PUBERTY IN THE PAST

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Puberty is emerging as an important and exciting new avenue of research in osteoarchaeology. Over recent years, Professor Mary Lewis and colleagues have developed innovative methods for assessing the stage of puberty of adolescent skeletons that combine clinical observation with identifiable landmarks of the developing human skeleton (Shapland and Lewis, 2013, 2014; Lewis et al., 2016). The ability to identify the stage of puberty being experienced by an adolescent at the time of their death not only provides physical details regarding their appearance, sound of their voice, and their reproductive capacity; it may have also played a key role in their social identity.

PUBERTY STATUS RECORDING FORM

Site **Skeleton:**
Age:
Sex:
Puberty Status: Pre Acc PHV Dec Mat Post PHV Menarche reached Y/N

1. Sex Assessment

Using features of the humerus, pelvis and mandible, estimate the sex of the individual. Three areas need to agree for sex to be assigned to an individual with an unfused innominate (nr=not recordable):

PELVIS	Male	Male?	?	Female?	Female	nr
Sciatic notch depth						
Sciatic notch angle						
Auricular elevation						
Pubis morphology						

SKULL	Male	Male?	?	Female?	Female	nr
Mental prominence						
Skull (over 17 yrs)						

HUMERUS	Male	Male?	?	Female?	Female	nr
Trochlear symmetry						
Olecranon fossa						
Medial epicondyle						

Sex assessment: _____

Method	M	F	Reference
Ilium			
Greater sciatic notch depth	shallow	deep	Schutkowski (1993)
Greater sciatic notch angle	under 90°	Over 90°	Schutkowski (1993)
Auricular surface elevation	Flat compared to retroauricular area	Same level as retroauricular area	Weaver (1980)
Humerus			
Olecranon fossa shape	triangle	oval	Rogers (2009)
Trochlear symmetry	asymmetrical	symmetrical	Rogers (2009)
Medial epicondyle	Parallel with table	Raised above table	Rogers (2009)
Mandible			
Chin shape	Square/flat	pointed	Schutkowski (1993)

Figure 1: first page of the puberty status recording form

Osteoarchaeologists working in the commercial sector are uniquely placed to take part in, and enhance, the study of puberty in the past, as they are excavating and analysing newly discovered skeletons every day. The essential combination of the osteological data with the burial context of the skeleton provides researchers like Prof Lewis, and many others in the future, a wealth of information about the lives and deaths of adolescents in the past.

In order to introduce and encourage osteoarchaeologists to employ these new osteological methods, CIfA's Human Osteoarchaeology Special Interest Group (Osteo SIG) ran a sold-out workshop in July 2019. We were privileged to have Prof Mary Lewis, of the University of Reading, work closely with the workshop attendees, teaching them (both through lectures and hands-on experience with skeletal remains) essential osteological methods for analysing non-adult skeletal remains (ie estimation of age-at-death), as well as new advances in more challenging estimates (ie sexing techniques). Attendees were also provided with a set of criteria to allow puberty stage to be estimated quickly and efficiently.

As the Osteo SIG puberty workshop was sold out, the innovative methods are provided here, with the aim to introduce them to all interested CIfA professionals and to stimulate interest in the study of puberty in the past. Additional workshops are in the pipeline at the University of Reading. It is hoped commercial osteoarchaeologists will apply these puberty criteria to all applicable skeletal remains and make them part of the routine observations undertaken during the standardised osteological analysis.

As those experiencing puberty represent such a small subsection of the assemblages recovered during archaeological investigations, by working together and compiling a central database of these criteria, we can begin to investigate the meanings and rites of passage allotted to those in the transition between child- and adulthood. Prof Lewis (m.e.lewis@reading.ac.uk) is keen to hear from commercial osteoarchaeologists who have recorded puberty information for any skeleton(s), and would like to invite them and their information to be included on a central database of puberty information in British archaeology. Contributors will be included as authors of any publications that arise from the data.

The methods

To assess the pubertal stage, seven individual osteological markers have been developed, including the extent of the development of the mandibular canine root and hook of hamate, fusion epiphyses of the hand phalanges, distal radius and humerus and proximal ulna, the presence and fusion of the iliac crest epiphysis, and the morphology of the cervical vertebral body. A recording form has been developed to summarise the assessment criteria (Figure 1), to aid the application of the techniques. A summary table has also been developed to aid the estimation of the stage of puberty the individual was

Skeletal and dental features associated with the phases of pubertal maturation in boys and girls

	Phase	External Physical changes	Canine Mineralisation[1]	Hamate Hook[2]	Hand Phalanges[3]	Wrist[3] (fusion score)	Iliac Crest[4] (fusion score)	CMV[5]
0	Pre-Puberty		E	Stage G Hook absent	Stage 1 Proximal epiphysis of hand phalanges narrower than shaft	Stage 1 Distal radius unfused (0) Humerus capitulum unfused (0)	Risser 1 Epiphysis not present	1
1	Initiation (onset)	Ovaries enlarge Hormones released	F Root ½ to 3/4	Stage G Hook absent	Stage 1 Proximal epiphysis of hand phalanges narrower than shaft	Stage 1 Distal radius unfused (0) Proximal ulna unfused (0) Humerus capitulum unfused (0)	Risser 1 Epiphysis not present	1
2	Acceleration	Breast buds Pubic hair Increased body mass	G/H Root complete to apex 1/2	Stages H or H.5 Hook appearing or increased	Stage 2 Phalangeal epiphyses of equal width to shaft	Stage 1 Distal radius unfused (0) Proximal ulna unfused (0) Humerus capitulum unfused (0)	Risser 2 Epiphysis 50% complete, unfused	2
3	PHV (transition)	Breast development Musculature Voice breaks	H Apex complete	Stage I Hook complete	Stage 3 Capping of phalangeal epiphyses	Stage 2 Distal radius unfused (0) Proximal ulna fusing/fused (1-2) Humerus capitulum fusing (1)	Risser 2-3 Epiphysis 50-75% complete, Unfused (0)	3
4	Deceleration	Menarche Ovulation	H Apex complete	Stage I Hook complete	Stage 4 phalangeal epiphyses fusing (1) (menstruation = fusion of the distal phalanx of MC2)	Stage 3 Distal radius unfused (0) Proximal ulna fused (2) Humerus capitulum fused (2)	Risser 3-4 Epiphysis 75-100% complete, Non to partial union (0-1)	4-5
5	Maturation	Regular ovulation Outwardly sexually mature	H Apex complete	Stage I Hook complete	Stage 5 phalangeal epiphyses fusing (1)	Stage 4 Distal radius fusing (1)	Risser 4 Epiphysis 100% complete, partial union (1)	5-6
6	Completion (post-puberty)		H Apex complete	Stage I Hook complete	Stage 6 Phalanges fused (2)	Stage 5 Distal radius fused (2)	Risser 5 Fusion complete (2)	6

[1.] Cherkow (1980) based on Demirjian et al.'s dental stages (1973); Grave and Brown (1976); Chertkow (1980); Shapland and Lewis (2013); [2.] Grave and Brown (1976); Hägg and Taranger (1982) for the phalangeal epiphyses; Hägg and Taranger (1982) and Zhang et al. (2008) for the distal radius. [3.] Hewitt and Anderson (1961a, b) (a and b); Scoles et al. (1987); Scheuer and Black (2000); [4.] Hassel and Farman (1995) for cervical vertebra 3, Baccetti et al. (2002) for cervical vertebrae 2-4, Shapland and Lewis (2014).

Figure 2: Revised puberty assessment table

experiencing, as well as provide an indication of the physical changes the body was undergoing at the time of death (Figure 2). You can download both of these documents from the Human Osteoarchaeology SIG page on the ClfA website www.archaeologists.net/human-osteoarchaeology-special-interest-group.

(below) Adolescent male from later medieval St Oswald's Priory, Gloucester. Formation of the hamate bone in the wrist suggests that this 14–15-year-old was in the acceleration phase of puberty. Credit: Mary Lewis

References

Lewis, M, Shapland, F and Watts, R, 2016 On the threshold of adulthood: a new approach for the use of maturation indicators to assess puberty in adolescents from medieval England, *American Journal of Human Biology*, 28(1), 48–56

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Professor Mary Lewis (BA Leicester, MSc Bradford, PhD Bradford)

Mary is a Professor of Bioarchaeology in the Department of Archaeology, University of Reading. She specialises in non-adult skeletal pathology in relation to socio-economic transitions in the past and is programme director for the MSc in Professional Human Osteoarchaeology. Mary's publications include *The Bioarchaeology of Children* (CUP, 2007) and *Paleopathology of Children* (AP, 2018). In addition to her work on puberty assessment, Mary's research has helped to outline the criteria for the diagnosis of leprosy (2002), tuberculosis (2011), thalassaemia (2010) and trauma (2014) in child skeletal remains.

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