James Elliott

CoRIPS Research Grant 186

£5,000 awarded

Title: Best practice in projectional radiography of human dry bone specimens – A literature review and confirmatory research using an archaeological assemblage

Principle Aim

To investigate best practice for projectional radiography of human dry bone specimens for forensic and archaeological contexts.

Primary research question

What is best practice for radiographic technique of human dry bones?

Secondary research questions

What is best practice for handling and storage of specimens for radiographic imaging?

What is best practice for storage and presentation of subsequent imaging?

Outcomes

- List of literature relevant to the principle aim of the study.
- Reflective diary for radiographic survey of archaeological assemblage.
- Radiographic [and photographic] images of archaeological assemblage.
- Generation of recommendations based upon literature and researcher experience during survey.

Review of literature and identification of current gap in knowledge

The Society of Radiographers state that members undertaking forensic radiography must have appropriate training and education1. Whilst postgraduate courses exist there is sparse literature addressing the appropriate practical application of projectional radiography on human dry bones. Guidance from the International Society of Forensic Radiology and Imaging clearly states the importance of projectional imaging within disaster victim identification2 whilst also recognising the lack of empirical research across forensic radiology3.

Indeed, priorities for research highlight human identification, biological profiling, image quality and consistency as key areas that require addressing3.

A common bond exists between archaeology and forensics whereby both disciplines wish to reconstruct the biological profile of the deceased. Projectional radiography has established a role within both disciplines, as demonstrated by a number of review articles within academic literature4, 5, 6, 7. Furthermore, an abundance of research articles demonstrate or test the application of radiography in human identification using archaeological or forensic remains8, 9, 10, 11. The widespread use of projectional radiography is evident but there is a lack of specific guidance or empirical research for the act of imaging, i.e. radiographic technique.

Forensic radiography makes use of imaging to answer questions of the law12, whilst archaeology documents the deceased to learn about past human activity. Despite the distinct difference in end purpose, the two disciplines offer useful founts of information to guide practice. For instance, whereas the Society of Radiographers, Royal College of Radiologists and International Association of Forensic Radiographers lack guidance on imaging human bones, the British Association for Biological Anthropology and Osteoarchaeology (BABAO) fills this void. Whilst not directly addressing the radiographic methods deployed, BABAO provides standards for recording the deceased13 and recommendations for the use of digital imaging14. In contrast, there are a plethora of well-known academic textbooks concerning radiographic imaging and patient care within projectional radiography15, 16. Understandably, these do not address the handling or imaging of dry bones in either forensic or archaeological contexts. Similar academic textbooks specifically addressing practical forensic radiography are absent, although radiology in forensic medicine is well catered for12, 17, 18, 19.

Specialist books, or chapters therein, concerning the handling and imaging of archaeological remains have been published and are invaluable to this study20, 21, 22, 23, 24, 25. Interestingly, multiple authors state that theirs is the first textbook to have addressed the use of radiological imaging in archaeology23, 24, possibly highlighting a lack of cohesion in academic efforts. Irrespective of this, most of these publications focus upon the diagnostic utility of projectional radiography or provide an overview of its application in recent literature. Several books provide practical considerations and recommendations20, 21, 22, 24 but relate to the use of conventional radiography. These are somewhat dated and require revisiting as computed and digital radiography are the dominant systems in current practice.

In summary, the disciplines of archaeology and forensics may both provide recommendations for the projectional radiography of human dry bones. The use

of radiography in such instances is widespread and represented within academic literature but associated guidance for radiographic technique is lacking or dated. It is hoped that the collation and synthesis of relevant literature will generate up-to-date recommendations. The testing of these recommendations with an archaeological assemblage of human dry bones will further refine the findings and provide empirical research to support best practice.

Methodology

Phase one – Literature review – Collation and synthesis of recommendations

Rationale:

Literature concerning the application of projectional radiography within archaeology and forensics use a diverse range of terminologies and contrasting objectives. Whilst a systematic review of the literature would provide greater scientific rigour, the creation of a protocol may inevitably prove too discriminative or too open to be of value. The principle aim of this study is to investigate rather than provide quantitative specificity/sensitivity data or quantitative thoughts/opinions on radiographic technique. For these reasons, a literature review will be conducted. A tabulated search strategy is shown below, the findings of which shall be synthesised and presented as idealistic action points for application during the radiographic survey in phase two.

Search strategy			
Databases	Search terms	Inclusion factors	Exclusion factors
• PubMed • CINAHL • Medline • Science Direct • Google Scholar • Hand searching of reference lists	• Radiograph(y) • X-rays • X-radiography • Roentgenogram • Imaging • Forensic • Paleo/palaeoradiography • Skeletal / dry bone	• All publication dates • All geographical publication locations • Grey literature • professional bodies or organisations • Books, journals. • Quantitative and qualitative research	• Non-English language • Literature with suspicion of bias (e.g. manufacturer). • Low quality evidence such as magazines, blogs.

Phase two – Confirmatory research – Radiographic survey of archaeological remains

Overview:

The second phase shall involve the radiographic survey of archaeological human remains. Photography shall be used alongside to document the process and individual specimens. Recommendations for radiographic technique shall be applied and a reflective diary will be used to evaluate the practical application.

Source of archaeological human remains:

Between 2010-2011 the remains of 132 individuals (3rd-4th century AD, late Roman) were excavated from the Hallet's garage on St Dunstan's Street in Canterbury. These are being held by Canterbury Archaeological Trust within the storage facility in Wincheap. The storage facility is within close proximity of Canterbury Christ Church University.

Method to be adopted:

Confirmatory research through reflective practice.

Sampling strategy:

A representative sample of the assemblage shall be imaged to reflect a spectrum of age, gender, states of preservation and suspected cases of pathology or trauma. This would mimic the range and diversity of human dry bone specimens encountered within archaeology and forensics by other investigators. The osteological report by Amanda Bailey shall aid the selection process26.

Sample size:

Around 50 individuals shall be imaged, depending upon study progress and time limitations.

Data collection method:

Imaging –

Digital radiography shall be conducted using the x-ray room at Canterbury Christ Church University (CCCU) using the risk assessment form submitted during ethical approval. The DICOM, JPEG and photographic data shall be transferred onto a dedicated external hard drive and backed-up on DVD's. A free DICOM viewer, such as MicroDicom or PostDicom, shall be used to view the images offline and remotely. An open source PACS system is being investigated for long term use of the imaging.

Reflective practice –

Recommendations for radiographic practice found during the literature review will be listed as idealistic action points. Each of these action points shall be evaluated by the investigator using Rolfe's et al framework for reflective learning; What, So What, Now what?27. The reflective diary, along with rough survey notes, shall be written within an A4 notebook and relevant portions shall be transcribed into a word document.

Data analysis method:

Images shall not be assessed for quality, although a general assessment of sharpness, resolution, density and contrast for each image will be conducted using the investigator's clinical experience. Themes, revelations and novel solutions noted within the reflective diary shall be extracted and coherently organised for analysis and discussion.

Reliability, validity, credibility, trustworthiness of data:

Limitations of this study include the potential bias of the investigator during phase two towards preferential radiographic technique. This may be offset by rigorous use of supporting literature (i.e. evidence-based practice), advice from clinical colleagues and adherence to the reflective framework. Subject specific advice shall be sought from CCCU academic colleagues in archaeology, forensics and radiography.

Ethical implications:

Ethical approval for radiographic and photographic imaging of the archaeological remains has already been approved by Canterbury Christ Church University. Reference: 18-AH21-JE/EW.

Potential impact

The recommendations may contribute towards the standardisation of digital radiography for forensic and archaeological human dry bones. This will facilitate a scientifically robust system of evidence collection (notably in forensics) and comparable datasets for future scientific enquiry.

The generation of best-practice guidelines may have far reaching appeal to a wide variety of professions; archaeologists, pathologist technologists, physical anthropologists, radiographers, radiologists, and scene of crime officers. Worldwide adoption of these recommendations may occur, although it is accepted that documentation and recording standards differ between countries.

The generation of primary data from the radiographic and photographic survey will facilitate follow-on scientific analysis (such as anthropology) and creation of an image bank for educational use. Potential users of the image bank may include students of radiography, archaeology and forensics.

Dissemination Strategy

It is envisaged that both phases of this study shall be amalgamated into one document for dissemination within the Radiography journal. If necessary, results may be split into dedicated articles. Prior to this, preliminary results may be presented at conference as a poster or talk depending upon study progress.

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