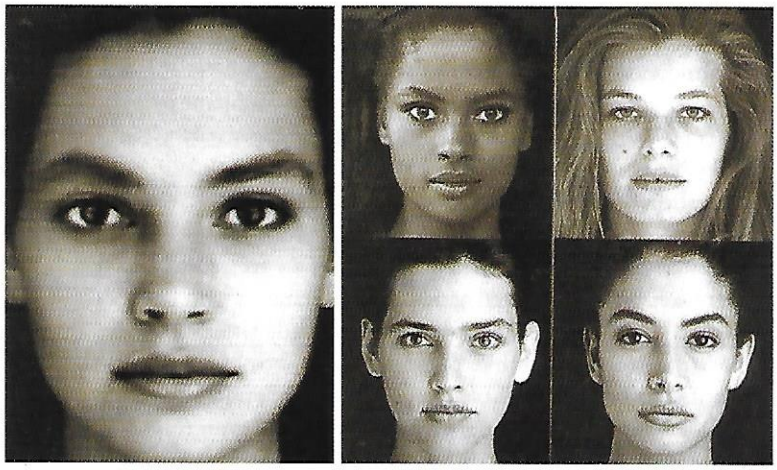

Figure 9: Left, ideal image of a beautiful face produced by Nancy Burson; software design by David Kramlich. Four facial images on right from top left to right, bottom left to right: Karen Alexander, Cordula Reyer, Lauren Lindberg, and Kara Young. Images by permission of *Vogue Magazine*.

The best features from these models from top left to right and bottom left to right, Karen Alexander, Cordula Reyer, Lauren Lindberg, and Kara Young were digitized and combined to create this "perfect face." If we were to disregard skin color as a factor entirely, it would appear that this computerized, "perfect" face shares many of the features seen on Karen Alexander, who is obviously a very beautiful, Black model. Figure 10 shows side-by-side comparison of model Karen Alexander (skin lightened by *Photoshop* and mirror-imaged) next to the computerized beautiful face image to highlight just how much these two faces look alike. By visually cross-referencing the computerized image of the beautiful face to the four models, we can see that all beautiful faces share common features.

Finally, there are no other illustrations that can dramatize the universality of facial beauty better than the pictures shown in Figure 11. These pictures basically illustrate four beautiful faces representing each of the major racial types. The picture on the top left is that of a beautiful Black woman. The one on the top right is that of a beautiful Asian woman, and the one on the bottom left is that of a beautiful Caucasian woman. In actuality, they are all pictures of the same woman which is the one on the bottom right. The shape, size, configuration, and proportion of the four faces are exactly the same; the only difference is the makeup/skin color and the wigs.

This illustration clearly supports what was stated earlier. When the gross anatomy of the human head and face is analyzed, surface distinction of skin color, hair, and facial features, etc. have nothing to do with the basic biology of human differences. Compared to the common genetic thread that binds all human beings to one another, any physical differences are so insignificant that they are almost non-existent. In my lectures, I have always stressed that there is only one race on this planet, and that is the "human race."

TMJ Health and Physiologic Harmony

The position of underlying bone has a direct effect on the health of TM joints and physiologic harmony. See Figure 12. Patients who have long faces tend to have upper airway obstructions and temporomandibular disorder.[45-47] Patients who have short faces tend to have severe myofascial pain and temporomandibular disorder.[48-50] Patients who have normal facial proportion (and profile) tend to have very little problems in the way of TMD and physiologic problems. These observations support the various biologic laws discussed earlier, such as conservation of energy and conservation of tissue.

Fonder[51,52] described many physiologic and TMD benefits to patients when the facial-skeletal structures are treated to their proper positions. He showed actual cases of patients who had scoliosis. Once facialskeletal correction was made either through orthodontic treatment or bite plane appliance, he observed significant straightening of the spinal column. He noted other physiologic benefits including alleviation of TMD symptoms, improvement of respiratory disorders and allergic symptoms, increased hearing acuity, and improvement in skin disorders and rashes. He, along with Olsen et al,[53] found that women who had craniomandibular dysfunction (TMD) had significantly more premenstrual complaints and other gynecological problems, such as premenstrual syndrome and infertility. Smith[54] supported

Figure 10: Left image Karen Alexander photoshopped, right image composite computerize face of the four beautiful models.

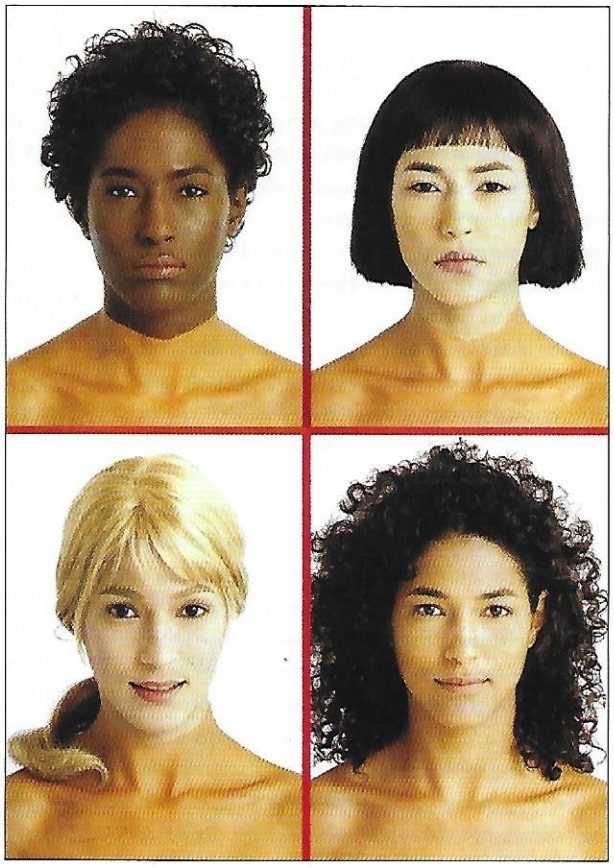

Figure 11: These pictures illustrate beautiful faces representing the major racial types. Illustration from *New Woman Magazine*. Makeup by Paddy Crofton. Images by permission of Todd Eberle, Photographer.

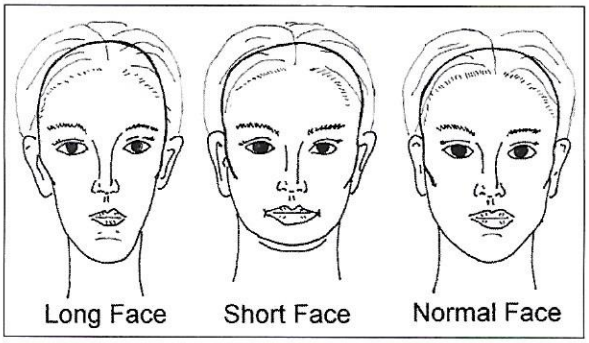

Figure 12

many of Fonder's findings. Even more fascinating, Fonder cited the case of a 12-year-old male patient who had mental retardation, grand mal seizures, and severe head forward posture. He had been diagnosed as microcephalic with the epicranius not fully developed. His mandibular position and vertical was corrected initially with a TMD splint and later with bonded pivotal bilateral molar buildup. The treatment results were dramatic. His posture improved and his seizures decreased significantly in number and duration. There was also elimination of chronic fatigue syndrome, improvement of mental acuity and memory, better respiration, and a lessening of depression.

Marasa and Ham[55] and Loudon[56] cited improvement in otitis media in children by increasing skeletally short verticals via primary molar buildups. Jefferson[57] cited improvement of TMD symptoms and other physiologic problems when skeletally short and/ or retrognathic mandibles were moved to the physiologically correct position either through orthodontic/ orthopedic therapy or through orthotic appliance therapy. Conversely, moving the mandible to the incorrect position can augment TMD symptoms and cause other physiologic problems. Kahnberg[58] studied 13 patients who underwent maxillary osteotomy with superior repositioning of the maxilla for correction of open-bite deformity and maxillary excess. Sixty percent of these patients developed TMD symptoms.

The cranio-mandibular structure has a tremendous impact on the total health of the human body. As explained in Fonder's text[52] where many of the references were cited, it is because the jaws and the dental structures (except tooth enamel) are formed from the neural crest cells along with the endocrine system, while the central nervous system is formed from the neural tube.[59] The entire nervous system, the endocrine system, and the dental system are formed from these embryonic cells.[60] Since the jaw and the nerves have common tissue origin, there appears to be a strong structural and physiological connection. The oral cavity and the cranio-mandibular complex are highly innervated and have strong proprioceptive mechanisms. Any hard tissue malignment and impingement has the potential to send messages to the brain, which in turn, will cause the body to respond - even in an unhealthy manner.

Along with the cranio-mandibular's close association with the nervous system, it is my opinion that faces that do not conform to ideal biologic proportions create biomechanical problems within the architectural framework of the craniofacial structure. This can create what I call hard tissue impingement of vital biologic functions. That is why patients with long face syndrome tend to have nasal airway obstruction because the hard tissues of the sinus cavities are narrow and compressed. That is why patients with short face syndrome, who usually have compressed TM joints, tend to suffer from severe and chronic migraine headaches because the hard tissues of the head of the condyles tend to press up against the glenoid fossa. This may impinge on vital structures such as the auriculotemporal nerve and the superficial temporal artery which can create pain symptoms.

There are many other examples of hard tissue impingement due to facial-skeletal disharmony that can create physiologic problems. Patients with retrognathic mandibles tend to have head-forward posture. Head-forward posture is not natural, but for some individuals with retrognathic mandibles, it is a survival mechanism. This head-forward position helps to alleviate the posteriorly displaced mandible from compressing the trachea which can obstruct airflow. However, the weight of the head in head-forward posture places tremendous strain on the spine and muscles of the neck and shoulders which can cause neck, shoulder, and back pain. Furthermore, posterior cross bites and uneven mandibular planes of occlusion tend to cause lateral bending of the spinal column.[61-63] This explains why Fonder noted improvement of scoliosis with bite plane therapy. I have termed the mandible as a "biologic gyroscope" with many neurological pathways influencing head position.

The importance of correct facial-skeletal position has been expounded by other researchers. Stoll[64] stated, "Correct posture of the mandible is a prerequisite for good body mechanics and physical fitness. It is acknowledged that good posture statically and dynamically is essential for health and conservation of energy, and the first prerequisite for it is alignment of all the skeletal parts in harmony with gravity and balance."

Cephalometric Analysis of Choice

An appropriate cephalometric analysis can help in the assessment of facial-skeletal disharmony. There are many analyses that can be used, some better than others. For instance, Downs[65] used angle of convexity for the maxilla and facial angle for the mandible in determining their skeletal position. Steiner[66] used the SNA angle for the maxilla and SNB for the mandible in their positional determination. Using linear measurements, Koski[67] used Op-Pr for the maxilla and Op-Id for the mandible and compared them to OP-ANS to determine their A-P position. McNamara,[68] in conjunction with soft tissue evaluation, measured the distance of A-point for the maxilla and pogonion for the mandible from nasion perpendicular to assess their A-P relationship to the cranium. These analyses are helpful, but most do not give all of the information necessary to help make an accurate skeletal diagnosis. Furthermore, most are based on sets of ideals determined by group samples and not based on ideal biologic proportion.

To diagnose proper facial-skeletal relationship accurately, the analysis must assess the anterior-posterior position of the maxilla and the mandible based on the cranial base as well as the vertical relationship of the mandible to the cranial base. McNamara's cephalometric analysis is very good in satisfying these requirements. It references off the nasion perpendicular as its cranial base, and it does assess lower facial vertical height. The one negative is that it has different sets of norms depending on age and sex of the patients. Ideally, a cephalometric analysis should be:

1. *Easy to trace* - should have minimal number of landmarks
2. *Easy to diagnose* - should provide visual comparison of patients to the ideal norm and not columns of angular and linear measurements
3. *Efficient* - should not take more than ten minutes to trace and diagnose
4. *Universal* - norm should apply to all individuals, regardless of race, sex, age, etc.
5. *Accurate*
6. *Based on biologic proportion* - should assess skeletal disharmony based on the divine proportion

The cephalometric analysis of choice, in my opinion, is the Jefferson Archial Analysis. The tracing technique and the interpretation of this analysis is fully detailed in the March, 1990 issue of the *Journal of General Orthodontics* (this analysis was then called the Modified Sassouni Analysis).[69] This analysis evolved from the great works of Sassouni[70,71] and Beistle.[72,73] There are two major modifications that differentiates Jefferson from Sassouni analysis. First, Jefferson analysis uses the cranial plane instead of Sassouni's parallel plane. Because the parallel plane in the Sassouni analysis is complicated to describe and to extrapolate, I have replaced it with a plane that I discovered which I call the "cranial plane." The second major modification or changes is that Jefferson analysis only uses three reference arcs: the anterior arc, the age-4 arc, and the age 18-arc, whereas Sassouni analysis uses many reference arcs and many other measurements. The Jefferson Archial Analysis is easy to trace and diagnose, efficient, universal, accurate, and based on the Divine Proportion. It takes less than 5 minutes to trace and diagnose. Much of the following landmarks and tracing techniques were borrowed from Beistle's article.[72]

Landmarks for this analysis are very similar to the Steiner analysis. However, there are few additional landmarks. See Figure 13. They include:

1. Roof of orbit
2. Lateral wall of orbit
3. Posterior nasal spine (PNS)

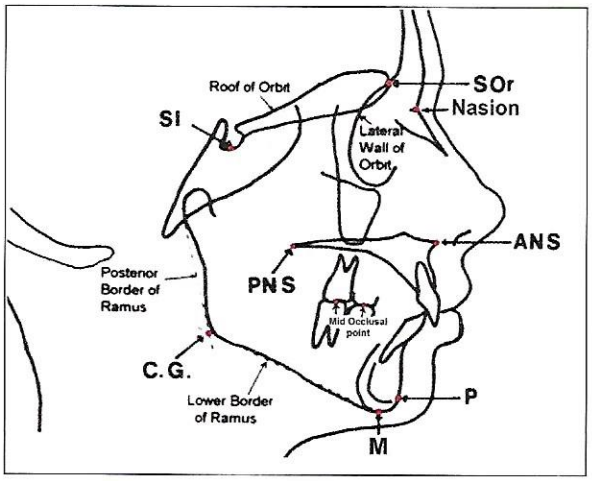

Figure 13: Sassouni points

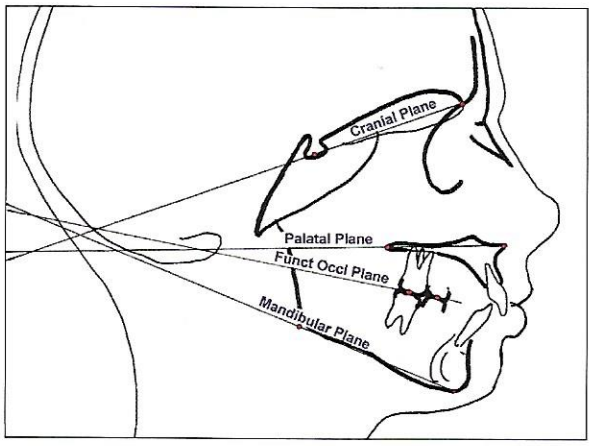

Figure 14: Four major planes

Once all the anatomic landmarks are drawn, important Sassouni points should be plotted. Refer to Figure 13. These points are defined as:

1. SOr (supraorbitale): Most anterior point of the intersection of the shadow of roof of orbit and its lateral contour
2. SI (sella inferior): Lower-most point on the internal contour of the sella tursica
3. ANS (anterior nasal spine): Anterior tip of premaxilla on midsagittal plane
4. PNS (posterior nasal spine): Most posterior point on the contour of the maxillary bony plate
5. M (Menton): Most inferior border of the boney chin
6. C.G. (constructed gonion): The intersection of two lines, of which one line is drawn from articulare and runs tangent to the posterior border of ramus, and the other line is drawn from menton and runs tangent to the lower border of corpus. This point is usually a few millimeters distal and inferior to actual gonion.
7. Mid-Occlusal point of upper and lower first molars
8. Mid-Occlusal point of upper and lower 2nd Bicuspids or 2nd deciduous molars

Once the Sassouni points are determined, the four major planes of the face should be established. Refer to Figure 14. In the Jefferson Archial Analysis, Sassouni's parallel plane will be replaced with the cranial plane which is easier to extrapolate and trace. The four planes crucial to this analysis are cranial plane, palatal plane, functional occlusal plane, and the mandibular plane.

The fours facial planes are drawn by connecting two points as follows:

1. Cranial plane: Line drawn from SOr to SI and extended posteriorly
2. Palatal plane: Line drawn from ANS to PNS and extended posteriorly
3. Functional occlusal plane: Line drawn from Mid-occlusal points of the upper and lower 2nd Bicuspids/2nd deciduous molars to Mid-occlusal points of the upper and lower 1st molars
4. Mandibular plane: Line drawn from menton running tangent to the lower border of corpus and passing through constructed gonion

When the four major planes are established, draw and extend these four lines posteriorly. The appearance of these planes should be such that they converge toward an area where the four major planes are most concentrated, and then they begin to diverge. Crucial to the Jefferson Archial Analysis is the ability to locate Center "O." Refer to Figure 15. Center "O" is shown and labeled. In this tracing, the four planes almost converge to a point; in most cases, the four planes to Center "O" will not converge quite so tightly together.

To determine Center "O," view the 4 major planes. The four planes are the widest apart near the front of the face, but as the planes move toward the back of the head, they begin to converge tightly. These four planes rarely converge to a single point, but they converge where they all seem to come closer together. Then they start to diverge and start to get wider apart. Locate the convergence where the superior most plane and the inferior most plane are the shortest distance. Draw a vertical line

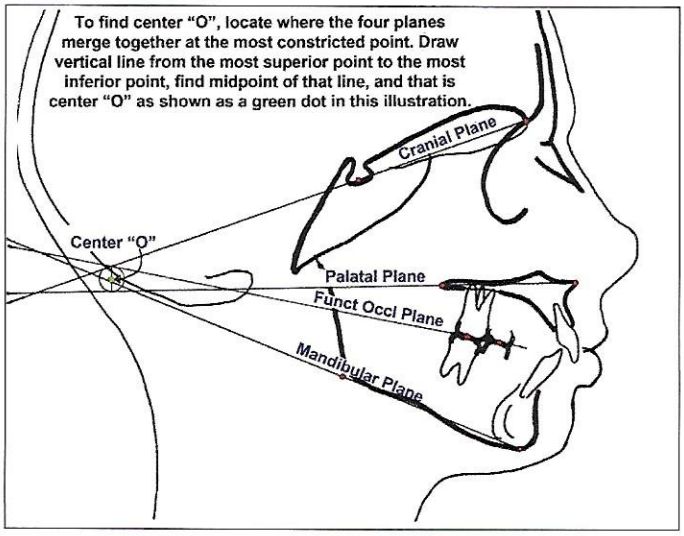

Figure 15: Center "O"

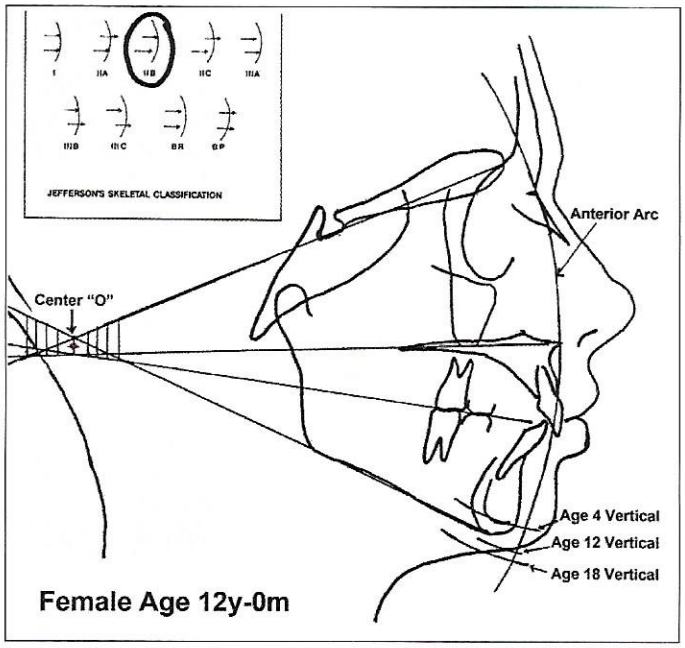

Figure 16: Female patient, 12 years-old

perpendicular to the floor. If series of vertical lines are drawn closer to the face from the uppermost plane to the lowermost plane, the vertical lines would get shorter and shorter as it moves towards the convergent area, then when it moves past the convergent area, the vertical lines get increasingly longer. You are looking for the shortest line from the uppermost plane to the lowermost plane. Locate the midpoint of that shortest line, and that is center "O." In most patients, the planes usually converge toward an area about the size of a dime. Once Center "O" is established, an anterior arc is drawn from center "O" with a compass.

Although the Sassouni Archial Analysis uses many arcs of reference as well as many other dental measurements, the Jefferson Archial Analysis uses only three arcs of reference which are the most crucial in assessing facial-skeletal disharmony. Again, in the Jefferson analysis, they are the anterior arc, age-4 vertical arc, and the age-18 vertical arc. The anterior arc assesses the anterior-posterior position of the maxilla and the mandible. The age-4 vertical arc assesses the lower vertical height of the mandible at age 4, and the age-18 vertical arc assesses the lower vertical height of the mandible at age 18 and older.

To establish the anterior arc, place the metal point of the compass on Center "O" and place the marking point of the compass on N (nasion). Draw an arc from nasion down past the soft tissue of the chin. To establish the vertical arcs, take the metal point of the compass and place it on ANS (anterior nasal spine) and place the marking point of the compass on SOr (supraorbitale). Rotate the compass down toward the menton area and strike a small arc. This will be the age-4 vertical arc. Now increase the compass by 10mm using a millimeter ruler and strike another short arc. This will be the age-18 vertical arc.

Interpretation of the Jefferson Archial Analysis is very simple. In ideal anterior-posterior skeletal position, ANS of the maxilla and pogonion of the mandible should be within 2mm of the anterior arc. In so doing, both the maxilla and the mandible are in correct relationship to each other, but more importantly, they are in correct relationship to the cranial base. In ideal lower facial vertical height position, menton should be on the age-4 vertical arc when patients are four years old. Menton should be on the age-18 vertical arc when patients are 18 years old or older. From age four, the lower face grows downward at the rate of .75mm (3/4mm) per year until age eighteen. The menton stops growing downward by age 18. It is conceivable that by using this calculation, we can determine the correct lower facial vertical of our patient almost to the millimeter.

In the tracing of an actual female patient who was exactly 12 years old in Figure 16, it can be seen that her ANS is exactly on the anterior arc which is ideal. However, her pogonion sits behind the anterior arc and is clearly retrognathic. In the vertical assessment, her menton is just a little longer than the age-4 vertical arc, but is not long enough to reach age 12 vertical. The age-12 vertical was determined by subtracting age 4 from age 12 which equaled eight. Eight years times .75mm equaled 6mm. Hence, there should be 6mm of growth in 8 years from the age-4 vertical arc.

Based on the Skeletal Archial Analysis, this 12 year old patient has a normal maxillary position. However, her mandible is retrognathic, and she is skeletally short as assessed from Age-12 vertical. In viewing her soft tissue profile, it did not appear to be that unattractive. However, she did suffer from TMD and headaches which necessitated treatment. Treating this patient to ideal proportion will enhance her facial profile, alleviate potential TMD problems and physiologic problems. Jefferson analysis shows that her mandible should be repositioned forward closer to the anterior arc, and the lower facial height should be lengthened closer to her age-12 vertical. In the proposed skeletal classification system which will be explained later, her skeletal classification is Skeletal Type IIB, Short.

For those who would like to view a YouTube video instruction on how to do the Jefferson cephalometric analysis by this author, go to any search engine, and at the address bar, type: Video instruction Jefferson Ceph Analysis.

Skeletal Classification System

The Jefferson Archial Analysis is accurate and helpful in assessing facial-skeletal disharmony. This is based on hundreds of cephalometric tracings, diagnoses, and treatments rendered in my office for over 30 years. Several major orthodontic lecturers are teaching this analysis nationally and internationally. A Few foreign orthodontic students received their orthodontic specialty degrees using this analysis as their orthodontic thesis, and I was informed that their professors spoke highly of it. Even so, any cephalometric analysis, including this one, should be viewed as one of many diagnostic evaluations to be used in assessing specific treatment modalities for individual treatment. First and foremost, the treating doctors must assess their patients' soft tissue, both in frontal and profile view, to make their final diagnosis. Jefferson Archial Analysis should be used to confirm their soft tissue assessments. Because it is appropriate and easy to use, the proposed skeletal classification system will be based on the Jefferson analysis.

The nomenclature for the proposed skeletal classification of malposition will be somewhat analogous to Angle's dental classification of malocclusion. Dr. Angle so clearly defined and illustrated ideal dental occlusion as well as various types of malocclusion with his publication that his concept has become firmly entrenched in the minds of all orthodontic practitioners even to this day.[2] His observations have been accurate and have withstood the test of time. More importantly, it is universally accepted because it applies to all individuals, regardless of race, age, sex, and other variabilities.

Similar to Angle's dental classification of Class I, II, and Ill, the skeletal classification will be designated Type I, II, and Ill. However, because the maxillary and the mandibular position will be in relation to the cranial base, maxillary malposition will be designated **A**, mandibular malposition will be designated **B**, and a combination of maxillary and mandibular malposition will be designated **C**. Additionally, if the maxilla and the mandible are both malpositioned behind the anterior arc, the skeletal nomenclature will be bi-skeletal retrognathic or **BR**. If both the maxilla and the mandible are both malpositioned in front of the anterior arc, the skeletal nomenclature will be bi-skeletal prognathic or **BP**.

In order to understand how the Jefferson Archial Analysis is used in determining patients' skeletal classification, a skeletal diagram is shown in Figure 17. The curved vertical arc in front of the two arrows represents the anterior arc of the Skeletal Archial Analysis. The top arrow, designated **A**, represents the maxilla. The lower arrow, designated **B**, represents the mandible. The tip of the arrow point A represents ANS, and the tip of the arrow point B represents pogonion. Since both arrow points are touching the curved vertical arc, this skeletal diagram indicates that this patient has ideal maxillary and mandibular A-P position. If the vertical assessment of this patient was found to be normal, then this patient's skeletal classification would be **Skeletal Type I, Normal**.

As practitioners become more proficient in using the Jefferson Archial Analysis, they will begin to see myriads of facial-skeletal problems that they may not have been aware of previously. Most practitioners currently do not see certain types of facial-skeletal disharmony because most analyses are mainly concerned with upper jaw-lower jaw relationship but do not adequately address the maxillary and mandibular relationship to the cranial base. The Wits analysis is an excellent method of assessing A-P relationship of the maxilla and the mandible to each other but does not assess their position relative to the cranial base.[74,75] Why is the assessment of the maxilla and the mandible relative to the cranial base so important? Because it has tremendous impact on the patients' facial esthetics, TMJ health, upper airway respiration, and physiologic harmony. All this really goes back to the basic understanding of the Divine Proportion.

The skeletal diagram as shown in Figure 18 shows the various types of skeletal malposition that may be found in the general population. Skeletal Type I is ideal maxillary and mandibular skeletal position. Not only are the maxilla and the mandible perfectly related to each other with respect to A-P position, they are also perfectly related to the cranial base.

Skeletal Type IIA is defined as the maxilla being prognathic to the cranial base and the mandible as being in normal A-P position to the cranial base. Type IIB is defined as the maxilla being in normal A-P position and the mandible as being retrognathic, Type IIC is defined as the maxilla being prognathic and the mandible being retrognathic; it is a combined problem.

Skeletal Type **BR** (bi-skeletal retrognathic) is defined as both the maxilla and the mandible being retrognathic to the cranial base. Skeletal Type **BP** (bi-skeletal prognathic) is defined as both the maxilla and the mandible being prognathic to the cranial base. The various types of skeletal malposition with their designated nomenclature are clearly illustrated in the skeletal diagram of malpositions. Dr. Derek Mahony, is a renowned

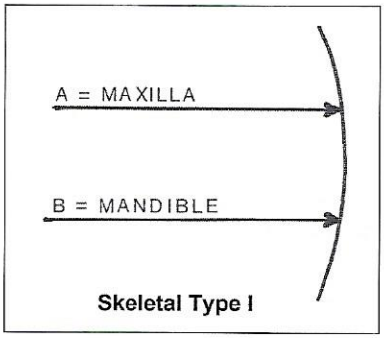

Figure 17: Skeletal diagram showing Skeletal Type I

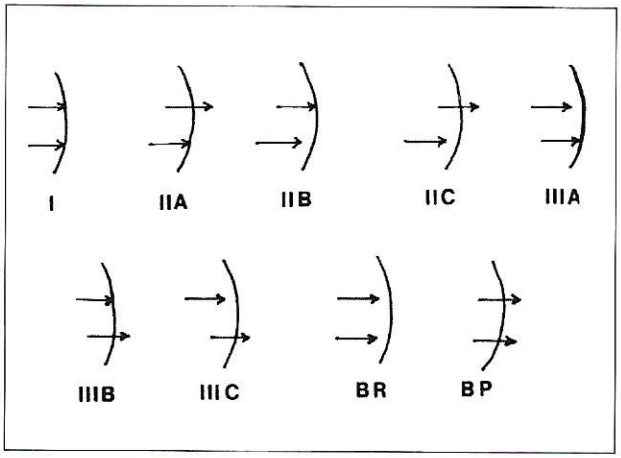

Figure 18: Skeletal diagram showing various types of malpositions

orthodontist and educator from Sydney, Australia. He lectures world-wide, and insists that his course participants learn the Jefferson Archial analysis. In his practice, he has diagnosed many patients who are bi-skeletal retrognathic, as well as Skeletal Type I, II, or IIIs. In such cases, he gives a primary and secondary skeletal classifications. Therefore, if a patient is BP as well as IIB short, his skeletal diagnosis for this patient is Primary: Skeletal Type BP; Secondary: Skeletal II, B Short.

Although the skeletal nomenclature and diagram refers to anterior-posterior relationship of the maxilla and the mandible to the cranial base, **it must be emphasized that the vertical position of the mandible must also be assessed and identified.** Just as maxillary and mandibular A-P malposition can create esthetic and physiologic problems, vertical malpositions can also create enormous esthetic and physiologic problems as well. The following example is given to show how to assign the correct skeletal classification nomenclature. If the Jefferson Archial Analysis shows that the maxilla is in normal position, the mandible is retrognathic, and the lower facial vertical height is short as shown previously in Figure 16, then the correct skeletal classification is **Skeletal Type IIB, Short.** If on the other hand, this analysis showed that the lower facial vertical was long, then the correct skeletal classification is **Skeletal Type IIB, Long**. If the vertical is normal, then it is designated **Skeletal Type IIB, Normal**. Skeletal Verticals can be normal, long or short in Skeletal Type I, II's, III's, BR, and BP

Practical Application of Skeletal Classification System

Many studies and articles have attempted to describe ideal facial esthetics. Broadbent,[76] Peck and Peck, [77] Burnstone, [78] Bowbeer,[79] and Mew,[80]for example, have published on this very important topic. Many have stressed the importance of visual soft tissue assessment for facial esthetics. However, Peck and Peck[77] state that cultural biases can create aberrant esthetic preferences. For example, they warn that "if all of us began practicing indiscriminate extractions on all patients, surely we would soon perceive a new 'beauty' in the 'dished-in' profile." Fortunately, Ricketts stated that we are all endowed with the innate ability to appreciate faces and forms that must satisfy strict criteria of ideal balance and harmony. In a universal setting, this will always take precedent over any fad or cultural bias. One of the treatment objectives of orthodontic/ orthopedic therapy is to treat patients toward improved facial appearance. In order to accomplish this, practitioners must be able to assess accurately facial-skeletal disharmony and to understand ideal facial-skeletal position.

The position of the facial-skeletal structures has a tremendous impact on the ultimate appearance of the face and on the physiologic harmony of the patient. The ultimate goal of the orthodontic/orthopedic practitioner is to treat patients toward ideal facial-skeletal position which will maximize facial esthetics and physiologic harmony. The Jefferson Archial Analysis with its corresponding skeletal classification system is an excellent method to aid in the assessment of skeletal malposition. It clearly directs where the skeletal problem lies, whether it is in the maxilla, mandible, or both. Additionally, it will tell you if the maxilla and/or the mandible is too far back or too far forward relative to the cranial base, or if the lower facial height is normal, too short, or too long. There appears to be no other analysis to date that can give you this much information so quickly and so accurately. More importantly, this analysis is based on ideal biologic proportion which is directly related to the Divine Proportion. A few doctors have asked me, "How do you know that your ceph analysis treat to the Divine Proportion?" Good question. My first answer is if the face has become more beautiful post-orthodontic treatment after using the information from the Jefferson Analysis, then the face has moved more toward Divine Proportion. The second answer is to just measure certain key facial anatomic points pre-treatment and post-treatment and see if those points move towards the Divine Proportion. For instance, measuring the width of the face, cheek-to-cheek, and the length of the face from top of the head to the bottom of the chin.

No matter what the skeletal malposition may be, the ultimate goal of the practitioner is to treat the patient as close to Skeletal Type I, normal vertical as possible. To illustrate clearly the practicality of the Jefferson Archial Analysis and the proposed skeletal classification system, several case reports will be presented. The first case report will show a patient with ideal facial esthetics and profile. The other case reports will show various types of skeletal malpositions.

Case report #1, Figures 19 and 20, show what I felt had nearly all the criteria for an ideal face. By clearly illustrating ideal facial form and profile, I offer a visual model that can be used as reference. See Figure 19. Furthermore, by showing actual cephalometric tracing, it can be seen that the Jefferson Archial Analysis accurately reflects the soft tissue profile. See Figure 20. This analysis clearly shows that this 21 year-old patient's maxilla and mandible are in ideal A-P and vertical position. By developing toward these ideal positions, this patient has achieved maximum facial esthetics and physiologic harmony. Her skeletal classification is Skeletal Type I, Normal. The description of assessing facial esthetics using the Skeletal Archial Analysis is explained in greater detail in a previous publication by this author. [81]

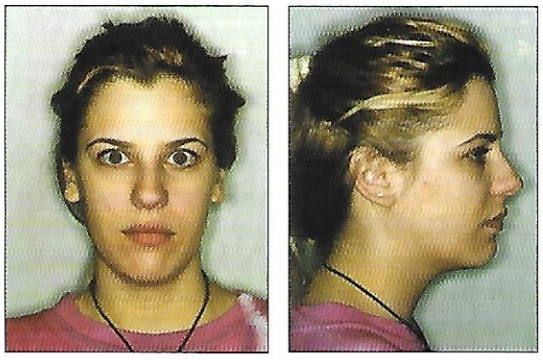

Figure 19: Ideal facial form and profile

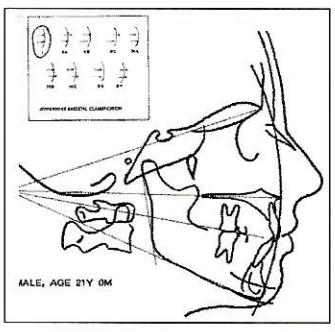

Figure 20: Ideal facial form and profile

Case Report #2. Figures 21 and 22, show an adult patient with short face syndrome. As can be seen in Figure 21, a patient with short face syndrome does not have ideal facial proportion and balance which can have a negative effect on facial esthetics. The Jefferson Archial Analysis in Figure 22 accurately reflects the skeletal position of this adult female patient. Her A-P position of the maxilla is normal. However, this patient's mandible is over-closed by approximately 19mm. The counter-clockwise rotation of her mandible due to her overclosure causes her mandible to jut forward ahead of the anterior arc. Her skeletal classification is Pseudo Skeletal Type IIIB, Short. This is a Pseudo Type Ill situation because if she were treated to her correct vertical, her mandible would rotate clockwise to a more normal Skeletal Type I position. This patient suffered from severe TMD and other physiologic problems.

Figure 21: Facial form: short face syndrome

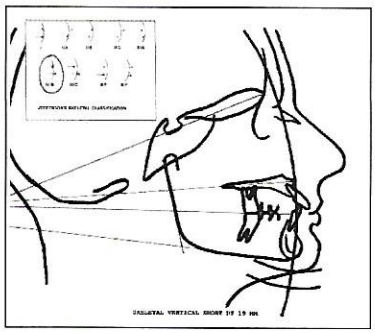

Figure 22: Skeletal Archial Analysis showing Pseudo Skeletal Type IIIB, Short

Case Report #3, Figures 23 and 24, show a female patient, age 16 years-7 months, with long face syndrome. As can be seen in Figure 23, a patient with long face syndrome does not have ideal facial proportion and balance which can negatively affect facial esthetics. The Jefferson Archial Analysis in Figure 24 accurately reflects her soft tissue profile. The A-P relationship of her maxilla is in normal position. However, her mandible juts forward ahead of the anterior arc, and it also extends below the age-18 vertical arc. Her skeletal classification is Skeletal Type IIIB, Long. This patient suffers from severe nasal airway obstruction. Many clinicians and researchers have attributed mouth breathing as the primary cause of long face syndrome.[82-87] Physiologic problems are associated with facial-skeletal disharmony. Case Reports #2 and #3 are prime examples of such direct correlations.

Figure 23: Facial form: Long face syndrome

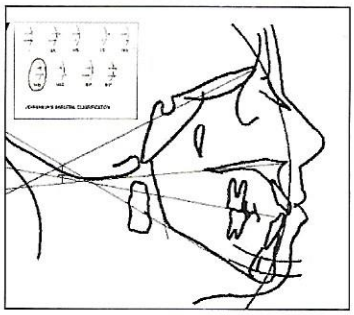

Figure 24: Skeletal Archial Analysis showing Skeletal Type 111B, Long

Case #4, Figures 25 and 26, show a female patient, age 13 years-1 month, with a short face syndrome. As can be seen in Figure 25, she does not have ideal facial proportion and balance. The Jefferson Archial Analysis in Figure 26 accurately reflects her soft tissue profile. Her maxilla is retrognathic, and her mandible is prognathic (due to her short vertical). This is a combination A-P problem. Her skeletal classification is Pseudo Skeletal Type IIIC, Short. Pseudo because if her mandible was lowered to proper vertical, pogonion would rotate in clockwise rotation to a more ideal A-P position. This patient suffered from constant and chronic headaches.

It is important to note that this patient is not a surgical case. This patient was treated with a bionator to increase her lower facial height. By skeletally increasing her vertical, her mandible rotated in a clockwise rotation which brought it closer to a Skeletal I relationship. The retrognathic maxilla was brought forward closer to ideal position with an anterior push sagittal.

Figure 25: Facial form: Short face syndrome

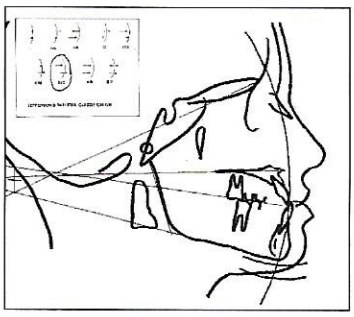

Figure 26: Skeletal Archial Analysis showing Skeletal Type IIIC, Short

Figure 27: Facial form: Short face syndrome

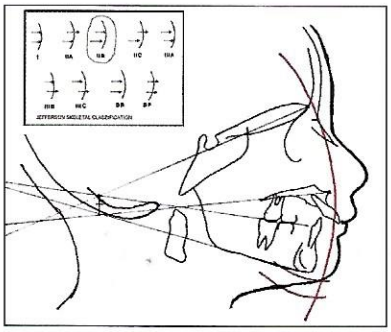

Figure 28: Skeletal Archial Analysis showing Skeletal Type IIB, Short

The treatment was finalized with straightwire fixed appliance therapy.

Case Report #5, Figures 27 and 28 show a female patient age 8 years-10 months. This patient's facial profile and balance are not ideal. Her Jefferson Archial Analysis, Figure 28, accurately reflects her soft tissue profile. Her maxilla is in an ideal A-P position; however, her mandible is significantly retrognathic, and she is skeletally short. Her skeletal classification is **Skeletal Type IIB Short**. A patient with this type of facial-skeletal disharmony has an almost 100 percent chance of developing temporomandibular disorder. Repositioning her mandible in a more ideal position via functional appliance therapy would offer this patient tremendous benefits in esthetics, TMJ health, and physiologic harmony.

Discussion

Much of what has been said may sound theoretical and may even go against ideas and philosophies that were taught in dental schools. However, they are based on years of clinical observations which seem to support the universality of facial beauty and Divine Proportion. The concept of a universal standard for facial beauty evolved when it became apparent that all my orthodontic patients regardless of race, age, sex, and other variabilities were being treated toward the same universal classic profile, and they were very pleased with the treatment results.

Cephalometric analysis is helpful in assessing facial-skeletal malpositions. However, analyses such as Tweed, Downs, and Steiner concentrated too much on assessing dental problems and not enough on facial-skeletal problems. Furthermore, they often had different values for different segments of the population. These disadvantages ultimately led me to the Sassouni Archial Analysis.

The Sassouni Archial Analysis, published in the 1950s, was ahead of its time. It assessed facial-skeletal malpositions at a time when our profession did very little skeletal corrections. However, it became complicated and confusing to use when it also attempted to assess dental problems as well. Eventually, I developed a much simpler and much more streamlined version of this analysis, the Jefferson Archial Analysis, to specifically assess skeletal problems and to help determine the skeletal classification.

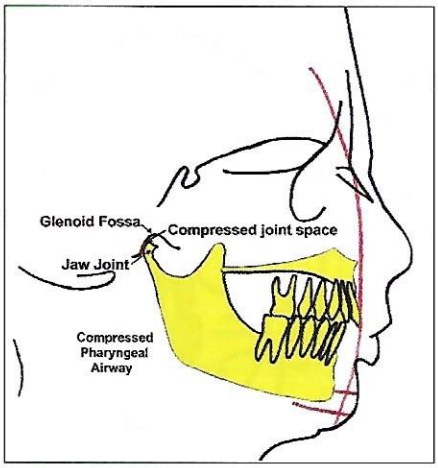

Figure 29: Compression of TMJ space

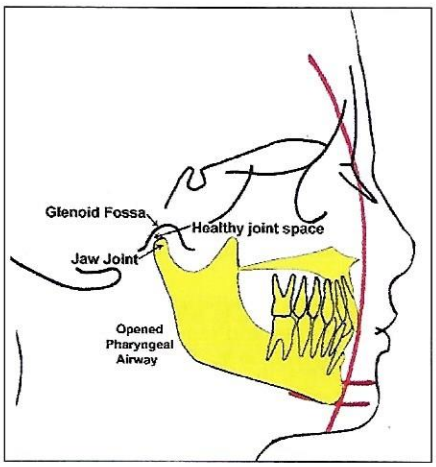

Figure 30: Healthy TMJ space

Cephalometric analysis as well as soft tissue assessment, TMJ evaluation, upper airway evaluation, and physiologic consideration should be used to obtain accurate diagnosis. By treating patients to the correct facial-skeletal position based on these criteria, there will occur a beneficial "domino effect" in over 90 per cent of the cases. The first benefit is improved facial and dental esthetics; this is followed by alleviation of any TMD symptoms and upper airway obstruction, and other medical problems.

As stated previously, patients with short face syndrome and/or retrognathic mandibles seem to have higher incidence of TMD. By increasing lower facial height which enhances facial esthetics, the joint spaces increase to a healthier position, and symptoms of migraine headaches often improve. Figure 29 shows how short faces and/or retrognathic mandibles compress the TMD joints. Retrognathic mandible also tend to compress the pharyngeal airways causing potential sleep apnea. Figure 30 shows by treating the patient to ideal maxillary and mandibular position, TM joint spaces open to a more healthier joint space, and the pharyngeal airways open alleviating potential for sleep apnea.

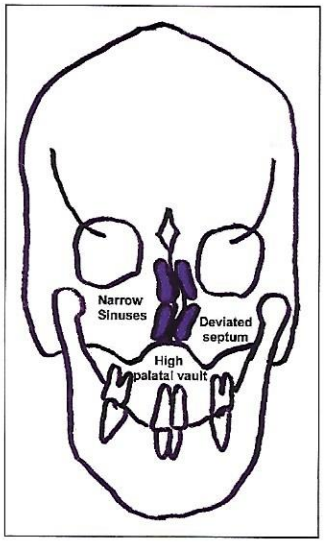

Figure 31

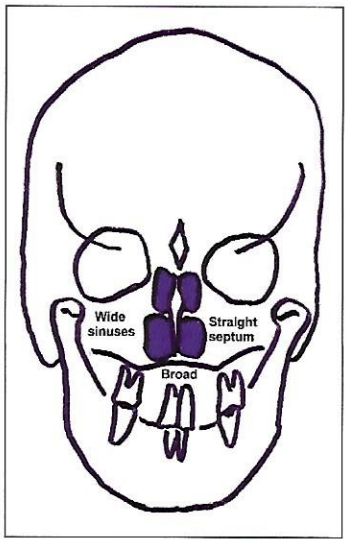

Figure 32

Although the Jefferson Archial analysis and the Skeletal Classification system assess sagittal or lateral view of the cephalometric radiographs, it is important to discuss the frontal facial abnormalities.

Patients with long face syndrome and narrow faces seem to suffer from nasal airway obstruction and tend to be mouth breathers. Hershey, Stewart and Warren,[88] Turbeyfill, [89] and Hartgerink et al,[90] found that by expanding the palate which widens the sinuses, nasal respiration often improves. Figure 31 shows how individuals with long, narrow, faces tend to have narrow sinuses as well as deviated septum due to high palatal vaults which in combination impede nasal respiration. Figure 32 shows how expanding the palate with expansion appliances can widen the sinuses lowers the palatal vault and helps to straighten the nasal septum which in combination help to increase nasal respiration.

Previously, I mentioned how functional appliance therapy can alleviate ADD/hyperactivity, increase IQs, increase academic performance, and maximize growth and development. Many of these medical issues are directly or indirectly related to sleep disorder or sleep deprivation. There are many studies to show that sleep disorders have a negative impact on academic performance, growth and development, and other physical, emotional, and psychological problems.[91-95] One of the most exciting recent discoveries is the correlation between sleep disorder and ADD/hyperactivity. Many studies show that poor sleep causes or augments ADD/hyperactivity.[96-100] Armed with this knowledge, this author treated a 5 year-old male child who was failing in every subjects and had severe behavior problems in school. He had swollen tonsils and adenoids which were surgically removed and had his narrow palate expanded with a Schwarz appliance. Just these two treatments alone had a tremendous positive impact on his ability to breathe through his nose, which enabled him to sleep normally. His academics and behavior improved dramatically. He not only was a straight "A" student, he was placed in the gifted program in school.[101]

By treating to the Jefferson Analysis, and positioning the maxilla and the mandible to their proper A-P position, as well as expanding the palate to their proper width, the orthodontic practitioner will maximize and enhance their patients' upper airway respiration. Proper upper airway respiration is key to normal sleep and overall health and well-being. Finally, the skeletal classification system evolved out of necessity to describe the multitude of facial-skeletal problems that were becoming evident while using the Jefferson Archial Analysis. In some cases, new problems never previously described such as Skeletal Type IIIC, Short, were being manifested. The beauty of both systems, the Jefferson Archial Analysis and the skeletal classification system, is the simplicity and ease by which they can be used. They indicate whether the skeletal A-P discrepancy is in the maxilla, mandible, or both. Just as important, they indicate whether there is a vertical problem.

The Jefferson Archial Analysis and the skeletal classification system do not provide information on maxillary and mandibular width and facial asymmetry. If desired, these two designations can be added to the skeletal classification system; for example, Skeletal Type IIB, Short, Narrow Mx, Asymmetry Left Mn. A patient with this skeletal classification would have a normal maxillary A-P position, a retrognathic mandible, skeletally short vertical, narrow maxilla, and facial asymmetry where the mandible shifts to the left. Frontal Assessments can also be added to the Jefferson Skeletal Classification. For example, Skeletal Type II B, long; Frontal facial Narrow. The ultimate treatment goal is to treat patients as close to Skeletal Type, normal vertical as possible.

Although diagnosis and treatment of skeletal problems are emphasized, the treatment of dental problems must also be addressed. In almost every instances, correction of skeletal problems helps to resolve many dental problems. A perfect example is dental crowding due to a constricted maxillary arch. Major crowding can be corrected with palatal expansion which creates room to allow the dentition to unfurl and to begin aligning more ideally. The balance of the dental problems can be corrected with fixed appliance therapy. Many other dental problems are more easily corrected when the skeletal problems are first corrected.

Summary

In random studies, some faces will deviate toward Type II skeletal and some toward Type Ill. Some will deviate toward a skeletally short vertical while some toward long. In their study, Langlois and Roggman[102] digitized individual faces through a computer. As more and more faces were entered, the cumulative composites of these faces became more and more attractive. From this, they concluded that attractive faces are only average. The "average" face may very well conform to the Divine Proportion. However, some faces are strikingly beautiful, and Alley and Cunningham[103]in their study attempted to explain these attributes.

Individuals who are blessed with attractive features are treated differently in our society. Ackerman[104] states, "Attractive people do better: in school, where they receive more help, better grades, and less punishment; at work, where they are rewarded with higher pay, more prestigious jobs, and faster promotions; in finding mates, where they tend to be in control of the relationship and make most of the decisions; and among strangers, who assume them to be more interesting,

honest, virtuous, and successful." Many would find this special treatment objectionable and unfair. The irony is that beautiful individuals make up a very small percentage of the population; they have very little power to dictate how society should act and behave.

Various disciplines have studied the nature of facial beauty. Individually, they provide partial answers; however, when viewed together, they begin to weave provocative insights as to its biologic significance.

It is intricately related to Divine Proportion, and all living creatures have the genetic potential to develop toward it. The appreciation for this proportion is primitive and inborn; it is a biologic mechanism by which all living creatures are attracted to potential mates who conform to this strict proportion because they are biologically strong, healthy, and fertile.

It was Sir Francis Bacon in 1597 who said, "Knowledge is power." I often wondered, what good is knowledge if we cannot put it to use. I feel, "the ability to use knowledge is the ultimate power." Many great and knowledgeable individuals have brought forth individual concepts of facial beauty, Divine Proportion, and various cephalometric analyses to assess dental and skeletal norms, etc. These concepts individually may be fascinating, but they are individual pieces of the biologic puzzles that in itself may not be too useful. However, put these individual concepts together, and the total picture becomes clearer and more useful. It is my hope, as the author of this paper, that in some small way, I have been able to put some of the pieces of the puzzles together and unravel the mystery of facial beauty and its effect on health. In so doing, we can do so much for our patients, for mankind, and for our entire planet.

To date, there is no other profession other than our dental profession that has the knowledge and the expertise to treat facial and dental abnormalities, non-surgically. We have a keen interest in facial and dental esthetics. We understand occlusion, TMJ anatomy, and facial-skeletal relationship to soft tissue profile. Unlike plastic surgery, where the soft tissues are superficially recontoured for better esthetics, we can make real and meaningful skeletal changes. We are able to correct the architectural framework of the face to its physiologically correct position. In so doing, we can not only improve our patients' appearance but improve their overall health.

There are those in our profession who are afraid of changes. They will not accept what has been presented with the usual excuse that they are "anecdotal" and not supported in the scientific world with rat and monkey studies. Although the concepts presented are complicated and controversial, I have attempted to present them clearly and simply with many references. A few of the concepts presented here are new information for which no studies or references are available to date. There will be those, however, who will stubbornly continue to disbelieve the efficacy of functional appliance and TMD therapy even though in the real world, there are thousands of successes with human patients using functional appliance therapy. In time, the truth will become self-evident.
Finally, it is not my intent to say that everyone should look alike. Superficial variations and differences appropriate to certain climatic conditions and other environmental factors are often necessary for the survival of the species. Additionally, in rare instances, some Skeletal Type II individuals have shorter mandibles than normal due to TM joint trauma or genetic abnormalities. Understand that most individuals with retrognathic mandibles have normal length mandibles; but due to poor occlusion, their mandibles are occluding in a retrognathic position. Many times, these individuals are erroneously diagnosed as having short mandibles or "weak chin." In these individuals, the mandible should be repositioned forward into ideal A-P position. Mandibular advancement surgery to lengthen the mandible in these patients is contraindicated. To surgically lengthen the mandible in individuals with normal length mandibles has the potential of creating TM joint compression when occluding post-surgery and cause TMD/pain/headaches, etc. However, individuals who actually have short mandibles need mandibular advancement surgery. To reposition these rare individuals with short mandibles forward closer to the anterior arc may create a "dual" bite situation. In other rare instances, Skeletal Type III individuals may have longer mandibles than normal. To reposition these mandibles posteriorly closer to the anterior arc may cause impingement of TMJ spaces and TMD.

As more and more information is gathered, it is becoming clear that the physical, emotional, and psychological health of our patients are intimately related to the facial-skeletal anatomy.

Individuals with facial disharmony are often ridiculed and ostracized. The damage to their self-image and self-worth can create an impenetrable barrier to their ultimate self-realization and self-fulfillment. [105] By correcting problems closely associated with the human psyche - the human face - we can help them achieve equal opportunities for health, happiness, and success. There can be no greater gift than this to bestow on another human being. Our greatest challenge today is having the courage to seek the truth, understanding the enormity of our professional capabilities, and being humbled by it. As John Ruskin once wrote, "The highest reward for man's toil is not what he gets for it but what he becomes by it."

References

1. Milacic M, Markovic M: A comparative occlusal and cephalometric study of dental and skeletal anteroposterior relationships. *Brit J of Orthod* 1983; 10: 53-54.
2. Angle, EH: Classification of malocclusion. *Dental Cosmos* 1899; 41:248-264.
3. Eirew, HL: An Orthodontic Challenge. Int. J of Ortho 1976; 14(4): 21-25.
4. Tweed, CH: The Frankfort mandibular plane angle. *Am J Orth and Oral Surg* 1946; 32: 175-230.
5. Margolis HI. A basic facial pattern and its application in clinical orthodontics application in clinical orthodontics, I. The Maxilla-facial Triangle. *Am J. of Ortho. and Oral Surg* 1947; 33: 631-641.
6. Reidel AA: An analysis of dentofacial relationships. *AJO* 1957; 43:103-117.
7. Goldman S: The variations in skeletal and denture patterns in excellent adult facial types. Angle Ortho 1959; 29(: 63-92.
8. Pertes AA: A review of vertical facial types and craniomandibular disorder. *NYS Dent J* 1959; 59(9): 570, 572, 575-8.
9. Chang H: Assessment of anteroposterior jaw relationship. *AJO* 1987; 92(2): 117-122.
10. Johnson EL. The Frankfort mandibular plane angle and the facial pattern. *AJO* 1960; 36: 516-533.
11. Lusterman EA: The esthetics of the occidental face: A study of dentofacial morphology based upon anthropologic criteria. *AJO* 1963 Nov; 49(11): 826-850.

12. Satravaha S,Schiegel KD: The significance of the integumentary profile. *AJO* 1987 Nov; 92(5): 422-426.
13. Park I, Bowman D, Klapper L.A: a cephalometric study of Korean adults. *AJO* 1989 July; 96(1): 54-59.
14. Love RJ, Murray JM, Mamandras AH: Facial growth in males 16 to 20 years of age. *Am J Orthod Dentofacial Orthop* 1990 Mrc; 97(3): 200-6.
15. Bishara SE, Abdella EM, Hoppens BJ: Cephalometric comparisons of dentofacial parameters between Egyptian and North American adolescents. *AJO* 1990 May; 97(5): 413-421.
16. Ben-Bassat Y, Dinte A, Brin I, Koyoumdjisky-Kaye E: Cephalometric pattern of Jewish East European adolescents with clinically acceptable occlusion. *AJO* 1992 Nov; 102(5): 443-448.
17. D'Aloisio D,Pangrazio-Kulbersh V: A comparative and correlational study of the cranial base in North American Blacks. *AJO* 1992 Nov; 102(5): 449-455.
18. Swierenga D, Oesterle LJ, Messersmith ML: Cephalometric values for adult Mexican-Americans. *AJO* 1994 Aug; 106(2): 146-155.
19. Huntley HE: *The divine proportion.* New York: Dover Publications, 1970.
20. Hambridge, J. *The elements of dynamic symmetry.* New York: Dover Publications, 1967.
21. Ghyka M: *The geometry of art and life.* New York: Dover Publications, New York, 1977.
22. Rickett RM: The biologic significance of the divine proportion and Fibonacci series. *AJO* 1982; 81(5): 351-370.
23. Thornhill R, Gangestad S: Human facial beauty: averageness, symmetry and parasite resistance. *Human Nature* 1993; 4: 237-269.
24. Leary RF & Allendorf FW: Fluctuating asymmetry as an indicator of stress: Implications for conservation biology. *Trends in Eco and Evol* 1989; 4: 214-217.
25. Valentine DW, Soule ME, Samollow P: *Fish Bull* (USA), 1973; 71: 357-370.
26. Scuilli PW, Doyle WJ, Kelly C, Siegel P & Siegel M.I: Am J Phys Anthropol 1079; 50: 279-284.
27. Mack MR: Vertical dimension: A dynamic concept based on facial form and oropharyngeal function. *J of Prosth Dentistry* 1991 Oct; 66(4): 478-485.
28. Hamilton WD, Zuk M: Heritable true fitness and bright birds: A role of parasites? *Science* 1982; 218: 384-387.
29. Hausfater G,Thornhill R (Eds): Parasites and sexual selection. (Special issue), *Am Zoologist* 1990; 30(2).
30. Zuk M: The role of parasites in sexual selection: Current evidence and future directions. *Adv Study of Behav* 1992; 21: 39-67.
31. Iliffe A: A study of preferences in feminine beauty. *Br J of Psychology* 1960; 51: 267-273.
32. Udry R: Structural correlates of feminine beauty preferences in Britain and the U.S.: A comparison. *Sociology and Social Research* 1965; 49: 330-342.
33. Patzer G: *The physical attractivness phenomena.* New York: Plenum, 1985.
34. Bernstein IH, Lin T, McClellan P: Cross-vs. within-racial judgments of attractiveness. *Percep & Psychophys* 1982; 32: 495-503.
35. Cunningham MR: Measuring the physical in physical attractiveness: Quasi experiments on sociobiology of female facial beauty. *J of Soc and Personality Psych* 1986; 50: 925-935.
36. Johnson RW, Dannenbring GL, Anderson NR, Villa RE: How different cultural and geographic groups perceive the attractiveness of active and inactive feminists. *The J of Social Psych* 1983; 119: 111-117.
37. Maret SM: Attractiveness ratings of photographs of Blacks by Cruzans and Americans. *The J of Psych* 1983; 115: 113-116.
38. Maret SM, Harling GA: Cross cultural perceptions of physical attractiveness: Ratings of photos of Whites by Cruzans and Americans. *Percep Motor Skills* 1985; 60: 163-166.
39. Richardson SA, Goodman N, Hastorf AH, Dornbusch SM: Cultural uniformity in reaction to physical disabilities. *Am Soc Review* 1961; 26: 241-247.
40. Thakerar JN, Iwawaki S: Cross-cultural comparisons in interpersonal attraction of females toward males. *J of Soc Psych* 1979; 108: 121-122.
41. Weisfield GE, Weisfield CC, Callaghan JW: Peer and self perception in Hopi and Afro-American third and sixth graders. *Ethos* 1984; 12: 64-83.
42. Langlois JH, Roggman LA, Casey RJ, Ritter JM, Rieser-Danner LA, Jenkins VY: Infant preferences for attractive faces: Rudiments of a stereotype? *Dev Psych* 1987; 23: 363-369.
43. Samuels CA & Ewy R: Aesthetic perception of faces during infancy. *Brit. J Devel. Psychol* 1985; 3: 221-228.
44. Shapiro BA, Eppler M, Haith MM, Reis H: An event analysis of facial attractiveness and expressiveness. Paper presented at the meeting of the Society for Research in Child Development, Baltimore, MD, April, 1987.
45. Timms DJ, Trenouth MJ: A quantified comparison of craniofacial form with nasal respiratory function. *AJO* 1988; 94: 216-22.
46. Weimert T: On airway obstruction in orthodontic practice. *JCO*, Vol. XX, No. 2: 96-104, 1986.
47. Champagne M: Upper airway compromise (UAC) and the long face syndrome. *JGO* 1991 Sep; 2(3): 18-25.
48. Zarb GA, Speck JE: The treatment of temporomandibular joint dysfunction. A retrospective study. *J Prosthet Dent* 1977; 38: 420.
49. Van Sickels JE,Ivey DW: Myofacial pain dysfunction: A manifestation of the short-face syndrome. *J Prosthet Dent* 1979 Nov; 42(5): 547-550.
50. Abadi BJ, Okeson JP: Alteration of vertical dimension in the treatment of Cranio-mandibular Disorders. *J of Craniomand Prac* 1982-83; 1: 55-59.
51. Fonder AC. *The dental physician.* Rock Falls, IL: Medical-Dental Arts,. pp. 430, 1985.
52. Fonder AC.The dental distress syndrome. Rock Falls, Il: Medical-Dental Arts. pp. 210, 1990.
53. Olson GB, Peters CJB, Franger AL: The incidence and severity of premenstrual syndrome among female craniomandibular pain patients. *J of Craniomand Prac* 1988 Oct; 6, No. 4: 330-337.
54. Smith GH: Headaches aren't forever. International Center for Nutritional Research, Inc., Newtown, PA. pp. 163, 1986.
55. Marasa FK, Ham BD: Case report involving the treatment of children with chronic otitis media with effusion via craniomandibular methods. *J of Craniomand Prac* 1988 July; 6(3): 256-270.
56. Loudon ME: Recent Advancements in vertical Dimension: Primary molar buildups. *Functional Orthodontist, AAFO* 1990 Jan/Feb; 7(1): 10-17.
57. Jefferson Y: TMD assessment using the Sassouni analysis. *JGO* 1991 Mar; 2(1): 11-15.
58. Kahnberg K: TMJ complications associated with superior repositioning of the maxilla. *J of Craniomand Prac* 1988 Oct; 6(4): 312-315.
59. Jones J: Craniomandibular pain and dysfunction. World Congress IV, Dixon, IL. July 5-8, 1984.
60. Arlen H: Symposium on the multi disciplinary management of the chronic head, neck and jaw pain dysfunction, St. Joseph Mercy Hospital, Pontiac, Michigan, Jan. 20-21, 1978.
61. Rocabado M: Biomechanical relationship of the cranial, cervical, and hyoid region. *J of Craniomand Prac* 1983 Aug; 1(3): 62-66.
62. Darnel, MW: A proposed chronology of events for forward head posture. *J of Craniomand Prac* 1983 Sept-Nov; 1(4): 49-54.
63. Makofsky H: The effect of head posture on muscle contact position: The sliding cranium theory. *J of Craniomand Prac* 1989 Oct: 7(4): 286-292.
64. Stoll V: The importance of correct jaw relations in cervico oro-facial orthopedics. Basal Facts 1977 Spring; 2(1): 34-39.
65. Downs WB: Variations in facial relationships: Their significance in treatment and prognosis. *AJO* 1948; 34: 812-840.
66. Steiner CC: Cephalometrics for you and me. AJO 1953; 39: 729-755.
67. Koski K: The norm concept in dental orthopaedics. *AO* 1955; 25(2): 113-117.
68. McNamara JA, Jr: A method of cephalometric evaluation. *AJOP* 1984 Dec; 86(6): 449-469.
69. Jefferson,Y: Skeletal classification system for describing maxillary and mandibular A-P relationship using a modified Sassouni Analysis. *JGO* 1990 March; 1(1): 5-11.
70. Sassouni V: A roentgenographic cephalometric analysis of cephalofacial dental relationships. *AJO* 1955 Oct; 41: 735-764.
71. Sassouni V: Diagnosis and treatment planning via roetgenographic cephalometry. *AJO* 1958 June; 44: 433-463.
72. Beistle RT: SASSOUNI PLUS, a comprehensive cephalometric system for diagnosis and treatment planning in functional therapy. *Functional Orthodontist*, AAFO1984 May-June; 1, (1): 39-48.
73. Beistle RT: Simplified Sassouni Plus: An update. *Functional Orthodontist*, AAFO 1987 May-June; 4(3): 12-17.
74. Jacobson A: The "Wits" appraisal of jaw disharmony. AJO 1075; 67: 125-134.

75. Jacobson A: Application of the "Wits" appraisal. *AJO* 1976; 79: 179-189.
76. Broadbent J: Essence of a beautiful face. *Functional Orthodontist*, AAFO 1989 Sept/Oct; 6(5): 18-30.
77. Peck H, Peck S: A concept of facial esthetics. *AO* 1070 Oct; 40(4): 284-317.
78. Burstone CJ: The integumental profile. *AJO* 1958 Jan; 44, No. 1: 1-25.
79. Bowbeer GRN: Saving the face and TMJ-Part 4. *Functional Orthodontist*, AAFO 1987 Jan/Feb; 4, No. 1: 8-21.
80. Mew J: Use of the 'Indicator Line' to assess maxillary position. *Functional Orthodontist*, AAFO 1991 Jan/Feb; 8, No. 1: 29-32.
81. Jefferson Y: Facial esthetics-presentation of an ideal face. *JGO* 1993 March; 4(1): 18-23.
82. Ricketts RM: Respiratory obstruction syndrome. In Forum on the tonsil and adenoid problems in orthodontics. *AJO* 1968; 54: 495-514.
83. Harvold EP: The role of function in the etiology and treatment of malocclusion. *AJO* 1968; 54: 883-898.
84. Harvold EP, Chierici G, Vargervik K.: Experiments on the development of dental malocclusions. AJO 1972; 61: 38-44.
85. Paul JL Nanda RS: Effect of mouth breathing on dental occlusion. *Angle Ortho* 1973; 43: 201-206.
86. Ngan P, Fields HW: Open bite: a review of etiology and management. *Am Acad of Pediatric Dent* 1997; 19:2.
87. Jefferson Y: Spontaneous correction of long face tendency-a case report. *JGO*, Vol. 5, No. 3: 18-25, Sept., 1994.
88. Hershey HG, Stewart BL, Warren DW: Changes in nasal airway resistance associated with rapid maxillary expansion. *AJO*, 69: 274-284, 1976.
89. Turbeyfill WJ: The long-term effect of rapid maxillary expansion (Master Thesis). University of North Carolina, 1976.
90. Hartgerink DV, Vig PS, Abbott DW: The effect of rapid maxillary expansion on nasal airway resistance. *AJO*, 92: 381-389, 1987.
91. Lewin DS, Wang G, Chen YI, Skora E, Hoehn J, Baylor A, Wang J: Variable school start times and middle school student's sleep health and academic performance. *J Adolesc Health* 2017 May; 139x(17) 20104-0.
92. Strobl JS, Thomas MJ: Human growth hormone. *Pharmacol Rev.* Vol 46, No. 1: 1-34. Mar 1994.
93. Ahrberg K, Dresler M, Niedermaier S, Steiger A, Genzel L: The interaction between sleep quality and academic performance. *J of Psychiatric Research.* 46: 1618-22, 2012.
94. Davidson JR, Moldofsky H, Lue FA: J *Psychiatry Neurosci* 16(2): 96-102, Jul 1991.
95. Orzel-Grygkewska J: Consequence of sleep deprivation. *International J of Occupat Med and Environ Health.* 23(1): 95-114, 2010.
96. Owens J: A clinical Overview of sleep and attention-deficit/hyperactivity disorder in children and adolescents. *J Can Acad Child Adolesc Psychiatry.* 18(2): 92-102, May 2009.
97. Sobanski E, Schredl M, Kettler N, Alm B: Sleep in adults with attention deficit hyperactivity disorder (ADHD) before and during treatment with methylphenidate: a controlled polysomnographic study. *Sleep* 31(3): 375-381, Mar 2008.
98. Cortese S, Vincenzi B, Angriman M: Identifying and managing sleep disorders associated with ADHD. *Neuropsychiatry.* 2(5): 393-405, 2012.
99. O'Brien LM, Ivanenko A, Crabtree VM Holbrook CR, Bruner JL, Klaus CJ, Gozal D: Sleep disturbances in children with attention deficit hyperactivity disorder. Pediatric Res 54: 237-43, 2003.
100. Lycett K, Sciberras E, Mensah FK, Gulenc A, Hiscock H: Behavioural sleep problems in children with attention-deficit/hyperactivity disorder (ADHD): protocol for a prospective cohort study. *BMJ* 4:e004070, 2014.
101. Jefferson Y: Mouth breathing: adverse effects on facial growth, health, academics, and behavior. *Gen Dent* 2010 Jan-Feb; 58(1): 18-25.
102. Langlois J & Roggman LA: Attractive faces are only average. *Psychological Science* 1990; 1: 115-121.
103. Alley TR, Cunningham MR: Average faces are attractive, but very attractive faces are not average. *Psychological Science* 1991; 2: 123-125.
104. Ackerman D: *A natural history of the senses.* New York: Random House, 1990.
105. Grealy, L: *Autobiography of a face.* Boston, MA: Houghton Mifflin Company. 1994.

Dr. Yosh Jefferson graduated from UMDNJ and has a general practice in Mount Holly, NJ, since 1982. He has lectured nationally and internationally, and has written many professional articles and a manual on Jefferson Cephalometric Analysis. He is a member of the ADA, AGD, and IAO. He is past president of NJAGD and IAO, and currently he is a board examiner for IBO.