

52 **ABSTRACT**

53 The preponderance of men in the narrative of anatomical education during the 1800s
54 has skewed the historical perception of medical cadavers in favour of adult men, and
55 stifled the conversation about the less portrayed individuals, especially children.
56 Although underrepresented in both the historical literature and skeletal remains from
57 archaeological contexts dated to the 1800s, these sources nevertheless illustrate that
58 foetal and infant cadavers were a prized source of knowledge. In the late 1700s and
59 1800s foetal and infant cadavers were acquired by anatomists following body
60 snatching from graveyards, from the child's death in a charitable hospital, death from
61 infectious disease in large poor families, or following infanticide by desperate unwed
62 mothers. Study of foetal and infant remains from the 1800s in the anatomical
63 collection at the University of Cambridge shows that their bodies were treated
64 differently to adults by anatomists. In contrast to adults it was extremely rare for
65 foetal and infant cadavers to undergo craniotomy, and thoracotomy seems to have
66 been performed through costal cartilages of the chest rather than the ribs themselves.
67 However, many infants and fetuses do show evidence for knife marks on the
68 cranium indicating surgical removal of the scalp by anatomists. These bodies were
69 much more likely to be curated long term in anatomical collections and museums than
70 as was case for adult males who had undergone dissection. They were prized both for
71 demonstrating normal anatomical development, but also congenital abnormalities that
72 led to an early death. Our findings show that the dissection of foetal and infant
73 cadavers was more widespread than previous research on anatomical education
74 suggests. This research details the important role of the youngest members of society
75 in anatomical education during the long nineteenth century, and how the social
76 identity of individuals in this subgroup affected their acquisition, treatment and
77 disposal by elite medical men of the time.

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79

80 **INTRODUCTION**

81 In 1877 Flora McLean gave birth in a Lying-in Hospital in Glasgow. McLean
82 complained about the neglectful treatment of her baby and two days later the infant
83 died. Some time later Flora got out of bed to go to see the body of her deceased infant
84 in another room before the burial. Upon entering the room, to her dismay she found
85 the body of the infant had been dismembered and sewn back together again. She had
86 paid the ten shilling burial fee required for a proper burial and was distraught at the
87 state in which she discovered the mutilated body. Upon seeing her baby in that state,
88 McLean became irate and berated several hospital employees about the inhumane
89 treatment of her baby. The police were ultimately informed and the body of the infant
90 was found at the hospital in the condition that McLean described. An investigation
91 was launched into the goings on at the hospital and a warrant was issued to examine
92 the body of the infant. When the doctors in charge of the investigation, Dr Moore and
93 Dr Dunlop, arrived to examine the body they found that the head of the infant had
94 been subsequently severed and they were unable to immediately locate it. Through the
95 investigation it was uncovered that the head, and later the body was taken to the
96 Royal Infirmary for dissection without the consent or knowledge of Flora McLean
97 (Southern Reporter and Cork Commercial Courier, 1877: 2).

98

99 The socio-political climate surrounding human dissection in the 1700s and 1800s has
100 been thoroughly examined by historians (Richardson, 1987; Hurren, 2012). This body
101 of research reveals that in general the public reaction to human dissection was almost
102 exclusively negative outside of the medical community. The story of the McLean

103 baby highlights one of the major themes commonly investigated within the context of
104 anatomical education during the nineteenth century: the fear of human dissection. The
105 horror and disgust instilled in the populace by this sensational tale concerning the
106 unauthorised use or retention of a loved one are not unique, nor are they limited to the
107 distant past. The relatively recent Alder Hey scandal caused by the retention of organs
108 in UK hospitals echoes these historic fears (Ellis, 2004: 42-43). Throughout the
109 nineteenth century stories of concealed dissections and stolen bodies plagued the
110 thoughts populous. Yet, amid this public outcry, dissection practices only increased in
111 frequency. The direct examination of the body by students through either human
112 dissection or by examining anatomical preparations in medical museums was deemed
113 necessary for students to gain a spatial and tactile understanding of the human body.
114 By the late 1700s, well before the dissection of the McLean baby, the undeniable
115 educational value of dissection had caused this practice to become entrenched in
116 anatomical education (Dittmar and Mitchell, 2015a).

117
118 Within the majority of the research on human dissection, cadavers are generally
119 portrayed as adult men from a low socio-economic status, with adult women from a
120 similar background appearing occasionally (Hurren, 2012; Hutton, 2013). It is
121 perhaps unsurprising that the majority of the research on anatomical education
122 features adults, specifically men. From its inception, the bodies of men have generally
123 been at the centre of the discussion about dissection. Within the context of medical
124 education men played all of the roles; educator, dissector and dissected. The male
125 form has predominately been featured in the dissection manuals and was most
126 commonly depicted in the media. The preponderance of men depicted in the medical
127 literature and within historical research has skewed the historical identity of medical
128 cadavers as adult men and has stifled the conversation about the less portrayed
129 individuals, specifically children. The role of young children, particularly foetuses (3
130 gestational months-birth) and infants (birth to 1 year postpartum) in anatomical
131 education has received very little attention.

132
133 The historical literature from the 1700s and 1800s showed that foetal cadavers were
134 valued for the study of growth and development, and were often kept in anatomical
135 museums (Hunter, 1774; Humphry, Unpublished; Duckworth, unpublished). The
136 valuable and unique knowledge that could only be obtained from the examination of
137 these developing bodies made them essential to the study of anatomy. Due to their
138 importance and presence in medical museums it is highly unlikely that foetal and
139 infant bodies were dissected to destruction, but very little evidence of this practice
140 remains in the archaeological or historical record. When the bodies of children are
141 briefly mentioned in historical research about anatomical education, they are
142 generally as part of a discussion of cadaver acquisition (Hurren, 2012). The lack of
143 widespread information surrounding foetal and infant bodies has caused this group to
144 be largely overlooked in the on-going research about anatomical education in the
145 1800s. Subsequently, minimal research has been undertaken on how their unique
146 socio-political identify affected their use and treatment by medical professionals.

147
148 During the eighteenth and nineteenth centuries children, especially the illegitimate,
149 had a particularly marginalised role in society. Many factors affected this position and
150 their subsequent treatment including the high infant mortality rate during the early
151 nineteenth century. Infant deaths were not the uncommon, shocking event that they
152 are today. The stillbirth and premature death of infants was an all too common
153 occurrence and it has been argued that the likelihood of the death of a child affected

154 the attachments formed by the parents (Ariès, 1979). This effect was magnified in the
155 mothers of illegitimate children because of legislative actions against them and their
156 illegitimate children in the form of ‘the New Poor Law’ (Anonymous, 1834). The
157 law ended financial support from both the parish and father of the illegitimate child
158 (Higginbotham, 1989). This loss of support in addition to the loss of job opportunities
159 experienced by the mother threatened both her and her infant’s life. The desperate
160 financial situations in which mothers found themselves, resulted in not only decreased
161 attachment to a pregnancy, but also in malicious actions against it. An extreme
162 example of this is illustrated by examples of miscarried foetal remains or deceased
163 infants, possibly the victims of infanticide, being given or sold to anatomists
164 (Withycombe, 2015; Hurren, 2012).

165

166 The lack of infant bodies presented in the historical literature is not surprising, but it
167 is also not representative of the important and unique role that foetuses and infants
168 had in anatomical education. This paper puts forward additional information about the
169 socio-political climate surrounding foetuses and infants in a medical context by using
170 a combined osteological and historical approach. The combination of historic and
171 archaeological evidence is needed to provide a more complete picture of the role
172 infants and foetuses had in anatomical education during the late eighteenth and
173 nineteenth centuries. The most effective way to undertake an examination of the
174 treatment of the bodies in this subgroup is to examine the bodies themselves. The
175 skeletal remains of foetal and infant cadavers excavated from archaeological sites or
176 preserved in medical museums are a rich and unstudied resource, which allow us to
177 recover the experiences of the individuals in this age group. This will be
178 complemented by an examination of historical sources and previously published
179 literature in order to explore how the social identity of infants and foetuses increased
180 the likelihood that they would be acquired, how they would be treated, and how their
181 bodies were disposed of by elite medical men during the long nineteenth century.

182

183

184 **ACQUISITION OF CADAVERS**

185 It is clear from the research into the procurement of cadavers during the eighteenth
186 and nineteenth centuries that this was considered the primary challenge for anatomical
187 education. The acquisition of bodies for anatomical education has been extensively
188 studied since the publication of Ruth Richardson’s seminal work on the socio-political
189 climate surrounding the Anatomy Act in 1832 (Richardson, 1987). This large body of
190 work elaborates on the difficulty anatomists faced in securing sufficient numbers of
191 cadavers and the ways in which they tried to overcome this. From the mid 1500s to
192 the end of the 1800s, restrictive legislation on cadaver procurement resulted in a long
193 history of the procurement of cadavers through nefarious means.

194

195 The examination of both archaeological and historical sources reveal that the bodies
196 of men were much more commonly acquired and dissected than those of women or
197 children. The imbalance in the demographics of dissected individuals linked to the
198 legal history of the practice and the sources from which bodies were acquired. The
199 legal history of human dissection in England can be traced to 1540 when Henry VIII
200 granted four hanged felons to the United Companies of Barbers and Surgeons for
201 dissection (Anonymous, 1540). Following this, the Charter for Anatomies in 1565
202 granted a group of physicians and surgeons of the College of Physicians the bodies of
203 four criminals per annum for dissection (Anonymous, 1565).

204

205 These eight hanged felons, almost entirely men, comprised the entire legally available
206 supply of medical cadavers until 1752 with the passing of *An Act for Better*
207 *Preventing the Horrid Crime of Murder* or ‘Murder Act’ (25 Geo. 2, c.37, 1752)
208 (Anonymous, 1752). This act gave anatomists the right to dissect the bodies of
209 murderers publicly to deter the ‘horrid crime of murder’.

210

211 The Murder Act, perhaps unintentionally, cemented the connection between adult
212 men and the dissection table. Eternal punishment in the form of dissection was
213 generally reserved for the most heinous crime of murder for which women and
214 children were rarely convicted. This made the legal availability of female cadavers
215 very rare compared with those of men. Women were occasionally hanged, of course,
216 and subsequently dissected. From 1800-1832, only seven of the forty-five dissections
217 performed by William Clift at the College of Surgeons were women (MacDonald,
218 2006). Many of the women sentenced to death were found guilty of the most
219 horrifying type of murder, infanticide. In alignment with the societal norms, a
220 convicted, pregnant woman destined for the gallows would be granted a stay of
221 execution until after the birth. The unique stipulation of pregnancy as a means to
222 promote life and protect the innocent provides a morally consistent reason as to why
223 the 1752 legislative change did not facilitate the acquisition of foetal or infant
224 cadavers (Anonymous, 1752). Infant cadavers for dissection would have likely not
225 been available through legal channels prior to the passing of *An Act for Regulating*
226 *Schools of Anatomy* (2&3 Will. IV c.75, 1832) or the ‘Anatomy Act’ in 1832
227 (Anonymous, 1832) but it would have always been possible to access them through
228 illegal channels in the same way as illicit adult cadavers.

229

230 **Resurrection**

231 Even with the passing of the Murder Act in 1752 the bodies of these felons hardly
232 made a dent in the ever-growing demand for bodies to dissect during the late 1700s
233 and early 1800s (Anonymous, 1752). Between 1805-1820, 1,150 people were
234 executed in Britain, an average of 77 per year (Ball, 1928:46). However, according to
235 the Report of the Committee appointed by the House of Commons to enquire into the
236 manner of obtaining subjects for dissection in the Schools of Anatomy in 1828, there
237 were over 800 students attending the Schools of Anatomy in London dissecting 450-
238 500 bodies a year (Great Britain, 1828). The disparity between the number of legally
239 available cadavers and the number required for anatomical education triggered the
240 rise of the resurrectionists, or grave robbers. These men, often members of gangs,
241 were infamous for digging up freshly buried bodies from graveyards or breaking into
242 houses and stealing the deceased from the coffin while awaiting burial (Great Britain,
243 1828). Bodies obtained through illicit means became the main source of dissection
244 subjects before the passing of the Anatomy Act.

245

246 The legal channels through which human dissection material was obtained were
247 insufficient to meet the needs of the medical sciences, not only in numbers but also in
248 the age and sex of bodies needed to fully investigate the variation and the growth of
249 the human body. The bodies of women would have been rarely available from the
250 gallows and the bodies of children would have been completely unavailable.
251 However, this was not the case with illegally acquired cadavers.

252

253 There exists only one first hand account detailing resurrectionist activity, *The Diary of*
254 *a Resurrectionist* (Bailey, 1896). This recounts how bodies of adults, referred to as
255 ‘large’ were resurrected far more commonly than those of children, ‘small’ or

256 foetuses. The presumed author of the diary, Joseph Naples, stated in an interview to
257 the Select Committee on Anatomy that his gang acquired 360 adults¹ and 44 ‘smalls’
258 in 1809-1810 and 332 adults and 47 ‘smalls’ in 1810-11. This trend was continued in
259 1811-1812, with 360 adults and 56 children resurrected, but only 9 foetuses. One key
260 explanation for this was the price a larger body could fetch. ‘Small’ bodies (under 3ft
261 long) were paid for by the inch. These prices ranged from £1 0 0 to £1 10 0, whereas
262 the average price of an adult body was stated to be £4 4s 0d, but as high as £7 17 6
263 (Bailey, 1896; Great Britain, 1828). The work by Hurren (2012) on the St
264 Bartholomew’s Hospital registers revealed that 1% of the bodies sold for dissection
265 were below the age of ten. Although it is clear that infants were resurrected, this
266 method was not the main source of foetal material.

267

268 **Unclaimed Bodies allocated by the Anatomy Act**

269 Medical men continued to rely on the gallows and resurrectionists for bodies to
270 dissect until the passing of the Anatomy Act in 1832. The introduction of this new
271 legislation in 1832 provided a more plentiful supply of bodies, by permitting masters
272 of workhouses, hospital managers and Poor Law guardians to donate unclaimed
273 bodies of the poor. The socio-political ramifications of this act on the poor have been
274 extensively researched (Richardson, 1987). This act was not only exploitative to the
275 poor, but also largely ineffective in ceasing the trade in bodies. Although the
276 intentions of this act were put in place to prevent grave robbing and other deceitful
277 methods of obtaining the bodies of those who did not want to be dissected, the
278 enforcers of this act did not have the power to effectively do this and bodies continued
279 to be obtained through nefarious means (MacDonald, 2009; Hurren, 2012).

280

281 Following the passing of the Anatomy Act, the primary source for unclaimed bodies
282 were the large voluntary hospitals. These charitable institutions founded during the
283 eighteenth century had varied criteria for admittance but very few permitted entry to
284 pregnant women, children or those deemed ‘incurable’. The findings of
285 archaeological investigation at institutions like the Royal London Hospital and the
286 Newcastle Infirmary reflect these strict entry policies, as the majority of the
287 population of these hospital burial grounds were adults, of which, less than one third
288 were women (Fowler and Powers, 2012; Chamberlain, 2012). The unclaimed bodies
289 from these predominantly adult male institutions did very little to increase the
290 availability of legally acquired infant bodies for dissection. A notable exception was
291 the Foundling Hospital, established in 1739 by Captain Thomas Coram, which
292 exclusively cared for abandoned infants. The mortality rates for infants surrendered to
293 this institution during the second half of the eighteenth century were variable but far
294 exceeded the equivalent rates for London (Levene, 2007). The bodies of these
295 unfortunate children, if unclaimed by a parent, could be legally acquired for
296 dissection.

297

298 Research into the populations of workhouses reveals that by the end of the nineteenth
299 century the majority of the individuals present in workhouses were elderly adults,
300 mostly men (Ritch, 2015). However, these institutions were used by entire families,
301 and records support the presence of infants. Workhouses were inhospitable, desperate
302 places that were nearly always lethal to infants. Jonas Hanway, a champion for the
303 lives of poor children railed against the conditions of the London workhouses after he

¹ This number includes 37 bodies that were sent to Edinburgh, and 18 which the gang had in hand but were never used.

304 collected statistics between 1757 and 1763. The parish poorhouses and workhouses
305 authorised by parliament had near a 100% mortality rate for infants, which led
306 Hanway to lament that in these institutions the ‘poor infants were mowed like grass’
307 (Hanway, 1766). The ultimate demise met by so many infants was exacerbated by the
308 lack of nursing facilities and care to support them. Upon arriving at a workhouse the
309 infant would be handed off to either a ‘carelef[s]s, worthlef[s]s young female, or a
310 decrepid old woman’ (Hanway, 1766:4). Such circumstances led Hanway to confirm
311 the claims made by a parish workhouse ‘...that of the 54 children born, and taken into
312 their workhouf[s]e, not one out-lived the year in which it was born...’ (Hanway 1766:
313 9). The deceased from these locations including the infants would have been given, or
314 sold to the anatomists if unclaimed by their family.

315

316 **Stillbirths & Infanticide**

317 In the event that an infant was stillborn, certain financial circumstances would have
318 promoted the sale of the body to an anatomist. Those from the lowest socio-economic
319 ranks would have not been able to afford a proper burial for a stillborn infant.
320 However, up until 1838 the law did not require a stillborn baby to be registered and a
321 body could be easily sold to an anatomist through an intermediary. This loop-hole in
322 the legislation that facilitated the sale of these bodies generally produced no formal
323 records. Even at institutions where young bodies are reported, as is the case for St.
324 Bartholomew’s Hospital, the actual number of infants purchased is probably
325 underrepresented (Hurren, 2012). This has made it impossible to determine the exact
326 number of stillborn infants or give any indication of the scale on which this trade
327 occurred. Although it remains impossible to completely reconstruct the trade of
328 stillborn infants, some of the information can be found in historic hospital records
329 such as cause of death and origin of the body. Recent research by Hurren illustrated
330 that even with this minimal amount of information, it is possible to gain insight into
331 the experiences of the individuals involved in this trade (Hurren, 2012).

332

333 The opportunistic acquisition of deceased infants from the desperate poor during the
334 nineteenth century was not limited to those infants who died of natural causes.
335 During the eighteenth and nineteenth century illegitimate children had a particularly
336 marginalised role in society, which often led to the inhumane treatment of individuals
337 within this group. The proportion of illegitimate births began to rise in the 1720s and
338 sharply increased in 1730s (Laslett et al., 1980). Concurrently, there was an increase
339 in infanticide resulting from illegitimacy in the 1730s. This trend continued and
340 increased over the next 100 years. Infanticide became even more of a problem during
341 the Victorian era. Legislation aimed at controlling the costs of the continually
342 increasing illegitimate birth rate was enacted in 1810 which was later replaced in
343 1834 with *The Poor Law Amendment Act* or ‘the New Poor Law’ (Anonymous,
344 1834). The New Poor Law ended parish outdoor relief for unmarried women and the
345 availability of assistance from the father of an illegitimate child (Higginbotham,
346 1989). The mothers of these illegitimate children were then solely responsible for
347 them until they reached 16 years of age. The New Poor Law was completely
348 ineffective in curtailing the illegitimate birth rate. But this law did effectively
349 contribute to the desperate social and financial situations that faced the mother of
350 illegitimate children.

351

352 Many of the mothers directly affected by the New Poor Law were poor unwed women
353 in service positions. Upon the discovery of their pregnancy, most of these women
354 would have been forced to give up their positions and would have been subjected to

355 societal shame resulting in additional loss of opportunity. Without parish relief, as
356 restricted by the New Poor Law, these women were left in desperate financial
357 situations with no way to take care of an infant. This left very few options for these
358 women, all of which were life threatening: the workhouse, prostitution, abortion and
359 infanticide. Although some braved the workhouses or turned to prostitution, the social
360 and financial repercussions for having an illegitimate baby introduced by the New
361 Poor Law made the elimination of the foetus or infant an unthinkable yet practical
362 option for many desperate women.

363

364 By the 1860s the infanticide in England reached epidemic proportions. There were
365 times when inquests into the death of infants in Marylebone were held ‘nearly every
366 day’ (*Times*, 24 October 1862: 6). The coroner for Central Middlesex, Edwin
367 Lankester estimated that over a several year period in the mid-nineteenth century,
368 ‘12,000 women, or one in 30’ had murdered their infants without detection in London
369 (*Medical Times and Gazette*, 26 April 1866:446). These figures were slightly revised
370 after he received intense criticism, but he maintained that ‘...in England and Wales
371 there could not be fewer than 1,000 cases of infanticide annually’ (*Times*, 6 Oct
372 1866:12). The victims of this heinous crime were not uncommonly found in the
373 streets or hidden away in unseemly places (*Times*, 22 Sept 1862:11; *Times*, 29 April
374 1862:8; *Examiner*, 9 Sept 1865: 576).

375

376 As reported by the special committee on infanticide by the Harveian Society, ‘...the
377 life of the bastard is infinitely less protected than that of the legitimate...’ (*Lancet*, 12
378 Jan 1867: 61). The particularly vulnerable social position held by these illegitimate
379 infants in combination with the desperation felt by many poor mothers likely
380 contributed to their ultimate demise and their use in anatomical education. In the light
381 of the dismal options, many of the unwed mothers would have had a lesser attachment
382 to unwanted infants. The corpses of unwanted infants, that were sold by a family
383 member to anatomical institutions through intermediaries, were gladly accepted by
384 anatomists as a source of dissection material.

385

386 **Miscarriages and acquiring foetal material**

387 The bodies of foetuses could be acquired by an anatomist through various interactions
388 with the mothers, by examining the deceased, pregnant body post-mortem or through
389 the examination of miscarried remains. Obstetric texts of the period indicate that both
390 of these methods were necessary to construct a complete anatomical timeline from
391 conception to birth. The eminent obstetrician and anatomist, William Hunter
392 examined many women at different stages of pregnancy as well and ‘collected
393 innumerable fresh miscarriages’ from as early as ‘the sixth week’ (Hunter and Rigby,
394 1843, p. 63).

395

396 Foetal material was invaluable to medical research in the nineteenth century but
397 potentially difficult to acquire, just as today. The procurement of this material was
398 dependant on the emotional response to a miscarriage experienced by women. For
399 many childless women, a miscarriage was perceived as a tragic event that deprived
400 them of the idyllic and revered position of motherhood. Although, historically
401 miscarriages are generally presented as a devastating event, recent research reveals
402 that a miscarriage elicited a number of emotions in women during and after the event.
403 Among this variety of emotions was relief (Withycombe, 2015). The difficulties
404 facing pregnant unwed mothers, described above, would disappear in the event that
405 the mother miscarried. This regaining of control and opportunity could result in relief

406 or even elation. Perhaps surprisingly, relief after a miscarriage was not only
407 experienced by those in desperate personal or financial situations, but also by well-
408 off, married women. These emotions of relief allowed for the miscarried foetal
409 material to be acquired, generally by the doctor who attended the event (Withycombe,
410 2015). In many cases women willingly gave over the miscarried foetus to the doctor
411 attending her. It has been hypothesized that women may have been comforted by a
412 medical interest in seeking answers about reproduction (Withycombe, 2015).

413

414 The post-mortem examination of pregnant women, through dissection or autopsy
415 provided a unique opportunity to examine a foetus in utero and an opportunity to
416 extract fetuses for further study. Dissection of pregnant women was not the norm
417 and the opportunity to dissect a woman and foetus under the unique circumstances, as
418 depicted in William Hunter's famous text, *Anatomia Uteri Humani Gravidi Tabulis*
419 *Illustrata (The Anatomy of the Human Gravid Uterus Exhibited in Figures)* published
420 in 1774, was incredibly rare. After the careful dissection or the examination of the
421 abdomen in the case of an autopsy, the foetus could be removed, dissected and
422 possible retained for a museum. Many of the specimens in medical museums were
423 acquired in this manner: secretly and without consent. Extant collections including the
424 Hunterian Collection and the Royal College of Surgeons, still house many organs
425 harvested from post-mortem examinations (Richardson, 2000). These harvested foetal
426 bodies were not only displayed in museums, they were also immortalised in published
427 texts. William Hunter's iconic early obstetric text featured the organs of fifteen
428 women, seven infants, eight pre-term fetuses and supplementary material from
429 miscarriages, some of which must have come from post-mortem examinations
430 (McDonald and Faithfull, 2015; Hunter, 1774).

431

432

433 **TREATMENT AND USES OF FOETAL AND INFANT BODIES**

434 Medical cadavers of all ages were used in multiple ways in anatomical teaching
435 including human dissection. Evidence of the treatment of bodies from a medical
436 context can be assessed by examining the skeletal remains that have been retained in
437 medical museums or excavated from archaeological sites. In recent years a number of
438 excavations have uncovered skeletal remains with evidence of surgical cut marks
439 consistent with human dissection (Chamberlain, 2012; Fowler and Powers, 2011;
440 Kausmally, 2012; Mitchell, 2012; Webb et al., 2014; Western, 2012). Evidence of
441 human dissection in archaeological assemblages is generally identified through the
442 presence of tool marks on the bones.

443

444 In dissected adult skeletons, the most commonly identified procedures that indicate a
445 post-mortem examination has taken place are craniotomy and thoracotomy. A
446 circumferential craniotomy, the process of sawing open a skull in order to examine
447 the brain, is the most commonly associated procedure with human autopsy and
448 dissection in archaeological contexts. During the nineteenth century, a knife was used
449 to cut the scalp, generally in a coronal direction. The scalp was then pulled down to
450 reveal the cranial vault, which was then sawn around so the top of the calvaria could
451 be removed and the brain examined. During this procedure sometimes a knife or saw
452 was used to remove any soft tissues adhering to the bones of the skull. Although
453 craniotomy was not always undertaken in dissection, either craniotomy or cut marks
454 indicating scalp removal are generally required to make a convincing argument for
455 dissection in skeletal remains without historical documentation. A thoracotomy is a
456 procedure in which the thoracic cavity is opened in order to examine the internal

457 organs. There is considerable evidence to support variation in this procedure during
458 the eighteenth and nineteenth century, but commonly found evidence includes sawn
459 clavicles, knife or saw marks on the manubrium and sternal elements, as well as sawn
460 ribs (Figure 1).

461

462 **Dissection at Cambridge**

463 In recent years we have undertaken research analysing the skeletal remains of infants
464 from the late eighteenth and nineteenth centuries showing signs of dissection. Our
465 study of the skeletal collection retained from the Cambridge dissecting room (1768-
466 c.1913) reveals that the age of the individual seems to dictate the role that each
467 individual had in anatomical teaching and how the individual was treated (Dittmar
468 and Mitchell, 2015b). Foetal and infant cadavers were used for student dissection, but
469 these bodies were treated differently to individuals of other ages. Foetuses were not
470 generally dissected before the 6th gestational month. We suspect this was due to the
471 very small size of the individual before the 6th gestational month.

472

473 Evidence of the examination of a foetal head via a craniotomy was rarely found. Only
474 one transverse craniotomy was identified on an infant skull in the Cambridge
475 collection, out of a total of 54 foetal/infant specimens. Knife marks were much more
476 commonly found on foetal and infant crania that had undergone dissection (44%). It is
477 presumed the remainder were defleshed by non-surgical techniques such as boiling
478 the cadaver. In those who had knife marks present, the location of the knife marks
479 typically extended coronally over the cranial vault (Figure 2). These incisions are
480 consistent with cutting the scalp with a knife and pulling the skin away to reveal the
481 vault. Generally this preceded a craniotomy in adults, but clearly this was not the case
482 for the vast majority of foetal remains.

483

484 Evidence of thoracotomies on foetal and infant remains are even more difficult to
485 identify than craniotomies. Historical sources indicate the chest of infants was opened
486 in a similar way to contemporary adults (Figure 1). The lack of tool marks indicative
487 of this procedure found on skeletal remains suggest that the thorax was opened by
488 transecting the cartilaginous portions of the ribs.

489

490 Although variation is seen in the treatment of bodies between age groups, the surgical
491 instruments used in the dissection of foetal and infant bodies at Cambridge were
492 similar to those used on adults. Evidence of both knives and saws were identified and
493 in the case of the transverse craniotomy performed on a foetus in the 38th gestational
494 week, clear evidence that a saw was used to open the cranium was present (Figure 3).
495 The morphological characteristics of the saw marks are consistent with a surgical saw
496 with an alternate tooth set (Figure 4). This type of saw was used to perform
497 craniotomies on individuals of all ages. However, the standard saws used to divide the
498 ribs of adults would have been much too large to use on infant bodies. Special saws
499 for the dissection of infants were not made because the end result could be achieved
500 using different surgical tools already in existence, such as bone nippers or scissors.

501

502 **Anatomical preparations**

503 The procedural changes in the dissection of foetal and infant remains may have
504 resulted from the importance placed on these bodies to medical museums. The skulls
505 appear to have been intentionally spared to preserve them for teaching or display.
506 Museums were particularly important to anatomical teaching, as they allowed for
507 prolonged and careful study of preparations, both anatomical and pathological. These

508 young bodies were especially important to illustrate developmental changes, and most
509 museums would have had a series of preparations that would illustrate the process
510 from embryonic development to birth. With the increased interest in obstetrics,
511 birthing preparations were commonly created for museums. These small bodies were
512 also preferable to adults to display the anatomy of the nervous system and circulatory
513 system. These preparations generally required the entire body to be injected. Pole in
514 his book on anatomical preparations suggests that the bodies of adults were not ideal
515 for creating such preparations. In place of an adult, the bodies selected for exhibiting
516 the arteries were 'from the earliest infancy, to about the age of fourteen years'
517 preferably 'a thin emaciated subject' (Pole, 1790, p. 36-37).

518

519 The preparations created from foetal and infant bodies were clearly valued by
520 anatomists as is illustrated by the measures taken to preserve the skeleton intact and
521 undamaged. The value placed on foetal preparations likely contributed to the
522 differential treatment of these bodies during dissection as well as well as after. Unlike
523 adult bones, foetal material was not generally kept for handling by students as they
524 were too fragile and porous to examine the muscle attachments and other anatomical
525 markers.

526

527 The museum journey of foetal osteological preparations seems to have been different
528 to that of an adult preparation. As seen in the former Cambridge anatomical
529 collection, the osteological preparations of adult bones can go through several phases
530 of use within an institution. Initially the body is dissected, then a single or multiple
531 preparation is made from the body and put on display. After an unspecified amount of
532 time this preparation may no longer be needed in a museum collection and may
533 become a teaching preparation, or a handling preparation that is used by students to
534 learn anatomy. In the event that a preparation is broken or no longer useful, it was
535 discarded. This journey varies in length and is affected by many factors but may last
536 for hundreds of years. Many teaching institutions retain the anatomical preparations
537 created by founding members of the institution, such as the Hunterian Collections in
538 London and Glasgow (Paget and Stanley, 1863; Fordyce et al., 1840). This journey is
539 often much less varied and potentially shorter for infant skeletal remains. Due to their
540 fragility they were more likely to be damaged if handled, so these elements were more
541 likely to be hidden in a storeroom or discarded when no longer fit to display.

542

543 **Prized Museum Preparations**

544 During the eighteenth and nineteenth century abnormal bodies were featured in many
545 exhibitionary contexts. The commercial exhibition of 'Siamese' or conjoined twins
546 could be found among dwarves, giants, and hermaphrodites at establishments such as
547 the Egyptian Hall, the Regent Gallery and the Rummer in Three Kings Court, Fleet
548 Street (Anonymous, c.1880-1900). These living people were placed along side
549 anatomical specimens and even occasionally great beasts to produce a spectacle of
550 anatomical variation to serve both as a reminder of morality and for public
551 amusement.

552

553 The fascination with 'monsters' was universal and even among medical men this type
554 of preparation was collected and curated in many anatomical museums. This interest
555 is clearly illustrated in the book, *Human Monstrosities*, published in 1891, which
556 features developmental defects in fetuses (Hirst, 1891). Within medical contexts, the
557 abnormal was not sensationalised for profit in the way that was seen in the
558 commercial establishments. As a point of professional pride, anatomists remained

559 detached and viewed these non-normative bodies through a scientific lens (Porter,
560 2001). In alignment with this calculated scientific approach, the term ‘monster’ that
561 was liberally applied to the ‘abnormal’ by commercial outfits was refined within
562 medical circles to the examination of physical malformations during the early
563 embryonic development.

564

565 The rarity of malformed fetuses led them to be highly valued, even among other
566 abnormal preparations. The unique niche held by fetuses that illustrated
567 developmental defects led to the majority of the bodies being preserved intact. In
568 comparison with preparations of malformed adult organs or organs illustrating a
569 pathological process, preparations made from foetal bodies were much more likely to
570 feature the body in its entirety. This is primarily because the most severe and often
571 fatal congenital defects such as anencephaly (a congenital malformation where major
572 parts of the brain and skull are missing) only exist in foetal form. Even in the event
573 that a malformed foetal body was dissected prior to being put on display, the body
574 would be stitched back together before being preserved in spirit and displayed (Hirst,
575 1891). This was not the case for adult bodies. Both convenience and necessity played
576 a role in curatorial decisions when it came to the retention of entire bodies to illustrate
577 congenital abnormalities. The lack of display space was a continual battle for many
578 museum curators and practically, it is much easier to prepare, store and display a
579 small jar containing a fetus than it is to do the same with an adult body.

580

581

582 **DISPOSAL**

583 Given that these bodies played an important role in anatomical education, the lack of
584 archaeological evidence of individuals in this subgroup raises questions about the
585 disposal practices used. Based on the unique and yet marginalised role that fetuses
586 and infants played, it is likely that a combination of disposal methods were used for
587 individuals in this group. However, even the conventional methods for disposing of
588 dissected individuals do not always align with traditional burial practices. The
589 disposal of bodies following dissection included burial in private or hospital burial
590 grounds. The remains of dissected cadavers were supposed to be buried in a church
591 burial ground for a ‘proper burial’. However evidence from archaeological sites does
592 not suggest that these regulations were always followed. This was especially the case
593 when the bodies were obtained through illicit means. For example, dissected
594 individuals have been uncovered in pits behind hospitals (Western, 2012).

595

596 The majority of dissected skeletal remains uncovered in archaeological contexts
597 indicate that disposal of bodies following dissection was primarily burial in private
598 and hospital burial grounds (Mitchell, 2012). Burial of dissected remains was not
599 always formal even within formal burial locations. Within allocated burial grounds,
600 especially hospital burial grounds, the burial of dissected remains did not adhere to
601 normative societal burial practices. It was not uncommon to place dissection portions
602 into the coffin of another person or to bury a coffin containing mismatched human
603 and animal body parts (Fowler and Powers, 2012). The concealment methods
604 generally used to dispose of dissected bodies, especially before the passing of the
605 Anatomy Act in 1832, were more effective in hiding the infant bodies than those of
606 adults. Sections of bodies not belonging to the occupant of a coffin have been
607 identified in archaeological excavations (Fowler and Powers, 2012). This was a
608 money saving measure as well as an attempt to conceal the dissection of illicitly
609 acquired bodies. The size of the body and legislation regarding burial practices of

610 foetuses and infants until the 1840s facilitated the treatment of these bodies as
611 material waste.

612

613

614 **CONCLUSION**

615 This historical, osteological and archaeological assessment demonstrates that foetal
616 and infant bodies played a larger role in the study of anatomy during the eighteenth
617 and nineteenth centuries than was previously realised. These bodies were made
618 uniquely available to anatomists by socio-cultural factors. Infant cadavers were often
619 acquired via body snatching until the early 1800s, and after 1832 following a child's
620 death in a charitable hospital. However, they also became available through
621 anatomists' dissection of pregnant women, from the high mortality rates in infants
622 from poor families at that time due to infectious disease, and following infanticide by
623 unwed, vulnerable women in desperate circumstances.

624

625 Once acquired, the treatment of an infant body by anatomists was largely dependent
626 upon whether the body was to be used in research or education. Foetal cadavers were
627 valued for the study of growth and development, and were often kept in anatomical
628 museums. Little archaeological evidence for dissection exists due to the manner in
629 which foetuses and infants were treated by anatomists during the nineteenth century.
630 The rarity of craniotomy in order to keep the skull intact, and ease of thoracotomy
631 through cartilaginous parts of the ribs, means that many individuals who underwent
632 dissection as a foetus or infant have probably not been identified at archaeological
633 excavation. However, our research into the foetal and infant remains from 200 years
634 ago in the Cambridge anatomy collection is starting to shed new light on how the
635 youngest members of that society were studied by the anatomists of the time.

636

637

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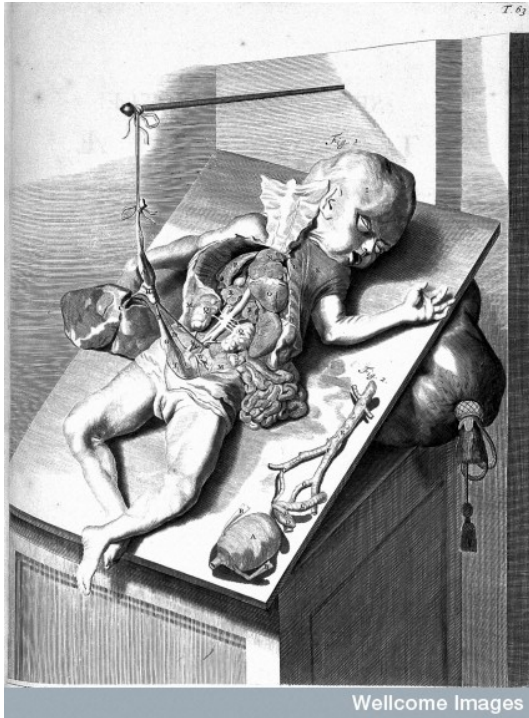
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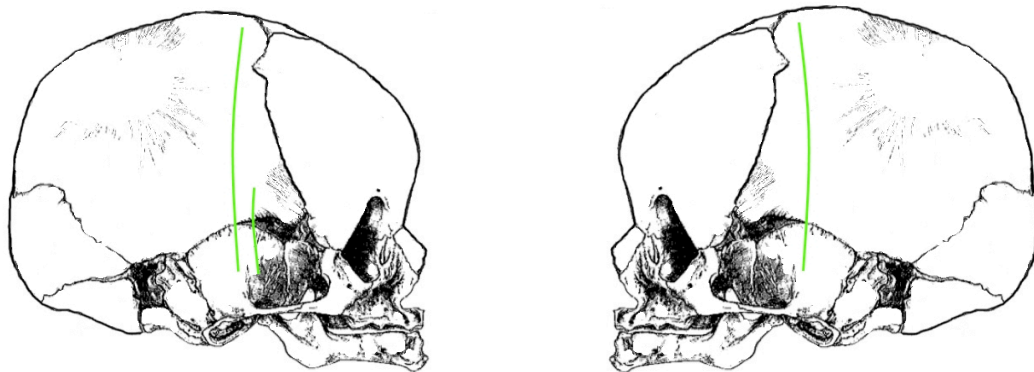
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Figure 1: Dissection of an infant c.1685. Engraving by Gerard de Lairesse published in Anatomia Humani Corporis by Govard Bidloo. Wellcome Library, London



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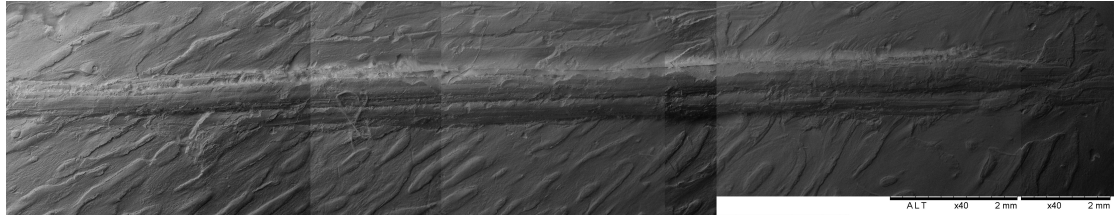
Figure 2: Pattern of knife marks (in green) on a full term foetal skull (5752) from the University of Cambridge c.1911



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Figure 3: Craniotomy and incomplete saw mark on the skull of (5741) from Cambridge, Duckworth Collection c.1911



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Figure 4: SEM micrograph of an incomplete saw mark on the right parietal bone of a foetus in the 38th gestational week (5741) dissected at the University of Cambridge, c.1911

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