HUMAN SKELETAL ANATOMY

ABOUT THE AUTHORS

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Dr. Fairgrieve received his B.Sc.(Hon.) in Anthropology from the University of Toronto at Mississauga (Erindale College) in 1986. In 1987. he received an M.Phil. in Biological Anthropology from the University of Cambridge, England. Subsequently, he studied under Dr. Jerry Melbye at the University of Toronto, receiving his Ph.D. in Anthropology (specializing in human skeletal biology) in 1993. Since 1991, Dr. Fairgrieve has been a member of the faculty at Laurentian University and is cross-appointed between the Anthropology Program and the Department of Biology as a tenured Associate Professor. Dr. Fairgrieve is a member of the Canadian Society of Forensic Science, Canadian Identification Society and a Fellow of the American Academy of Forensic Sciences. Dr. Fairgrieve is a consultant to various law enforcement services in Northern Ontario. Dr. Fairgrieve's research has centered on biochemical analysis of RomanoChristian human skeletons from the Dakhleh Oasis, Egypt. More recently, Dr. Fairgrieve's research has concentrated on problems of determining age at death and the postmortem interval of human skeletons. He is also head of the only Forensic Biology Option within a Biology Program in Canada.

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Ms. Tracy Oost received her B.A. (Hon.) and B.Sc.(Hon.) in Anthropology and Biology, respectively , from Laurentian University in 1996. Currently, Ms. Oost is an M.Sc. candidate in the Department of Biology at Laurentian University. Her thesis research is centered on the application of bone citrate levels as a means of estimating postmortem intervals in mammalian species. Currently, she teaches courses in Human Anatomy and Physiology, Basic Pharmacology, and Chronic Diseases. Ms. Oost is a member of the Canadian Identification Society, Canadian Society of Forensic Science and the American Academy of Forensic Sciences. Additionally, Ms. Oost is the Manager of the Forensic Osteology Laboratory at Laurentian University. Her work also involves scene documentation and collection of evidence with police personnel in a forensic casework setting. Ms. Oost has been involved in running laboratories for educating students in human anatomy and physiology, human skeletal anatomy and forensic biology.

To the students of Human Skeletal Biology at Laurentian University who provided us with valuable feedback.

PREFACE TO THE INSTRUCTOR

The *Human Skeletal Anatomy: Laboratory Manual and Workbook* has been designed to help students who are enrolled in courses dedicated to this topic. It is the product of many years of designing and instructing a Human Skeletal Biology course for undergraduate students. The key to this manual is flexibility. Instructors may utilize as much or as little of the manual as they see fit.

This manual is largely based on the regional approach to anatomy. However, the first section of the manual begins with a survey of the microscopic and macroscopic structure of bone. After grounding the student in the basics of bone structure the manual then turns to the gross morphological anatomy of skeletal elements. The axial skeleton is dealt with first, then the appendicular skeleton. However, as you will note, the manual is designed to cover material in an incremental fashion. Specifically, the anatomy of less complicated bones such as the ribs, sternum and hyoid are discussed prior to other axial bones in order to acquaint students with how to handle real bone material in the laboratory. Each successive laboratory session demands more from the student in both the level of understanding and expectations in assigned laboratory exercises.

Each laboratory begins with an introduction in order to familiarize the student with the areas to be studied. Subsequently, the laboratory has a stated purpose with clear instructions of expectations and learning objectives. "Important Terms" are clearly indicated in boxes to stress to students that these must be understood. This is then followed by a clear laboratory **Procedure** for the student to follow. This usually involves the identification of particular features or assigning specific tasks as identified in the various **Exercises.** Finally, as a means of stressing the applicability of what has been learned in the laboratory exercise, the student will be requested to generate an evaluation of some aspect of the anatomy (such as using a method for determining age at death) from assigned specimens. The student is then required to interpret this information and produce, for the next class or session, a "Laboratory Research Report". Guidelines for these reports are contained within this manual.

Diagrams/photographs have been provided for the students to label. These diagrams are meant to be a study guide. Instructors may wish to add

anatomical features or deemphasize certain features accordingly.

The Laboratory Assignments have been designed for a 2-3 hour laboratory session. Therefore, depending on the course, instructors may wish to use less of the manual than provided. However, the design of the manual is such that it does cover all significant anatomical features. Significance in this case pertains to that feature being useful in identification of fragmentary remains or in some form of analysis.

We wish to make the point that no manual should be considered an exclusive tool for self-instruction. Anatomical study is very much a hands-on experience for the student, especially for those who aspire to pursue further studies in human skeletal analysis.

This manual only covers the anatomy of the human skeleton. It is well known to instructors in this area that human skeletal biology also covers aspects of age-at-death determination, sex determination, stature, genetic ancestry, pathology, facial reproduction and skeletal anomalies for identification. This manual is meant to act as a basic instructional aid for skeletal anatomy, the root of all these other areas. In a brief survey of courses dealing with the human skeleton, it was found that there were as many ways of dividing the topics listed above as there were courses. Therefore, it was decided that the best fit for all courses was to provide just the anatomy of the human skeleton, including dental tissues, nonmetric variation, and basic osteometrics. These topics seem to be covered in all courses, and as such, this manual will provide you with a good fit for your course.

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PREFACE TO THE STUDENT

This laboratory manual has been developed with the help, advice and feedback from students taking courses in Human Skeletal Biology over a period of several years. In order to progress in any discipline you must first understand the basic terminology within that discipline. In other words, learn how to communicate with other researchers. This is especially true of human anatomy, and in this case, human skeletal anatomy. As a result, this course of study is memory intensive. There are many terms and anatomical features that must be memorized.

The laboratory exercises are designed to provide you with clear guidelines on what is expected of you in the lab. In most cases, you will be required to both read about skeletal anatomy from a text on the subject as well as to study relevant lecture notes. As a result you should go into your lab sessions well prepared to complete the lab exercises. This way of teaching a subject is structured to give you the theoretical background information first, and then to have it all reinforced with a practical lab session that is hands-on.

You will notice that most of the terms in the lab manual are easily defined through use of your text, lecture notes, or other anatomy references. Although we have tried to use the most current anatomical terminology, you may encounter terms that are unfamiliar to you, or are not readily recognizable. This may be because another term for a particular bone or feature is being used rather than the familiar lecture/text term. An example of this may be the os coxa. Other names for this bone include the "innominate" (literally meaning 'no name'), and the "hip bone." It is important for you, as students, to be aware that terminology does change over time. You must also be aware of the other names of bones as they will come up in various publications. Schwartz (1995) actually has a section concerned with "Bone Synonymy" that you may wish to use as a reference.

Initially, each laboratory starts with a rationale for performing the exercise. Typically, the introduction highlights the various features of the lab you are about to do. After a brief statement of the purpose of the laboratory exercise, we have provided you with a few statements of what you can do ***Before You Begin*** the lab. This serves as a reminder of what you should be doing before you come into the lab. Otherwise, you may find your knowledge-base is behind the other students and the lab exercises may be much more challenging than you anticipated. The ***Objectives*** listed provides you with a concrete list of what you are expected to be able to accomplish by the end of the lab session. You should think of this as a list of the types of questions you could be asked in a laboratory test situation. The ***Materials*** section is essentially a list of the equipment/specimens you will need in order to complete the lab exercise. If some of these are not available, your lab instructor will have made alternate arrangements. **Important Terms** will be listed inside a doublebordered box. These are the terms you must clearly understand by the end of the laboratory session. In many cases these terms are anatomical features of bones that you will be expected to learn for identification purposes. The ***Procedure*** is an actual outline of what you are to consider or do during your lab session. Within each section of the "Procedure" are exercises that require you to label a diagram or perform some other task. At the end of each lab is a section referred to as the ***Laboratory Research Report.*** This section of the lab exercise requires you to apply your new knowledge in a practical application. Usually you are required to generate data of some sort, such as applying an aging method to the bones you have studied and then to prepare a formal research report for submission and marking. This not only demonstrates how knowledge of a particular part of the anatomy can be applied in a practical way, but also requires you to examine the professional literature and discuss your results in that context. Not all instructors will require this portion of the lab be done, however, it does provide you with an excellent opportunity to review the literature on these topics and also see how the anatomical terminology is applied in real-life situations.

The key to the successful use of this manual is preparation. The manual is purposefully designed to be a supplement to your course in human skeletal anatomy, not a substitution for the assigned text and lecture. If you approach the manual in that way, and use the other required sources in your course, you will find that the manual will help reinforce your understanding of human skeletal anatomy.

RESEARCH REPORT PREPARATION[1]

[1]Reproduced with the kind permission of Dr. Gerard M. Courtin, Department of Biology, Laurentian University.

Upper level students are required to write scientific reports and term papers that are much more formal and involved than the laboratory reports written on a week-to-week basis in first year courses.

A properly written scientific report is rather like a gift. A great deal of thought should go into choosing and presenting the contents, and this should then be packaged as painstakingly as possible. The best of gifts loses some of its impact if it is poorly wrapped with bits of ribbon and paper sticking out all over the place.

A scientific report or paper is normally divided into the sections described below although variations from this theme may be necessary at times to cope with the particularities of a certain type of research You should consult your instructor about any deviations from this scheme.

1. Introduction

This section should typically be done last. At this time the material in the report is fresh in your mind and you can write an Introduction that is clear, brief and to-the-point. The Introduction must cover the following points:

a) Why the work is being done?
b) A brief survey of the literature that leads up to the present work.
c) A statement of what the report or paper to follow sets out to show (or prove).

2. Methods

This section is indispensable as it allows the reader to appreciate whether or not your particular way of conducting your experiments is sound and likely to lead to valid data. It also permits another researcher to use your methodology and, either to duplicate your work to ensure himself/herself of its validity, or to perform similar work elsewhere or under different conditions for purposes of comparison. The criterion of a well written Methods section is that someone who is totally unfamiliar with your work should be able to reproduce exactly what you have done. If the method is new, the description should read like the recipe in a cookbook. Only in the case of methods that are well established in the literature may one simply refer to the appropriate paper. For example, sex determination from the os pubis using the method by Phenice has been cited in the literature hundreds of times. One would simply state; “Sex was determined using the Phenice Method (1969)”. Lastly, if one uses a method described in the literature but one modifies it in some way, then the modification must be described in detail.

3. Results

It is a common misconception among many students that a Results section is comprised simply of data that are displayed either as graphs or as tables or as both. Although true to a point, there is far more to a Results section than that. First, there is a format for the presentation of Figures (graphs) and Tables that is more or less standard throughout the scientific literature.

The best way to find examples is to study one of the current journals in the field that most interests you (e.g., *American Journal of Physical Anthropology, International Journal of Osteoarchaeology)*. Pay particular attention to the format. You will see that the format does not vary greatly from paper to paper. In a typewritten or word processed manuscript, however, the figure caption is traditionally placed on the page facing the figure, not beneath it. However, given the advances made in computer technology and scanning of figures and generating graphs, you may wish to put your caption with figure number beneath your figure. A table title or caption is placed above the table. Remember that a figure should be kept simple and should carry a clear message ("a picture is worth a thousand words"). It is often wise to graph the same data in several different ways until you find the one that you feel makes the point most clearly. Note that in the case of tables, a double line separates the caption from the body of the table and that data are not separated by vertical lines but by the way in which the column headings are underlined. Note also that captions for both figures and tables should be sufficiently explicit to stand on their own without reference to the text, i.e., you should be able to look at a figure or table in isolation from the paper in which it appears and understand what it is about.

So much for the visual presentation of data

This is only one part of the Results. The other part is the verbal description; the text that describes the results and helps the reader to identify the main point that the writer is trying to make with the help of a given figure or table. Once again, pay attention to the way in which results are presented in a journal paper and the way in which the pertinent figure or table is referred to in the text. In a typed manuscript, a particular figure or table always follows the page or text in which it first appears.

4. Discussion

This section is the "meat" of a report or paper. Here you attempt to do two things: a) to explain to the reader the value of your data, and b) to present the data in the context of other, similar findings in the literature, to show how your data agree (or disagree) with the data obtained by others. It is here that one displays one's ability to think, to analyse, to criticize, to infer, and even to predict. It is one thing to design an experiment properly and to gather the data with care and precision; it is quite another to extract the full meaning from those data. Often, data does not conform to your hypothesis. It is up to you to convince the reader that your data are believable or to point out possible errors or weaknesses. It is by demonstrating insight, honesty, and the fact that you are human that you establish your reputation as a good scientist. Lastly, do not for a moment think that the exercise is easy. Writing a discussion section is very hard work.

5. Conclusions

This section should be brief and concise. Its aim is to highlight the major points of the report or paper. A reader should be able to gather the gist of your work simply by reading the Introduction and Conclusions.

CONTENTS

TABLES

FIGURES

Literature Cited

This section is simply an alphabetical listing of all the authors that you have cited in your report. A complete citation should include the name(s) of the author(s), the year, the title of the book, chapter from an edited book, or journal paper, the title of the journal, the volume and appropriate page numbers. Once again, your best guide to the format is to refer to a paper in a scientific journal (e.g., the *American Journal of Physical Anthropology)*. Remember that any work from which you draw ideas or information must be cited in the text. Failure to give credit to the work of others is considered plagiarism. This is "literary theft" and is regarded in the same light as any other kind of theft. When cited in the text, the work must also be listed in the Literature Cited section. Pay particular attention to how journal articles and books are cited. Although there is some variation between journals, a consistent format is always followed. Your instructor will likely indicate which type is preferred.