# A comparative cephalometric investigation of the Greek craniofacial pattern through 4,000 years

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Craniofacial morphology provides valuable data for determining genetic affinities[1] and evolutionary adaptedness[2,3] of prehistoric human populations. Craniofacial investigations yield reliable clues to the ethnic or biological affinity of the skeletal series[4] because craniofacial traits 1) can be evaluated in both living and prehistoric populations, unlike serological characters; 2) have high heritability values; 3) are numerous and more expressive than any other skeletal traits.

It is an accepted fact that craniofacial features such as size,[5] shape[6] and form,[7] facial pattern,[1] as well as dental arch morphology,[8-10] are genetically determined. As such, these features will show variations in different genera, species, races and subraces, like any other genetically determined character, and are equally subject to evolutionary modifications due to hybridization, natural selection and genetic drift.

Furthermore, Solow[11] has identified the degree of association between one craniofacial region and another. Other workers have noted that there is also a relationship between the arrangement of tooth roots, dental arch, and skull form.[12] Consequently, the craniofacial complex must be considered as a biological entity rather than a group of discrete but interrelated units.

In view of the foregoing, the skull, facial skeleton and the dentition have been used to distinguish one human population from another.[13,14]

### Statement of objectives

The specific aims of the present study were:

1. To compare and identify differences and similarities in the craniofacial skeleton between modern Greeks and their predecessors using roentgenographic cephalometry.
2. To interpret the genetic affinity (to the extent provided by craniofacial pattern) between ancient Greeks and their contemporaries on the basis of cephalo-dentofacial relationship.

**Abstract**

A comparative cephalometric investigation was conducted between modern and ancient Greeks to determine craniofacial characteristics and to examine the significance of ethnic heritage. The modern sample was composed of 54 individuals chosen on the basis of ethnic background, normal occlusion and facial harmony. The ancient sample consisted of 40 skulls with normal occlusion dated back to the Minoan civilization (ca. 1,800-1,200 B.C.) A remarkable similarity in craniofacial morphology was revealed between the two groups, suggesting a close genetic affinity between modern and ancient Greeks.

The ability of the craniofacial complex to make compensatory or balancing changes was noted. The craniofacial complex was seen to function as an integrated biological entity. Moreover, the cranial base showed a definite influence on skeletal profile configuration. These results provide a more comprehensive understanding of how craniofacial variables interact and contribute to the morphology of the dentofacial skeleton. This article was originally submitted March 1986.

**Key Words**

Craniofacial morphology • Cephalometric analysis • Greek • Racial characteristics • Genetic affinity

**Figure 1**
**A skull mounted in a cephalostat.**

**Figure 2**
**Fresco painting, commonly known as "The Ladies in Blue", from the Palace of Knossus (ca. 1,800 B.C.), Heracleion Museum, Crete, Greece.**

**Figure 3**
**A typical tracing of a cephalometric roentgenogram depicting the landmarks used in this study.**

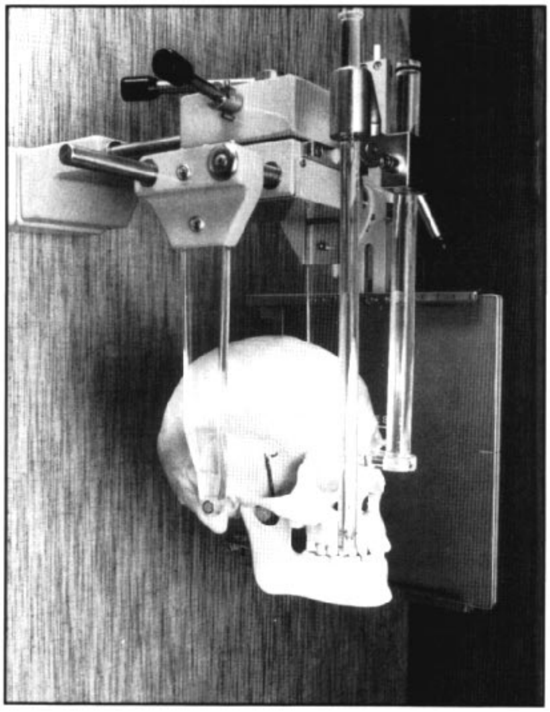

Figure 1

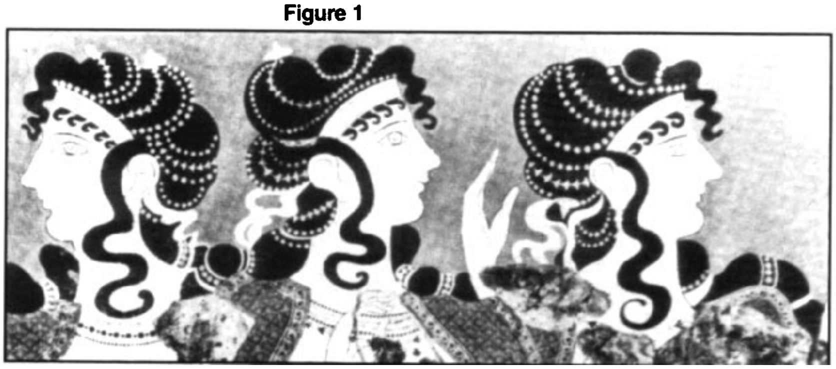

Figure 2

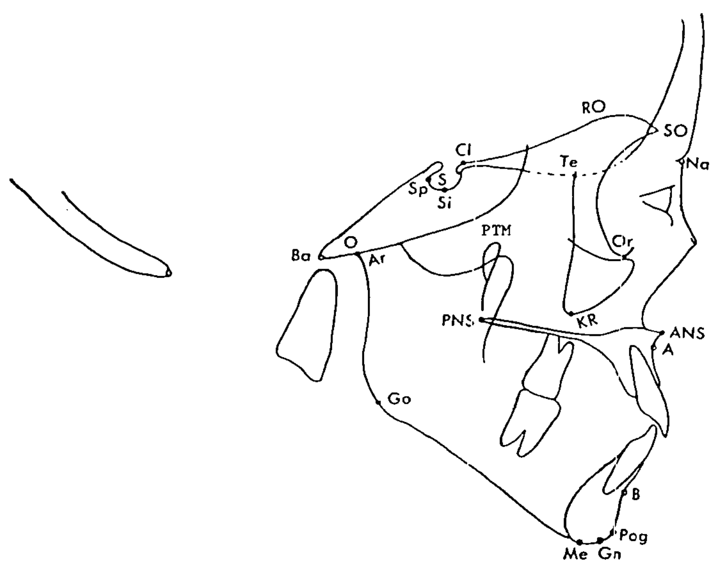


Figure 3

## Materials and methods

The sample of the modern Greeks consisted of 54 native Greek children (30 girls and 24 boys) born and reared in Athens and Pireaus (Greece) having an average age of 12 years. The ages ranged from 10 years to 14 years.

Apart from age, the following criteria were used for selection of the modern Greek sample:

1) Bilateral Class I molar and canine relationships (Angle classification, 1907) with incisor contact and well-aligned teeth.
2) Harmonious facial proportions with normal lip seal.
3) No history of previous orthodontic treatment, not even interceptive treatment.

One lateral cephalogram with a Broadbent-Bolton cephalometer was taken of each individual with the teeth in centric occlusion and the lips relaxed (100-115 Kv. 50 mA. with an exposure time of 80-100 milliseconds).

The material representing the ancient Greeks was drawn from the collection of crania in the museums of Herakleion and Chania, both located on the major Greek island, Crete. The skulls, articulated with the mandibles in centric occlusion, were mounted in a cephalostat. Forty (40) ancient skulls constituted the material of the ancient Greeks. One lateral cephalogram was obtained for each young skull with the teeth in centric occlusion (Figure 1). All the skulls belonged to young human adults (post-adolescence) although their age and sex were not known with certainty. The age range was based on the dental eruption and the dental attrition. Post-adolescent skulls were chosen for the sample because only adult crania were selectively kept by the excavators while the rest of the skeletal material was discarded or even reburied. The ancient skeletons were poorly preserved, making it impossible to separate the material according to sex. The post cranial skeleton, which could have been used as a reference to determine sex, was not available.

All but three of the ancient skulls had normal dental occlusions. The three exceptions displayed only minor anomalies, such as minor rotations or large spacing between the maxillary central incisors. The ancient Cretan skulls dated back to Minoan civilization, during the Bronze Age of 1,800-1,200 B.C. (Figure 2). At the time of the Minoan civilization, the Cretans represented a single homogeneous racial element, i.e., the Mediterranean, which still predominates throughout Greece.[15]

On all lateral cephalograms, anatomical bony structures were traced on .003 matte translucent acetate paper with a 0.5 millimeter F lead

| MEASUREMENTS | Ancient Greek Mean | Ancient Greek S.D. | Modern Greek Mean | Modern Greek S.D. | Significance Level for the Difference P | |
|---|---|---|---|---|---|---|
| **SKELETAL** | | | | | | |
| Anterior Cranial Base Length SN (in mm) | 73.96 | 4.01 | 69.77 | 3.32 | P<.001 | Ancient>Modern |
| *Maxilla Length ANS-PNS (in mm) | 58.42 | 3.66 | 53.04 | 3.33 | P<.001 | Ancient>Modern |
| **Mandible Length Pog-Ar (in mm) | 114.86 | 5.23 | 109.38 | 5.60 | P<.001 | Ancient>Modern |
| SNA Angle | 83.76 | 2.75 | 81.95 | 3.88 | P<.05 | Ancient>Modern |
| SNB Angle | 79.20 | 2.01 | 79.17 | 3.50 | NS | |
| SN Pog Angle | 80.42 | 2.17 | 80.26 | 4.17 | NS | |
| Angle of Convexity (Na-A-Pog) | 7.20 | 3.81 | 4.06 | 4.09 | P<.05 | Ancient>Modern |
| Facial Angle (Na-Pog to FH) | 87.98 | 2.36 | 86.88 | 3.86 | NS | |
| Y — Axis Angle (S-Gn to FH) | 61.17 | 2.73 | 60.65 | 4.36 | NS | |
| SN to GoGn Angle | 31.42 | 3.93 | 32.16 | 4.31 | NS | |
| Mandibular Plane Angle (GnGo to FH) | 23.80 | 3.40 | 26.25 | 5.24 | NS | |
| Cranial Base Angle (N S Ba) | 130.07 | 3.93 | 129.18 | 4.35 | NS | |
| Upper Facial Height % $\frac{(\text{N-ANS})}{(\text{NM})}$ % | 42.11 | 1.99 | 45.6 | 3.87 | P<.001 | Ancient>Modern |
| Lower Facial Height % $\frac{(\text{ANS-Me})}{(\text{NM})}$ % | 57.88 | 1.99 | 54.4 | 4.45 | P<.001 | Ancient>Modern |
| **DENTAL** | | | | | | |
| $\underline{1}$ to SN Plane Angle | 99.35 | 6.19 | 101.94 | 6.36 | NS | |
| $\overline{1}$ to SN Plane Angle | 54.04 | 4.68 | 53.98 | 5.59 | NS | |
| $\underline{1}$ to $\overline{1}$ Interincisal Angle | 134.35 | 7.30 | 132.18 | 7.09 | NS | |
| $\overline{1}$ to GoGn Plane Angle | 93.93 | 3.73 | 93.62 | 5.60 | NS | |
| Occlusal Plane to SN Plane Angle | 15.90 | 2.93 | 17.14 | 4.14 | NS | |
| $\underline{1}$ to A-Pog (in mm) | 4.05 | 1.76 | 5.36 | 1.98 | NS | |
| $\overline{1}$ to Na-Pog (in mm) | 1.95 | 1.45 | 2.94 | 2.64 | NS | |

* This was measured as the projection to Frankfort Horizontal Plane (FH)
**This was measured as the projection to the Mandibular Plane (GoGn)

**Table I**
**A comparison of 21 craniofacial measurements: means, standard deviations and level of significant differences, between the modern Greek sample and the ancient Greek sample.**

pencil. The midline of all contours of bilateral structures was traced to minimize the error due to positioning, differential magnification and asymmetry.

Definitions of all reference points (Figure 3) and reference planes used throughout this investigation were in accordance with the standard definitions given by Björk[16] and by Krogman and Sassouni.[17]

Overall, 21 measurements, including five linear, 14 angular and two proportional were used for the comparison. A special attempt was made to select measurements which would reliably express inter-population differences. The lengths of the maxilla (ANS-PNS) and mandible (Pog-Ar) were measured as projections to the Frankfort horizontal and mandibular plane (GoGn) respectively.[18]

Details of all these measurements defined by Brodie,[19] Björk,[16] Downs,[20] Wylie[18] and Steiner[21] are well-known and need not be discussed further. In order to check the accuracy of measurements, an inter-judge test was used. The Pearson product-moment correlation coefficient was used to check the correlation of measurements between the two judges.

## Method of analysis

**Statistical analysis:** All data obtained from the 21 measurements performed on each subject, relative to skeletal and dental proportions, were subjected to statistical analysis. In Björk's graphical analysis and Sassouni's composite superimposition analysis, no attempt was made to test the significance of the findings by statistical means.

The mean, range, standard deviation and standard error were computed for each measurement for both groups. For the inter-group comparisons, the Students' $t$-test was used to determine statistically significant differences. The accepted levels of statistical significance for this study were as follows:

| | |
|---|---|
| $P<0.05$ | Probably Significant |
| $P<0.01$ | Significant |
| $P<0.001$ | Highly Significant |

Figure 4

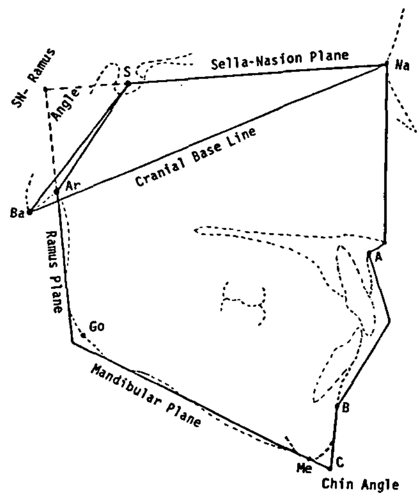


Figure 5

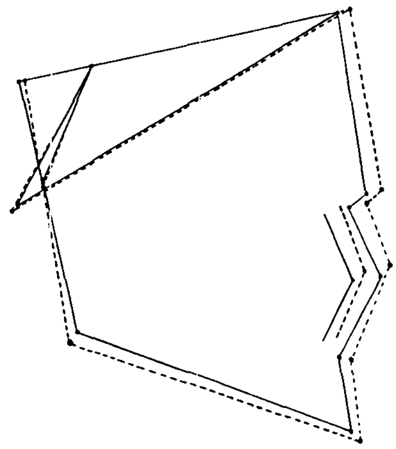

Figure 6

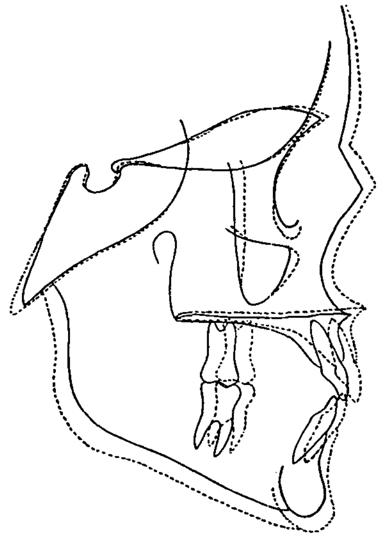

**Figure 4**
**Schematic drawing illustrating the points, planes and angles for the construction of craniofacial polygon (Björk) used in this study.**

**Figure 5**
**Comparison between the mean craniofacial polygons (Björk) from modern (_____) and ancient (- - - -) Greek samples. The polygons are superimposed on the Sella-Nasion Plane and registered at Sella (S).**

**Figure 6**
**Comparison of the modern (_____) and ancient (- - - -) Greek composite standards by superimposing on DeCoster's Line and Optic (Sassouni) Plane.**

If the probability was declared probably significant (denoted by $P<0.05$), a second diagnostic method was considered in order to establish conclusive evidence as to the significance of the difference.

**Björk's craniofacial polygon analysis (Figure 4):** In this method of analysis a geometric craniofacial diagram is constructed separately for each of the two groups, based on the mean values of the measurements selected from Björk's method. The two resulting mean polygons, superimposed on the SN plane with Sella (S) registered, were compared to illustrate differences in the skeletal profile configuration due to the shape of the cranial base.

**Sassouni's composite superimposition analysis:** In this technique a comparison in size, shape and especially position of different skeletal and dental structures, which is not possible to evaulate by means of angular and linear measurements, were performed. Similarities or differences in skeletal configuration between these two groups were assessed by visual observation and by linear measurements.[22]

Sassouni's archial analysis was employed on each one of the final composite standard tracings. This analysis allowed the comparison of form irrespective of the size of the head and the face. In addition, it strengthened the statistical significance of earlier controversial numerical findings.

## Results

**Angular-linear measurements (Table 1)**

The results obtained revealed a striking similarity in 12 of the 14 measurements. Only the SNA and NAPog angles were probably statistically significant between the two groups (at the $P<0.05$ level). However, the N-A-Pog angle may not be considered reliable due to the large standard deviation found in both groups.

As expected, age changes were observed in most of the skeletal linear measurements ($P<0.001$).

Mean values of both major angular and linear dental measurements were almost identical in both groups.

**Björk's craniofacial polygon analysis**

Study of the geometric portraits of each craniofacial complex revealed that, despite differences in some of the linear dimensions, craniofacial form was remarkably similar in both groups (Figure 5). It also illustrates how the skeleton polygon of the modern group was disposed slightly retrognathically when compared to the ancient group. This was due to linear differences resulting from age.

It is obvious that the considerable resemblance in the skeletal profile was correlated with the shape of the cranial base. The shape of the cranial base angle, i.e., its deflection as given by the angles N-S-Ba and N-S-Ar, was identical in both groups. Furthermore, the straight profile configuration in both groups was associated with a close approximation of the skeletal outlines. The angles S-N-ANS, SNA, SNB, SNPog, NSAr, NSBa were almost identical in both groups.

In conclusion, the greatest similarity between the two groups lies in their dental pattern which

**Table II**
**A comparison of modern Greek and ancient Greek cephalometric composite standards by Sassouni's composite superimposition analysis.**

| | Measurements | Difference of Modern to Ancient Greek Sample | Amount |
|---|---|---|---|
| Size | Anterior Cranial Base Length (S-Na) | Smaller | 4 mm |
| | Posterior Cranial Base Length (S-Ar) | Same | - - - - |
| | Maxilla Length (ANS-PNS) | Smaller | 3 mm |
| | Mandibular Corpus Length (Go-Pog) | Smaller | 4.5 mm |
| Position | Position of ANS related to Na | Same | - - - - |
| | Position of Pogonion related to Na | Same | - - - - |
| | Position of Point A related to Na | Same | - - - - |
| | Position of Point A related to ANS | Same | - - - - |
| | Position of Point B related to Na | Same | - - - - |
| | Position of Point B related to Pog | Same | - - - - |
| | Position of $\underline{1}$ to Maxillary Plane | Same | - - - - |
| | Position of $\overline{1}$ to Mandibular Plane | Same | - - - - |
| Total Anterior Facial Height | (SOR-Me) | Shorter | 6 mm |
| Upper Anterior Facial Height | (SOR-ANS) | Same | - - - - |
| Lower Anterior Facial Height | (ANS-Me) | Shorter | 6 mm |
| Total Posterior Facial Height | (Sp-Go) | Shorter | 7 mm |
| Upper Posterior Facial Height | (Sp-PNS) | Same | - - - - |
| Lower Posterior Facial Height | (PNS-Go) | Shorter | 7 mm |
| Cranial Base Angle | (N-S-Ba) | Same | - - - - |
| Saddle Angle | (N-S-Ar) | Same | - - - - |
| Articular Angle | (S-Ar-Go) | Slightly Smaller | 2 degrees |
| Gonial Angle | (Ar-Go-Me) | Smaller | 3 degrees |
| Maxillary Plane Inclination to Supraorbital Plane | | Same | - - - - |
| Mandibular Plane Slope to Supraorbital Plane | | Same | - - - - |
| Mandibular Corpus to Anterior Cranial Base Ratio | | Same | - - - - |

was identical. Following that, the next closest similarity was in the uniformity of their skeletal form and pattern, while a somewhat larger variation seems to exist between the linear measurements of the two groups.

**Sassouni's composite superimposition analysis**

The two final composite standards were superimposed at the areas of greatest similarity on the cranial base and the greatest similarities on the part of DeCoster's line (Figure 6). This method demonstrated the overall size of the craniofacial structures of the modern group to be smaller than that of the ancient group; these findings conform with most studies of the developing human face.

Table II presents a comparison between the two groups. The position of different anatomical structures was assessed by superimposing the two final composite standards on the Optic Plane[23] with Na as a registration point. From the above findings, it can be concluded there was no difference between the two groups using this positional analysis since all the measurements were found to be about the same in both groups.

These findings are in agreement with the numerical measurements discussed before.

Sassouni's archial analysis applied to the final composite standards revealed that the basic architecture of the head and the face and the relative proportions of the various parts were harmonious and well-proportioned for each group according to age (Figure 7 and Figure 8). Among the findings, it is interesting to note that the mandibular corpus length (Go-Pog) in both groups is slightly greater (on the prognathic borderline) than the normal length specified by the drawing arcs; however, it is still within the limits of the acceptable range established for Class I skeletal patterns. The last finding gave further supporting evidence to the concept of the slightly prognathic Greek profile, as previous research by the author had emphasized.[24] The recent study reconfirms that the slight (but

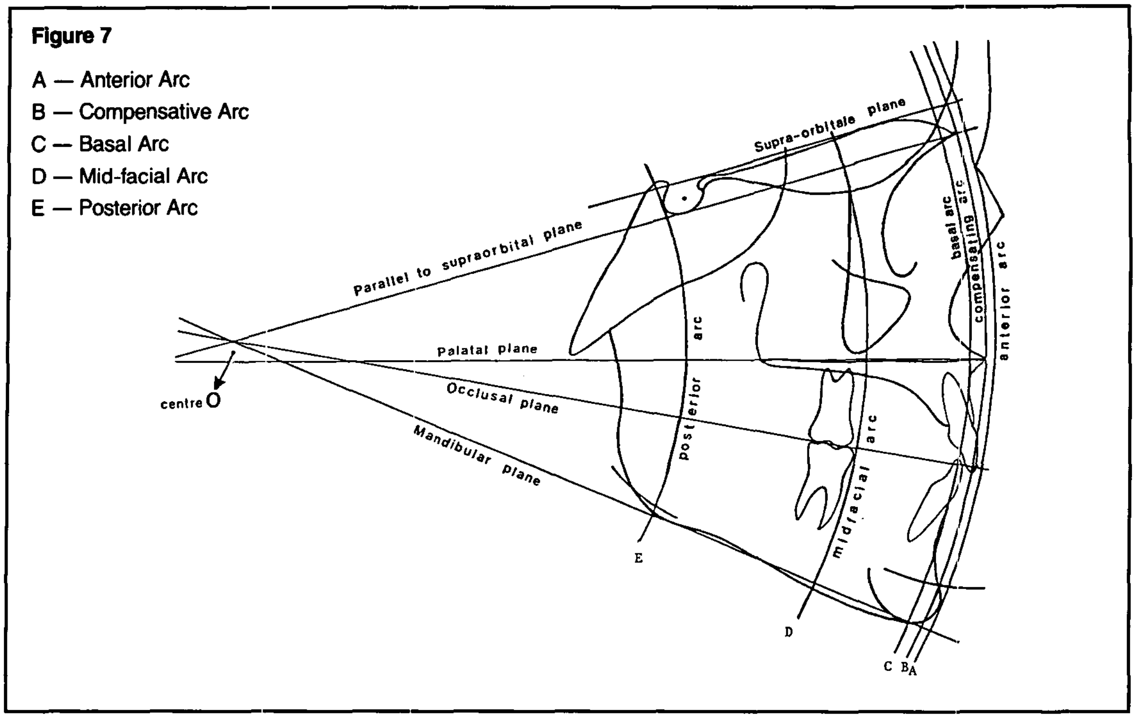


**Figure 7**
**Sassouni archial analysis applied on the ancient composite standard (derived from the lateral tracings of the ancient Greek sample).**

still within normal range) prognathic mandible is a morphological characteristic expressed plainly as much in the ancient as in the modern Greek ethnic group. Therefore, the Greek configuration is characterized by a slight prognathic profile with a Class I skeletal pattern.

The maxillary convexity in the ancient Greeks, as interpreted by the angular measurements, cannot be substantiated by the readings of archial and composite superimposition analyses (Sassouni). In view of the foregoing, the uncertain differences in the SNA and NAPog angles between the two groups were rejected by the findings of the above analyses.

## Discussion

An overall view of the findings obtained from these cephalometric analyses indicates that the Greek ethnic group has remained genetically stable in its cephalic and facial morphology for the last 4,000 years.

Considering the angular measurements (Table I), it was observed that 12 out of a total 14 measurements did not reveal any statistically significant differences between the two groups ($P>0.001$ and $P>0.01$). The mean value of the angles SNA and Na-A-Pog, which express maxillary prognathism, were higher in the ancient sample, and probably statistically significant ($P<0.05$). This finding could have suggested that the maxillary alveolar base was more prognathic in the ancient sample than in the modern, since identical angles of mandibular prognathism were reported for both groups (the mandibular prognathism was expressed by the mean values of SNB, SNPog and NaPog/FH angles). However, this was not the case, as no conclusive evidence could be based only on one numerical value at the $P<0.05$ level. Thus, an additional diagnostic method (Sassouni Archial Analysis) was employed, which permitted a comparison of maxillary prognathism between the two groups, irrespective of age. The information gained from archial analysis rejected the contention that the ancient sample exhibited a more pronounced maxillary convexity than the modern sample. Different readings between the two methods stem from the fact that archial analysis takes into account age, sex and growth potential variations, while the conventional numerical analyses fail to consider these elements. Therefore, the findings of different cephalometric diagnostic analyses should be interpreted with caution.

The foregoing data can be further substantiated by the cephalometric composite standards, which were produced to facilitate comparison. The close similarity in facial convexity between the two groups becomes readily apparent in Sassouni's composite superimposition analysis. This similarity was considerable for both position and shape of skeletal and dental structures, but was less evident in their size.

Although proportions of the craniofacial skeleton expressed by the angular measurements seem to differ slightly, there was a striking difference in linear measurements on skeletal structures between modern and ancient groups. This was to be expected due to the age difference

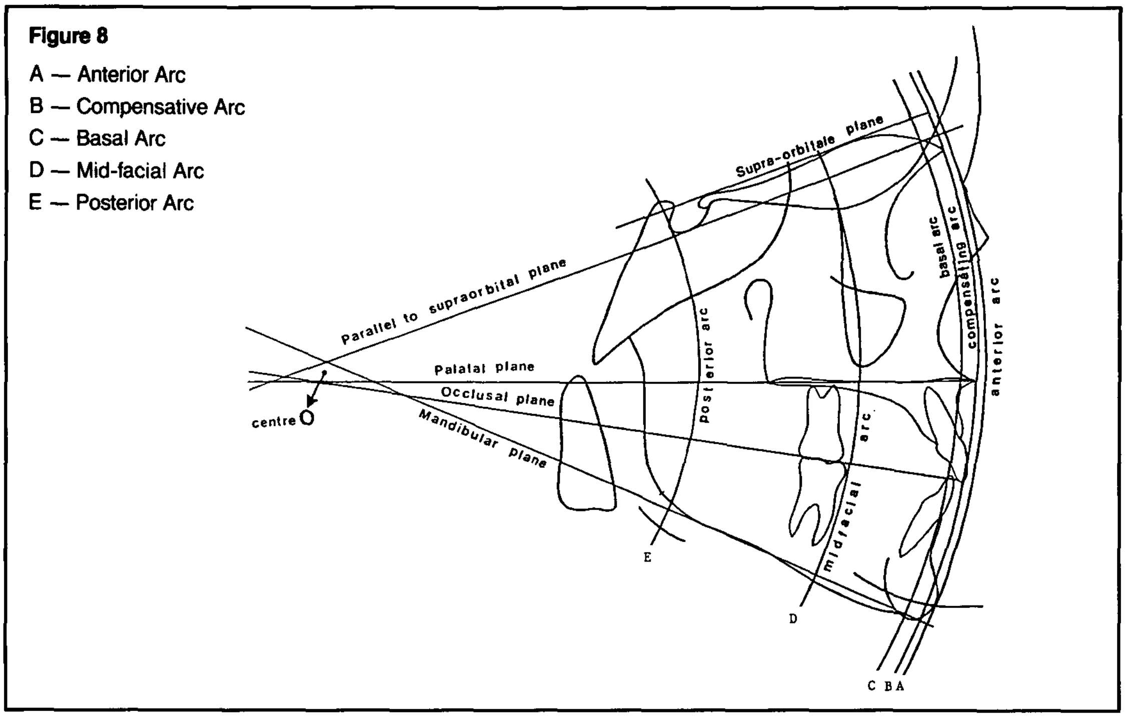


**Figure 8**
**Sassouni archial analysis applied on the modern composite standard (derived from the lateral tracings of the ancient Greek sample).**

between the two groups. The mean linear size of anatomical structures was greater in the ancient sample than in the modern one, and most revealed highly significant differences ($P<0.001$). This applied more to facial height than to facial depth. The difference in linear measurements was especially evident in the craniofacial polygons and cephalometric composite standards analyses.

In contrast to the linear measurements, it was evident that the angular measurements tended to remain relatively constant or each year brought a slight variation.[25-27] Therefore, none of the differences in linear size between the two groups could be considered conspicuous, since they represent age differences and will change with growth.

Similar reasoning might well explain the variability of the standard deviations. Judging from the standard deviations and the range of variations, the modern sample was generally more variable than the ancient sample. This lesser degree of variability in the ancient sample could be related to the fact that skeletal maturity has already been attained, by comparison with the modern sample.

There is one further point to consider when interpreting Björk's craniofacial polygons and cephalometric composite standards. Despite age differences in some of the linear measurements between the two samples, the way in which the dentoskeletal parts fit together, i.e., how the angular, proportional and linear figures correlate, revealed a marked similarity in skeletal shape, a uniformity in facial profile and a more pronounced resemblance in dental pattern. This is due to genetic affinity between the two groups and closely conforms to the findings of other investigators.[14,27,28] The above results also support the concept of the craniofacial complex as a complete biological entity and, thus, no single measurement means much by itself.[29-34]

The close similarity in skeletal profile configuration is reinforced by a remarkable similarity in the shape of the cranial base,[34-36] which has been emphasized particularly in racial identification.[6,17,25,28] The shape of the cranial base, as expressed by the angles NSBa and NSAr (Table II), strongly indicates a genetic homogeneity between the two groups. Our results also support the observation that the cranial base is completely developed before the facial cranium.[16,17,37] They further support Enlow's[36,38] philosophy that there is an association between the configuration of the cranial base and the facial type.

According to Enlow et al.,[36,38] the inclination of the middle cranial fossa has a definite influence on the facial profile. Three principal morphologic features of the craniofacial skeleton that contribute to the similarity in skeletal profile configuration and which were found to be common to both groups were:

1. The forward and upward rotational orientation of the ramus.
2. The upright inclination of the middle cranial fossa.

| Dentoskeletal Parameters | Armenian Sample Age Range 10-14 yrs (Bedrossian) | Modern Greek Sample Age Range 10-14 yrs (Present Study) | Ancient Greek Sample Young Adults (Present Study) | Arabian Sample Age Range 10-14 yrs (Nashashibi) | Iranian Sample Age Range 10-14 yrs (Davoody and Hajighadimi) |
|---|---|---|---|---|---|
| SN (in mm) | 75.25 | 69.77 | 73.96 | — | 75.41 |
| ANS-PNS (in mm) | 53.98 | 53.04 | 58.42 | — | 50.74 |
| Pog-Ar (in mm) | 104.92 | 109.38 | 114.86 | — | 105.4 |
| SNA Angle | 81.50 | 81.95 | 83.76 | 83.77 | 80.82 |
| SNB Angle | 77.50 | 79.17 | 79.20 | 80.50 | 77.52 |
| S N Pog Angle | 78.12 | 80.26 | 80.42 | 81.52 | 77.88 |
| Na-A-Pog Angle | 6.97 | 4.06 | 7.2 | 7.34 | 7.37 |
| Na-Pog to FH Angle | 83.42 | 86.88 | 87.98 | 84.53 | 85.81 |
| S-GN to FH Angle | 63.50 | 60.65 | 61.17 | 66.4 | 61.4 |
| N S Ba Angle | 133.24 | 129.18 | 130.07 | 127.86 | 131.98 |
| N-ANS / NM % | 47% | 45.6% | 42.11% | 44.55% | 45.6% |
| ANS-Me / NM % | 53.1% | 54.4% | 57.88% | 55.45% | 54.4% |
| 1 to SN Plane Angle | 102.31 | 101.94 | 99.35 | 108.53 | 104.05 |
| 1 to SN Plane Angle | 46.78 | 53.98 | 54.04 | 50.19 | 45.10 |
| 1 to 1 Angle | 125.48 | 132.18 | 134.35 | 122.65 | 125.6 |
| Occ. Pl. to SN Pl. Angle | 18.03 | 17.14 | 15.90 | 16.87 | 16.77 |
| 1 to GoGn Plane Angle | 101.13 | 93.62 | 93.93 | 95.45 | 96.90 |
| 1 to A-Pog (in mm) | 5.93 | 5.36 | 4.05 | 4.36 | 5.86 |
| 1to Na-Pog (in mm) | 4.87 | 2.94 | 1.95 | 6.04 | 5.28 |
| SN to GoGn Angle | 33.56 | 32.16 | 31.42 | 33.85 | 34.91 |
| GnGo to FH Angle | 28.20 | 26.25 | 23.80 | 29.63 | 28.02 |

**Table III**
**A comparison of the ancient Greek dentoskeletal parameters with other races of the Eastern Mediterranean (modern Greeks, Lebano-Armenians, Arabs, Irano-Mediterraneans).**

3. The notably broader ramus relative to the middle cranial fossa.

All these characteristics are schematized in Figures 5 and 6. The almost identical dental pattern between the two groups adds further confirmation to the concept of their common ethnic origin. Lusterman[39] concluded that even within the four basic subgroups of the European stock, differences are expressed in the dental area, since the dental area is subjected to great inter-group variation. Similarly, Richardson[14] noted that dentoalveolar parameters show great differences among ethnic and racial groups. In view of the above, one would expect that, if differences had existed in the craniofacial complex between the two groups studied, they would have been expressed primarily in the dental area rather than in other parts of the craniofacial skeleton. But, as has been established, this was not the case.

While not the principal purpose of this study, an interesting finding was made regarding the relationship of skeletal chin to cranial base. The results derived from archial analysis, which particularly emphasizes facial harmony, revealed that chin prominence was similar in both groups, tending towards prognathism but still within the normal limits established for Class I skeletal type. The above observation gave further supporting evidence to the racial origin of Greeks, since the slightly prognathic mandible, a typical morphological characteristic of the modern Greeks, was also a dominant feature in the ancient sample.

**Comparison of the Greek craniofacial pattern (present findings) with other modern races of the Eastern Mediterranean (Armenians, Arabs, Iranians)**

The degree of similarity between the two Greek samples can be appreciated fully by comparison with other races of the Eastern Mediterranean. The Greek dentoskeletal measurements were compared with those of the Armenians residing in Lebanon,[40] Arabs[41] and Iranians (Irano-Mediterranean) which are a branch of the Mediterranean race.[42,43]

In order to secure the validity of the comparison, only the studies which used the same criteria for sample selection as those of the present research were selected (i.e., sample size, sex, type of malocclusion and same chronological age range, 10-14 years).

Table III shows that the craniofacial pattern of the ancient Greeks is closer to that of the modern Greeks than it is to the Armenians, Arabs and Iranians. The dental pattern of the above mentioned groups showed a definite bimaxillary protrusion. The most striking difference was focused on the inter-incisal angle. In addition, all the measurements reflected the dental procumbency in the Armenians, Arabs and Iranians when compared to the Greeks.

## Summary and conclusions

The findings of this study can be summarized as follows:

**Similarities:**

1. The shape, form and pattern of the craniofacial skeleton showed striking similarity in

both ancient and modern Greek groups as demonstrated by Björk's facial and Sassouni's composite superimposition analyses.

2. The dental pattern was remarkably similar in both groups.
3. The position of the different skeletal structures of the craniofacial complex relative to cranial base revealed remarkable stability in the anteroposterior direction in both groups as shown by Sassouni composite superimposition analysis.
4. The similarity in skeletal profile between the two groups was associated with a closely related cranial base shape.
5. The horizontal chin prominence, as revealed by archial analysis, was equal for both groups suggesting that this morphologic feature is dominant in the Greeks (race-linked).

**Differences:**

1. Most linear measurements of the ancient group exceeded those of the modern group (i.e., the length of the maxilla, the length of the mandible and the height of the face). The age distribution may well explain these differences.
2. The degree of similarity between the two Greek samples is greater than it has been between ancient Greeks and the other modern races of the Eastern Mediterranean, which were used as the control samples.

In conclusion, the similarity in craniofacial morphology found between the two Greek samples gives valuable clues to the genetic affinities of ancient Greeks with their contemporaries (modern Greeks).


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