ANTHROPOMETRIC FACIAL PROPORTIONS IN MEDICINE

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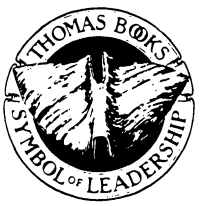

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To our children
Julia
and
Karen, Neal and Christopher

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FOREWORD

The monograph of Leslie Farkas and Ian Munro is not among the books we commonly read before going to sleep, or that we can toy with and casually pick up a chapter today and by chance another next week. It deserves recurrent study, but this attention is well rewarded. Such a book is missing from our recent medical literature.

From a clinical standpoint nothing is more difficult than to establish what features are normal or abnormal in a given face, except obvious malformations. Because so many variant features occur from age, race, sex and type, and also fashion, there are no absolutes when examining a patient. However, from a morphological evaluation, to produce a diagnosis one must conclude to orthomorphy or dysmorphy. And herein lies the basic question of orthoplastic facial surgery. What is "ortho" and what is "dys"?

From this evaluation a program of surgical intervention may be clearly indicated, or only minimally suggested. I am sure that there is no conscientious orthoplastic surgeon who has never questioned what goals are possible to obtain in a patient, and what procedures are best employed to obtain the intended result. There is no recipe for surgical intervention, only a continuous need for judgment, and all of us are looking for advice from experts. Here is a book of expert analysis which, when applied, can provide judgments, and judgments good or bad, on the foundation of knowledge.

This book by Doctors Farkas and Munro will help not only the orthoplastic surgeon, but also pediatricians, orthodontists, and psychologists in their diagnosis and decision for treatment or abstention.

The book is not bound within the confines of anthropomorphic measurements. The most important aspect of this book is that the authors never depart from the guiding line of proportion. Harmony or disharmony does not lie within angles, distances, lines, surfaces or volumes. They arise from proportion.

A book such as this cannot exhaust a subject with variations as endless as the humanity it studies. The authors have wisely avoided the stumbling block of excessive iconography. They have correctly chosen demonstrative drawings and diagrams to reinforce through patterns of analysis rather than dissect isolated cases presented in photographs.

This book will not be just another "reference book." For those who read and study and consider the material contained, they will find a compass map and route marker, to assess whether or not the position is correct and the direction true.

DOCTOR PAUL TESSIER
PARIS, FRANCE

INTRODUCTION

In both the abstract and the concrete worlds, comparison is the method by which the quality of an idea, living creature or inanimate object is judged. Balance is the magic word, defining the status in which the negative and positive signs of an object are brought into equilibrium.

When judging the quality of a face we compare its individual parts, and the verdict is based on our impression of whether they are well balanced or harmonious, or whether they reach only a satisfactory level or remain well below the average. The study of the relationship of the various parts of the human body in Antiquity and later in the Renaissance led to formulation of the proportion canons. Five centuries later they were accepted as directives defining the Ideal, the Harmony, a status of well-balanced signs.

The judgment of facial quality in plastic surgery is based mostly on visual impression and/or scanty measurements, unsatisfactory in modern medicine, a discipline of the biological sciences. It is time to renew and develop the examination methods of the pioneer anatomists from the past few centuries, applying anthropometric methods in morphologic studies of the human body.

In constructive, reconstructive and aesthetic plastic surgery, and in all other disciplines where the head and face are the center of attention (not only orthodontics, genetics, dysmorphology and endocrinology, but also criminology and medical illustration), we seek the definition of at least one of these conditions: average; better than average but still normal; or above the average range and, therefore, abnormal. Our judgment is influenced by so many complex factors and such a degree of subjectivity that it cannot entirely reflect the reality. The only reliable approach is to use measuring techniques, direct from the surface of the body and indirect from roentgenograms (cephalograms). In the process of investigation, the next step is to bring the individual measurements into working relationships, a process that duplicates the visual recording. The basic elements of this method are the proportion indices, the subject of this study.

L.G. Farkas

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In the preparation of the material for the monograph the assistance of our former coworker, Marko J. Katic, B.A., and the indefatigable efforts of our present associate, John C. Kolar, Ph.D., are highly esteemed. We are also greatly indebted to Adele Csima, M.A., and Tünde Szathmáry, B.A., M.H.Sc., of the Department of Biostatistics, University of Toronto, for their professional help. The computer program that generated and formatted Tables 1 to 166 was written by Cheri Aitken, Michael Durocher, B.P.H.E., and Ihor Prociuk, M.Sc.

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CONTENTS

LIST OF THE PROPORTION INDEX TABLES

The principles explaining the naming of the tables, the creation of their symbols and the order in which they are placed are explained in Chapter 14. With the help of that chapter, the reader will be able to identify which table represents a particular relationship by scanning this list quickly.

ANTHROPOMETRIC FACIAL PROPORTIONS IN MEDICINE

Chapter I

THE POPULATION SAMPLES

L.G. FARKAS

Normal proportion indices were determined based on measurements of the head and face from normal North American or Western European Caucasian children and young adults (Table I-I).

TABLE I-I

CAUCASIAN POPULATION GROUPS EXAMINED FOR DETERMINATION OF NORMAL PROPORTION INDICES

Years of Examination	Number of Subjects Examined		
	Males	Females	Total
1973-1976	654	658	1312
1978-1979	40	40	80
1981-1982	100	89	189
1983-1984	75	278	353
1967	328	302	630
Total	1197	1367	2564

The most basic 129 indices were established using the measurements taken from 1312 normal North American 6- to 18-year-olds between 1973 and 1976 (654 boys and 658 girls).[1] This group is referred to as the "children" for convenience although the oldest age group consists of young adults.

Studies in the youngest children (birth to 6 years old) were done in 630 normal West German Caucasians in 1967.[2]

All the other subjects were North American young adults. For more detailed examination of the orbits, 80 subjects were examined in 1978–79. Intensive investigation of the surface anatomy of the lower face, particularly the lower lip and chin, was based on measurements in 189 subjects in 1981–82.[3] The validity of the neoclassical proportion canons formulated in the Renaissance for modern populations was investigated in a group of 153 subjects (75 males, 78 females) in 1983–84.[4] In the same period, proportion indices in above-average, average and below-average faces in 200 women (including 50 professional models) were compared.[5]

About 40 per cent of the North American subjects were Anglo-Saxon, 33 per cent were Latin (French, Italian, Spanish, Portuguese) and the remainder were Germanic (German, Swedish, Dutch, Danish, Norwegian) or Slavs (Ukrainian, Polish, Slovak, Croatian) or belonged to small miscellaneous groups of Caucasians (e.g., Hungarian, Estonian, Finnish, Latvian).

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Chapter II

THE PROPORTION INDEX

L.G. FARKAS

INTRODUCTION

While restoration of the normal is the main goal in reparative surgery, the ultimate aim of aesthetic plastic surgery is to create an above-average or attractive face, which demands attention to proportionality. The relationship of two or more measurements taken from the surface of head and face is quantified by the numerical proportion index.

The visual impression of the face is a composite effect of the projective and surface distances, inclinations and angles obtained from the three-dimensional face. When observing a face, we unknowingly relate one measurement to others. Subconsciously, we see them as proportions. To study facial morphology objectively, however, the proportion qualities of normal and anomalous faces must be examined quantitatively. These indices are not all stable values: some are subjected to age-related changes (Ch. 5), others show certain differences between the sexes (Ch. 5) and between various ethnic groups (Ch. 4).

THE INDEX FORMULA

In the formulation of an index, the smaller measurement is multiplied by 100 (numerator) and divided by the larger measurement (denominator). Thus, the smaller measurement is expressed as a percentage of the larger. The general formula is:

$$\text{Index (I)} = \frac{\text{Numerator (smaller measurement)}}{\text{Denominator (larger measurement)}}$$

In these indices, usually the measurements compared are of the same quality (e.g., distances). However, an index in which the numerator is a projective measurement and the denominator the surface measurement of the same dimension can help to estimate the contour quality of the surface. We identified two basic categories of indices: areal and interareal. *Areal indices* are those composed of measurements and/or inclinations/angles from only one anatomical area (e.g., orbits, nose). *Interareal indices* contain measurements and/or inclinations/angles from two or more anatomical areas (e.g., orbits and nose, nose and face).

INTERPRETATION OF THE INDEX VALUE

Since the smaller measurement is normally divided by the larger, the index is less than 100. In some cases the index exceeds 100, because at certain ages the numerator is the larger measurement.

An index of 100 for a facial contour indicates that the surface is flat (e.g., the projective and surface measurements composing the index are equal in length). Indices denote increasing curvature of the feature (e.g., upper orbital rim, nasal root slopes, alae, cheeks) as they decrease from 100, without specifying whether the surface is concave or convex.

An index involving two measurements in one plane of the face or parallel planes (e.g., width of the nose and of the face, nose and face height) is sometimes easier to visualize if the index value is converted into halves, thirds, quarters, or fifths. For example, in a 6-year-old boy, the eye fissure height is about one-third the eye fissure length (eye fissure index), mandible height is half its width (mandibular index), and mandible width is two-thirds of the face width (mandible-face width index).

NORMAL RANGE OF INDICES

Index values obtained from a representative number of randomly selected similar subjects (i.e., similar in state of health, age, sex, race, ethnic origin) provide the data for calculating the *mean index value.* Therefore, the mean index value represents the average proportion between the related measurements.

Individual proportion indices may differ somewhat even in the most homogeneous sample, which is the clue to individuality. *Standard deviation* (*SD*) quantifies the normal differences between the index values of the members of the samples. Thus, it determines the width of the *normal range* of the index, from 2 SD below to 2 SD above the mean. All indices in the normal range are regarded as variations of normal proportions.

Obviously the normal proportions will be more variable in a wide normal range than in a narrow normal range. The wide normal range accounts for a larger number of variations. A small SD in combination with a large mean indicates high homogeneity, whereas a large SD suggests large differences within the range. Thus, the mean and SD can be good indicators of the normal proportion variations.

DISPROPORTION

The face is regarded as proportionate if the indices are in the normal range (mean ± 2 SD). The relationship between two measurements is disproportionate if the proportion index value is outside the normal range. A subnormal index is smaller than the lowest normal value (smaller than mean -2 SD), and a supernormal one exceeds the highest normal index (larger than mean $+2$ SD).

Extent of the Disproportion

After a disproportion is discovered, its extent must be established. Extent is expressed as a percentage: in a subnormal disproportion, it is reported as a percentage of the lowest normal value (mean -2 SD): in a supernormal disproportion, the extent is expressed as a percentage of the highest normal value (mean $+2$ SD). For example,