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 **UNDERGRADUATE SUMMER VACATION SCHOLARSHIP AWARDS – FINAL SUMMARY REPORT FORM 2018/19**

***NB: This whole report will be posted on the Society’s website therefore authors should NOT include sensitive material or data that they do not want disclosed at this time.***

**Name of student:**

Morven Burton

**Name of supervisor(s):**

Dr Eilidh Ferguson

**Project Title: (no more than 220 characters)**

Anatomical Variation within Teaching Skeletons: An Appraisal of the University of Glasgow Skeletal

Collection

**Project aims: (no more than 700 words)**

A physical and practical approach to learning anatomy, including the use of osteology specimens, is essential in understanding the variation between individuals. In addition, studying these 3-dimentional structures directly can improve spatial awareness of the human skeleton and associated anatomical relations (Azer and Azer, 2016).

Historically, teaching skeletons were provided by osteology supply houses for Medical Schools and Universities in the UK (Morris, 2007). These anatomical collections remain an invaluable and precious resource for teaching and research, particularly for introducing students to real-life anatomical variation.

Maintaining a detailed and current catalogue of such teaching specimens is therefore not only important for the appropriate and ethical storage and management of collections, but also for facilitating the use of these resources for education and research purposes.

**Aims/Objectives**

1. To analyse and catalogue teaching skeletons within the University of Glasgow Anatomy Facility, with the aim of providing a clearer description of the collection with regards to preservation, completeness, and potential commingling of skeletal elements.
2. To develop a new digital database and associated recording forms of skeletal elements held within the collection, with a view to increasing accessibility for teaching and research.
3. To identify and record the presence of anatomical variation and bone pathology within the analysed subset of the collection.
4. To determine skeletal elements demonstrating high levels of anatomical variation and/or pathological conditions to identify potential avenues for future research. It was hypothesised, based on anecdotal evidence from previously catalogued remains, and the published literature (Jancuska *et al.*, 2015), that the lumbosacral region will be a key area of anatomical variation within the collection.

**Project Outcomes and Experience Gained by the Student (no more than 700 words)**

1. To analyse and catalogue teaching skeletons within the University of Glasgow Anatomy Facility.

A total of 60 boxes, containing 5149 bones/fragments, were analysed and catalogued as part of this project.

1. To develop a digital database and associated skeletal diagrams of skeletal elements held within the collection, with a view to increasing accessibility for teaching.

A new digital specimen database was created, which allows users to search for specimens demonstrating specific anatomical variations or pathologies. Inventory and skeletal diagram forms were adapted from the Institute of Field Archaeologists and Interpol Disaster Victim Identification (DVI) recording forms respectively (Brickley and McKinley, 2004; Interpol, 2019). Inventory forms listed elements present, while skeletal diagram forms were shaded to depict elements present. The completed forms were laminated and stored with individual boxes, providing a quick visual tool to determine the contents of each box.

1. To identify and record the presence of anatomical variation and pathology within the analysed subset of the collection.

A total of 138 instances of anatomical variation were recorded within the collection and ranged from the presence of additional foramina (sternum and humerus) to variations in fusion of elements (such as cranial sutures and pedal phalanges). The most frequent anatomical variation documented was the presence of fused skeletal elements. A total of 190 instances of pathologies were identified throughout the collection. Degenerative changes, often associated with advancing age, were the most often encountered bone pathology.

1. To determine skeletal elements demonstrating high levels of anatomical variation and/or pathological conditions with potential for future study.

The lumbosacral region was shown to be highly variable, as hypothesised. Jancuska and colleagues (2015) found that between 4-35.9% of the population may possess lumbosacral transitional vertebrae, which supports the results found in this study. Large numbers of transitional vertebrae and the presence of unfused/cleft neural arches were identified. The variability of the lumbosacral region in this collection provides a potential area for future research.

**Experience Gained**

I have gained experience working in an ethically aware laboratory-based environment. I have been given the opportunity to utilize and apply my knowledge of human anatomy as well as learning the bones of the lower limb, which I had not previously studied, as in our programme lower limb anatomy is part of the final year.This has given me a much more in-depth and comprehensive understanding of the skeleton.

I have experienced first-hand the complexity of the human skeleton and have learned to recognize pathologies and variations within and between individual skeletal elements and use appropriate reference texts to aid in identification. I have learned to recognise whether bones articulate or whether commingling may have occurred. I was also taught the principles of age and sex determination methods currently used in forensic practice.

I created a digital specimen database and made use of standard forensic and archaeology inventory forms. This was greatly beneficial as it gave me insight into how professional practitioners in this field catalogue and identify human skeletal remains.

I am more confident in my anatomical knowledge and my skills to work both independently and in collaboration with other students and staff. This project has set me in good standing for beginning my final year of my degree in Human Anatomy, particularly for my Honours project. My experience gained from this project is invaluable for my future career in science.

Please state which Society Winter or Summer Meeting the student is intending to present his/her poster at:

Winter

**Proposed Poster Submission Details (within 12 months of the completion of the project) for an AS Winter/ Summer Meeting – (no more than 300 words)**

This project aimed to catalogue and assess teaching skeletons housed within the University of Glasgow’s Anatomy Facility to quantify anatomical variations and pathologies, with a view to informing future use in teaching and research. Anecdotal evidence from previous cataloguing efforts, along with published literature, have led to a hypothesis that the lumbosacral region may demonstrate increased variability within this skeletal assemblage (Jancuska, Spivak et al. 2015).

Teaching skeletons were catalogued in a newly created digital specimen database. The presence of anatomical variations and/or pathology was recorded, and physical inventory forms were created as a rapid visual tool to identify the contents of each box.

Sixty boxes containing a total of 5149 skeletal elements were analysed.  Overall, 138 instances of anatomical variation and 190 instances of bone pathology were recorded. The lumbosacral region displayed a high degree of variability, as hypothesised, with large numbers of transitional vertebrae and unfused/cleft neural arches identified.

By cataloguing and assessing anatomical variations and pathologies in the University of Glasgow teaching collection, through the creation of a new searchable database, this project has taken the first step to ensuring that this invaluable collection continues to play an integral role in future anatomy teaching and research.

**Brief Resume of your Project’s outcomes**: (**no more than 200-250 words)**.

*The title of your project and a brief 200-250 word description of the proposed/completed project. The description should include sufficient detail to be of general interest to a broad readership including scientists and non-specialists. Please also try to include 1-2 graphical images (minimum 75dpi). NB: Authors should NOT include sensitive material or data that they do not want disclosed at this time.*

**Anatomical Variation within Teaching Skeletons: An Appraisal of the University of Glasgow Skeletal**

**Collection**

Anatomy has been taught at the University of Glasgow since the early 1700s. To this day, it remains an essential subject taught to students throughout the Life Sciences, Medicine, Dentistry, and Nursing. Knowledge of the human skeleton is fundamental in understanding anatomy, as it forms the framework for the human body. Access to teaching skeletons in education are therefore an invaluable and essential resource, particularly for introducing students to real-life anatomical variation. This project aimed to analyse the teaching skeleton collection of the University of Glasgow, by creating a bespoke digital specimen database, in addition to quantifying anatomical variation and pathologies present within the skeletal assemblage to facilitate future use in teaching and research.

From the analysis of 60 boxed teaching skeletons, containing 5149 bones/fragments, 138 instances of anatomical variation and 190 instances of bone pathology were recorded. Fused elements were the most frequently documented anatomical variation. Degenerative changes, typically associated with bone diseases such as osteoarthritis, were the most observed bone pathology. It was noted that the lumbosacral spinal column showed high rates of variation, supporting previous findings in the literature (Jancuska, Spivak et al. 2015).

This project has developed a searchable digital database that will enhance anatomy education at the University of Glasgow, by providing a rapid method of locating appropriate specimens for teaching. In addition, this study has provided insight into the frequency of variations and pathological conditions present within teaching skeletons, helping to provide a better understanding of bone anatomy and disease within this osteology collection.

**Other comments: (no more than 300 words)**

**References:**

Azer, S. and Azer, S. (2016) 3D Anatomy Models and Impact on Learning: A Review of the Quality of the Literature. *Health Professions Education*, 2(2), pp.80-98.

Brickley, M., & McKinley, J. I. (2004) Guidelines to the Standards for Recording Human Skeletal Remains. IFA Paper No. 7. Southampton and Reading: BABAO and the Institute of Field Archaeologists.

Interpol. (2019) Disaster Victim Identification (DVI) Guide. [online] Available at: <https://www.interpol.int/en/How-we-work/Forensics/Disaster-Victim-Identification-DVI> [Accessed 22 Aug. 2019].

Jancuska, J.M., Spivak, J.M., Bendo, J.A., (2015) A Review of Symptomatic Lumbosacral Transitional Vertebrae: Bertolotti’s Syndrome. *International Journal of Spine Surgery*, [online] Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4603258/> [Accessed 12 Aug. 2019].

Morris, A.G. (2007) Documentation: History and the Sources of Skeletons in Collections. In: Cassman, V., Odegaard, N., and Powell, J. (eds.) *Human Remains: A Guide for Museums and Academic Institutions*, pp.151-161. United Kingdom: Altamira Press.

 *Signature of student...........M. Burton...... ......Date…02/09/2019………..*

 *Signature of supervisor……*E. Ferguson*............. Date…02/09/2019……….…*

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