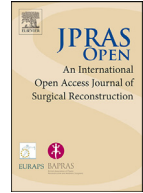




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Original Article

Facial asymmetry, the right-side dominance: A retrospective analysis of 315 consecutive series of patients

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ABSTRACT

Background: Asymmetry of the face is a common finding that has been discussed in a variety of fields including art, poetry, philosophy, and medicine. In the surgical literature, facial asymmetry in general and the laterality of this observation were described mostly as a casual note, without profound discussion. In our study, we hypothesized that facial asymmetry in the normal unbiased population has a unique laterality appearance.

Patients and methods: A consecutive series of 315 patients were included in the study, and all had anterior facial digital pictures taken in the same technique and loaded onto Image-J Software™. Four measurements were taken from the midline, to the right and left sides, to the Zygoma point in the middle face, and to the Gonion point in the lower face. The results given by pixels were loaded onto an excel sheet, office 2016 software™, and processed and analyzed by SPSS software™.

Results: Using the paired t-test, the middle and lower thirds of the face on the right side had a significant dominance size wise with p-values of < 0.019 and < 0.039, respectively.

Conclusion: Our study results support our main hypothesis and strongly demonstrate right side, size wise, and dominance in the middle and lower face.

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Introduction

Facial appearance, size, shape, beauty, symmetry, and harmony have been discussed profoundly in the literature for over 2000 years.¹⁻⁴ However, a well-documented research work did not begin till the Renaissance era, when Leonardo da Vinci elucidated his theories and ideas in a vast number of manuscripts regarding human proportions and his quest for the ideal facial proportions.^{5,6} A great number of prominent Italian art masters made enormous contributions to the understanding of human beauty and symmetry, such as Michelangelo and Raphael; continued in the last 300 years with writers, philosophers, and scholars, emphasized rational and scientific knowledge, which led to the neoclassical canon's proportions.¹

In the modern scientific and medical literature, facial appearance was thoroughly investigated, studied, and presented in a variety of publications, all of which include the inevitable knowledge that all of us, the humans, have some degree of asymmetry.⁷⁻¹² The asymmetry was measured using different reference structures, from skeleton measurements as in the extensive innovative work of Farkas on the cephalometric studies, and continued by a variety of publications at all surface levels.¹³⁻¹⁵

Over the last 20 years, the authors examined facial structure in thousands of patients and raised the hypothesis that facial asymmetry is not arbitrary but rather had a unique repetitive laterality. The purpose of this study was to explore the clinical observation by the authors, which means that facial asymmetry in the normal unbiased population has a unique repetitive pattern between right and left sides, and to discuss some implications of the findings.

Materials and methods

A consecutive series of 500 patient frontal facial pictures were treated by the surgeons for a variety of facial procedures to enter the study. The pictures were taken by a digital Nikon camera with a 60 mm macro lens from the same distance. Any patients, that according to the medical file, whose chief complaint was facial asymmetry, who had prior injections for facial contouring enhancement during the last 12 months, undergone prior facial surgeries, required significant dental, or orthodontic work performed, and or who had significant morbid obesity, were excluded off the study. The pictures were loaded onto a Mac computer, and the measurements were performed by using an Image-J softwareTM. The Image-J software transformed the digital camera data into measurable pixels, which means that accurate measurement can be applied without fear that a slight distance difference between the object and the lens may alter the measurements. The midline divider was a straight line drawn between Glabella – Nasion – SubNasale – Menton, and the reference points were right and left Zygoma points, (1 and 2, respectively) and right and left Gonion points (3 and 4, respectively) - see figure one, all of which can easily be found, drawn, and marked on frontal picture with minimal (if at all) bias or question, whether is the right point. Following that, four measurements were taken at 90 degrees to the midline divider, measured by pixels, loaded on excel sheet office 2016 softwareTM, and converted the data into SPSS softwareTM, allowing our statistical consultant to analyze the data.

Results

Following implementation of all the exclusions criteria, 315 patients enter the study process: 250 females and 65 males ranging in age from 21 to 65, with an average of 34 years. Using the paired t-test, in the middle and lower thirds of the face, the right side has a significant definitive dominance

Table 1
Facial measurements in pixels were included in multivariate analysis.

Distance	Mean (pixels) +/- SD	P - Value
Midline - Right Zygoma (1)	738.60 +/- 249.53	P < 0.019
Midline - Left Zygoma (2)	692.81 +/- 239.15	
Midline - Right Gonion (3)	570.47 +/- 209.72	P < 0.039
Midline - Left Gonion (4)	536.58 +/- 202.36	



Figure 1. Facial landmarks .1,2 Zygoma right and left, respectively. 3,4 Gonion right and left, respectively.

with p-values of < 0.019 and < 0.039, respectively. (See [Table 1](#)). [Figures 2-5](#) demonstrate a few patient measurements.

Discussion

Asymmetry of the face is a common finding that has been discussed in a variety of fields including art, poetry, philosophy, and medicine.^{1,13-16} In the surgical literature, facial asymmetry was described mostly as an anatomical note without profound discussion of the laterality.⁷⁻¹² Although in a variety of studies, we could find casual notes about laterality, including right-side dominance, but none discussed it in depth.¹⁷⁻¹⁹

In our study, the midline was based on well-established external landmarks connected by a straight line, which can easily be found and marked on frontal picture with minimal, if at all, bias or question about where the right point is.²⁰ The facial width in the middle and lower thirds of the face was measured by connecting the four landmarks' points at 90 degrees to the midline.¹³⁻¹⁵ The data obtained were loaded and processed with Image-J softwareTM, and the data (in pixels) were inserted into an excel sheet, office 2016TM, and analyzed with SPSS softwareTM.²¹ The statistical analysis shows clearly and significantly and is in line with our hypothesis of right-side lateralization dominance. We found that the right side is dominant over the left side, size wise in both the middle face (M right= 738.60, SD =249.53, M left= 692.81, SD =239.15, $t_{(315)} = 2.35$, $p<0.019$) and the lower face (M right= 570.47, SD =209.72, M left= 536.58, SD =202.36, $t_{(315)} = 2.06$, $p<0.039$). These findings to our best knowledge have not been discussed or published ever in the medical English literature; however, in the artistic literature, the left side get dominance over the right, without statistical significance.²²⁻²⁴ We would like to note that our study contains facial measurements of adults only, which eliminates



Figures 2–6. Frontal Picture of 5 patients included in the study.

the possibility of post maturation changes.²⁵ In the non-English literature, Busse, which analyzed visually facial photographs, did not find either side to be dominant over the other.¹⁴

Facial appearance and symmetry are the outer reflection of the inner structures, the skeleton, including teeth, muscles of mastication, muscles of expression, subdermal fat, and the Bichat fat pad. As we observe from vertex caudally, we have more structures involved in contouring the outer shape. At the zygoma point we have bone, muscle, and fat; and in the Gonion reference point, we add to the equation the teeth and the occlusion, which are more subject to dental changes, so it reflects more diversity in the measurement; and as a result, we notice a reduction in the power of the statistical power in the right laterality dominance ($p < 0.039$) compared to the middle face ($p < 0.019$).^{8,26,27}

The soft tissue components, which contain skin, fat, and muscle, have various ethnic differences, but since all our patients were Caucasians and we exclude significant obese patients, these three elements have minimal effects on results deviation.²⁸ Although studies suggest that the left hemi-face is more expressive of emotions, which means the expression muscles in the left side are more active, it did not over roll our findings of right-side dominance size wise.^{9,29,30} In 1938, Fink published his study entitled “the right eye dominance”. Does it impose unnoticed tilt of the face? We carefully examine the frontal pictures and could not find any findings to support it.³¹ Does people in general uses the right side for chewing and have a larger mastication muscle in the right side, which has not been well discussed in the literature yet.³² We did not find in our study results any relevance to

gender identity, which is consistent with Lambros' finding related to facial aging.³³ The relevance of potential exogenous contributors to facial asymmetry, such as sleep position, stress, smoking, alcohol consumption, and tension headache was not currently studied.²⁷ Our study analyzed our own crude data as appears in patients' files. In the effort to explain the findings, we did an extensive search in the literature, even for possible factors such as right or left handedness and new genetic published studies; however, we could not find any solid relationship to the right-side dominance size wise that we found.

In conclusion, our study results strongly support right side size dominance at the middle and lower face, findings that can help with patient's interaction by providing them solid information regarding the inherited asymmetry that we all have; and help in the process of explaining the expected results of facial procedures including major and minor surgical procedures, fillers, and other procedures since we all have some degree of inherited lateral asymmetry; further studies will be helpful in elucidating the factors that induce to our findings.

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Conflict of interest

None declared.

Ethical approval

Not required.

We declare that patients consent for photo publication in the manuscript was given in writing without exception.

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