Evaluation of Sexual Dimorphism of Maxillary Central Incisors in the Greek Population Through Three - Dimensional Morphometric Analysis

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SUPPLEMANTERY MATERIAL

References

1. Mehndiratta A, Bembalagi M, Patil R. Evaluating the Association of Tooth Form of Maxillary Central Incisors with Face Shape Using AutoCAD Software: A Descriptive Study. J Prosthodont. 2019 Feb;28(2):e469-e472. doi: 10.1111/jopr.12707.
2. Williams JL. A new classification of human teeth with special reference to a new system of artificial teeth. Dental Cosmos. 1914;52:627–628.
3. de Oliveira Farias F, Ennes JP, Zorzatto JR. Aesthetic Value of the Relationship between the Shapes of the Face and Permanent Upper Central Incisor. Int J Dent. 2010;2010:561957. doi: 10.1155/2010/561957.
4. Frush JP, Fisher RD. How dentogenic restorations interpret the sex factor. The Journal of Prosthetic Dentistry, vol. 6, no. 2, pp. 160–172, 1956.
5. Senn LF, Lazos JP, Brunotto M. Assessment of maxillary central incisor crown form. Int J Periodontics Restorative Dent. 2013 May-Jun;33(3):347-53. doi: 10.11607/prd.1206.
6. Wang H, Yin J, Lu P, Yu Q. Three-dimensional geometric morphometric measurement and classification of maxillary central incisors. Arch Oral Biol. 2019 Jun;102:141-146. doi: 10.1016/j.archoralbio.2019.04.005.

7. Polychronis G, Christou P, Mavragani M, Halazonetis DJ. Geometric morphometric 3D shape analysis and covariation of human mandibular and maxillary first molars. Am J Phys Anthropol. 2013 Oct;152(2):186-96. doi: 10.1002/ajpa.22340.
8. Yong R, Ranjitkar S, Lekkas D, Halazonetis D, Evans A, Brook A, Townsend G. Three-dimensional (3D) geometric morphometric analysis of human premolars to assess sexual dimorphism and biological ancestry in Australian populations. Am J Phys Anthropol. 2018 Jun;166(2):373-385. doi: 10.1002/ajpa.23438.
9. Bookstein FL. Landmark methods for forms without landmarks: morphometrics of group differences in outline shape. Medical Image Analysis. 1998;1:3, 225-243. doi: 10.1016/s1361-8415(97)85012-8.
10. Gunz P, Mitteroecker P, Bookstein FL. Semilandmarks in Three Dimensions. Modern Morphometrics in Physical Anthropology. Plenum Publishers. 2005: 73-98.
11. Gower JC. Generalized Procrustes analysis. Psychometrika. 1975;40:33–51.
12. Gunz P, Mitteroecker P. Semilandmarks: A method for quantifying curves and surfaces. Hystrix It. J. Mamm. 2013;24:103–109.
13. Rohlf FJ, Slice D. Extensions of the Procrustes method for the optimal superimposition of landmarks. Syst. Zool. 1990;39:40–59.
14. Zorba E, Moraitis K, Manolis SK. Sexual dimorphism in permanent teeth of modern Greeks. Forensic Sci Int. 2011 Mar;210(1-3):74-81. doi: 10.1016/j.forsciint.2011.02.001.
15. Agrawal A, Manjunatha BS, Dholia B, Althomali Y. Comparison of sexual dimorphism of permanent mandibular canine with mandibular first molar by odontometrics. Journal of Forensic Dental Sciences. 2015;3:238-243.
16. Kapila R, Nagesh KS, Iyengar AR, Mehkri S. Sexual Dimorphism in Human Mandibular Canines: A Radiomorphometric Study in South Indian Population. Journal of Dental Research, Dental Clinics, Dental Prospects. 2011;2:51-54.
17. Klingenberg CP, Barluenga M, Meyer A. Shape Analysis of Symmetric Structures: Quantifying Variation Among Individuals and Asymmetry. Evolution. 2002; 1909-1920.

18. Klingenberg CP. Analyzing Fluctuating Asymmetry with Geometric Morphometrics: Concepts, Methods, and Applications. Symmetry. 2015;7:843-934. doi:10.3390/sym7020843.
19. Pedrosa VO, França FMG, Flório FM, Basting RT. Study of the morpho-dimensional relationship between the maxillary central incisors and the face. Braz Oral Res. 2011 May-Jun;25(3):210-6. doi: 10.1590/S1806-83242011000300006.
20. Nichani AS, Ahmed AZAJ, Ranganath V. The Shape of the Maxillary Central Incisors and Its Correlation with Maxillary Anterior Papillary Display: A Clinical Study. Int J Periodontics Restorative Dent. 2016;36(4):541-547.
21. Peres-Neto PR, Jackson DA, Somers KM. How many principal components? Stopping rules for determining the number of non-trivial axes revisited. Comput Stat Data Anal. 2005;49:974-997.
22. Schwartz GT, Dean MC. Sexual Dimorphism in Modern Human Permanent Teeth. Am J Phys Anthropol. 2005;128:312-317.
23. Soundarya N, Jain VK, Shetty S, Akshatha BK. Sexual dimorphism using permanent maxillary and mandibular incisors, canines and molars: An odontometric analysis. J Oral Maxillofac Pathol. 2021;25:183-188.
24. Al-Shahrani I, Dirks W, Jepson N, Khalaf K. 3D-Geomorphometrics tooth shape analysis in hypodontia. Front Physiol. 2014;5:154.
25. AlShahrani I. Three-dimensional geometric morphometric analysis of tooth shape in hypodontia: II size variation. Anat Sci Int. 2019; Accepted 24 July 2019.
26. Brook AH, Griffin RC, Townsend G, Levisianos Y, Russell J, Smith RN. Variability and patterning in permanent tooth size of four human ethnic groups. Arch Oral Biol. 2009;54S:S79-S85.
27. Cabello M, Alvarado S. Relationship between the shape of the upper central incisors and the facial contour in dental students. Lima. Peru. J Oral Res. 2015;4(3):189-196.
28. Işcan MY, Kedici PS. Sexual variation in bucco-lingual dimensions in Turkish dentition. Forensic Sci Int. 2003;137:160-164.
29. Jackson DA. Stopping rules in Principal Components Analysis: A comparison of heuristical and statistical approaches. Ecology. 1993;74(8):2204-2214.

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4. Viewbox, dHAL Software https://www.dhal.com/viewbox.htm
5. MorphoJ https://morphometrics.uk/MorphoJ_page.html

Image Acknowledgements

1. https://ferrebeekeeper.wordpress.com/
2. https://doi.org/10.1016/j.beproc.2022.104667
3. https://www.semanticscholar.org/paper/30-independent-evolution-of-outer-ear-asymmetry-owl-newton-kavanagh/
4. https://sketchfab.com/3d-models/maxillary-left-central-incisor-c8a7c2d9280d4c92bc651cfa1459866a

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