

FACIAL GEOMETRY

ABOUT THE AUTHOR

Dr. Robert M. George is a member of the biology faculty at Florida International University where he teaches human and comparative anatomy, primate and human evolution, and forensic osteology. He received his doctorate in physical anthropology from the University of Washington and has held appointments in several medical schools including Brown University, the University of Kuwait, St. George's University (Grenada), The University of Chicago and the University of South Carolina. In 1985, he began research in the field of forensic facial approximation and has served as a consultant on numerous forensic cases from coast-to-coast including the notorious "Green River Killer" case. His professional memberships have included the American Association of Anatomists, the American Association of Physical Anthropologists, the American Academy of Forensic Sciences and the Florida Division of the International Association for Identification where he currently serves as the chairperson of the Forensic Composite Art Committee. When not teaching, consulting, or approximating, he enjoys portraiture and has a passion for caricaturing.

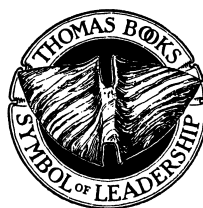
FACIAL GEOMETRY

Graphic Facial Analysis for Forensic Artists

By

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*To my loving wife, Mary, who is truly golden in the
eyes of this beholder.*

BEAUTIFUL QUOTES

The human features and countenance, although composed of but some ten parts or little more, are so fashioned that among so many thousands of men there are no two in existence who cannot be distinguished from one another.

Pliny the Elder (circa 50 A.D.)

It is the common wonder of all men, how among so many millions of faces there should be none alike.

Thomas Browne

Beauty is the opposite of deformity.

Leonardo

There is no excellent beauty which hath not some strangeness of proportion.

Francis Bacon

Beauty is (altogether) in the eye of the beholder.

Margaret Hungerford
(Lew Wallace)

No standard rules are included for those average heads which don't exist.

Louise Gordon

If the beauty of Helen of Troy was powerful enough to sink a thousand ships, then that force capable of sinking a single ship would be a milliHelen.

Anonymous

FOREWORD

Robert George, B.A., M.S., PhD., anatomist,
physical anthropologist and artist.

That is my memory of his personal card about twenty years ago given to me after his first lecture at the Facial Reconstruction Seminar held then on Wednesday evening at the annual meeting of the American Academy of Forensic Sciences.

After twenty years of professional and personal contact with Dr. George and watching his career productivity, the inescapable conclusion is that card announced the special power of those disciplines all rolled into one great mind.

In being a clinical orthodontist, similarly, my interest is the face, particularly the growing face and what can be done to modify facial bones along with tooth movement so that my patient's final records, both radiographic, cephalometric and photographic, illustrate how close I can strong-arm the anatomy to fit our anatomic and esthetic measured ideals for facial and dental proportion.

However, in forensic dentistry and anthropology, the quest is not for measuring sameness, if you will, but rather for dissecting out the characteristics that make the person different from all others, as in the human identification protocol. My collaboration with Dr. George involved utilization of these records for research.

Dr. George has used his own built-in basic multidisciplinary talent to add real science to the study of the relationship of hard tissue to soft tissue in the face, particularly radiographic. Knowing limitations of technique and the statements that can and cannot be made from scientific studies, his terminology "facial approximation" is a learned professional contribution.

Dr. Arthur Burns
Jacksonville, FL
2007

PREFACE

Forensic art may be defined as “portrait art minus a tangible subject.” Whether rendering a composite illustration as dictated by a witness or attempting a facial approximation (reconstruction, reproduction, etc.) on an unidentified skull, the primary goal of the forensic artist remains the same—to depict as accurately as possible the overall shape and contouring of the face including its ciliary adornments. While the precise details of eye, nose and lip anatomy are extremely difficult to ascertain from verbal descriptions or bony substrates, it is possible to accurately position these features and to relate them via numerous craniofacial indices.

Cephalometry, the measurement of the head and face, is a centuries-old science developed by anatomists, anthropologists, artists, maxillofacial surgeons, orthodontists and others interested in facial esthetics. The subdiscipline of graphic facial analysis (GFA) is the quantitative assessment of the relationships of facial features as determined by specific indices and angles. For example, a nose may be judged to be long with reference to total facial length, the mouth to be wide relative to facial width, the mandible to be prognathic as determined by the mandibulo-facial angle, and so on. An understanding of GFA is essential for composite drawings, forensic facial approximations and photographic comparisons.

Forensic art came of age in 2001 with the publication of Karen Taylor’s masterwork, *Forensic Art and Illustration*. This book covered all aspects of forensic art in 18 chapters and a weighty 561 pages. Another excellent reference work is *Forensic Facial Reconstruction* by Caroline Wilkinson (2004) and newer computer techniques have been introduced by John Clement and Murray Marks in their book *Computer-Graphic Facial Reconstruction* (2005). The main objective of the present more modest manual is to present a series of practical indices interrelating the key features of the human face that will provide a foundation for

any exercise in forensic art from composite sketch to post-mortem “re-facing.” These indices will be illustrated with a survey of the numerous and often surprising geometric forms that permeate facial design. We will examine the various triangles and rectangles, rhomboids and trapezoids, parallelograms and circles that on the one hand define the human face (the theme) and on the other, give it its individuality (variations on the theme).

This book deals purely with the measurement of facial variation. It is **not** a discourse on esthetics or the analysis of beauty which has been a major entertainment over the centuries. Ever since Phidias (5th century B.C.) created “golden geometry” with his golden ratio (a.k.a. the divine proportion), artists and mathematicians have been scrutinizing the human face for its “golden plan.” The underlying assumption is that the more golden relations, rectangles or triangles a face possesses the more beautiful it will be. This theme was developed by the mathematician Matila Ghyka in her fascinating book *The Geometry of Art and Life* (1946). Ricketts (1982) and Shoemaker (1987) used similar analyses in their studies of dental esthetics and the maxillo-facial surgeon, Dr. Stephen Marquardt (2002), has constructed the ultimate golden mask purportedly underlying the essence of facial beauty. In this book, I am not concerned with value judgments since I have no way of knowing if 1.618 is actually prettier than 3.141 or 6.022.

Neither is this book intended as a clinical reference. Clinical cephalometry was completely covered by Farkas and Munro in their classic *Anthropometric Facial Proportions in Medicine* (1987) with more recent applications provided by Kolar and Salter in *Craniofacial Anthropometry* (1997). These are works of solid research and sound scholarship and provide the statistical data base followed in the present book.

This book is divided into four chapters. Chapter 1 defines the cephalometric points, planes, areas and lines that demarcate the human face. The detailed surface anatomy of the eye, nose, mouth and ear is also included. Chapter 2 reveals the underlying geometry of the human facial plan. A selection of triangles, rectangles and other polygons are illustrated, some “golden” and some less lustrous. Chapter 3 covers the graphic facial analysis (GFA) of the frontal face. Sixteen indices and triangles are defined and illustrated with their means and ranges of variation. Chapter 4 details the GFA of the lateral face by means of 8 angles and indices with special attention given to the nose and ear.

Forensic art has long suffered from a lack of standardization. Not only do forensic artists vary in skill from rank amateurs to professional por-

traitists, they also use different methods, proportion templates and tissue thickness tables. The major objective of this book is to provide a working set of facial indices that have been statistically evaluated for male and female Caucasians as a step toward such standardization. Equivalent data for people of African and Asian ancestry is singularly lacking and is an open field for future research.

R.M.G.

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FACIAL GEOMETRY

Chapter 1

FACIAL GEOGRAPHY

The human face is a marvel of contouring displaying hills and valleys, slopes, crests, ridges and crevasses all wrapped around a spherical skull. Throughout this irregular terrain there are certain constant landmarks which are denoted by an array of precisely defined cephalometric points. These points allow us to map the geography of the face, to zone its areas and ultimately, to develop indices by which subtle relationships may be revealed. Facial cephalometric points correspond to underlying skeletal craniometric points and a knowledge of their correlations forms the scientific basis of forensic facial approximation (George, 1987, 1993). The most significant of these facial points are defined in the following section and illustrated in Figures 1.1 and 1.2.

CEPHALOMETRIC POINTS

Cranial Points

- **vertex (v)**—the midline apex of the neurocranium (braincase).
- **supraglabella (sg)**—an arbitrary point about one inch above the glabella (used in forensic facial approximations).
- **glabella (g)**—the “bald spot” between the eyebrows on the midsagittal plane (MSP).
- **euryon (eu)**—the most lateral point of the neurocranium in the parietotemporal area, best plotted from the frontal view.
- **auriculotemporale (at)**—the superior junction of the ear with the side of the head; this point is highly variable, subject to rotational distortions and usually obscured by hair; it is significant when plotting certain facial triangles (new term proposal).

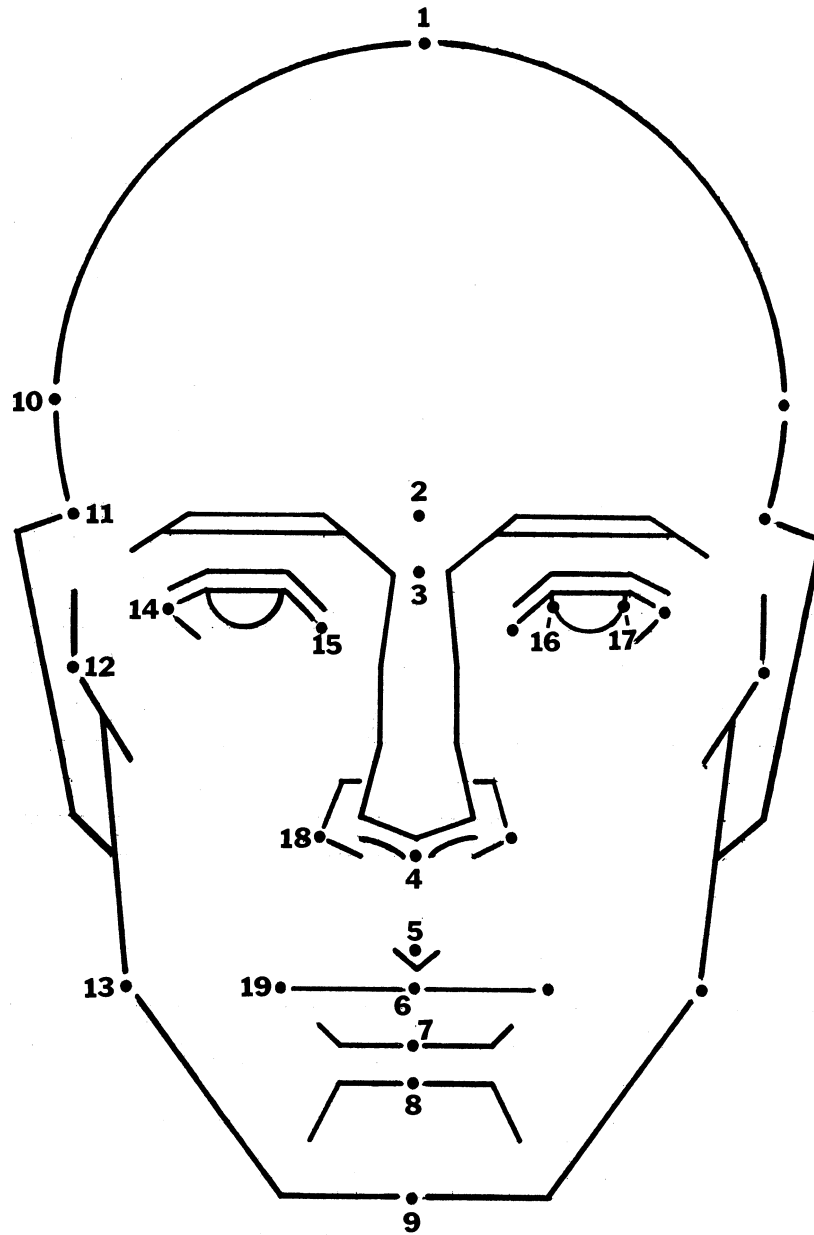


Figure 1.1. Cephalometric Points - Frontal View: 1 = vertex; 2 = glabella; 3 = nasion; 4 = subnasale; 5 = labiale superius; 6 = stomion; 7 = labiale inferius; 8 = labiamentale; 9 = gnathion; 10 = euryon; 11 = auriculotemporale; 12 = zygion; 13 = gonion; 14 = ectocanthion; 15 = endocanthion; 16 = iridion mediale; 17 = iridion laterale; 18 = alare; 19 = cheilion.

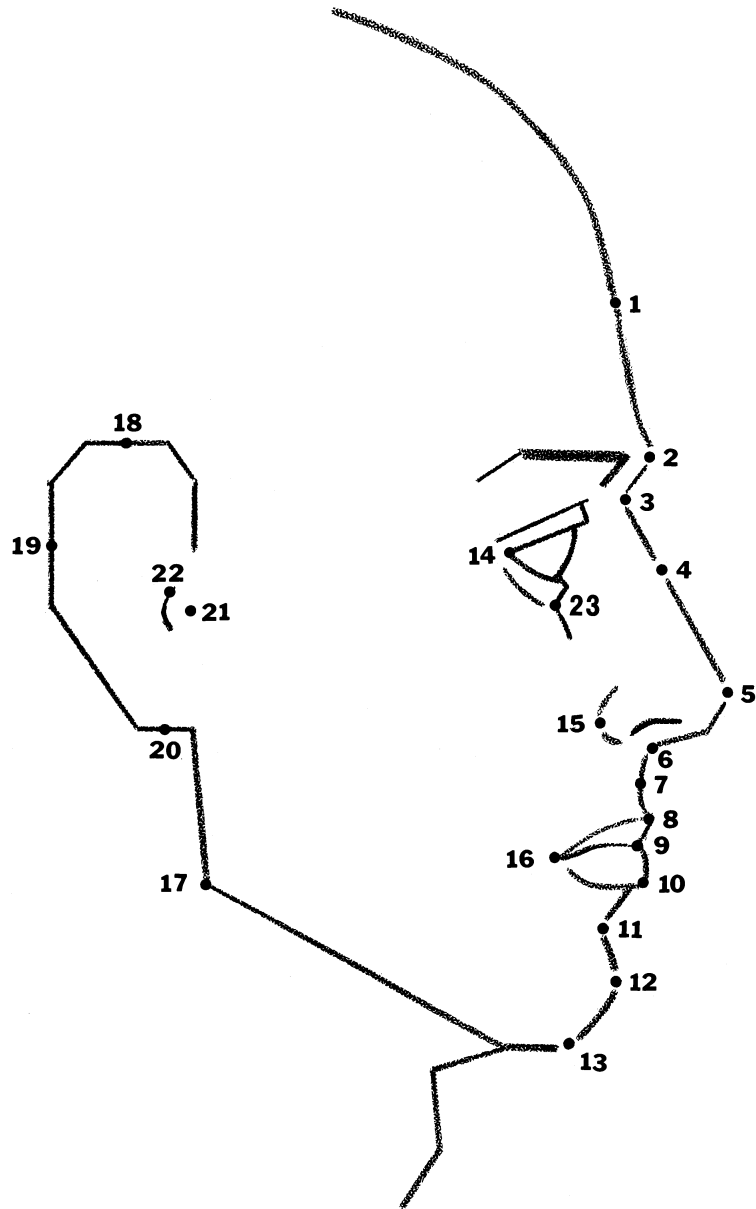


Figure 1.2. Cephalometric Points - Lateral View: 1 = supraglabella; 2 = ciliare (glabella); 3 = nasion; 4 = nasale; 5 = pronasale; 6 = subnasale; 7 = superior labial sulcus; 8 = labiale superius; 9 = stomion; 10 = labiale inferius; 11 = labiomentale (inferior labial sulcus); 12 = pogonion; 13 = gnathion; 14 = ectocanthion; 15 = alare; 16 = chelion; 17 = gonion; 18 = supraaurale; 19 = postaurale; 20 = subaurale; 21 = preaurale; 22 = tragion; 23 = orbitale.