Table of Contents

Accompanying CD-ROM

Preface

The method of radiographic cephalometry originally derived from anthropologic cephalometry has been routinely used in orthodontics for well over half a century. No longer the exclusive domain of the orthodontist, its value as a diagnostic, treatment, and research vehicle has since been recognized by maxillofacial and plastic surgeons and selectively by prosthodontists, pediatric dentists, and general practitioners.

For the uninitiated, the difficulty in identifying an appropriate reference can be a major obstacle to assimilating the literature on cephalometry. Most orthodontic textbooks devote chapters to cephalometric techniques and analyses, but the information is generally directed toward those who are familiar with the subject. Widespread demand for an updated text prompted an expansion of the original volume, *Radiographic Cephalometry: From Basics to Videoimaging*. Like its predecessor, this revised edition is intended to introduce those who have little or no experience in the field, including predoctoral students, students in graduate programs, and general practitioners wishing to familiarize themselves with the subject, for academic reasons and for purposes of clinical application. Given the burgeoning advances in products and technology and in the light of tremendous advances in cephalometry, all of the original chapters have been updated and six entirely new chapters added.

The early chapters discuss the need for an understanding of cephalometric concepts, particularly for the clinical practice of orthodontics, and present the principles, procedures, and equipment required for taking and processing good cephalometric radiographs. Regardless of whether radiographs are to be traced manually or digitally, accurate identification of landmarks is essential. For novices, a unique stepwise approach offers clear instructions for headfilm tracing and landmark identification using transparent templates provided on the accompanying CD-ROM.

In subsequent chapters, some classic cephalometric analyses are described in detail. The analyses selected are not necessarily the ones recommended for clinical or student use; they are provided to acquaint the reader with the various skeletal and dental measurements and, particularly, the reason for their selection and interpretation. Most schools and clinicians tend to modify the existing analyses or devise their own, generally based on measurements extrapolated from those described, often adding a few of their own measurements. To have attempted to include all analyses devised by schools or selected clinicians would not only have been futile, but would serve little more than to confuse the reader.

These chapters are followed by discussions of the importance of and various methods for assessing soft tissue contours and facial proportions, the complexity of facial growth analysis, and the integral relationship between growth and cephalometry. Cephalometry is used as a diagnostic aid, but serial radiographs are also used to evaluate and measure growth and treatment changes. To accomplish this, various methods of superimposing serial radiographic images are debated. Traditionally, intracranial reference points and lines have been used to assess facial morphology. The chapter on natural head position questions the accuracy of the interpretation of such methods.

The integration of computer systems into dentistry has revolutionized the practice of orthodontics; whereas traditional headfilms were manually traced and measured, computers and contemporary imaging technology have altered many aspects of orthodontic practice. Today, radiographic (cephalometric, panoramic, and periapical), facial, and intraoral photographic images are immediately captured and stored. The technology facilitates diagnosis and treatment planning, communication between doctor and patient, data management, and interoffice communication. The advantages and accuracy of digital imaging are discussed in an early chapter. Procedures and requirement for effective facial imaging and evaluation are also clearly described.

The proportionate template is a practical and relatively simple means of identifying and/or demonstrating the extent of dental and skeletal disharmony. It entails visually comparing a lateral cephalometric tracing of the patient with a transparent proportionate template. For hands-on learning, an “average” template and larger and smaller “normal” templates are provided on a CD-ROM enclosed in an envelope at the back of the book. Also provided are instructions for the digital application of the templates to accommodate skulls of all sizes.

Recent advances in imaging technology now allow orthodontists to visualize the head, face, airway, and temporomandibular joints in three dimensions using laser scanning, structured light imaging, magnetic resonance imaging, stereophotogrammetry, surface image analysis, and cone-beam volumetric tomography. Together, these tools provide clinicians and researchers with more accurate and additional information—allowing a quantum leap forward in diagnosis and treatment. A three-dimensional cephalometric analysis presents soft and hard tissue norms from the lateral and frontal views and from multiple perspectives.

The ability to store, process, and retrieve information electronically has enabled the prediction of treatment outcomes within certain limits. Nevertheless, digital cephalometry, however advanced, is a tool—not a panacea—in diagnosis and treatment planning. The accuracy of prediction methods and the determination as to whether orthodontics has evolved from an art form to a science is a question that is explored. After reading this book, the reader should have acquired sufficient appreciation of cephalometry to be able to read and interpret the many available cephalometric analyses in any format.

Contributors

Page W. Caufield, DDS, PhD
Professor
Division of Diagnostics, Infectious Disease and Health Promotion
School of Medicine
New York University
New York, New York

Department of Cariology and Comprehensive Care
College of Dentistry
New York University
New York, New York

André Ferreira, DMD, MS
Assistant Professor
Department of Orthodontics
School of Dentistry
University of Alabama
Birmingham, Alabama

Joseph G. Ghafari, D Chir Dent, DMD
Professor and Head
Department of Orthodontics and Dentofacial Orthopedics
American University of Beirut Medical Center
Beirut, Lebanon

Professor of Orthodontics
School of Dentistry
Lebanese University
Beirut, Lebanon

Adjunt Professor
Department of Orthodontics
College of Dentistry
New York University
New York, New York

William E. Harrell, Jr, DMD
Private Practice
Orthodontics
Alexander City, Alabama

David C. Hatcher, DDS, MSc
Private Practice
Oral Radiology
Sacramento, California

Alexander Jacobson, DMD, MS, MDS, PhD
Professor Emeritus
Department of Orthodontics
School of Dentistry
University of Alabama
Birmingham, Alabama

Richard L. Jacobson, DMD, MS
Clinical Instructor of Orthodontics
School of Dentistry
University of California, Los Angeles
Los Angeles, California

Private Practice
Orthodontics
Pacific Palisades, California

Lysle E. Johnston, Jr, DDS, MS, PhD
Professor Emeritus
Department of Orthodontics
Center for Advanced Dental Education
Saint Louis University
St Louis, Missouri

Mark W. Johnston, DMD, MS
Private Practice
Orthodontics
Marietta, Georgia

Herbert A. Klontz, DDS
Clinical Associate Professor
Department of Orthodontics
College of Dentistry
Health Sciences Center
University of Oklahoma
Oklahoma City, Oklahoma

Shane Langley, DMD
Department of Orthodontics
School of Dentistry
University of Alabama
Birmingham, Alabama

James Mah, DDS, MS, MDSc
Clinical Assistant Professor
Division of Craniofacial Sciences and Therapeutics
Department of Orthodontics
School of Dentistry
University of Southern California
Los Angeles, California

Scott McClure, DMD, MS
Department of Orthodontics
School of Dentistry
University of Alabama
Birmingham, Alabama

Coenraad F. A. Moorrees, DDS†
Professor Emeritus
Department of Orthodontics
School of Dental Medicine
Harvard University
Cambridge, Massachusetts

Senior Staff Member Emeritus
Forsyth Dental Center
Boston, Massachusetts

P. Lionel Sadowsky, DMD, BDS, MDent
Professor and Chairman
Department of Orthodontics
School of Dentistry
University of Alabama
Birmingham, Alabama

David M. Sarver, DMD, MS
Private Practice
Orthodontics
Birmingham, Alabama

James L. Vaden, DDS, MS
Chair
Department of Orthodontics
College of Dentistry
Health Science Center
University of Tennessee
Memphis, Tennessee

Christos Vlachos, DMD, DDS, MS
Clinical Assistant Professor
Department of Orthodontics
School of Dentistry
University of Alabama
Birmingham, Alabama

Richard A. Weems, DMD, MS
Associate Professor
Director of Oral and Maxillofacial Radiology
Department of Diagnostic Sciences
School of Dentistry
University of Alabama
Birmingham, Alabama

†Deceased

Soft Tissue Evaluation

Alexander Jacobson
Christos Vlachos

Throughout recorded history, and even earlier as evidenced by archeological artifacts, humans have been aware of beauty and facial esthetics. The study of facial esthetics has been primarily the domain of painters, sculptors, and philosophers. In the thirteenth century, Thomas Aquinas stated a fundamental truth of esthetics: "The senses delight in things duly proportioned." St Thomas was expressing the direct and very often measurable relationship that exists between beauty and mathematics, both in nature and in art.

Attempts to describe ideal facial or body proportions by measuring specific body parts and relating them as multiples of other parts of the body have been made throughout history, most notably in the work of Leonardo da Vinci in the 16th century (see chapter 2). In the 20th century, Edward H. Angle, popularly regarded as the father of orthodontics, asked his artist friend Edmond H. Wuerpel to tell his students how to achieve the perfect face but was not able to understand why Wuerpel could not provide a simple formula to answer this question.

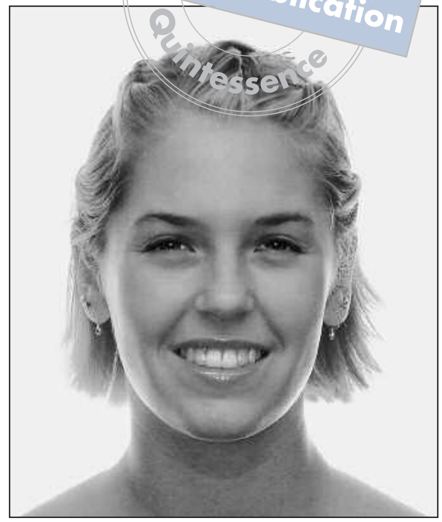
Orthodontics is an art struggling to become a science. Since the inception of orthodontics as a specialty, orthodontists have been intrigued with measurement. Only when something is amenable to measurement can it be regarded as scientific. The greatest thrust in this direction evolved with the advent of cephalometry and its application to clinical orthodontics. It provided a fertile field of opportunities for measurement resulting in scores of analyses and stockpiles of statistical data. Having exploited hard tissue measurements, orthodontists sought to survey the soft tissues covering the face. Having completed the cycle, we have returned to Angle's question of what constitutes the perfect face.

Symmetry and balance in nature are clearly recognizable. Gross facial imbalance is readily discernible, but what is not as evident is subclinical facial imbalance or asymmetry, and that is, in effect, what orthodontics addresses. Even more difficult is the ability to quantify imbalance or asymmetry specifically for clinical purposes. The ability to quantify imbalance forms the basis of cephalometry, in which the degree of skeletal and dental disharmony is measured.

Successful diagnosis in orthodontics entails gathering information from plaster casts, cephalometric tracings, and facial analysis. Plaster casts and/or clinical evaluation of the occlusion indicate the need for correction. Facial analysis is used to identify positive and negative facial traits in an effort to optimize facial changes. Correction of the occlusion alone may not necessarily improve facial balance—in fact, it may cause facial balance to be impaired. When the skeletal pattern is so pronounced as to alter soft tissue

Fig 19-3 Vertical facial proportions. The upper face is measured by G-Sn; the lower face is measured by Sn-Me'. The ratio for esthetic balance is 1:1.

Fig 19-4 Division of the face by a symmetry line passing through G, Pn, midpoint of upper lip, and midpoint of chin.



19-5 Maxillary incisor–lip relationship upon smiling. The ideal exposure with smile is three quarters of the crown height to 2 mm of gingiva.

Facial symmetry

The face can be divided along the midsagittal plane with a symmetry line passing through G, Pn, midpoint of upper lip, and midpoint of chin (Fig 19-4). The Pn and midsymphysis point are more likely to deviate from the symmetry axis. Few faces show perfect symmetry.

Maxillary incisor–lip relationship

In repose, the distance between Sts and the incisal edge of the maxillary incisor is measured. The normal range is 1 to 5 mm. Upon smiling, ideal exposure with smile is three quarters of the crown height to 2 mm of gingiva (Fig 19-5). Women tend to show more gingiva than men.[7] Variability in gingival exposure is related to lip length, vertical maxillary length, and magnitude of lip elevation with smile.[8] Peck and Peck[9] suggest that a gingival smile line is not necessarily esthetically objectionable. Gingival smile lines diminish with age.

Profile Evaluation

Middle–lower facial third ratio

In the vertical dimension, the anterior facial proportionality is assessed by taking the ratio of middle third facial height to lower third facial height measured perpendicular to HP (Fig 19-6). The ratio of the distances G-Sn and Sn-Me' should be approximately 1:1. This proportion is also known as the *upper to lower face ratio*.

Upper lip–lower lip height ratio

The length of the upper lip, or the distance from Sn to Sts, should be approximately one third of the total lower third of the face (Sn-Me'); the distance from Sti to Me' should be about two thirds (see Fig 19-6). This can be summarized by the following ratio:

$$\frac{\text{Sn-Sts}}{\text{Sti-Me'}} = \frac{1}{2}$$

Assessment of the nose

Landmarks used to evaluate the nose include G (most prominent aspect of the frontal bone), radix, nasal dorsum, supratip depression, Pn, columella, and nasolabial angle (Figs 19-7 to 19-9).[10] Pn is the most projecting part of the nose. Nasal projection is evaluated by the angle formed by the intersection of a line drawn from G to Pog' with a line drawn along the axis of the radix. This angle is called the *nasofacial angle* and is approximately 30 to 35 degrees (see Fig 19-7). Rohrich and Bell[11] advocate assessing the inclination of the nasal base (ie, the angle formed between the true vertical and a line through the long axis of the nostril). The angle varies from

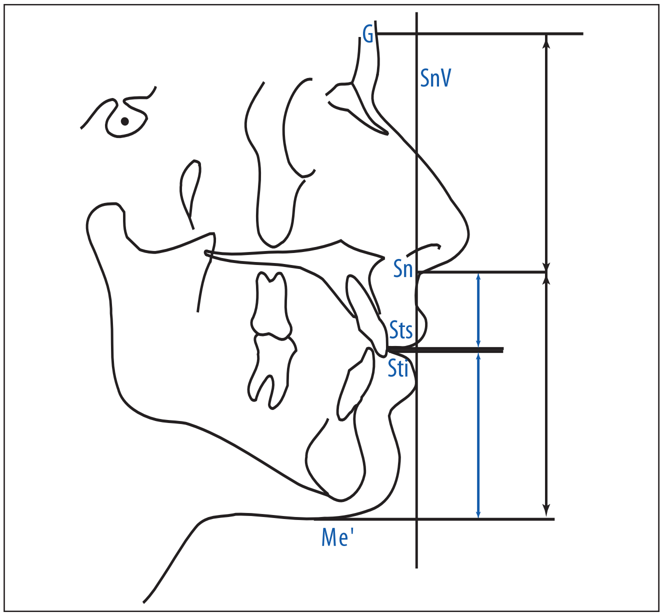


Fig 19-6 Vertical proportions in profile view. The ratio of upper to lower face should be approximately 1:1; the upper lip–lower lip height ratio should equal 1:2.

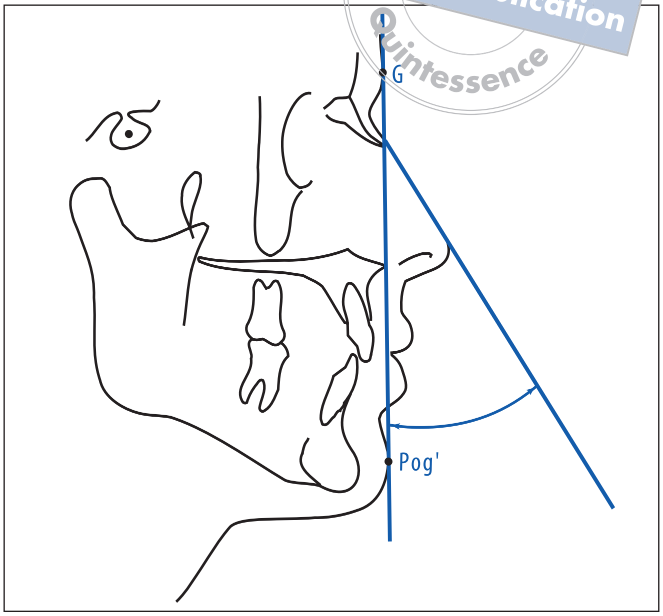


Fig 19-7 The nasofacial angle is formed by the intersection of a line drawn from G to Pog′ (G-Pog') with a line drawn along the axis of the radix of the nose. The average value is 30 to 35 degrees.

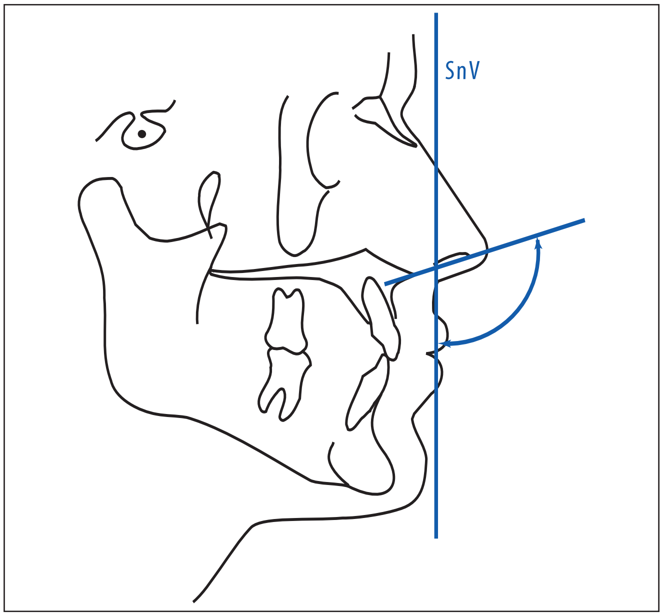


Fig 19-8 Inclination of the nasal base. The angle formed between true vertical (eg, SnV) and the long axis of the nostril varies from about 90 degrees in men to as much as 105 degrees in women.

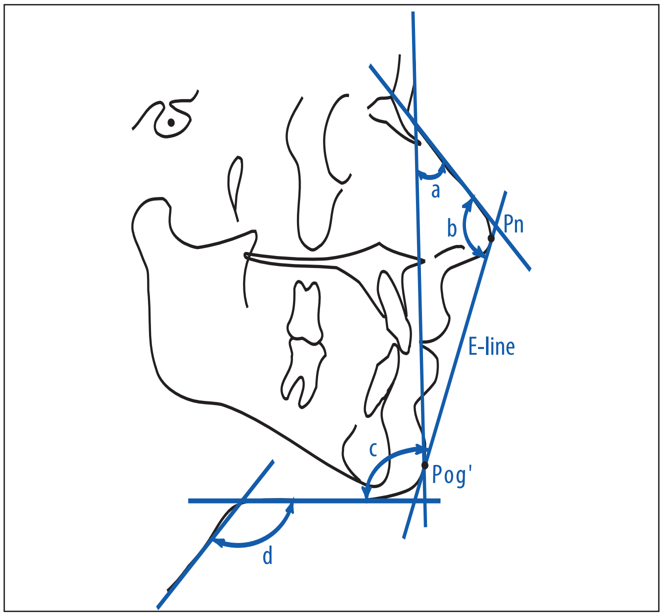


Fig 19-9 a = Nasofacial angle. For esthetic balance, it averages 30 to 35 degrees (see Fig 19-7). b = Nasomental angle. Constructed by a line drawn along the axis of the radix and a line drawn from Pn to Pog′ (E-line), it ranges between 120 and 132 degrees. c = Mentocervical angle. Formed by the intersection of the E-line and a tangent to the submental area, it ranges between 110 and 120 degrees. d = Submental-neck angle. It is formed by a submental tangent and a neck tangent (men = 126 degrees; women = 121 degrees).