



ARCL0115: Variation and Evolution of the Human Skull

2023-24, Term 1
MSc BAFA Core Module
15 Credits

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Room 204b, 2nd Floor Institute of Archaeology
Drop-in Hours: Wednesdays 13.00 – 16.00

IMPORTANT INFORMATION REGARDING ASSESSMENTS:

The **coursework coversheet** is available here: <https://www.ucl.ac.uk/archaeology/current-students> under “Policies, Forms and Guidelines”

Please enter **your five-digit candidate code** on the coversheet and as the name of the file you submit.

Please refer to <https://www.ucl.ac.uk/archaeology/current-students/ioa-student-handbook/13-information-assessment>
<https://www.ucl.ac.uk/archaeology/current-students/ioa-study-skills-guide/referencing-effectively-and-ioa-guidelines>
<https://www.ucl.ac.uk/students/exams-and-assessments/academic-integrity> <https://library-guides.ucl.ac.uk/referencing-plagiarism/acknowledging-AI> for instructions on coursework submission, IoA referencing guidelines and marking criteria, as well as UCL policies on penalties for late submission, over-length work, the use of text generation software (AI) and academic misconduct.

1. MODULE OVERVIEW

MODULE DESCRIPTION

This half-unit module, taught in Term 1, gives a detailed introduction to the methodology used in the study of the skull in archaeology and physical anthropology, and the main current issues in research. It provides an anatomical background to the skull, as well as morphological variation, changes with age and development, and pathology, dealing specifically with the remains of Late Pleistocene and Holocene hominids, especially anatomically modern humans, but including Neanderthals. The week-by-week schedule is given below.

MODULE AIMS

This module introduces students to the study of the skull in archaeology and physical anthropology, and the main current issues in research. It provides an anatomical background to the skull, as well as morphological variation, sexual dimorphism, changes with age and development, and cranial pathology. It deals specifically with the remains of Late Pleistocene and Holocene anatomically modern humans.

LEARNING OUTCOMES

On successful completion of the module, in addition to specialist knowledge and skills, students should have developed skills of observation and inference, critical reflection and application of acquired knowledge.

It is intended that this module will provide students with the skills required to plan a research project, under the supervision of a more experienced researcher. When they have successfully completed the module, students should:

- be able to identify confidently all the bones of the skull in both adult and juvenile remains
- be able to label the main features and landmarks of the skull
- have an understanding of variation in size and shape of the skull, and its interpretation in terms of sexual dimorphism, growth and modern human origins
- to be able to take the most commonly used skull measurements and have a working knowledge of the main statistical methods used to interpret them
- have an understanding of development of the skull and its role in estimating age-at-death
- be able to recognise the most common types of pathological lesions and developmental anomalies in the skull and discuss the ways in which they may be interpreted.

METHODS OF ASSESSMENT

This course is assessed by means of:

- (a) one essay of 2,500 words, which will contribute 60% to the final grade for the course. **Due on MONDAY 27th of November 2023.**
- (b) one practical examination, to be held on **THURSDAY 7th December 2023**, which will contribute 40% to the final grade for the course

COMMUNICATION

- **Moodle is the main hub** for this course
- Important information will be posted by staff in the **Announcements section of the Moodle page** and you will automatically receive an email notification for these
- Please post any general queries relating to module content, assessments and administration **in the Moodle forum** (or via email if you prefer). The forum will be checked regularly
- For personal queries, please contact the co-ordinator by email.

WEEK-BY-WEEK SUMMARY

Lectures will take place on Mondays between 12:00-13:00 in room 433, 16 Taviton Street. Practical classes will take place on Thursdays in room 308 of the Institute of archaeology at the following times:

Group A: 10:00-12:00, **Group B:** 13:00-15:00

You will join ONE of two practical groups. Prior to the first session a list will be circulated, asking you to indicate your preferred time slot. You will then be assigned to a group and the list will be circulated via email.

Week	Lecture	Practical
1	Craniology and Terminology	Norma lateralis
2	What Defines a Human Skull?	Norma verticalis and occipitalis
3	Origins and Dispersals of Modern Humans	Norma frontalis
4	How Skulls Vary in Size and Shape	Norma basilaris
5	Essay Writing Seminar	Endocranial landmarks
6	Reading week	
7	Development of the Skull	Individual cranial bones
8	Development of the Face	Individual facial bones
9	Cranial Pathology	Non-adult skull bones
10	Cranial Modification	Practical examination
11	Facial Reconstruction	Skull measurements

WEEKLY MODULE PLAN

The module is taught through lectures and practical classes. Students will be required to undertake set readings, and complete pre-class activities in order to be able to actively participate. Each week, on Monday, the lecture slides for that weeks' lecture will be made available on Moodle.

WORKLOAD

This is a 15-credit module which equates to 150 hours of learning time including session preparation, background reading, and researching and writing your assignments. With that in mind you should expect to organise your time in roughly this way:

30 hours	<i>Staff-led teaching sessions (lectures, practical sessions)</i>
50 hours	<i>Self-guided session preparation (reading, listening, note-taking and online activities), about 5 hours a week</i>
40 hours	<i>Reading for, and writing, the research essay</i>
30 hours	<i>Preparing for the Practical Examination</i>

2. ASSESSMENT

Each assignment and possible approaches to it will be discussed in class, in advance of the submission deadline. If students are unclear about the nature of an assignment, they should discuss this with the Module Co-ordinator in advance (via drop-in hours or class Moodle forum). You will receive feedback on your written coursework via Moodle and have the opportunity to discuss your marks and feedback with the co-ordinator in their office hours.

For more details see the 'Assessment' section on Moodle. The coursework coversheet is available on the course Moodle page and here: <https://www.ucl.ac.uk/archaeology/current-students> under "Policies, Forms and Guidelines. Please make sure you enter your five-digit candidate code on the coversheet and in the subject line when you upload your work in Moodle.

The [IoA marking criteria](#) can be found in the IoA Student Handbook (Section 13: Information on assessment) and the [IoA Study Skills Guide](#) provides useful guidance on writing different types of assignment.

Generative artificial intelligence (AI) is a form of AI that can be used to produce new content including images, audio, video and text. The use of AI software to generate content for your essay is not permitted. You can, however, use AI software to check the grammar, spelling and punctuation of your writing. Should you choose to use any form of AI software it must be acknowledged in the relevant section of the coursework coversheet. Please note that **late submission, exceeding the maximum word count and academic misconduct (unacknowledged use of text generation software and plagiarism)** will be penalized and can significantly reduce the mark awarded for the assignment and/or overall module result. Serious offences will be punishable by death.

On requirements, please do consult

<https://www.ucl.ac.uk/archaeology/current-students/ioa-student-handbook/13-information-assessment> with sections 13.7-8: coursework submission, 13.10: word count, 13.12-14: academic integrity

<https://www.ucl.ac.uk/students/exams-and-assessments/academic-integrity> for UCL's guidance on academic integrity

<https://library-guides.ucl.ac.uk/referencing-plagiarism/acknowledging-AI> for UCL's guidance on how to acknowledge the use of text generation software.

ASSESSMENT 1: ESSAY (60%)

Word length: 2,500 words

Deadline: **27th November 2023**

Choose one of the following titles. They are all carefully focussed questions which have substantial literature and evidence, giving you the best chance to write a good essay. Write the title at the start of your essay and **DO NOT CHANGE IT IN ANY WAY**. One of the things we test you on in the essay is your ability to focus on a defined question and attempt to answer it.

- 1) Using evidence from published studies, discuss how the development of the chondrocranium may be used to estimate age-at-death for non-adult individuals, and evaluate how accurate these estimates are.
- 2) Is there evidence that an evolutionary trend in human skull morphology has taken place over the past 10,000 years? Use published examples to justify your answer.
- 3) Using published validation studies, discuss how accurate analyses of the human cranium are in estimating biological sex. Outline some of the limitations which may affect the accuracy of various methods.
- 4) Anatomical skeletal collections contain large numbers of known-age and -sex individuals, which are considered crucial for developing and testing anthropological methods.

However, their use has been called into question due to their associations with structural violence. What are the arguments for and against the continued use of these collections?

ASSESSMENT 2: PRACTICAL EXAMINATION (40%)

The practical examination will take place on **THURSDAY 7th December 2023** during your normal practical class time, in Room 308 of the IoA. The examination consists of 15-20 skull fragments which students are asked to write short notes on. This will include, for example, the element(s) present, the side of the body the fragment comes from, and which anatomical landmarks are present.

3. RESOURCES & PREPARATION FOR CLASS

You are expected to read 1-4 of the weekly reading list each week. Completing the readings is essential for your effective participation in the activities and discussions that we will do, and it will greatly enhance your understanding of the material covered. **Further readings are necessary** for you to get a sense of the range of current work on a given topic, and for you to draw upon for your essay assessment.

RECOMMENDED BASIC TEXTS AND ONLINE RESOURCES

These are intended to provide only the most basic of introductions to the various topics discussed during the lectures. A more comprehensive reading list for each week of the module is provided later in this handbook; however, this is not exhaustive, and it is expected that each student will expand upon these provided articles in their own time.

- Ayala, F.J. & Cela-Conde, C.J. (2017). *Processes in Human Evolution: The Journey from Early Hominins to Neanderthals and Modern Humans. Second Edition*. Oxford: Oxford Academic Press. Chapters 6 and 8-9. <https://oxford-universitypressscholarship-com.libproxy.ucl.ac.uk/view/10.1093/oso/9780198739906.001.0001/oso-9780198739906-chapter-11>
- Bass, W.M. (1979). *Human Osteology, a Laboratory and Field Manual of the Human Skeleton*. Columbia: Missouri Archaeological Society. IoA Library BB 2 BAS
- Grey's Anatomy. Available in room 308, Orthopaedics Library QS 4 GRA, or here: <https://archive.org/details/anatomyofhumanbo1918gray/page/n5/mode/2up?view=theater>
- Scheuer, L. & Black, S. (2000). *Developmental Juvenile Osteology*. San Diego: Academic Press. IoA Library BB 2 SCH <https://www-sciencedirect-com.libproxy.ucl.ac.uk/book/9780126240009/developmental-juvenile-osteology>
- White, T.D. & Folkens, P.A. (2005). *The Human Bone Manual*. New York: Academic Press. IoA Library BB 2 WHI <https://www-sciencedirect-com.libproxy.ucl.ac.uk/book/9780120884674/the-human-bone-manual>

Online skull atlases:

- <https://eskeletons.org/boneviewer/nid/12537/region/skull/bone/cranium>
- http://virtualhumanembryo.lsuhs.edu/IAHS/Skull/Skull_BL.html

4. SYLLABUS

WEEK 1: CRANIOLOGY AND TERMINOLOGY

- de la Cova, C. (2020). 'Making Silenced Voices Speak: Restoring Neglected and Ignored Identities in Anatomical Collections'. In: Cheverko, C.M., Prince-Buitenhuys, J.R. & Hubbe, M. (eds.) *Theoretical Approaches in Bioarchaeology*. London: Routledge. pp. 150-169. <https://www-taylorfrancis-com.libproxy.ucl.ac.uk/chapters/edit/10.4324/9780429262340-10/making-silenced-voices-speak-carlina-de-la-cova?context=ubx&refId=896b7430-d0aa-4431-8c85-99f529109513>
- de la Cova, C. (2019). 'Marginalized Bodies and the Construction of the Robert J. Terry Anatomical Skeletal Collection: A Promised Land Lost'. In: Mant, M.L. & Holland, A.J. (eds.) *Bioarchaeology of Marginalized People*. London: Elsevier. pp. 133-155. <https://www-sciencedirect-com.libproxy.ucl.ac.uk/science/article/pii/B9780128152249000075>

- Fee, E. (1979). 'Nineteenth-Century Craniology: The Study of the Female Skull'. *Bulletin of the History of Medicine*, 53(3): 415-433. https://www.jstor.org/stable/pdf/44450930.pdf?casa_token=i6LxvnHiybwAAAAA:UmkPOreaHCvsszSMilqWxnvSo6_vRf_bIXZnfHYw-U2cw2-DKDom4CRotj2u_xn9S3b8EyZWMjFYxgTeh3WM_bl7clzuPnS5A7YqSgDhwaCBxo3BqjCQ
- Gravlee, C.C. (2009). How Race Becomes Biology: Embodiment of Social Inequality. *American Journal of Physical Anthropology*, 139: 47-57. <http://onlinelibrary.wiley.com/doi/pdf/10.1002/ajpa.20983>
- Muller, J.L., Pearlstein, K.E. & de la Cova, C. (2017). 'Dissection and Documented Skeletal Collections: Embodiments of Legalized Inequality'. In: Nystrom, K. (ed.) *The Bioarchaeology of Dissection and Autopsy in the United States. Bioarchaeology and Social Theory*. Springer, Cham. pp. 185-201. https://link.springer.com/chapter/10.1007/978-3-319-26836-1_9
- White, T.D. & Folkens, P.A. (2005). *The Human Bone Manual*. New York: Academic Press. IoA Library BB 2 WHI <https://www-sciencedirect-com.libproxy.ucl.ac.uk/book/9780120884674/the-human-bone-manual>
- Watkins, R.J. (2018). 'The Fate of Anatomical Collections in the US: Bioanthropological Investigations of Structural Violence'. In: Henderson, C.Y. & Cardoso F.A. (eds.) *Identified Skeletal Collections: The Testing Ground of Anthropology?* Archaeopress. pp. 169-186. https://www.jstor.org/stable/j.ctv1pdrqct.11#metadata_info_tab_contents

WEEK 2: WHAT DEFINES A HUMAN SKULL?

- Aiello, L. & Dean, C. (1990). *An Introduction to Human Evolutionary Anatomy*. London: Academic Press. IoA Library BB 1 AIE
- Baab, K.L. (2021). 'Reconstructing Cranial Evolution in an Extinct Hominin'. *Proceedings of the Royal Society B: Biological Sciences*, 288: 20202604. <https://royalsocietypublishing-org.libproxy.ucl.ac.uk/doi/10.1098/rspb.2020.2604>
- Bergström, A., Stringer, C., Hajdinjak, M., Scerri, E.M. & Skoglund, P. (2021). 'Origins of Modern Human Ancestry'. *Nature*, 590: 229-237. <https://www.nature.com/articles/s41586-021-03244-5>
- Hajdinjak, M., Mafessoni, F., Skov, L. et al. (2021). 'Initial Upper Palaeolithic Humans in Europe had Recent Neanderthal Ancestry'. *Nature*, 592: 253-257. <https://www-nature-com.libproxy.ucl.ac.uk/articles/s41586-021-03335-3>
- Lahr, M.M. (1996). *The Evolution of Modern Human Diversity: A Study of Cranial Variation*. Cambridge: Cambridge University Press. IoA Library BB2 LAH
- Schwartz, J.H. & Tattersall, I. (2010). 'Fossil Evidence for the Origin of *Homo sapiens*'. *American Journal of Physical Anthropology*, 143: 94-121. https://onlinelibrary.wiley.com/doi/pdfdirect/10.1002/ajpa.21443?casa_token=FVmrgPT8OXQAAAAA:-e-EdQ47Txu_nvO7IVggZrLhSSb8GzXjd83O6O_LN85-ZE3-VAM6Hm0HL8sq2k1ga1d4O7aBobo4VxjU
- Smith, T.M., Tafforeau, P., Reid, D.J. et al. (2010). 'Dental Evidence for Ontogenetic Differences Between Modern Humans and Neanderthals'. *PNAS*, 107: 20923-20928. <https://www-pnas-org.libproxy.ucl.ac.uk/doi/full/10.1073/pnas.1010906107>
- Stringer, C. (2016). 'The Origin and Evolution of *Homo sapiens*'. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 371: 20150237. <https://royalsocietypublishing-org/doi/10.1098/rstb.2015.0237>
- Tattersall, I. & Schwartz, J.H. (2008). 'The Morphological Distinctiveness of *Homo sapiens* and its Recognition in the Fossil Record: Clarifying the Problem'. *Evolutionary Anthropology: Issues, News, and Reviews: Issues, News, and Reviews*, 17: 49-54. <https://onlinelibrary.wiley.com/doi/10.1002/evan.20153>

WEEK 3: ORIGINS AND DISPERSALS OF MODERN HUMANS

- Bae, C.J., Douka, K. & Petraglia, M.D. (2017). 'On the origin of modern humans: Asian perspectives'. *Science*, 358(6368). <https://www.science.org/doi/10.1126/science.aai9067>
- Belbin, G.M., Nieves-Colón, M.A., Kenny, E.E., Moreno-Estrada, A. & Gignoux, C.R. (2018). 'Genetic Diversity in Populations Across Latin America: Implications for Population and Medical Genetic

Studies'. *Current Opinion in Genetics & Development*, 53: 98-104.

https://www.academia.edu/37286794/Genetic_diversity_in_populations_across_Latin_America_implications_for_population_and_medical_genetic_studies

- Betti, L., Balloux, F., Amos, W., Hanihara, T. & Manica, A. (2009). 'Distance from Africa, not Climate, Explains Within-Population Phenotypic Diversity in Humans'. *Proceedings of the Royal Society B: Biological Sciences*, 276: 809-814. <https://royalsocietypublishing-org.libproxy.ucl.ac.uk/doi/10.1098/rspb.2008.1563>
- Hanihara, T., Ishida, H. & Dodo, Y. (2003). 'Characterization of Biological Diversity Through Analysis of Discrete Cranial Traits'. *American Journal of Physical Anthropology*, 121: 241-251. https://www.academia.edu/8770480/Characterization_of_biological_diversity_through_analysis_of_discrete_cranial_traits
- Howells, W.W. 1989. *Skull Shapes and The Map*. Cambridge, Mass: Peabody Museum of Archaeology and Ethnology, Harvard University. IoA Library BB 2 HOW
- Katz, D.C., Grote, M.N. & Weaver, T.D. (2017). 'Changes in Human Skull Morphology Across the Agricultural Transition are Consistent with Softer Diets in Preindustrial Farming Groups'. *Proceedings of the National Academy of Sciences*, 114: 9050-9055. <https://www.pnas.org/doi/10.1073/pnas.1702586114>
- Li, J.Z., Absher, D.M., Tang, H. et al. (2008). 'Worldwide Human Relationships Inferred from Genome-wide Patterns of Variation'. *Science*, 319: 1100-1104. <https://www-science-org.libproxy.ucl.ac.uk/doi/10.1126/science.1153717>
- Nakashima, A., Ishida, H., Shigematsu, M., Goto, M. & Hanihara, T. (2010). 'Nonmetric Cranial Variation of Jomon Japan: Implications for the Evolution of Eastern Asian Diversity'. *American Journal of Human Biology* 22: 782-790. <https://pubmed.ncbi.nlm.nih.gov/20721979/>
- Noback, M.L. & Harvati, K. (2015). 'The Contribution of Subsistence to Global Human Cranial Variation'. *Journal of Human Evolution*, 80: 34-50. https://www.academia.edu/22165097/The_contribution_of_subsistence_to_global_human_cranial_variation
- von Cramon-Taubadel, N. & Lycett, S.J. (2008). 'Brief Communication: Human Cranial Variation Fits Iterative Founder Effect Model with African Origin'. *American Journal of Physical Anthropology*, 136: 108-113. <https://onlinelibrary.wiley.com/doi/abs/10.1002/ajpa.20775>
- Witt, K.E., Villanea, F., Loughran, E. & Huerta-Sanchez, E. (2021). 'On the Apportionment of Archaic Human Diversity'. *bioRxiv*. <https://www.biorxiv.org/content/10.1101/2021.07.15.452563v1.full>
- Yang, M.A. & Fu, Q. (2018). 'Insights into Modern Human Prehistory Using Ancient Genomes'. *Trends in Genetics*, 34: 184-196. <https://www.sciencedirect.com/science/article/abs/pii/S016895251730210X>
- Zhang, Y., Lu, H., Zhang, X., Zhu, M., He, K., Yuan, H. & Xing, S. (2021). 'An Early Holocene Human Skull from Zhaoguo Cave, Southwestern China'. *American Journal of Physical Anthropology*. <https://onlinelibrary.wiley.com/doi/abs/10.1002/ajpa.24294>

WEEK 4: HOW SKULLS VARY IN SIZE AND SHAPE

- Bigoni, L., Velemínská, J. & Brůžek, J. (2010). 'Three-dimensional Geometric Morphometric Analysis of Craniofacial Sexual Dimorphism in a Central European Sample of Known Sex'. *Homo*, 61: 16-32. <https://www.sciencedirect.com/science/article/abs/pii/S0018442X10000053?via%3Dihub>
- Chovalopoulou, M.E., Valakos, E.D. & Manolis, S.K. (2016). 'Sex Determination by Three-dimensional Geometric Morphometrics of the Vault and Midsagittal Curve of the Neurocranium in a Modern Greek Population Sample'. *Homo*, 67: 173-187. <https://www.sciencedirect.com/science/article/abs/pii/S0018442X16300129>
- Garvin, H.M., Sholts, S.B. & Mosca, L.A. (2014). 'Sexual Dimorphism in Human Cranial Trait Scores: Effects of Populations, Age, and Body Size'. *American Journal of Physical Anthropology*, 154: 259-269. https://onlinelibrary.wiley.com/doi/abs/10.1002/ajpa.22502?casa_token=zrXT9ucuhn0AAAAA%3An9jfcUlcxkKZAPoolSiSKAq1UY2w8f44vGApWb4c7sjsiSI2rdAIOE_AWEe2Z5y_8DiNI-kMPtW27Wn4
- Kelley, S.R. & Tallman, S.D. (2022). 'Population-Inclusive Assigned-Sex-at-Birth Estimation from Skull Computed Tomography Scans'. *Forensic Sciences*, 2: 321-348. <https://www.mdpi.com/2673-6756/2/2/24/htm>

- Lewis, C.J. & Garvin, H.M. (2016). 'Reliability of the Walker Cranial Non-metric Mathos and Implications for Sex Estimation'. *Journal of Forensic Sciences*, 61: 743-751. https://onlinelibrary.wiley.com/doi/abs/10.1111/1556-4029.13013?casa_token=sq2ULU438PYAAAAA%3Asq7BqXFZbEJM-frNtKrRMG4gMbLUXfvkoNdPYjKb-vjclDUUrvDVx0mB30sAOfi7focZ9kzSbGis2Jqj
- Spradley, M.K. & Jantz, R.L. (2011). 'Sex Estimation in Forensic Anthropology: Skull Versus Postcranial Elements'. *Journal of Forensic Sciences*, 56: 289-296. <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1556-4029.2010.01635.x>
- Torralbo Lopez Capp et al. (2021). 'Sex Estimation of Brazilian Skulls using Discriminant Analysis of Cranial Measurements'. *Research, Society and Development*, 10: e266101018760 <https://rsdjournal.org/index.php/rsd/article/view/18760>
- Walker, P. (2008). 'Sexing Skulls Using Discriminant Function Analysis of Visually Assessed Traits'. *American Journal of Physical Anthropology*, 136: 39-50. <https://onlinelibrary.wiley.com/doi/abs/10.1002/ajpa.20776>
- Waxenbaum, E.B. and Feiler, M.E. (2020). 'Influence of Climatic Stress on Non-metric Sexually Dimorphic Features of the Skull and Pelvis'. *American Journal of Human Biology*, 23559. <https://pubmed.ncbi.nlm.nih.gov/33377211/>

WEEKS 7-8: DEVELOPMENT OF THE SKULL & FACE

- Bassed, R.B., Briggs, C. & Drummer, O.H. (2010). 'Analysis of Time of Closure of the Spheno-Occipital Synchrondrosis Using Computed Tomography'. *Forensic Science International*, 200: 161-164. <https://www.sciencedirect.com/science/article/abs/pii/S0379073810001817>
- Enlow, D. H. & Hansen, B. F. (1996). *Essentials of Facial Growth*. London: Saunders. Science Library MEDICAL SCIENCES JB 145 ENL
- Hisham, S., Flavel, A., Abdullah, N., Noor, M.H.M. & Franklin, D. (2018). 'Quantification of Spheno-Occipital Synchrondrosis Fusion in a Contemporary Malaysian Population'. *Forensic Science International*, 284: 78-84. <https://www.sciencedirect.com/science/article/abs/pii/S0379073818300057>
- Humphrey, L.T. & Scheuer, L. (2006). 'Age of Closure of the Foramen of Huschke: An Osteological Study'. *International Journal of Osteoarchaeology*, 16: 47-60. <https://onlinelibrary.wiley.com/doi/abs/10.1002/oa.807>
- Libby, J., Marghoub, A., Johnson, D., Khonsari, R.H., Fagan, M.J. & Moazen, M. (2017). 'Modelling Human Skull Growth: A Validated Computational Model'. *Journal of the Royal Society Interface*, 14: 20170202. <https://royalsocietypublishing.org/doi/10.1098/rsif.2017.0202>
- Madeline, L. A. & Elster, A. D. (1995). 'Suture Closure in the Human Chondrocranium: CT Assessment'. *Radiology*, 196: 747-756. <https://pubs.rsna.org/doi/abs/10.1148/radiology.196.3.7644639>
- Mahon, T.J., Friedling, L.J. & Gordon, G.M. (2017). 'Spheno-Occipital Synchrondrosis: Examining the Degree of Fusion in a South African Black Skeletal Sample'. *Forensic Science International*, 278: 408 e1-e5. <https://www.sciencedirect.com/science/article/abs/pii/S0379073817302177>
- Martinez-Maza, C., Rosas, A. & Nieto-Díaz, M. (2013). 'Postnatal Changes in the Growth Dynamics of the Human Face Revealed from Bone Modelling Patterns'. *Journal of Anatomy*, 223: 228-241. <https://onlinelibrary.wiley.com/doi/10.1111/joa.12075>
- Pate, R.S., Tingne, C.V. & Dixit, P.G. (2018). 'Age Determination by Spheno-Occipital Synchrondrosis Fusion in Central Indian Population'. *Journal of Forensic and Legal Medicine*, 54: 39-43. <https://www.sciencedirect.com/science/article/pii/S2665910720300347>
- Redfield, A. (1970). 'A New Aid to Aging Immature Skeletons: Development of the Occipital Bones'. *American Journal of Physical Anthropology*, 33: 207-220. <https://onlinelibrary.wiley.com/doi/abs/10.1002/ajpa.1330330206>
- Scheuer, L. & Black, S. (2000). *Developmental Juvenile Osteology*. San Diego: Academic Press. IoA Library BB 2 SCH <https://www-sciencedirect-com.libproxy.ucl.ac.uk/book/9780126240009/developmental-juvenile-osteology>
- Scheuer, L. & MacLaughlin-Black, S. (1994). 'Age Estimation from the Pars Basilaris of the Fetal and Juvenile Occipital Bone'. *International Journal of Osteoarchaeology*, 4: 377-382. <https://onlinelibrary.wiley.com/doi/10.1002/oa.1390040412>

- Shirley, N.R. & Jantz, R.L. (2011). 'Spheno-Occipital Synchronosis Fusion in Modern Americans'. *Journal of Forensic Sciences*, 56: 580-585.
https://www.academia.edu/565981/Spheno_occipital_Synchronosis_Fusion_in_Modern_Americans
- Tocheri, M.W. & Molto, J.E. (2002). 'Aging Fetal and Juvenile Skeletons from Roman Period Egypt Using Basiociput Osteometrics'. *International Journal of Osteoarchaeology*, 12: 356-363.
<https://onlinelibrary.wiley.com/doi/abs/10.1002/oa.634>

WEEK 9: CRANIAL PATHOLOGY

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