OPEN

PRS GLOBAL OPEN

ORIGINAL ARTICLE
Research

Decoding Facial Dissymmetry: A Comparative Morphological Study on Human Skulls and Facial Structures

Marc Divaris, MD*†‡

Background: This study provides a detailed examination of facial asymmetry and its relationship with skeletal structure and soft tissues, aiming to better understand the morphological variations of the face.
Methods: The facial characteristics of 615 patients were analyzed using morphometric measurements. To complement this analysis, 189 skulls were examined to establish a concordance between skeletal structure and soft tissues, allowing for a deeper understanding of the observed asymmetry. The data were statistically analyzed to identify patterns of asymmetry.
Results: The measurements revealed a prevalence of the "narrow face" on the right side, characterized by features such as a narrower orbit, a thinner lateronasal area, and a slightly higher and narrower maxillomalar block. Notable exceptions to this pattern were observed, indicating significant individual variations.
Conclusions: Facial asymmetry is a constant feature among individuals and is influenced by complex embryological development processes. Identifying these variations provides new insights for aesthetic procedures, emphasizing the importance of a personalized approach to facial diagnosis. *(Plast Reconstr Surg Glob Open 2025;13:e6514; doi: 10.1097/GOX.0000000000006514; Published online 19 February 2025.)*

INTRODUCTION

The human face is commonly perceived as symmetrical, yet it actually exhibits subtle asymmetries. These asymmetries can be categorized into 2 types: directional asymmetries, which reflect systematic differences between the sides of the face, and fluctuating asymmetries, which correspond to minor random variations.[1,2]

In most cases, 1 side of the face appears slightly narrower, with its contours positioned closer to the midline, whereas the other side is broader. Although this difference is often barely noticeable, it contributes to the natural asymmetry of the face. To describe these variations, the terms "narrow face" and "broad face" have been introduced, with the former referring to the narrower side and the latter to the broader side.

However, the current literature does not provide a comprehensive explanation of the respective roles of skeletal structure and soft tissues in these variations. For instance, Ferrario et al[3] demonstrated the presence of facial asymmetry across human populations, whereas Ercan et al[4] conducted a statistical analysis of facial asymmetry using soft tissue markers. Peck et al[5] identified skeletal asymmetries, even in aesthetically balanced faces, and Haraguchi et al[6] highlighted the contribution of mandibular asymmetries to overall facial asymmetry.

Despite these studies, there is still a limited understanding of how bone structure and soft tissues work together to create facial asymmetry. The aim of this study was to address this gap by analyzing a large population sample, providing a more comprehensive view of how variations in bone structure and soft tissues collectively shape facial asymmetry.

MATERIALS AND METHODS

This study is structured around 2 main axes: a morphometric analysis of the skull (see Skulls) and an evaluation

*From the *Maxilofacial Surgery Department, Pitié Salpêtrière University, Paris, Île-de-France, France; †Maxilofacial Surgery Department, Georges Mandel Office, Paris, France; and ‡Musée de l'Homme, Paris-Sorbonne University, Paris, France.*

Received for publication March 30, 2024; accepted December 13, 2024.

DOI: 10.1097/GOX.0000000000006514

Disclosure statements are at the end of this article, following the correspondence information.

Related Digital Media are available in the full-text version of the article on www.PRSGlobalOpen.com.

of the face using a 3-dimensional (3D) imaging system (see Faces), aimed at exploring the relationships between bone structures and soft tissues in the context of facial asymmetry.

Skulls

This study was carried out on European human skulls from the 20th century, preserved at the Musée de l'Homme in Paris. The width and height of the orbital base, the distance between the anterior nasal spine (NASP) and the outermost point of the piriform orifices, as well as the distance between the NASP and the malar projection point, were measured (Fig. 1). The malar craniometric point (Mal) was specifically identified for its role in the youth triangle. Measurements were taken using an electronic caliper, following the reference points established by the authors.[7,8]

For angle and height measurements (plane differential), a specific protocol for photographing skulls was applied:

- The skulls were consistently oriented according to the Frankfurt plane.
- The distance between the skull and the camera was kept constant, resulting in a 1:1 scale photographic image.
- The detector plane was positioned horizontally, with the camera parallel to the Frankfurt plane.

Three transverse planes were identified (Fig. 1):

- P1: top of the orbital roof.
- P2: orbital floor.
- P3: malar projection point.

The differential distance between each transverse plane on the right and left sides was calculated, with an average established over 2 measurements. The analysis also included determining the skeletal angle, formed by the vertical median axis of the skull passing through the gnathion and the axis connecting the gnathion to the malar point.

Faces

The study was carried out on a diverse sample of voluntary patients, ensuring the representativeness of the sample. Consent was obtained in accordance with Declaration of Helsinki standards:

1. Inclusion criteria
   a. Class 1 dental occlusion, absence of craniofacial deformities, previous facial trauma, or orthognathic surgery. The minimum age was set at 19 to avoid variations linked to juvenile growth.
2. Three-dimensional photographic system
   a. Use of Canfield's VECTRA H2.
   b. Positioning of 3D images within a spatial reference grid to standardize position, eliminate postural attitudes, and obtain a 1:1 ratio.
3. Facial landmarks and measurements[9–21] (Fig. 2).
   a. Use of mid-sagittal points (gnathion, stomion, subnasal, pronasal, trichion) and lateral points (cheilion, alar crest, point S, exocanthion, endocanthion, superior and inferior palpebral, superciliary, zygion, malar).
   b. Landmarks based on Farkas'[22] definition were selected on the 3D facial images (Figs. 2, 3).
   c. Identification of a malar projection point "Mal" corresponding to the most anterior projection point at the apex of the soft cheek tissue.
   d. Five transverse planes (P1–P5) and 1 sagittal plane (P6) (Fig. 3).
4. Three types of measurements:
   a. Distance between 2 landmarks.
   b. Facial angle between the gnathion and Mal points and the sagittal plane (Me).
   c. Differential distance between each right and left transverse plane from P1 to P6.

Takeaways

Question: Does the study investigate the intricacies of facial dyssymmetry and its connection to bone structure and soft tissues, shedding light on diverse morphological facial variations?

Findings: Analyzing 615 patients and 189 skulls, the research revealed common "narrow face" traits on the right side, such as narrower eye orbits, a slender lateronasal area, and a slightly higher, narrower maxillomalar block. Significant individual exceptions emphasize the complexity of facial dyssymmetry.

Meaning: The study highlights the prevalence of right-sided narrow face features linked to bone and soft tissues, underscoring the importance of personalized facial assessments in aesthetic practices.

RESULTS

This study quantifies facial dissymmetries by comparing the narrow (N) sides with the broad (B) sides via a paired Student *t* test.

This classification is based on the "Mal" point, a bony and facial landmark whose reduced proximity to the sagittal axis systematically identifies the narrower side.

This study examined 189 human skulls and 615 faces of volunteer patients (366 women and 249 men) 19–76 years of age (average age 49.5 y). The results show that 116 of the 189 skulls present a thinner right side, a trend also observed in 503 of the 615 faces analyzed. These significant asymmetries, common to both samples, confirm a recurring trend in the population (Table 1).

The *t* tests reveal a significant difference in the transverse eye dimension, with side N averaging 27.19 mm compared with 27.58 mm for side B, illustrating a horizontal asymmetry. Eye height, slightly lower on side N, also shows a notable difference.

The Sn-Mal distance shows the largest difference, confirming a marked asymmetry between the sides.

The width of each hemi-lip (St-Ch) reveals a relatively significant asymmetry. The facial angle (MeMal) is statistically highly significant with *P* values less than 0.01, with a more open broad facial angle of 4.03 degrees on average.

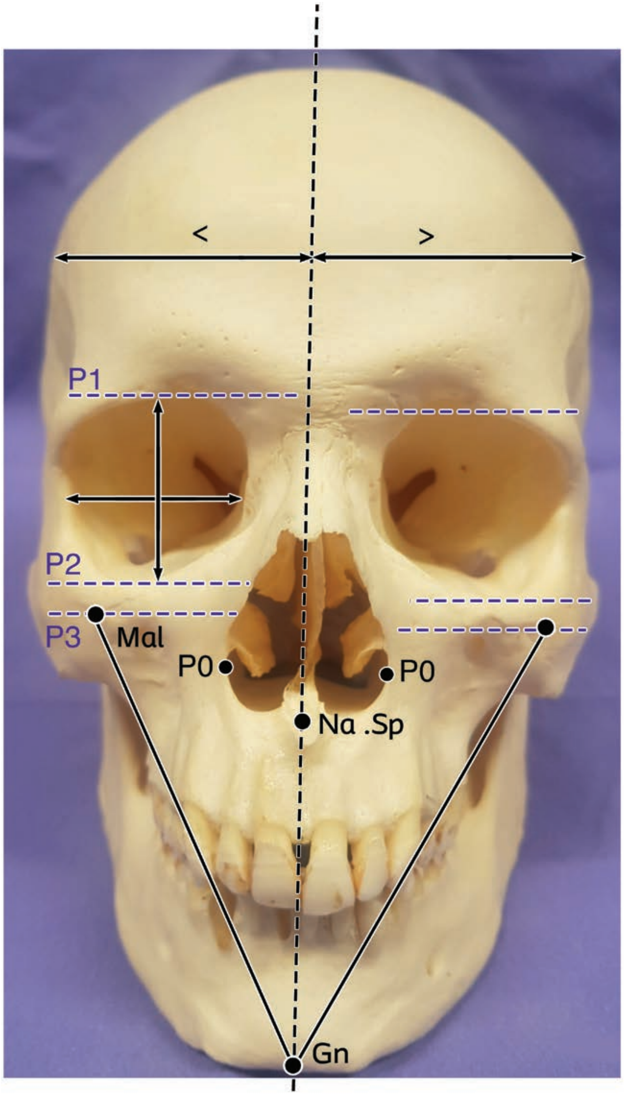


Fig. 1. The 20th-century European human skull with craniometric markings. Transverse and vertical orbital measurements, distance between the anterior NASP and the external point of the piriform orifices, between the anterior NASP and the malar point (Mal). Transverse planes passing through orbit roof (P1, P1′), orbit floor (P2, P2′), and malar projection point (P3, P3′).

The smaller distance (Sn-Mal) and facial angle characterize the narrow side, indicating a narrower hemiface.

The asymmetries observed are neither uniform nor specific to 1 side (Table 2).

Although the Tr-S distance is almost systematically longer on the narrow side, the facial angle is systematically more open on the broad side. The Sn-Mal distance is also longer on the broad side. However, when it comes to measuring orbital orifice distances, although the distances are greater on the broad side, the opposite is also true in about one-third of cases. These results highlight the complexity of facial asymmetries and the need for a nuanced approach to understanding the bone–soft tissue relationship.

Let us analyze the results of our *t* test study on our skull population (Table 3).

The cranial study reveals significant asymmetries, confirming the discrepancies observed in the soft tissues. Significant differences in eye width (transversal) and subnasal to malar distance (subnasal Mal), with *P* values less than 0.01, indicate that the narrow side is thinner than the broad side.

The skeletal angle (MeMal) also displays a significant asymmetry, aligned with the general tendency of bone structure to influence facial asymmetry. In contrast, eye height (vertical) showed no significant difference ($P = 0.32$). As with soft tissue, although the averages statistically indicate that the orbits on the narrow side are smaller, the transverse dimensions are larger for the narrow side in 19.12% of cases, and larger vertically in 39.57% of cases (Table 4).

Finally, Figure 4 shows a comparison of eye width (transversal orbit) for a sample of skulls and faces, highlighting asymmetry in relation to ideal symmetry. The majority of these points lie far from the line representing perfect symmetry, indicating that all the measurements present an asymmetry.

The second part of the study aimed to prove that, vertically, the cross-sectional planes of the narrow side (N) are generally higher than those of the broad side (B), across a sample of 615 subjects (Table 5).

Asymmetry is a constant in our measurements, as illustrated by the malar projection (P3 Mal), where an average of 2.56 mm reveals a significant difference in elevation between the 2 sides. This suggests that the narrow side often presents a higher malar projection, reflecting a common trait of asymmetry in facial structure.

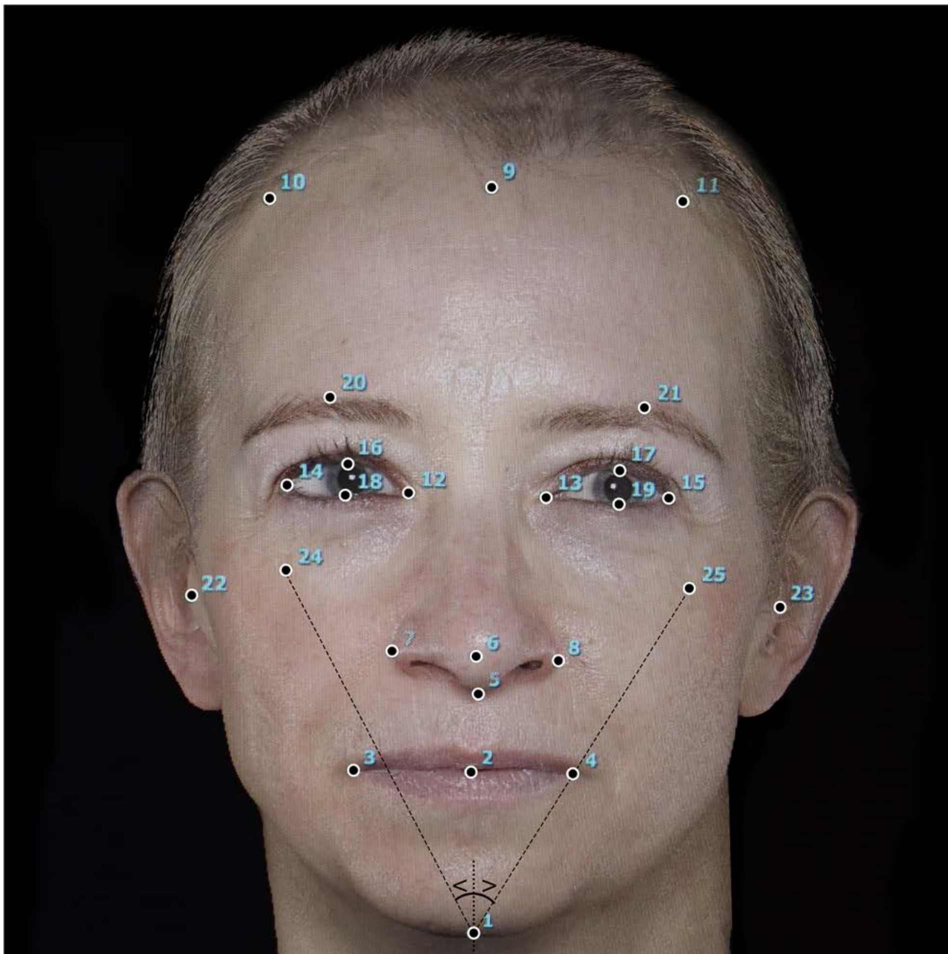
Concerning the absence of asymmetry, we note that there is symmetry of the eyebrows in 29.09% and the corners of the mouth in 27.27%. Malar projection, on the other hand, is virtually absent, with only 3.64% of measurements indicating no difference (Fig. 5).

The histograms show that for most facial markers—from the eyebrow (P1) to the mouth (P5)—the narrow side is generally higher, indicating a vertical asymmetry. Although a few divergent values show a negative differential, they remain exceptions to the general tendency of a higher narrow face. For P6, the tendency is for the external edge of the ear to protrude by around 1.387 mm on the broad side.

These results can be traced back to the bone (Table 6). The measurements done on patients confirm the impact of bone on facial asymmetries. They become more pronounced with aging, as the downward redistribution of soft tissue exacerbates right-left divergences. The cranial measurement method, although less precise, is nevertheless sufficiently reliable to support this conclusion.

DISCUSSION

Facial asymmetry has always captivated scientific minds, from eminent figures such as Lavater,[23] Hiss,[24] and Darwin[25] to modern researchers exploring human morphological variations, hence making facial



Landmarks			Définitions
1	-gn	Gnathion	The lowest point in the midline of the lower border of the chin.
2	-st	Stomion	The midpoint of the labial fissure when the lips are closed naturally.
3 & 4	-ch	Chelion	The outer corner of the mouth where the upper and lower lips meet.
5	-sn	Subnasal	The junction between the lower border of the nasal septum.
6	-pp	Photographic pronasal	The centroid of the surface of the nasal tip as seen in frontal view, Intersecting the facial sagital plane.
7 & 8	-ac	Alare crest	The most lateral point of the nostril wing.
9	-tr	Trichion	The midpoint of the hairline.
10 & 11	-S	S point	Point at the intersection of the temporal hairline and the anterior frontal line.
12 & 13	-en	Endocanthion	The inner corner of the palpebral fissure where the eyelids meet.
14 & 15	-ex	Exocanthion	The outer corner of the palpebral fissure where the eyelids meet.
16 & 17	-ps	Palpebral superius	The highest point of the upper margin of the middle portion of the eyelid.
18 & 19	-pi	Palpebral inferius	The lowest point of the upper margin of the middle portion of the eyelid
20 & 21	-su	Superciliary	The highest point of the margin of the superciliary crest.
22 & 23	-pz	Photographic zygion	The most external point on the margin of the face below the eyes.
24 & 25	-ma	Mal	The most projected point of malar.

Fig. 2. Landmarks used in face study. Female, 41 years old. Credits: Vectra Software.

asymmetry a subject of major interest. Various studies have explored the narrower side of the face, ranging from ancient skull samples[26] to contemporary populations, often revealing divided opinions regarding the dominant side of asymmetry. For example, Woo[27] noted a prevalence of the right side of the face, whereas others, such as Lundstrom[28] and Rossi et al,[29] emphasized the natural left-right asymmetry of craniofacial structures. Shah and Joshi[30] observed a wider facial area on the right side, whereas Vig and Hewitt[31] found an inverse asymmetry, with Kaipainen et al[32] observing this asymmetry more frequently on the chin.

This study meticulously analyzed facial asymmetries across a large cohort of 615 individuals as well as 189 contemporary 20th-century skulls, revealing that 81.95% of faces had a wider left side, similarly observed in 61.3% of skulls. As the time differences among the skulls studied did not exceed a century, they are unlikely to significantly influence the results, given the stability of cranial features over such a period of time.

It is also crucial to take note that this study does not differentiate between participants according to their ethnicity, in obedience to the requirements of French law. However, individual variations, notably linked to sex or age,[33–43] could influence the facial asymmetry observed. Research suggests that asymmetries may increase with age, notably due to age-related structural and tissue modifications. However, this study chose not to explore this aspect in detail, focusing instead on the concordance between bone and soft tissue features at an adult stage.

Fig. 3. Frontal view of a 3D face. Five defined transverse planes perpendicular to the mediofacial plane and the coronal plane passing through: P1, the highest point of eyebrow; P2, the lowest point of lower eyelid; P3, malar point (Mal); P4, the lowest point of the nostril wing; P5, chelion or tip of lip. On the opposite side of the face, the corresponding points are marked P1′, P2′, P3′, P4′, and P5′. The analysis of height differences between these points and their opposites enables assessment of facial asymmetry in the vertical position. Additionally, the zygion-P6 distance differential is evaluated in a sagittal plane. Credits: Virginie Denis.

Table 1. Dissymmetry Analysis of Facial Data Points

Observation	Side	N	Mean (mm)	Median (mm)	SD (mm)	Mean Difference (mm)	*t* Statistic	*P*
Upper third	N	615	61.95	62	14.81	7.5	12.8	0
	B	615	54.45	54	13.28			
Transversal orbit	N	615	27.19	27.34	3.32	−0.38	−2.65	0.01
	B	615	27.58	27.63	3.22			
Vertical orbit	N	615	9.78	9.72	1.43	−0.25	−2.18	0.03
	B	615	10.03	9.94	1.4			
Subnasal Mal	N	615	62.77	63.02	3.48	−4.8	−15.26	0
	B	615	67.57	67.5	3.51			
PNasa	N	615	32.42	32.41	3.07	0.18	0.73	0.47
	B	615	32.24	32.44	3.06			
StoChel	N	615	29.56	29.55	2.66	0.39	2.08	0.04
	B	615	29.17	29.11	3.06			
Angle: MeMal	N	615	34.61	34.46	2.87	−4.03	−8.849	0
	B	615	38.64	38.44	4.09			

Credits: Marc Divaris.

Table 2. Table of Proportions of Observations for N > B and B > N (Face)

Pair	N > B (%)	B > N (%)
Upper third N versus upper third B	98.53	1.46
Transversal orbit N versus transversal orbit B	30.2	69.7
Vertical orbit N versus vertical orbit B	31.5	68.5
Subnasal Mal N versus subnasal Mal B	0	100
PNasa N versus PNasa B	63.73	36.27
Angle: MeMal N versus MeMal B	0	100

Credits: Marc Divaris.

Table 3. Dissymmetric Analysis of Skull Data Points

Observation	Side	N	Mean	Median	SD	Mean Difference	*t* Statistic	*P*
Vertical orbit	N	189	33.51	33.49	2.80	−0.16	−1.01	0.32
	B	189	33.67	33.52	2.86			
Transversal orbit	N	189	37.71	37.84	2.90	−0.69	−4.98	0.00
	B	189	38.39	38.42	2.92			
Nas Sp–PO	N	189	15.00	14.70	4.71	−0.29	−1.77	0.08
	B	189	15.29	15.00	5.04			
Nas Sp–Mal	N	189	53.46	53.27	4.55	−2.30	−11.47	0.00
	B	189	55.76	55.40	4.37			
Angle: MeMal	N	189	28.94	29.00	1.18	−2.34	−12.56	0.00
	B	189	31.29	31.00	2.10			

Credits: Marc Divaris.

Table 4. Table of Proportions of Observations for N > B and B > N (Face)

Pair	N > B (%)	B > N (%)
Transversal orbit N versus transversal orbit B	19.12	80.88
Vertical orbit N versus vertical orbit B	39.57	60.43
Nas Sp–Mal N versus Nas Sp–Mal B	2.64	97.36
Angle: MeMal N versus MeMal B	2.11	97.8
Nas Sp–PO N versus Nas Sp–PO B	48.1	51.9

Credits: Marc Divaris.

The malar projection (Mal) was selected for its clear observability on both skulls and faces, effectively highlighting facial asymmetry. This feature defines the narrower and wider sides of the face. To build on this, distinct techniques were used to analyze cranial structures and soft tissues, ensuring sagittal plane alignment and eliminating postural variations. This approach enabled precise transverse plane comparisons and justified the use of "concordance" over "correlation." Instead of directly correlating, the focus was on comparing cranium measurements with soft tissue analysis. This provided a better understanding of the relationship between the skeletal framework and soft tissues.

All 3 levels of the face are analyzed.

Upper Third of the Face

The Tr-S frontal distance analysis showed a significant difference, with a mean anterior forehead line 7.5 mm longer on the side identified as narrow ($P < 0.01$). This extension is ascribable to a receding hemi-forehead, where the scalp follows the contour of the skull, pulling back the onset of the temporal zone.[44,45] These consistently observed features confirm a notable dissymmetry of the forehead in relation to a narrower maxilla-malar middle third (Fig. 6).

A study of the lower part of the frontal bone, corresponding to the roof of the orbit, reveals a frequent dissymmetry, with the P1 axis most frequently higher on the narrow side, both on skulls and faces, with a mean difference of 0.82 and 0.94 mm, respectively. This is consistent with the findings of previous studies.[46,47]

Middle Third of the Face

In the context of embryogenesis, the observed dissymmetry may be attributed to subtle movements of the maxillary bud, notably a slight withdrawal in 3D space which influences the positioning of the malar point (Mal) closer to the midline on the narrow side.

Eye and Orbit Dimensions

Measurements are never identical.[48–52] We can establish concordance between these 2 studies (skulls and faces) with similar results. However, whereas in a large majority of cases, the eye and orbit on the narrow side are smaller transversely, in lesser proportions they may be slightly larger in vertical diameter than on the broad side, in around a third of the cases, thereby demonstrating the complexity of individual variations. The study of orbital height P1, P2 reveals that the narrow side is often higher, indicating a frequent vertical asymmetry. However,

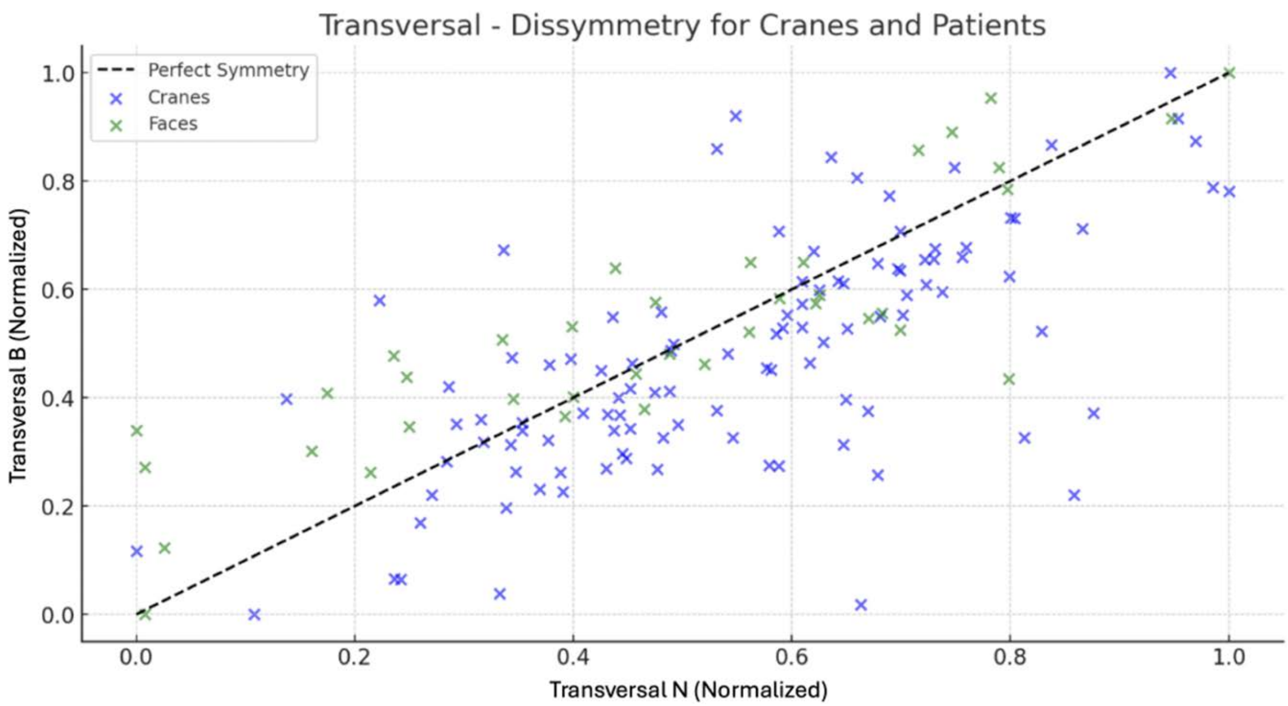


Fig. 4. Transversal orbit—dissymmetry for skulls and faces. Credits: Marc Divaris.

Table 5. Analysis of Bone Dysmetria in the Vertical Axis (Faces)

Measure	Mean (mm)	SD (mm)	*P*	Absence of Asymmetry (%)	No. Measure
P1 eyebrow	0.763	1.048	0.00	29.09	615
P2 Eyelids	0.948	0.887	0.00	16.36	615
P3 Mal	2.560	1.242	0.00	3.64	615
P4 Subnasal	0.929	0.866	0.00	18.18	615
P5 Mouth	0.647	1.028	0.00	27.27	615
P6 External ear	1.387	0.830	0.00	5.45	615

Credits: Marc Divaris.

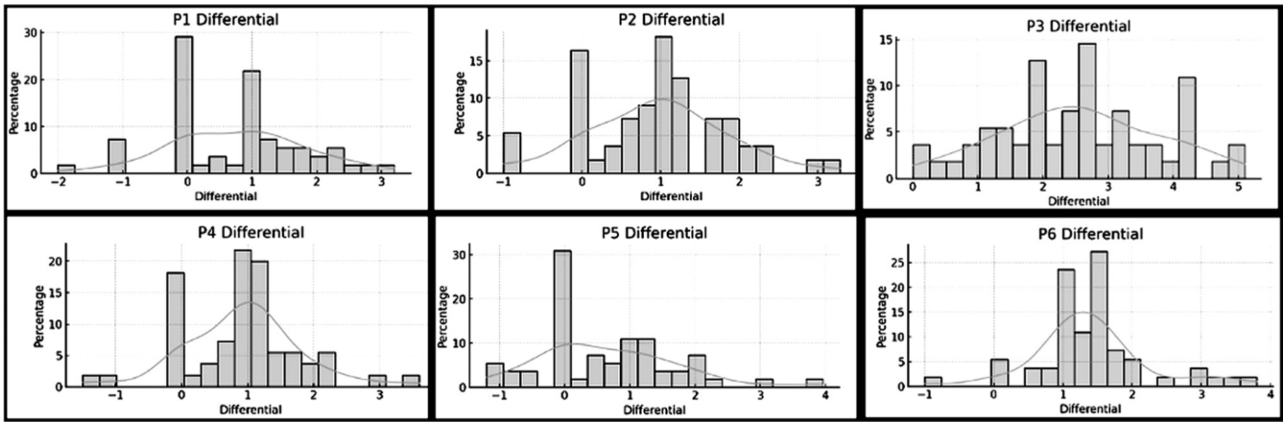


Fig. 5. Distribution of narrow vs broad differential for plans P1 to P6 (in millimeters). Credits: Marc Divaris.

some measurements diverge, sometimes showing a higher orbital height on the broad side.

Nose

Statistical analysis reveals that, despite a virtually similar Nas Sp–PO distance between the sides, the retroprojection of the nasal buds on the narrow side generates a narrower visual perception of the nostril orifice. This illusion is a consequence of the 3D perspective (Fig. 7). Statistical results also indicate a significant difference in height for axis P4, with the narrow side often showing a higher position; nevertheless, in 4.4% of cases, this height

Table 6. Vertical Axis Bone Dysmetria Analysis (Skulls)

Measure	Mean (mm)	Median (mm)	SD (mm)	*P*	Absence of Asymmetry (%)	No. Measure
P1 Orbit roof	0.72	1	0.78	0.00	19.29	189
P2 Orbit floor	0.34	0.5	0.49	0.00	42.14	189
P3 Mal projection	0.84	1	0.92	0.00	22.86	189

Credits: Marc Divaris.

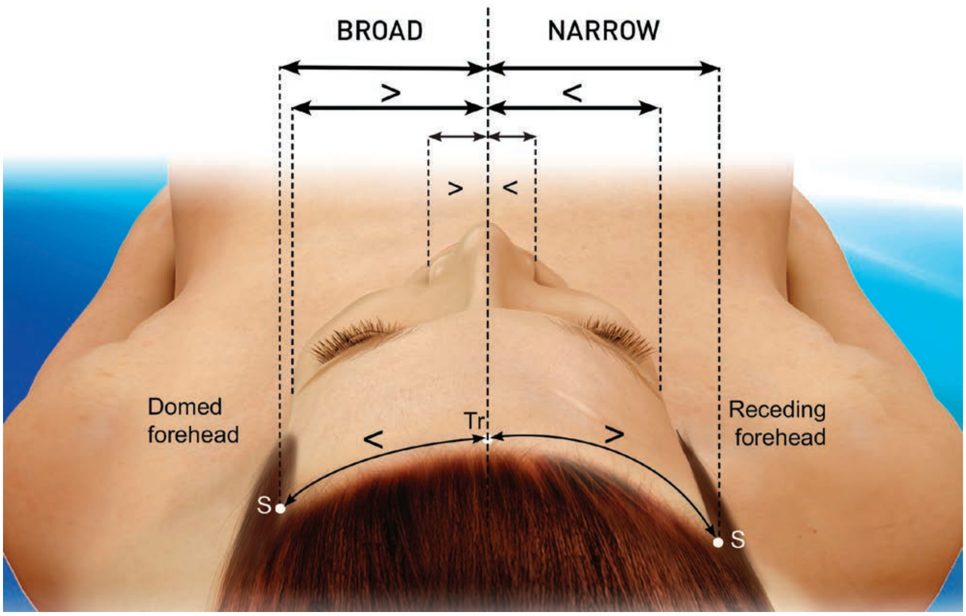


Fig. 6. Overhead frontal view of a patient with an analysis of the mid and upper thirds of the face. The frontal bone on the narrow face side is more receding, elongating the hemi-frontal line (Tr-S) on this side. The nasal wall on the narrow side of the face is narrower than that on the broad side of the face. The distance between the midline and the cheekbone is shorter on the narrow side. This position accentuates skeletonization and makes facial analysis easier.

is more pronounced on the broad side. We have identified a trend where the narrow side presents a lateronasal narrowness, with a narrower maxillary frontal process and a narrower middle and lower third of the nose. These findings corroborate clinical observations in the literature on the close relationship between nasal asymmetry and facial asymmetry.[53–60]

Lower Third of the Face

The mandible is most asymmetrical on the broad side,[6,61–64] where the mental tubercle and jowl are slightly more developed. Additionally, the horizontal ramus is slightly lower due to a more open skeletal angle. This asymmetry is supported by larger mean angle measurements on the broad side (+2.34 degrees for the skeletal angle and +4.03 degrees for the facial angle), illustrating how gravity accentuates the widening effect of the soft tissues on this side.

Our study highlights the indirect asymmetries caused by muscle insertions on unequal bony bases. On the narrow side, the balance of the P5 (0.647 mm) lip commissures is influenced by the slightly higher position of the maxillomalar block. The zygomaticus muscle, which inserts onto the zygoma, and the depressor anguli oris muscle, which inserts onto the horizontal mandibular ramus with a more closed angle, thus positioned higher, contribute to a subtle ascension of the labial commissure. In addition, the slightly outward orientation of the zygoma confers a discreet extension to the narrow upper lip (0.39 mm on average), which is often slightly longer and thinner. Conversely, on the broad side, the labial commissure is positioned at the same height or slightly lower.

In addition, analysis of the P6 axis reveals a more pronounced ear detachment on the broad side, owing to a more open skeletal angle of 2.34 degrees, which mechanically results in a more oblique position of the temporal bone.

Furthermore, that analysis has often revealed an axial coherence, particularly in areas such as the eyebrows (P1), wings of the nose (P4), and labial commissures (P5), where relative symmetry was observed (Table 5). These results suggest that although variation is consistently present, it does not always translate into complete asymmetry. To better describe this variation, we are introducing the term “facial dissymmetry” rather than asymmetry, emphasizing a relative lack rather than a total absence of symmetry. This concept reflects the complexity of the facial shapes observed more accurately.

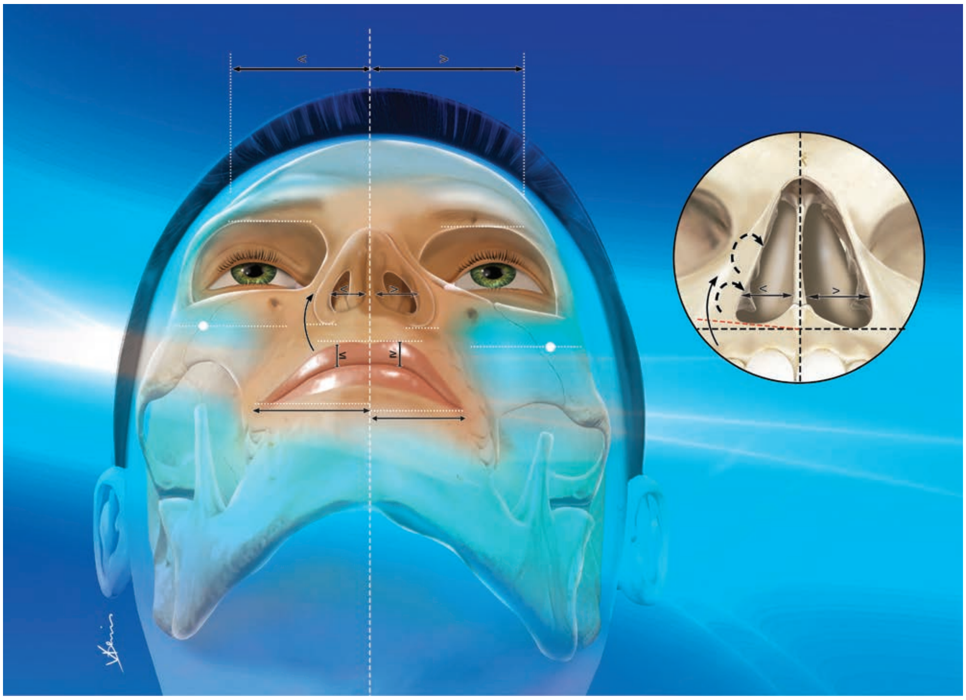


Fig. 7. Frontal, low-angle view revealing the very slight in-depth shift of the lateral part of the nose on the patient's right narrow side, resulting in a visibly narrowed nostril orifice. The arrows indicate the upward, immersive movement of the maxillomalar block, highlighting a thinner, often more elevated right hemiface. Credits: Virginie Denis.

To address the origins of facial dissymmetry, it is crucial to stress that its foundations are established long before external postnatal influences, as these arguments prove the following:

1. This study focuses on an adult, postossification population, with individuals 19 years of age and older, where major structural changes due to growth are complete.
2. A more receding forehead is always observed on the side of the narrower face, where the malar point is closer to the midline. This is accompanied by a rotation of the maxillomalar complex, and as a cascade effect, the hemifrontal bone also undergoes this rotation. Salder and Langman[65] and Larsen[66] describe the early fusion of the nasal and maxillary prominences, responsible for the central areas of the face from the fifth week of gestation, which explains lower SDs in these regions (such as Pp Ac). In contrast, the frontal and mandibular prominences, which fuse later, show higher SDs in the periphery, revealing greater variability. This cascading phenomenon amplifies small central variations in peripheral structures, reinforcing the idea that facial dissymmetry originates from embryological development.
3. In 1993, thesis research[67] involving histological sections of embryos provided precise measurements revealing a dissymmetry as early as the first weeks of development. (See **Video [online]**, which displays 3D visualization of facial asymmetry, and detailed anatomical layers for clinical insight.)
4. Although sleep posture or chewing habits are frequently invoked, these hypotheses remain controversial, and in the absence of well-controlled longitudinal studies, they cannot be scientifically validated.

To sum it up, facial dissymmetry is deeply rooted in embryonic development,[68–81] long before external or behavioral factors arise.[82–85] The face, in its 3D complexity, influenced by our genetic inheritance,[86–90] is shaped from the earliest phases by biomechanical forces, enduringly determining its front-view appearance in 2D (Fig. 8).

Based on these structural and tissue dissymmetry observations, the study synthesized the data into a representative model (Fig. 9). Using the mean values from a statistically significant sample, a composite portrait was created to illustrate the typical facial asymmetries in humans. Although each face is unique due to genetic and embryonic factors, recurring trends emerge, particularly 1 side being closer to the midline. Lower SDs show fluctuating asymmetries, whereas larger deviations reveal directional dissymmetry, observable across various populations and confirming this as a feature of the human species (Figs. 10–14).

CONCLUSIONS

This study represents a significant step toward merging anthropological knowledge with clinical practice, demonstrating that facial dissymmetry has always been a characteristic of humanity. The analysis of skulls,[91–95] ranging from Australopithecus Lucy to Neanderthal Man, reveals

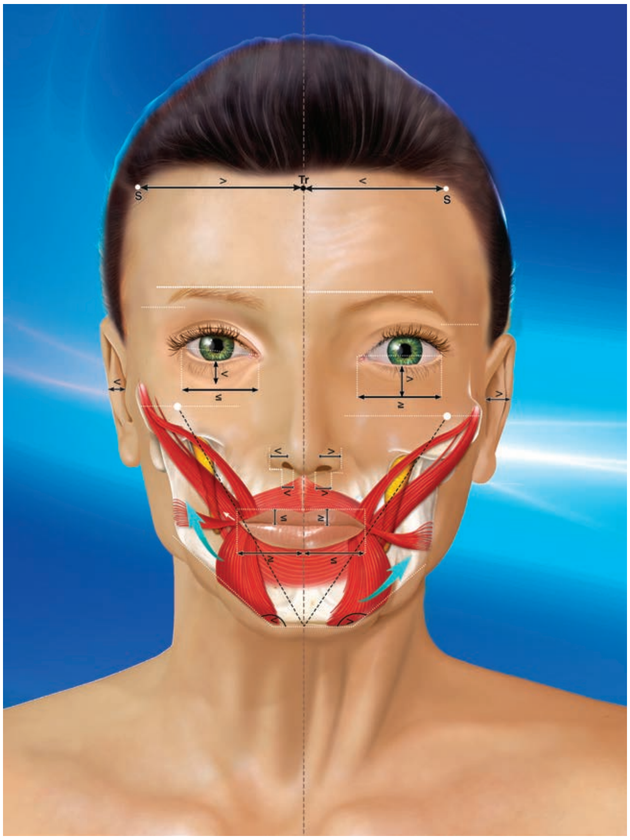


Fig. 8. The frontal view of the lower third of the face reveals asymmetrical muscle attachments due to the difference in level between the zygomatic and mandibular bones. The skeletal angle is more open on the broad face side, resulting in a wider face. Credits: Virginie Denis.

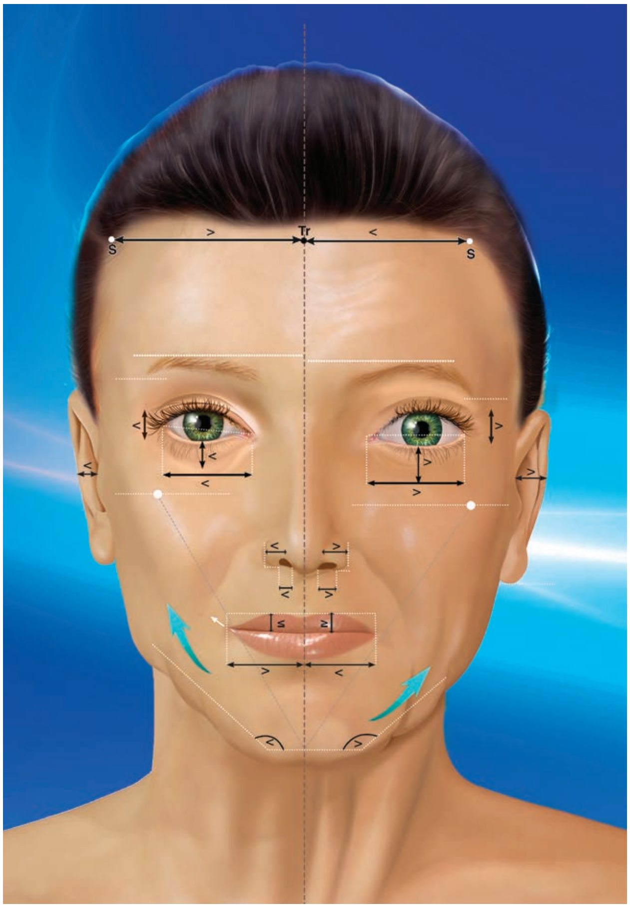


Fig. 9. Composite of contemporary man. Graphical synthesis of facial dissymmetry tendencies from the analysis of 615 faces, illustrating the narrow side on the right in more than 80% of cases, with its often subtly elevated and refined features, characteristic of our species. Credits: Virginie Denis.

a narrower side, affirming that this dissymmetry is not an anomaly but a fundamental feature of our species. The skull, this unchanging sculpture spared from the gravity that affects our soft tissues, preserves the essence of our intrinsic dissymmetry.

Based on a vast population, this study offers a statistically sound analysis of facial asymmetries. This analysis reveals consistent patterns that underline the congruence between bone and soft tissue, providing valuable insights for surgical applications, while also enlightening patients on the characteristics of their own faces.

Marc Divaris, MD
Department of Plastic and Maxillofacial Surgery
University of Pitie Salpetriere
32 Avenue Georges Mandel
75 116 Paris, France
E-mail: docteurmarcdivaris@gmail.com

DISCLOSURE

The author has no financial interest to declare in relation to the content of this article.

PATIENT CONSENT

Patients provided written consent for the use of their images.

REFERENCES

1. Van Valen L. A study of fluctuating asymmetry. *Evolution*. 1962;16:125–142.
2. Graham JH, Ozener B. Fluctuating asymmetry of human populations: a review. *Symmetry*. 2016;8:154.
3. Ferrario VF, Sforza C, Cimsa V. The effect of sex and age on facial asymmetry in healthy subjects. A cross-sectional study from adolescence to mid adulthood. *J Oral Maxillofac Surg*. 2001;59:382–388.
4. Ercan I, Ozdemir ST, Etoz A, et al. Facial asymmetry in young healthy subjects evaluated by statistical shape analysis. *J Anat. 2008*;213:663–669.
5. Peck S, Peck L, Kataja M. Skeletal asymmetry in aesthetically pleasing faces. *Angle Orthod*. 1991;61:43–48.
6. Haraguchi S, Iguchi Y, Takada K. Asymmetry of the face in orthodontic patients. *Angle Orthod*. 2008;78:421–426.
7. Olivier AG. Antropologie del craneo. In: Gomez Oliveros L, ed. *Lecciones de Anatomia Humana*. Marban; 1960:478–510.
8. Pernkopf E. *Anatomia Topografica Humana*. 1 ed. Edit Labor SA; 1968:1–18.
9. Schlager S. Sliding semi-landmarks on symmetric structures in three dimensions. *Am J Phys Anthropol*. 2012;147:261.
10. Economu S, Stoustrup P, Kristensen KD, et al. Evaluation of facial asymmetry in patients with juvenile idiopathic arthritis: correlation between hard tissue and soft tissue landmarks. *Am J Orthod Dentofacial Orthop*. 2018;153:662–672.e1.

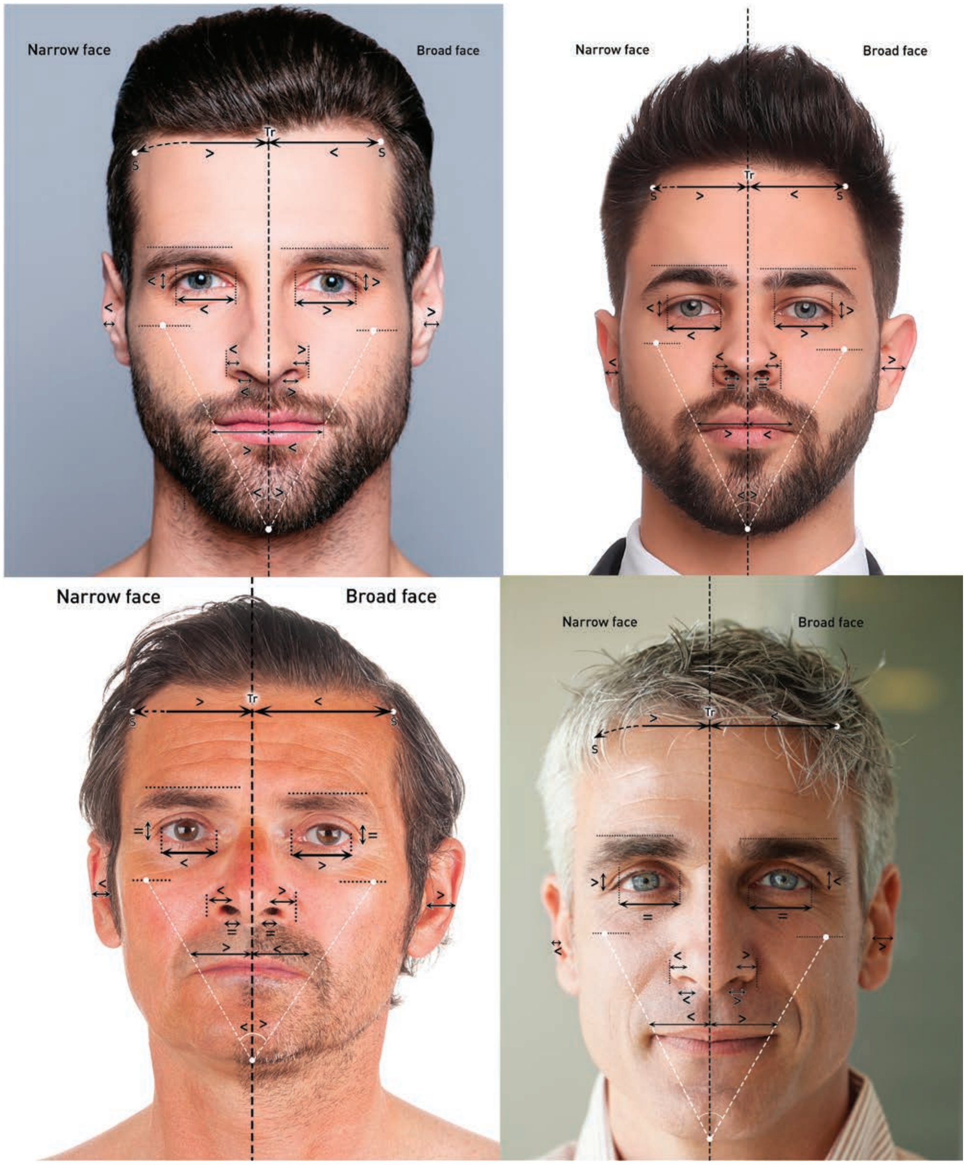


Fig. 10. European men with fair phenotype faces, with the narrow side located on the right. Distinctive features include a more receding hemiforehead on the narrow side and more pronounced traits on the broad side. Examples of both younger and older faces are presented. Credits: Virginie Denis.

11. Ferrario VF, Sforza C, Miani A, et al. Craniofacial morphometry by photographic evaluations. *Am J Orthod Dentofacial Orthop*. 1993;103:327–337.
12. Ferrario VF, Sforza C, Miani A, et al. A three-dimensional evaluation of human facial asymmetry. *J Anat*. 1995;186(Pt 1):103–110.m
13. Rolfe S, Davis C, Maga AM. Comparing semi-landmarking approaches for analyzing three-dimensional cranial morphology. *Am J Phys Anthropol*. 2021;175:227–237.
14. Watanabe A. How many landmarks are enough to characterize shape and size variation. *PLoS One*. 2018;13:e0198341.
15. Klingenberg CP. Morphological integration and developmental modularity. *Annu Rev Ecol Evol Syst*. 2008;39:115–132.
16. Klingenberg CP. Morphometric integration and modularity in configurations of landmarks: tools for evaluations hypotheses. *Evol Dev*. 2009;11:405–421.
17. Klingenberg CP. Analyzing fluctuating asymmetry with geometric morphometrics: concepts; methods, and applications. *Symmetry*. 2015;7:843–934.
18. Shaner DJ, Peterson AE, Beattie OB, et al. Assessment of soft tissue facial asymmetry in medically normal and syndrome-affected individuals by analysis of landmarks and measurements. *Am J Med Genet*. 2000;93:143–154.
19. Von Craman-Taubadel N, Frazier BC, Mirazón Lahr M. The problem of assessing landmark error in geometric morphometrics, theory, methods and modifications. *Am J Phys Anthropol*. 2007;134:24–35.
20. Mitteroecker P, Schaefer K. Thirty years of geometric morphometrics: achievements, challenges and the ongoing quest for biological meaningfulness. *Am J Biol Anthropol*. 2022;178:181–210.
21. Lam K, Yan H. An analytic-to-holistic approach for face recognition based on a single frontal view. *IEEE Trans Pattern Anal Mach Intell*. 1998;20:673–686.

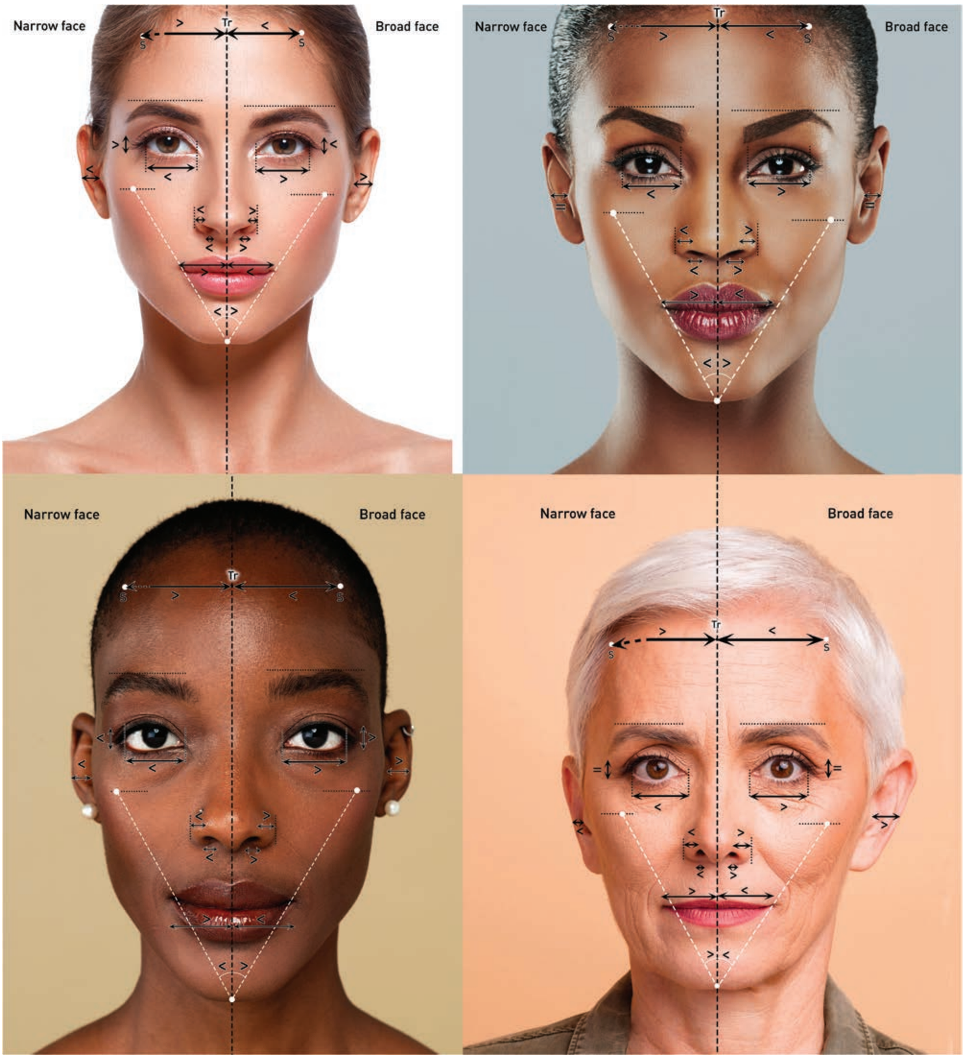


Fig. 11. Women with diverse phenotypes. Examples of 4 women with diverse phenotypes, showing facial dissymmetries that are more fluctuating, with lower standard deviations. Credits: Virginie Denis.

22. Farkas LG, Cheung G. Facial asymmetry in healthy North American Caucasians an anthropometrical. *Angle Orthod.* 1981;51:70–77.
23. Lavater JK. *Physiognomische Fragmente zun Befordering der Monschenhenntmis.* Weidmanns Erben und Reich; 1775.
24. His W. *Die Entwicklung des Menschlichen Gehirns während der ersten Monate.* S. Hirzel; 1904.
25. Darwin C. *The Expression of the Emotions in Man and Animals.* John Murray; 1872.
26. Crivellato E, Ribatti D. Body symmetry and asymmetry in early. Greek anatomical reasoning. *Clin Anat.* 2008;21:279–282.
27. Woo TL. On the asymmetry of the human skull. *Biometrika.* 1931;22:324.
28. Lundstrom A. Some asymmetries of the dental arches, jaws and skull and their ethiological significance. *Am J Orthod.* 1961;17:81–106.
29. Rossi M, Ribeiro E, Smith R. Craniofacial asymmetry in development: an anatomical study. *Angle Orthod.* 2003;73:381–385.
30. Shah SM, Joshi MR. An assessment of asymmetry in the normal craniofacial complex. *Angle Orthod.* 1978;48:141–148.
31. Vig PS, Hewitt AB. Asymmetry of the human facial skeleton. *Angle Orthod.* 1975;2:45.
32. Kaipainen AE, Sieber KR, Nada RM, et al. Regional facial asymmetries and attractiveness of the face. *Eur J Orthod.* 2016;38:602–608.
33. Monteiro LCP, Ripardo RC, Torro-Alves N, et al. Facial morphometric differences across face databases. Influence of ethnicities and sex. *Front Neurosci.* 2023;17:1–35.
34. Zhang YF, Xiao L, Li J, et al. Young people's esthetic perception of dental midline deviation. *Angle Orthod.* 2010;80:515–520.
35. Butovskaya ML, Rostovtseva VV, Mezentseva AA. Facial and body sexual dimorphism are not interconnected in the Maasai. *J Phys Anthropol.* 2022;41:3.
36. Nazari A. Maxillofacial anatomy: ethnicity and gender differences. *Oral Maxillofac Surg Implant.* 2024;1–151.
37. Cappella A, Solazzo R, Yang J, et al. Facial asymmetry of Italian children: a cross-sectional analysis of three-dimensional stereophotogrammetric reference values. *Symmetry.* 2023;15:792.
38. Bartlett SP, Grossman R, Whitaker LA. Age related changes of the cranio-facial skeleton: an anthropometric and histologic analysis. *Plast Reconstr Surg.* 1992;90:592–600.
39. Mendelson BC, Hartley W, Scott M, et al. Age related changes of the orbit and mid cheek and the implications for facial rejuvenation. *Aesthetic Plast Surg.* 2007;31:419–425.

Fig. 12. Faces with uncommon configurations. These 4 faces of men and women from diverse backgrounds show the narrow side on the left, a less common configuration.

40. Huang CS, Liu XQ, Chen YR. Facial asymmetry index in normal young adults. *Orthod Craniofac Res.* 2013;16:97–104.
41. Harnadkova K, Kočandrlová K, Kožejová Jaklová L, et al. The effect of sex and age on facial shape directional asymmetry in adults: a 3D landmarks-based method study. *PLoS One.* 2023;18:e0288702.
42. Watkins CD, Jones BC, Littles AC, et al. Cues to the sex ratio of the local population influence women's preferences for facial symmetry. *Anim Behav.* 2012;83:545–553.
43. Linden OE, He JK, Morrison CS, et al. The relationship between age and facial asymmetry. *Plast Reconstr Surg.* 2018;142:1145–1152.
44. Park JH. Correction de la ligne latérale des cheveux chez les patientes coréennes. *Plast Reconstr Surg Glob Open.* 2015;3:e336.
45. Rassman WR, Carson S. Micrografting in extensive quantities: the ideal hair restoration procedure. *Dermatol Surg.* 1995;21:306–311.
46. Knoll BI, Atthiss NJ, Persing JA. The influence of forehead, brow and penorbital aesthetic in perceived expression in the youthful face. *Plast Reconstr Surg.* 2008;121:1793–1802.
47. Katira K, Guyuron B. The deviated nose and asymmetric eyebrows; an important trap to avoid. *Plast Reconstr Surg.* 2014;133:519–523.
48. Kahn DM, Shaw RB, Jr. Aging of the bony orbit a three-dimensional computed tomographic study. *Aesthet Surg J.* 2008;28:258–264.
49. Lambros V. Observations on periorbital and midface aging. *Plast Reconstr Surg.* 2007;120:1367–1376.
50. Divaris M, Sabri E, Cancemi G, et al. LCL (locked cheek lift). Three-dimensional cheek lift and inferior palpebral rejuvenation. *Aesthetic Plast Surg.* 2018;42:825–838.
51. Gawlikowska-Sroka A. Analysis of variation of orbital openings in contemporary skulls. *Ann Acad Med Stetin.* 2013;59:76–80.
52. Schultz AH. The size of the orbit and of the eye in primates. *Am J Phys Anthropol.* 1940;26:389–408.
53. Chatrath P, De Cordova J, Nouraei SA, et al. Objective assessment of facial asymmetry in rhinoplasty patients. *Arch Facial Plast Surg.* 2007;9:184–187.
54. Wang TT, Wessels L, Hussain G, et al. Discriminative thresholds in facial asymmetry: a review of the literature. *Aesthet Surg J.* 2023;37:375–385.

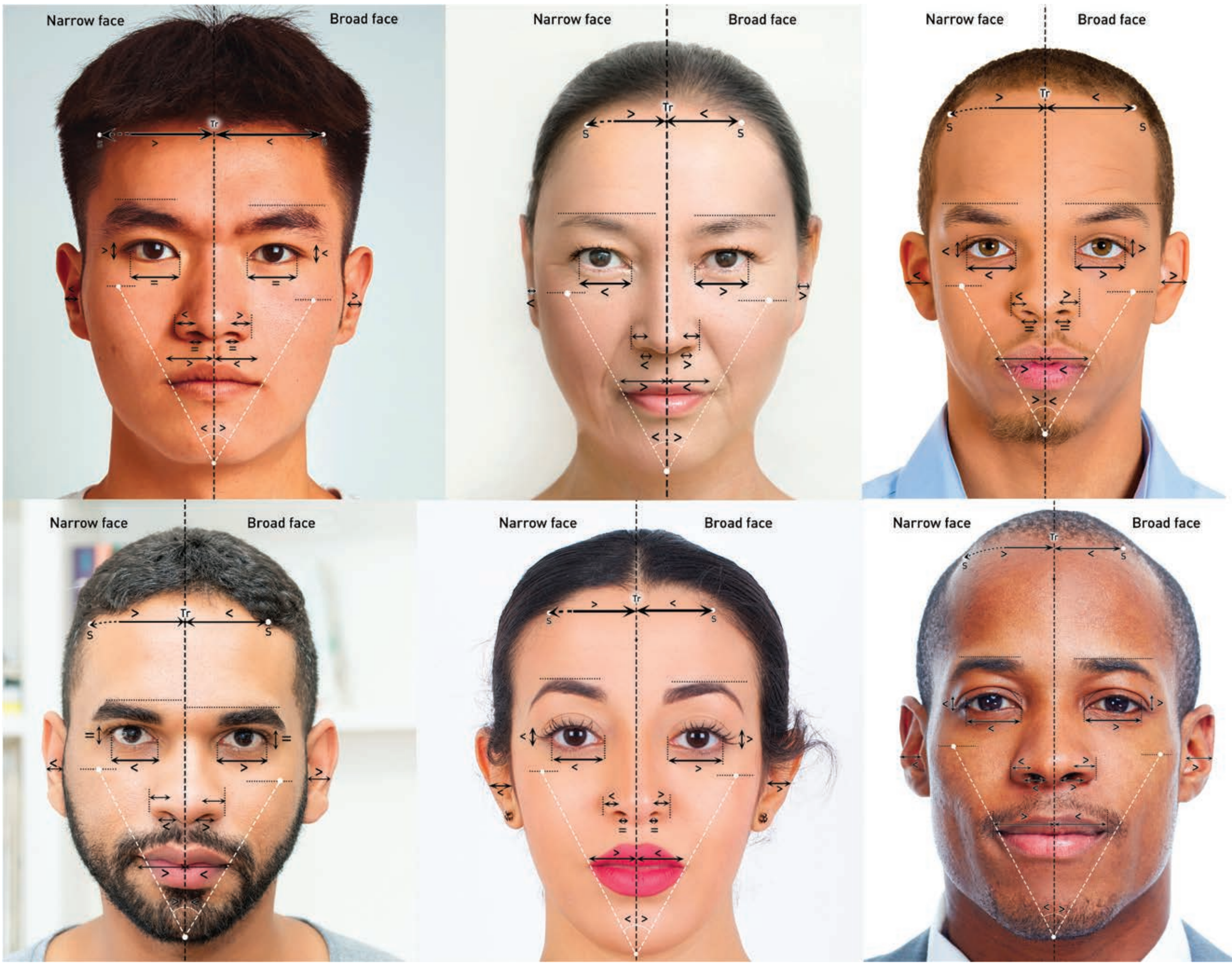


Fig. 13. Examples of Asian and Middle East and Africa individuals. These examples of men and women of Asian and Middle East and Africa origin, all young adults, display characteristic facial dissymmetries. Consistent traits include a slightly more prominent left ear, a subtly higher right eyebrow, a longer hemiforehead on the narrow side, and a narrower right lateral nasal area is narrower, with a slightly smaller nasal aperture.

55. Hafezi F, Naghibzadeh B, Nouhi AH, et al. Asymmetric facial growth and deviated nose: a new concept. *Ann Plast Surg*. 2010;64:47–51.
56. Rohrich RJ, Gunter JP, Deuber MA, et al. The deviated nose: optimizing results using a simplified classification and algorithmic approach. *Plast Reconstr Surg*. 2002;110:1509–1523; discussion 1524.
57. Yao F, Lawson W, Westreich RW. Effect of midfacial asymmetry on nasal axis deviation: indications for use of the subalar graft. *Arch Facial Plast Surg*. 2009;11:157–164.
58. Rohrich RJ, Villanueva NL, Small KH, et al. Implications of facial asymmetry in rhinoplasty. *Plast Reconstr Surg*. 2017;140:510–516.
59. Hafezi F, Naghipour R, Naghibzadeh B, et al. Practical classification of upper lateral cartilage in middle vault asymmetry. *Plast Reconstr Surg*. 2020;145:1410–1417.
60. Schlager S, Rûdell A. Analysis of the human osseous nasal shape—population differences and sexual dimorphism. *Am J Phys Anthropol*. 2015;157:571–581.
61. Kim EJ, Palomo JM, Kim S-S, et al. Maxillofacial characteristics affecting chin deviation between mandibular retrusion and prognathism patients. *Angle Orthod*. 2011;81:988–993.
62. Verhoeven TJ, Coppen C, Barkhuysen R, et al. Three-dimensional evaluation of facial asymmetry after mandibular reconstruction: validation of a new method using stereophotogrammetry. *Int J Oral Maxillofac Surg*. 2013;42:19–25.
63. Sutton PR. Lateral facial asymmetry-methods of assessment. *Angle Orthod*. 1968;38:82–92.
64. Haraguchi S, Takada K, Yasuda Y. Facial asymmetry in subjects with skeletal class III deformity. *Angle Orthod*. 2002;72:28–35.
65. Salder TW, Langman, J. *Langman's Medical Embryology*. 13th ed. Lippincott Williams & Wilkins; 2018.
66. Larsen WJ. *Human Embryology*. 4th ed. Churchill Livingstone; 2014.
67. Divaris M. Paroi médiale de l'orbite. Anthropologie, morphologie, evolution. In: *Museum histoire naturelle—Musée de l'homme: Tome 1 & 2*. Université Paris 1 Pantheon Sorbonne; 1994.
68. Burdine R, Schien A. Conserved and devergent mechanioms in left right asus formation. *Genes Dev*. 2000;14:763–776.
69. Helms JA, Schneider RA. Cranial skeletal biology. *Nature*. 2003;423:326–331.
70. Trainor PA. Craniofacial birth defects: the role of neural crest cells in the ethiology and pathogenesis of Treacher Collins syndrome and the potential for prevention. *Am J Med Genet A*. 2010;152A:2984–2994.

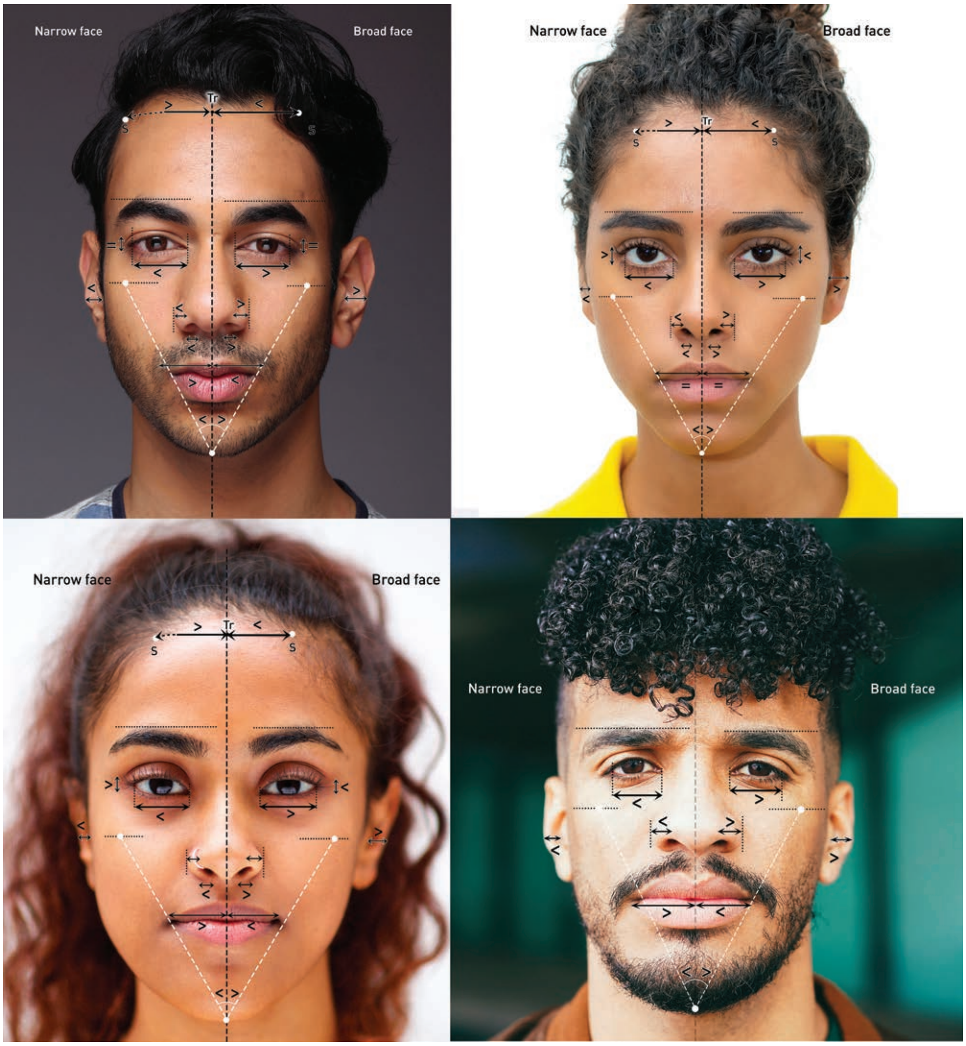


Fig. 14. South American individuals. These photographs present 2 young men and 2 young women of South American origin. All display a narrow side on the right, with distinctive traits such as a more receding hemiforehead, a slightly more prominent left ear, a subtly higher right eyebrow, and a narrower lateral nasal area on the right side.

71. Helms JA, Schneider RA. Cranial skeletal biology. *Nature.* 2003;423:326–331.
72. Tavares ALP, Cox TC, Maxson RM, et al. Negative regulation of endothelin signaling by SIX1 is required for proper maxillary development. *Development.* 2017;144:2021–2031.
73. Slavotinek AM. Eye development genes and known syndromes. *Mol Genet Metab.* 2016;104:448–456.
74. Brugmann SA, Goodnough LH, Gregorieff A, et al. Wnt signaling mediates regional specification in the vertebrate face. *Dev Biol.* 2007;308:293–304.
75. Hallgrimsson B, Lieberman DE, Liu W, et al. Epigenetic interactions and the structure of phenotypic variation in the cranium. *Evol Dev.* 2007;9:76–91.
76. Kondo S, Schutte BC, Richardson RJ, et al. Mutations in IRF6 cause Van der Woude and popliteal pterygium syndromes. *Nat Genet.* 2002;32:285–289.
77. Enlow DH, Hans MG. *Essentials of Facial Growth.* Saunders; 1996.
78. Levin M. The embryonic origins of left-right asymmetry. *Crit Rev Oral Biol Med.* 2004;15:197–206.
79. Le Douarin NM. The avian embryo as a model to study the development of the neural crest: a long and still ongoing story. *Mech Dev.* 1999;121:1089–1102.
80. Trainor PA. Craniofacial birth defects: the role of neural crest cells in the etiology and pathogenesis of Treacher Collins syndrome and the potential for prevention. *Am J Med Genet A.* 2013;161:2452–2461.
81. Noden DM. The role of the neural crest in patterning of avian cranial skeletal, connective and muscle tissues. *Dev Biol.* 1983;96:144–165.
82. Quinto Sanchez M, Munoz-Munez F, Gomes Valdes J, et al. Developmental pathways inferred from modularity, morphological integration and fluctuating asymmetry patterns in the human face. *Sci Rep.* 2018;8:963.
83. Beasley DAE, Benisioli-Alquati A, Mousseau TA. The use of fluctuating asymmetry as a measure of environmentally induced developmental instability: a meta-analysis. *Ecol Indic.* 2013;30:218–226.
84. Roosenboom J, Indencleef K, Lee MK, et al. SNPS associated with testosterone levels influence human facial morphology. *Front Genet.* 2018;9:497.

85. Harastani M, Benterkia A, Zadeh FM, et al. Methamiphetamine drug abuse and addiction: effects on face asymmetry. *Comput Biol Med*. 2020;116:103–475.
86. Windhager S, Schaschl H, Schaefer K, et al. Variation at genes influencing facial morphology are not associated with developmental imprecision in human faces. *PloS One*. 2014;9: e99009.
87. See MS, Roberts C, Nduka C. Age and gravity related changes in facial morphology: 3-dimensional analysis in mother daughter pairs. *J Oral Maxillofac Surg*. 2008;66:1410–1416.
88. Arriesta MI, Criado B, Martinez B, et al. Fluctuating dermatoglyphic asymmetry: genetic and prenatal influences. *Ann Hum Biol*. 1993;20:557–563.
89. Simon H. The architecture of complexity: hierarchic systems. *Proc Am Philos Soc*. 1962;106:467–482.
90. Quinto-Sanchez M, Adhikari K, Acuna-Alonzo V, et al. Facial asymmetry and genetic ancestry in Latin American admixed populations. *Am J Phys Anthropol*. 2015;157:58–70.
91. Divaris M, Sabri E, Ohana S. Mirror face lift: concept, description and evaluation 1 year postoperatively. *Plast Reconstr Surg Glob Open*. 2020;8.
92. Rak Y, Kimbel WH. Lucy's skeleton: reconstructing a human ancestor. *Sci Am*. 1994;270:86–93.
93. Antón SC. Evolutionary significance of cranial variation in Asian Homo erectus. *Am J Phys Anthropol*. 2002;118:301–323.
94. Hublin JJ, Richards MP. *The Evolution of Homo Sapiens*. Cambridge University Press; 2009.
95. Zollikofer CP, Ponce de León MS. Neanderthal cranial remains: subtle cues to population history and biology. *PLoS Biol*. 2010;8:e1000536.