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REVIEW

Soft-tissue anatomy of the extant hominoids: a review and phylogenetic analysis

S. Gibbs,[1] M. Collard[2] and B. Wood[3]

[1]*Department of Human Anatomy and Cell Biology, The University of Liverpool, New Medical School, Ashton Street, Liverpool L69 3BX, UK* [2]*Department of Anthropology and AHRB Centre for the Evolutionary Analysis of Cultural Behaviour, University College London, Gower Street, London WC1E 6BT, UK*
[3]*Department of Anthropology, George Washington University, 2110 G Street NW, Washington DC 20052, and Human Origins Program, National Museum for Natural History, Smithsonian Institution, Washington DC, USA*

Abstract

This paper reports the results of a literature search for information about the soft-tissue anatomy of the extant non-human hominoid genera, *Pan*, *Gorilla*, *Pongo* and *Hylobates*, together with the results of a phylogenetic analysis of these data plus comparable data for *Homo*. Information on the four extant non-human hominoid genera was located for 240 out of the 1783 soft-tissue structures listed in the *Nomina Anatomica*. Numerically these data are biased so that information about some systems (e.g. muscles) and some regions (e.g. the forelimb) are over-represented, whereas other systems and regions (e.g. the veins and the lymphatics of the vascular system, the head region) are either under-represented or not represented at all. Screening to ensure that the data were suitable for use in a phylogenetic analysis reduced the number of eligible soft-tissue structures to 171. These data, together with comparable data for modern humans, were converted into discontinuous character states suitable for phylogenetic analysis and then used to construct a taxon-by-character matrix. This matrix was used in two tests of the hypothesis that soft-tissue characters can be relied upon to reconstruct hominoid phylogenetic relationships. In the first, parsimony analysis was used to identify cladograms requiring the smallest number of character state changes. In the second, the phylogenetic bootstrap was used to determine the confidence intervals of the most parsimonious clades. The parsimony analysis yielded a single most parsimonious cladogram that matched the molecular cladogram. Similarly the bootstrap analysis yielded clades that were compatible with the molecular cladogram; a (*Homo*, *Pan*) clade was supported by 95% of the replicates, and a (*Gorilla*, *Pan*, *Homo*) clade by 96%. These are the first hominoid morphological data to provide statistically significant support for the clades favoured by the molecular evidence.

Key words cladistics; Hominoids; *Homo*; *Pan*; phylogeny; soft-tissues.

Introduction

The anatomy of the living hominoids, the extant primates most closely related to modern humans (Table 1), has long attracted the attention of researchers (e.g. Tulp, 1641; Tyson, 1699; Camper, 1782, 1799). The close similarities between modern human anatomy and the anatomy of chimpanzees (*Pan*), gorillas (*Gorilla*), orangutans (*Pongo*) and gibbons (*Hylobates*), and the particularly detailed similarities between modern humans and the African apes, have been noted by researchers for more than 150 years (e.g. Huxley, 1864). However, these observations made little impact on the taxonomy of primates, which continued to reflect the prevailing wisdom that modern humans differed so fundamentally from their closest non-human relatives that they deserved recognition at a high level in the

Correspondence
Professor B. Wood, Department of Anthropology, George Washington University, 2110 G Street NW, Washington DC 20052, and Human Origins Program, National Museum for Natural History, Smithsonian Institution, Washington DC 20650, USA.
Tel. +1 202 994 6077; fax: +1 202 994 6097; e-mail: bwood@gwu.edu

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Table 1 An example of a taxonomy of the living higher primates that recognizes the close genetic links between *Pan* and *Homo*. Note that the meanings of 'hominid', 'hominin' and 'hominine' differ from those used in more traditional taxonomies

Superfamily Hominoidea ('hominoids')
Family Hylobatidae
Genus *Hylobates*
Family Hominidae ('hominids')
Subfamily Ponginae
Genus *Pongo* ('pongines')
Subfamily Gorillinae
Genus *Gorilla* ('gorillines')
Subfamily Homininae ('hominines')
Tribe Panini
Genus *Pan* ('panins')
Tribe Hominini ('hominins')
Subtribe Hominina ('hominans')
Genus *Homo*

Linnaean hierarchy (e.g. Order Bimanus [Blumenbach, 1795] Family Hominidae [Gray, 1825]).

Technical advances in the last 100 years have made available new types of evidence for consideration by primate taxonomists. First, came molecular evidence about the differences among higher primates (e.g. Nuttall, 1904; Zuckerkandl et al. 1960; Goodman, 1963; Zuckerkandl, 1963; Sarich, 1967, 1968). In the past few decades this has been supplemented by comparative evidence about sequence differences at the level of the genome (e.g. Goodman et al. 1994; Ruvolo, 1997). Both these classes of evidence have reinforced the integrity of a group that includes the African apes and modern humans. However, it is only relatively recently that a cadre of researchers has been willing to promote, and adopt, a taxonomy that recognizes a particularly close relationship between *Homo* and *Pan*, and between these taxa and *Gorilla* (e.g. Goodman, 1963; Goodman et al. 1994; Shoshani et al. 1996) (Table 1).

Until the advent of molecular and DNA sequence data, nearly all the evidence taken into account by those studying hominoid systematics came from the hard tissues, and especially the hard tissues of the skull. Evidence from soft tissues has been incorporated into some systematic reviews (e.g. Groves, 1986; Shoshani et al. 1996), but in all cases soft-tissue data were substantially outnumbered by skeletal and dental characters. This near total reliance on skeletal and dental evidence is unfortunate for at least three reasons. First, it equates 'morphology' with 'hard tissue' or 'skeletal and dental' morphology. Second, recent studies have cast doubt on the effectiveness of traditional craniodental hard-tissue evidence for reconstructing hominoid phylogeny (Hartman, 1988; Harrison, 1993; Pilbeam, 1996; Collard & Wood, 2000). Third, opportunities to collect information about hominoid soft-tissue anatomy by dissecting animals sampled from populations in their original locations and habitat are dwindling. Deforestation is leading to the attrition of hominoid habitats at an unprecedented rate. When the ravages of deforestation are combined with the associated threat posed by the bushmeat trade (e.g. Bowen-Jones, 1998), the elimination of chimpanzees from their natural habitats is a real possibility within the next decade (Baillie & Groombridge, 1996). The seemingly inexorable progress of deforestation at other locations in Africa and Asia also threatens the long-term survival of gorillas, orangutans and gibbons in the wild (Baillie & Groombridge, 1996).

The living non-human hominoids have traditionally attracted the attention of hunters, collectors, naturalists and scientists. These individuals have, for a wide range of motives, assembled collections, both large and small, of extant hominoids. The most comprehensive collections include skins and complete skeletons, but many others comprise only skeletal evidence, and of these the majority are dominated by craniodental specimens. Providing resources are made available to curate and conserve these collections appropriately, they will continue to allow researchers to collect information about gross morphology, both external and internal, as well as providing opportunities to collect data about skeletal and dental microstructure. In addition, the skins, depending on the preservation medium (Hall et al. 1995), may also retain sufficient DNA to allow segments of the genome to be characterized. Some of the comparative collections include detailed information about the location, condition, size and weight of the carcass immediately after the animal was trapped and killed. In many cases these data are sufficiently precise to enable skeletal and dental variation to be studied at the level of the species and subspecies, and in some cases also at the level of the deme. However, because of the severely diminished size of hominoid populations in the wild, opportunities to collect comparable data for soft-tissue anatomy are effectively at an end.

Given this context, our study comprised three activities. First, we collated and reviewed evidence in the literature about the soft-tissue anatomy of the living hominoids. Second, we summarized these data to draw

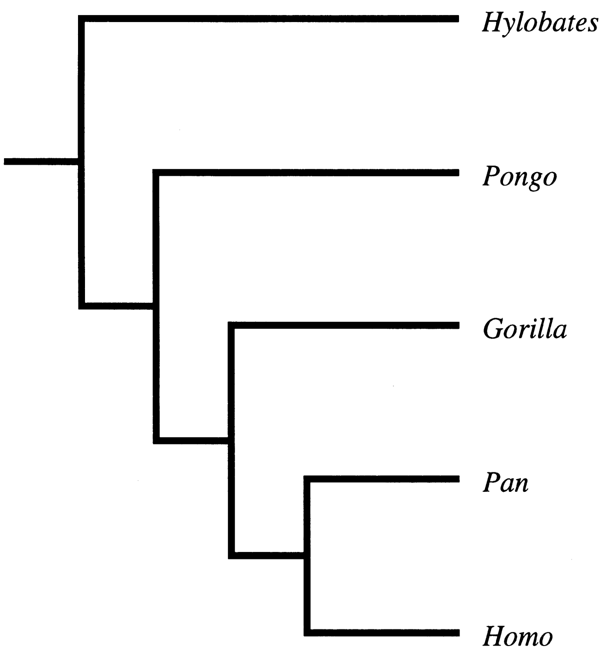

Fig. 1 Hominoid molecular relationships.

attention to the anatomical regions and the systems that are under represented, or not represented at all, in this data set. Third, where appropriate we converted the data that do exist into character states. These were then used in a phylogenetic analysis to test whether hominoid soft tissues are capable of recovering the hypothesis of hominoid relationships that is supported by a large number of independent molecular data sets (Fig. 1).

Review of published evidence

Introduction

There are sound reasons for regarding a short description by the Dutch physician Nicolaas Tulp of an anthropoid ape (presumably a chimpanzee) from Angola as the earliest contribution, at least in Western culture, to the scientific literature about the group we now refer to as the Hominoidea (Tulp, 1641). References to 'apes', as well as to 'monkeys' and 'baboons', by Aristotle in his *Historia animalium* hold the promise that the first of these refers to modern hominoids. However, the Ancient Greeks used the term 'ape' to refer to the 'tail-less' or 'Barbary' ape, which is known to modern biology as the Old World monkey, *Macaca sylvanus*. Likewise, when Andreas Vesalius wrote that 'Galen describes the vertebrae, sacrum and coccyx of the ape.' (Vesalius, 1543, Book 1, Chapter 18, p. 195), Vesalius was referring to *Macaca sylvanus* and not to a hominoid.

It is difficult to tease out the earliest references to the anatomy of individual great and lesser ape species because in the 17th century the terms 'Satyr' and 'Orang-Outang' were used more or less indiscriminately. With hindsight, it is clear that at various times these terms have been applied in different geographical regions to aboriginal modern humans as well as to genuine non-human hominoid primates. For example, although the 'Ourang Outang' anthropoid creature from Java referred to by Bontius (1658) is remarkably anthropomorphic in appearance, the context of the description suggests that the description, if not the illustration, was based on the Bornean orangutan (Yerkes & Yerkes, 1929). Likewise, despite the anthropomorphic nature of the figure in the famous engraved frontispiece of Tyson's (1699) monograph, the animal he described as '*Orang-Outang, sive Homo Sylvestris*' was a juvenile chimpanzee, the skeleton of which is on display in the Natural History Museum, London. Conversely, it is clear from the details provided by Buffon (1780) that the orang-utan cadaver dissected by Tyson and Cowper was actually that of a modern human.

Despite being entitled *Observations on the Anatomy of the Orang Outang*, Traill (1821) deserves the distinction of being the first anatomical description of the chimpanzee. Traill (1818) is sometimes referenced in this context, but this citation refers to an abstract not to a description. There is general agreement that it was the collaboration between the Protestant missionary, Thomas Savage, and the anatomist, Jeffries Wyman, that brought the second African great ape, the gorilla, to the attention of the Western scientific community. Savage & Wyman (1847) were apparently the first researchers to distinguish it clearly from the chimpanzee. Thereafter, Richard Owen – who was one of the first scientists after Traill to dissect a chimpanzee (Owen, 1846) – elaborated on the distinctiveness of the gorilla (Owen, 1849, 1859, 1865). The distinction of introducing the larger of the Asian apes, the orangutan, to Western science clearly falls to Peter Camper. His writings make it very clear that he had dissected at least one specimen of *Pongo* prior to his published commentaries (Camper, 1779, 1782). Yet again, Richard Owen was one of the pioneers who generated additional information about the orangutan from his own dissections (Owen, 1843). The first sound recognition of the gibbons should be attributed to Le Comte (1697). Buffon (1780) consolidated the case for their distinctiveness, and Keith (1896), in a review of the gibbons, refers to providing '... incomplete descriptions of the anatomy of five animals' (p. 372). Keith credits Kohlbrügge (1890/91) with the distinction of providing the first systematic description of gibbons based on dissection.

Although more than a century has elapsed since the publication of the last of these pioneering ape dissections, the amount of information about the soft tissues of hominoids that has been accumulated from subsequent dissection studies has been meager. The numbers of animals that have been systematically dissected is relatively small. For example, Henry Raven's (1950) anatomical researches on the anatomy of the gorilla were based on the dissection of a single adult male *Gorilla gorilla* carcass collected from southern Cameroon. Likewise, the observations on the thoracic and abdominal viscera made by Washburn (1950) and Elftman & Atkinson (1950) in the same volume are mainly based on information from the dissection of a single young adult female. These data were supplemented by observations from an adult male, but it seems likely that this was the cadaver Raven used. Swindler & Wood (1973) based their description of the soft-tissue anatomy of *Pan* on six individuals, and together with the four gibbon dissections reported by Kohlbrügge (1890/91), these are probably the largest comparative hominoid dissection series to have been reported in the literature. The same small sample sizes also apply to *Pongo*. For example, the primary data in Anderton's (1988) review of the appendicular myology of *Pongo* came from a single animal. The study of Thorpe et al. (1999) is one of the few recent investigations to involve the systematic dissection of a non-human hominoid, but whilst their sample comprised three *Pan* cadavers, the published information is confined to the muscular system.

There have been relatively few previous attempts to consolidate information about the soft tissues of the hominoids. Perhaps the most notable is the monumental multi-author *Handbuch der Primatenkunde* (Hofer et al. 1956) which includes data for hominoids together with information from other primate groups. Sadly Osman Hill did not live long enough to expand the coverage of his extraordinary monograph series *Primates: Comparative Anatomy and Taxonomy* to include the Hominoidea.

Materials and methods

Computer searches were made of contemporary anatomical, zoological, surgical and pathological journals. However, much of the relevant literature antedates computer-generated bibliographic resources. Thus, most journals had to be searched manually. The initial selection of journals was based on the titles that showed up regularly in the relevant sections of Ruch's (1941) *Bibliographia Primatologica* or in the reference lists of key articles (e.g. Sonntag, 1923, 1924a, 1924b; Hill, 1949, 1958) and monographs (e.g. Sperino, 1897; Raven, 1950). Some of these concentrated on a particular species, whereas others were based on a study of a particular anatomical region; the language of the article was not a bar to inclusion. Doubtless we have missed papers that contain useful information, but this project has at least initiated the process of gathering information about hominoid soft-tissue morphology in a systematic way.

This study used the modern human soft-tissue structures listed in the *Nomina Anatomica* (NA) as a reference tool for taking stock of the published data about non-human hominoid soft-tissue morphology. Clearly this list omits a few structures not normally found in modern humans. However, it has the advantage that, because it is a list that has been developed over time by experienced human morphologists, if it errs then it does so on the side of being conservative and comprehensive. Only a very few of the entries are too generalized to be useful (see the references to the skin below). With the minimum of modification it was possible to match observations in the literature on non-human hominoids with the structures listed in the NA. Thus, the total number of relevant NA soft-tissue structures – 1783 – is a sensible denominator to use in order to assess the coverage of information about the non-human hominoids, both by system and by anatomical region.

The organization of the information was based on the scheme used in the Sixth Edition of the NA (Warwick & Brookes, 1989). Information from the literature was organized initially by system, or major system component (e.g. 'arteries', 'veins', 'lymphatics' within the vascular system), and then it was cross-referenced by region where appropriate (i.e. for muscles, nerves, arteries and veins). Four relatively crude regional categories were recognized, the 'Head' (H), 'Forelimb' (F), 'Trunk' (T) and 'Hindlimb' (HL). Information about the limb girdles was included in the respective limb categories, and neck structures were included in the 'Trunk' category. Vessels and nerves were dealt with by region rather than by system, so that, for example, the vasculature of the gut is dealt with under the vessel type, and then assigned to the 'Trunk' regional category, rather than to the 'Alimentary System'.

Results

Some idea of the scope of the information gleaned from the literature can be gained by inspecting Appendix 1. The rows of information are the soft-tissue structures used in the NA, and they are identified using the untranslated NA nomina. Where appropriate the regional allocation (i.e. H, F, T and HL) is given in parentheses after each structure. The columns in Appendix 1 represent the living non-human hominoid genera, *Pan*, *Gorilla*, *Pongo* and *Hylobates*. Each column includes data about the relevant species and subspecies included in each of the genera as set out in Nowak (1991). Thus, for example, data about siamangs and pygmy chimpanzees are subsumed within the *Hylobates* and *Pan* columns, respectively.

To help the reader comprehend the large amount of information in Appendix 1, the data have been summarized in Table 2. The system categories, and when appropriate their regional subcategories, are set out in the rows of Table 2. The first column (NA) lists the total number of structures listed in the NA within that category, or subcategory. The second column (N-HH) gives the number of structures within any NA category, or subcategory, for which there is information for one, or more, non-human hominoid genus. Column three (NA%) provides the percentage, within each category and subcategory, of the NA structures for which information is available for at least one non-human hominoid. Column four (N-HH%) gives the cumulative percentage of the NA structures, for each category, or subcategory, for which there are data for at least one non-human hominoid. Column five (PA) provides the number of structures in the NA category, or subcategory, for which there are data that satisfy the criteria (see below) for inclusion in the phylogenetic analyses that form the second part of this contribution. Column six (NA%) gives the percentage of the PA structures in each of the NA categories, or subcategories. The final column (PA%) provides the cumulative percentage of PA structures, for each of the NA categories, and subcategories.

It is evident from Table 2 that the global figure of 35% of NA soft-tissue structures represented in the literature by information from more than one non-human hominoid obscures major differences in the representation of systems, tissues and regions. There are three general levels of sampling intensity. Muscles are sampled most intensively, with information being available for more than one non-human hominoid for nearly 90% of the muscles listed in the NA. Among the larger categories of structures the next level of sampling intensity, *c.* 40–50% of the NA structures, applies to the arteries, the heart and the nerves. The remaining numerically large NA categories are sampled at substantially lower levels of intensity. Of these, the best represented is the alimentary system with 27% of the NA structures represented in the literature. The venous component of the vascular system is the least well represented, at 12%. Among the categories with smaller numbers of structures listed in the NA, the endocrine glands and the skin are relatively well represented, at 43% and 44%, respectively. There appear to be discrepancies between the information under the 'Skin' system category given in Tables 2 and 3 and Appendix 1, and the zero score in this category in Table 4. This is because although there are data for the skin in the literature, these data do not correspond to any of the major structural skin subcategories given in the NA.

Regional differences in sampling intensity are also noteworthy, and will be referred to again in the 'Discussion' section. When the major system categories, or subcategories, are broken down into the four major regions, the forelimb is always either the most intensively sampled region, or, in the case of the muscles, it shares that distinction with the hindlimb. In contrast, the head is always the region least intensively sampled in the existing literature.

If the sampling criterion is altered to consider the NA structures for which information is available for all four of the non-human hominoid primates (Table 3), the dominance of evidence about muscles, and the more intensive sampling of the forelimb, are themes that are repeated. The organization of Table 3 follows that of Table 1, except that the N-HH column in the former refers to structures for which there is information for all four non-human hominoids. The muscle category comprises *c.* 48% of the structures thus sampled, and just less than half of these – 48 out of 112 – are forelimb muscles. An even more marked forelimb regional dominance – 23 out of 40 – is seen in the artery category.

	NA	N-HH	NA%	N-HH%	PA	NA%	PA%
Alimentary system							
Oral Cavity	14	4	29%	0.6%	0	0%	0%
Salivary Glands	5	4	80%	0.6%	0	0%	0%
Tongue	16	5	31%	0.8%	5	31%	2.9%
Fauces	7	1	14%	0.2%	0	0%	0%
Pharynx	13	2	15%	0.3%	0	0%	0%
Oesophagus	7	2	29%	0.3%	0	0%	0%
Stomach	15	1	7%	0.2%	0	0%	0%
Small Intestine	8	1	13%	0.2%	0	0%	0%
Large Intestine	29	14	48%	2.3%	0	3%	0%
Liver	43	6	14%	1.0%	0	0%	0%
Biliary Tract	10	2	20%	0.3%	0	0%	0%
Pancreas	8	5	63%	0.8%	0	0%	0%
Total	175	47	27%	7.6%	5	3%	2.9%
Arteries							
Head	106	40	38%	6.4%	0	0%	0%
Forelimb	39	27	69%	4.3%	11	38%	6.4%
Trunk	101	55	54%	8.9%	5	5%	2.9%
Hindlimb	41	16	39%	2.6%	9	22%	5.3%
Total	287	138	48%	22.2%	25	10%	14.6%
Bursae							
Total	28	0	0%	0%	0	0%	0%
Heart							
Total	52	22	42%	3.5%	0	0%	0%
Endocrine glands							
Total	14	6	43%	1.0%	0	0%	0%
Skin							
Total	9	4	44%	0.6%	4	44%	2.3%
Lymphatics							
Total	109	20	18%	3.2%	0	0%	0%
Muscles							
Head	83	61	73%	9.8%	3	4%	1.8%
Forelimb	51	50	98%	8.1%	56	124%	18.3%
Trunk	55	51	93%	8.2%	3	13%	1.8%
Hindlimb	51	50	98%	8.1%	43	98%	25.1%
Total	240	212	88%	34.1%	105	51%	61.4%
Nerves							
Head	88	24	27%	3.9%	0	0%	0%
Forelimb	25	18	72%	2.9%	9	48%	5.3%
Trunk	33	12	36%	1.9%	1	6%	0.6%
Hindlimb	28	17	61%	2.7%	10	39%	5.8%
Total	174	71	41%	11.4%	20	14%	11.7%
Pericardium							
Total	8	3	38%	0.5%	0	0%	0%
Peritoneum							
Total	54	2	4%	0.3%	0	0%	0%
Respiratory system							
Total	95	24	25%	3.9%	0	0%	0%
Sensory organs							
Total	33	8	24%	1.3%	0	0%	0%
Urogenital system							
Total	209	28	13%	4.5%	9	3%	5.3%
Veins							
Head	114	6	5%	1.0%	0	0%	0%
Forelimb	22	5	23%	0.8%	3	14%	1.8%
Trunk	139	21	15%	3.4%	0	0%	0%
Hindlimb	21	4	19%	0.6%	0	0%	0%
Total	296	36	12%	5.8%	3	1%	1.5%
Grand total	1783	621	35%	100%	171	11%	100%

Table 2 System and regional distribution of soft-tissue structures sampled in at least one non-human hominoid. System categories and regional subcategories form the rows. The columns are as follows: NA = Numbers of soft-tissue structures in each category, or subcategory, listed in the Sixth Edition of the *Nomina Anatomica*, N-HH = Number of soft-tissue structures for which data exist for one or more non-human higher primate genus, NA% = (N-HH/NA) × 100, N-HH% = Cumulative percentage of the NA categories and subcategories, PA = Those structures used for the phylogenetic analysis, NA% = Overall percentage of the NA structures used in the phylogenetic analysis, PA% = Cumulative percentage of PA structures, for each NA category, or subcategory

Table 3 System and regional distribution of soft-tissue structures sampled by all four non-human hominoids. System categories, and their regional subcategories, form the rows. The columns are as follows: NA = Numbers of soft-tissue structures in each of the system categories or regional subcategories listed in the Sixth Edition of the *Nomina Anatomica*, N-HH = Number of soft-tissue structures for which data exist for all four of the non-human primate genera, NA% = (N-HH/NA) × 100, N-HH% = Cumulative percentage of the NA categories and subcategories

	NA	N-HH	NA%	N-HH%
Alimentary system				
Total	175	10	5.7%	4.2%
Arteries				
Head	106	3	2.8%	1.3%
Forelimb	39	23	59.0%	9.6%
Trunk	101	5	5.0%	2.1%
Hindlimb	41	9	22.0%	3.8%
Total	287	40	13.9%	16.7%
Bursae				
Total	28	0	0%	0%
Heart				
Total	52	1	1.9%	0.4%
Endocrine glands				
Total	14	1	7.1%	0.4%
Skin				
Total	9	0	0%	0%
Lymphatics				
Total	109	0	0%	0%
Muscles				
Head	83	3	3.6%	1.3%
Forelimb	51	48	94.1%	20.0%
Trunk	55	16	29.1%	6.7%
Hindlimb	51	45	88.2%	18.8%
Total	240	112	46.7%	46.7%
Nerves				
Head	88	0	0%	0%
Forelimb	25	17	68.0%	7.1%
Trunk	33	5	15.2%	2.1%
Hindlimb	28	13	46.4%	5.4%
Total	174	35	20.1%	14.6%
Pericardium				
Total	8	0	0%	0%
Peritoneum				
Total	54	1	1.9%	0.4%
Respiratory system				
Total	95	7	7.4%	2.9%
Sensory organs				
Total	33	1	3.0%	0.4%
Urogenital system				
Total	209	23	11.0%	9.6%
Veins				
Head	114	1	0.9%	0.4%
Forelimb	22	4	18.2%	1.7%
Trunk	139	3	2.2%	1.3%
Hindlimb	21	1	4.8%	0.4%
Total	296	9	3.0%	3.8%
Grand total	1783	240	13.5%	100%

Comparable levels of forelimb dominance – 4 out of 9 – are also seen in the vein subcategory, and in the nerves, where 17 out of a total of 35 come from the forelimb. The head is consistently the least well sampled region. In the case of arteries, muscles and nerves, the head is the region with the poorest representation, and in the venous vascular subcategory it ties with the hindlimb as the region with the poorest sample. The bias in favour of the limbs in general, and the forelimb in particular, is even more remarkable when it is realised that the limbs generally contribute a relatively small percentage of the structures in the NA system categories that can be broken down into regional subsets (i.e. vessels, muscles and nerves).

The soft-tissue data are sorted by taxon in Table 4. The rows are the main NA categories. The first column is the total number of taxon occurrences in that category, and the second column gives the rank order of those occurrences. The remaining columns provide the number of occurrences for that taxon in each NA category, followed by the percentage of the total number. Overall, the non-human hominoid for which information is most abundant is *Pan*. This taxon has data recorded in the literature for almost a third, 32%, of the soft-tissue structures listed in the NA. *Gorilla* and *Pongo* have equal representation, with 26% of the NA structures sampled. *Hylobates*, at 16%, is the least well sampled living hominoid. For all but two (the pericardium and the urogenital system) of the major NA categories *Pan* is the best sampled hominoid. In both of the two exceptions *Gorilla* takes the place of *Pan* as the most intensively sampled taxon. Within the largest NA category, muscles, *Pan* and *Gorilla* are equally well sampled. The sampling intensity in *Hylobates* never exceeds that in the two non-human African apes, but in two of the major NA soft-tissue categories, the peritoneum and the urogenital system, *Hylobates* is more intensively sampled than *Pongo*.

Phylogenetic analysis

Introduction

As noted in the introduction, morphological analyses of extant hominoid phylogeny have relied heavily on hard-tissue characters, especially characters of the skull and dentition. A number of studies have included soft-tissue data, but with only a few exceptions (Groves, 1986, 1987; Shoshani et al. 1996) they have

Table 4 Soft-tissue structure information broken down by system category, and subcategories, and genus. System categories and subcategories form the rows. The columns are the total number of taxonomic appearances for that system, together with the system rank-order (R). The columns thereafter give the numbers for each genus. N-HH% = Percentage of the total numbers of appearances for that genus

	Total	R	*Pan*	N-HH%	*Gorilla*	N-HH%	*Pongo*	N-HH%	*Hylobates*	N-HH%
Alimentary system	129	5	44	34%	40	31%	27	21%	18	14%
Arteries	372	2	125	34%	84	23%	110	30%	53	14%
Bursae	0	–	0	0%	0	0%	0	0%	0	0%
Heart	40	8	19	48%	1	3%	19	48%	1	3%
Endocrine glands	17	10	6	35%	6	35%	4	24%	1	6%
Skin	0	–	0	0%	0	0%	0	0%	0	0%
Lymphatics	38	9	17	45%	9	24%	12	32%	0	0%
Muscles	700	1	206	29%	194	28%	184	26%	116	17%
Nerves	198	3	67	34%	52	26%	53	27%	26	13%
Pericardium	6	13	1	17%	3	50%	1	17%	1	17%
Peritoneum	7	12	2	29%	2	29%	1	14%	2	29%
Respiratory system	58	7	20	34%	13	22%	17	29%	8	14%
Sensory organs	16	11	8	50%	2	13%	5	31%	1	6%
Urogenital system	163	4	43	26%	51	31%	25	15%	44	27%
Veins	93	6	28	30%	23	25%	27	29%	15	16%
Total	1837		586	32%	480	26%	485	26%	286	16%

rarely incorporated more than a handful of soft-tissue characters (e.g. Kluge, 1983; Schwartz, 1984a, 1984b; Andrews, 1987; Schwartz, 1988; Barriel, 1997). To date, no phylogenetic analysis of hominoids has focused solely on soft-tissue characters, despite the accumulating evidence that hard and soft tissues may differ in their phylogenetic utility (e.g. Köntges & Lumsden, 1996; Collard & Wood, 2000; Gibbs et al. 2000).

Phylogenetic analyses of traditional cranial and dental morphological data have generally supported hypotheses of relationships for *Homo* and the living apes that conflict with the consensus molecular phylogeny for the group. The latter links *Homo* and *Pan* in a clade to the exclusion of *Gorilla*, positions *Pongo* as the sister taxon of the *Homo* and African apes, and locates *Hylobates* as the basal extant hominoid (Ruvolo, 1997; Fig. 1). In contrast, some of the analyses using traditional hard-tissue data have suggested that *Homo* and *Pongo* form a clade to the exclusion of *Gorilla* and *Pan* (Schwartz, 1984a, 1984b, 1988). Others suggest that the African apes, *Gorilla* and *Pan*, form a clade to the exclusion of *Homo* and *Pongo*, and that *Homo* and the African apes form a clade to the exclusion of *Pongo* (Andrews, 1987). Still other studies suggest that the Asian apes, *Hylobates* and *Pongo*, are more closely related to one another than either is to any of the African apes or to humans (e.g. Oxnard, 1987, p. 217). Yet more studies have produced phylogenies in which the three great apes are shown to be more closely related to each other than any of them is to *Homo* (Kluge, 1983; Collard & Wood, 2000). So far, the only morphological analysis to support the same hypothesis of relationship as the molecular data is Shoshani et al. (1996). However, a recent bootstrap analysis of the data used by Shoshani et al. has shown that their data set does not provide statistically significant support for the (*Homo*, *Pan*) clade (Gibbs, 1999). Thus, none of the morphological analyses of the extant hominoids carried out so far have can be said to support the same phylogeny as the molecular data. Rather, they have generally suggested relationships that conflict with the molecular phylogeny, or in the one case in which the resulting phylogeny is consistent with the molecular evidence, little confidence can be placed on the result. In view of the foregoing, we have used the soft-tissue data discussed in the first part of this paper as the basis of a new phylogenetic analysis.

Materials and methods

The soft-tissue structures selected for phylogenetic analysis are a subset of the 240 structures that are summarized in Table 3. They were chosen using three criteria. The first was that for a structure to be included relevant information had to be available for all five hominoid genera (*Homo*, *Pan*, *Gorilla*, *Pongo*, *Hylobates*). This avoided the problem of missing data. The second criterion was that at least two character states had to be present for each structure. This criterion excluded invariant characters. The third was that for each structure one of these character states had to be present in two or more species. This last criterion eliminated characters that were uniquely derived for a given species.

One hundred and seventy-one characters conformed with the three criteria. This is 26 fewer than the number of characters analysed by Gibbs et al. (2000). Since the publication of that study the character list has been further refined to eliminate redundancy, maximise the number of ordered characters, and to exclude characters where differences in sample size might have been influencing the choice of character states. We stress that, whilst we have made every effort to maximise the reliability of the data set, it should nevertheless be treated as a 'work in progress'. In particular, there is a pressing need for studies that will shed further light on variation in the 171 characters within each of the four extant ape genera.

Brief descriptions of the characters, their states and distribution, and the references from which the data were taken are given in Appendix 2. To facilitate further analysis of the characters, they have been organized into slightly different regional and system groups than those used in the NA and Table 2. For example, the characters relating to the neck and tongue, including the surface features of the latter, are included in the 'Head' region. Muscles originating in the trunk, but which attach distally to the lower limb, are included in the 'Trunk' region. Striated muscles of the male external genitalia are included in the 'Genito-Urinary' system, and not with 'Muscles'. The character state data were additively coded, and a taxon-by-character matrix was compiled.

The data matrix was used to perform two tests of the hypothesis that soft-tissue characters can be relied upon to reconstruct the phylogenetic relationships of the hominoids. The first test was based on parsimony analysis, which identifies the cladogram/s requiring the smallest number of *ad hoc* hypotheses of character state change to account for the distribution of character states among the taxa. The matrix was subjected to parsimony analysis using PAUP* 4 (Swofford, 1998), and the shortest cladogram compared to the consensus molecular cladogram for the extant hominoids (Fig. 1). Because parsimony analysis cannot discriminate 'true' and 'false' clades, we judged the hypothesis to be supported if the analysis favoured either a fully resolved cladogram that was consistent with the molecular cladogram, or a partially resolved cladogram that comprised only molecular clades. We also considered the hypothesis supported if the analysis produced several equally parsimonious cladograms whose strict consensus comprised only clades that were compatible with the molecular cladogram.

The second test of the hypothesis used the phylogenetic bootstrap. This methodology assesses the confidence interval associated with a clade (Felsenstein, 1985; Sanderson, 1995). Using PAUP* 4, 10 000 matrices were derived from each matrix by sampling with replacement. The new matrices were subjected to parsimony analysis, and a consensus of the most parsimonious cladograms was computed using a confidence region of 70% (Hillis & Bull, 1993). Thereafter, the clades of the consensus cladogram were compared to the molecular cladogram (Fig. 1). In this test the best supported clades should not be 'false' clades, since it is commonly assumed in primate phylogenetics that the better the bootstrap support for a clade, the more likely the clade is to be 'true' (cf. Corruccini, 1994).

In both the parsimony and the bootstrap analyses, characters were given equal weights. Where obvious transformation series could be identified (e.g. Extent of costal origin of serratus anterior: 0 = ribs 1–9 and occasionally rib 10, 1 = ribs 1–11, 2 = ribs 1–11 and last rib), characters were treated as ordered variables. Otherwise they were treated as unordered variables. Appendix 2 indicates whether a character was treated as an ordered or an unordered variable. Significantly, the results of an analysis in which all the characters were treated as unordered variables produced comparable results to the one described here. No *a priori* judgements were made as to the primitive or derived condition of characters. Instead, *Hylobates* was assumed to be the basal hominoid genus and the cladograms were rooted accordingly. The cladograms were obtained using the branch and bound search routine of PAUP* 4.0.

Results

The hypothesis that hominoid soft-tissue characters are reliable for phylogenetic reconstruction was supported by the results of the parsimony analysis. The analysis of the soft-tissue data set yielded a single most parsimonious cladogram whose branching pattern matched the consensus hominoid molecular cladogram. When rooted on *Hylobates*, the cladogram suggested that *Pongo* is the sister taxon of a clade comprising *Homo*

Table 5 Regional distribution of soft-tissue structures for three of the largest system categories in the *Nomina Anatomica*

	Vascular Arteries		Veins		Muscles		Nerves		Total	
Region	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Head	106	37%	114	39%	83	35%	88	51%	391	39%
Forelimb	39	14%	22	7%	51	21%	25	14%	137	14%
Trunk	101	35%	139	47%	55	23%	33	19%	328	33%
Hindlimb	41	14%	21	7%	51	21%	28	16%	141	14%
Total	287	100%	296	100%	240	100%	174	100%	997	100%
Forelimb + hindlimb	80	28%	43	15%	102	43%	53	30%	278	28%

and the African apes, and that *Gorilla* is the sister taxon of a (*Homo*, *Pan*) clade. The cladogram had a length of 323, a consistency index of 0.63, and a retention index of 0.34. It is noteworthy that this cladogram was 13 steps shorter than the next most parsimonious cladogram, which linked *Gorilla* and *Pan* to the exclusion of *Homo*, and grouped *Gorilla*, *Pan* and *Homo* to the exclusion of *Pongo*.

The bootstrap analysis also supported the hypothesis that hominoid soft-tissue characters are reliable for phylogenetic reconstruction. The (*Homo*, *Pan*) clade was supported by 95% of the bootstrap replicates, and the (*Gorilla*, *Pan*, *Homo*) clade by 96%. Alternative groupings, including the traditional (*Gorilla*, *Pan* and *Pongo*) clade and the (*Homo*, *Pongo*) clade promoted by Schwartz (1984a, 1984b, 1988) received less than 5% support.

Discussion

This study used soft-tissue structures listed in the *Nomina Anatomica* to summarise the published data about non-human hominoid soft-tissue morphology. The taxon coverage is summarized in Table 4. The predominance of information about *Pan* is intriguing, especially when it is realised that the vast majority of these observations about soft-tissue morphology were made and published well before it was realised that there is a particularly close relationship between *Pan* and modern humans. It is also noteworthy, for the same reason, that there is as much information about *Pongo* as there is about *Gorilla*. The gibbons come a poor fourth in the list, with information for *Hylobates* (16% of the total) only being available for half the number of NA structures for which data exist for *Pan*.

The rank order of the total taxon occurrences by system categories and subcategories is also given in Table 4. This rank order, at least for the six best represented NA categories and subcategories, is generally consistent across the four non-human hominoid taxa. The numerical pre-eminence of information about muscles, arteries and nerves is perhaps unsurprising given that across the years these structures have attracted the interest of comparative and clinical anatomists. However, the consistently higher rank for urogenital system structures compared to those from the alimentary system is unexpected, and not easily explained.

When we consider the pattern of regional representation of system categories and subcategories for the structures for which data exist for all four non-human hominoids (Table 3), it is evident that there are substantial regional biases. The most obvious bias is in favour of the limbs, and in particular the forelimb. This latter bias is particularly striking for the subcategories of the vascular system. The extent of the over representation of the limbs has to be considered in relation to the relative numbers of soft-tissue structures in the four anatomical regions in each of the major NA system categories. So, for example, whereas the limbs contribute 28% and 30% of the arteries and nerves in the relevant NA category (Table 5), they make up 80% and 95% of the respective structure categories in the PA (Table 6). The systematic under representation of the soft tissues of the head is in marked contrast to the situation for hard tissues. In the latter case, and probably because of the influence of taphonomy on the palaeontological record, information about the teeth and the skull for the non-human hominids far exceeds the hard-tissue data that are available for the rest of the body (Shoshani et al. 1996; Collard & Wood, 2000).

Table 6 Regional breakdown and major soft-tissue system categories for the characters used in the phylogenetic analysis

	Vascular Arteries		Veins		Muscles		Nerves		Urogenital		Total	
Region	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Head					8	7%					8	5%
Forelimb	11	44%	3	100%	56	51%	9	45%			79	46%
Trunk	5	20%			3	3%	1	5%	9	100%	18	11%
Hindlimb	9	36%			43	39%	10	50%			62	36%
Other											4	2%
Total	25	100%	3	100%	110	100%	20	100%	9	100%	171	100%
Forelimb + hindlimb	20	80%	3	100%	99	90%	19	95%			141	82%

What is remarkable is that interest in functional analysis has not stimulated researchers to more gather comparative information about the soft tissues of the head and neck. There is, for example, no information about the major masticatory muscles of the non-human hominids in the list of PA structures (see Appendix 2). There is clearly an urgent need to develop a comprehensive database for the head and neck soft-tissue anatomy of the non-human hominids.

Turning now to the phylogenetic utility of the soft-tissue morphology, the results of the parsimony and bootstrap tests strongly support the hypothesis that soft-tissue characters can be relied upon to reconstruct the phylogenetic relationships of the extant hominoids. The parsimony analysis unambiguously favoured a cladogram with the same topology as the molecular cladogram, and the bootstrap analysis returned high levels of support for clades that correspond to those of the molecular cladogram. The two main alternative hypotheses of relationship that have been suggested for the extant hominoids received extremely low levels of support in the bootstrap test. The (*Gorilla*, *Pan*) clade, that until recently was favoured by most morphologists (e.g. Andrews, 1987, 1992; Andrews & Martin, 1987), featured in less than 5% of the bootstrap cladograms, as did the (*Homo*, *Pongo*) clade promoted by Schwartz (1984a, 1984b, 1988). Thus, our data set provides unambiguous morphological endorsement for the phylogeny that is overwhelmingly supported by the molecular evidence. Given that the molecular phylogeny is widely considered to be accurate, our analysis suggests that extant hominoid soft-tissue characters have more phylogenetic utility than hominoid craniodental hard tissues, which conspicuously fail to recover the molecular consensus phylogeny (Hartman, 1988; Collard & Wood, 2000). It is worth noting that the analyses provide stronger support for the molecular phylogeny than those carried out by Gibbs et al. (2000) even though the revisions to the data set were made without reference to the molecular phylogeny.

Why do higher primate soft-tissue and hard-tissue characters differ in their phylogenetic utility? A clue may come from the results of experiments that used rhombomere quail-to-chick grafts to investigate the influence of hindbrain segmentation on craniofacial patterning (Köntges & Lumsden, 1996). This experimental study showed that each rhombomeric population remains coherent throughout ontogeny, with rhombomere-specific matching of muscle connective tissue and their attachment sites for all branchial and tongue muscles. If a similar system operates elsewhere in the body, it would help explain how muscle gross morphology is conserved, whereas the shapes of the skeletal elements to which the muscles are attached are susceptible to changes that contrive to obscure phylogeny.

Another contributory factor may be that soft-tissue characters are not as prone to homoiology as skeletal characters. The term homoiology has been used to refer to shared character states that are phylogenetically misleading and which result from similarities in the way that genotypes interact with the environment (Lieberman, 2000). It has been claimed that, because bone is a dynamic tissue, many osseous morphologies may be homoiologous (Lieberman, 2000). We suspect that homoiology plays a minor role in the generation of the phenotypes we use in our soft-tissue data set. Whereas the mass of a muscle may be affected by activity or inactivity, its attachments are unlikely to be.

Likewise, mechanical loading is unlikely to affect the branching pattern of an artery, or the number of digits supplied by a given nerve. Nevertheless, homoiology, as interpreted above, cannot be the whole explanation for the difference in phylogenetic utility between the hard and soft tissues. Because dental enamel does not remodel, it is not prone to homoiology. Yet Hartman (1988) found that molar morphology is unreliable for reconstructing the phylogenetic relationships of the extant hominoids. Thus, other factors must also be involved in reducing the phylogenetic utility of teeth relative to that of soft tissues. Some authors have suggested that function may be a cause of phylogeny-obscuring evolutionary change in tooth morphology (Hartman, 1988; Hunter & Jernvall, 1995). However, recent work on the dentition of the Lake Lagoda seal suggests that developmental constraints may also be a reason why tooth morphology is prone to homoplasy and is therefore a poor guide to low-level phylogenetic relationships (Jernvall, 2000).

This study has shown that for the extant hominoids, and by extension for other higher primates, the classic 'molecules vs. morphology' conflict (Patterson, 1987) does not hold. Rather, the contrast is apparently between molecules and soft-tissue morphology on the one hand, and cranio-dental hard-tissue morphology on the other. However, it is possible that factors other than the nature of the tissue may be influencing the outcome of this study. The 171 soft-tissue characters are not distributed across the major body systems in proportion to the numbers of structures listed in the NA (Table 5), nor are they distributed evenly across the regions of the body. Muscles (64%) predominate in the 171 PA characters (Table 6), whereas two out of the three vascular subcategories, the veins and the lymphatics, are poorly represented and unrepresented, respectively, in the PA structure list (Table 6). Like the distributions of the structures set out in Tables 2 and 3, the 171 PA characters are affected by very substantial regional biases that favour the limbs. Thus, 141 of the 171, or 82%, of the characters included in the phylogenetic analysis are limb characters (Table 6). In contrast, the head is badly under represented, so that, for example, there are no head and neck arteries or veins in the PA list (Table 6). Thus, there are two major differences between this and previous studies of relationships among the living hominids. First, there is its restriction to soft tissues. Second, because of the nature of the published information about non-human hominoid morphology, the majority of the data used in the study are from the limbs. The obvious next step is to use the consensus hominoid molecular cladogram to examine whether hard-tissue evidence from the limbs performs as well as limb soft-tissue evidence, and to see if soft-tissue evidence from the head performs as poorly as the hard-tissue evidence from the same region.

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Appendix 1 Extant hominoid soft-tissue structures by taxon, system and region. The list of hominoid soft-tissue structures is taken from the 6th edition of the *Nomina Anatomica*. An asterisk indicates the existence of an adequate description of the structure for that taxon. Where appropriate, structures are assigned to the 'Head' (H), 'Forelimb' (F), 'Trunk' (T), or 'Hindlimb' (HL) regions

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
ALIMENTARY SYSTEM				
Cavitas oris				
Caruncula sublingualis				*
Corpus adiposum buccae	*	*		
Frenulum labii				
Gingivae				
Labia oris				
Palatum molle	*	*	*	*
Papilla incisiva				
Papilla parotidea				
Philtrum	*	*	*	
Plica palatinae transversae				
Plica sublingualis				
Raphe palati				
Tunica mucosa oris				
Vestibulum oris				
Glandulae oris				
Lingualis anterior	*	*	*	*
Parotidea	*			
Salivariae minores				
Sublingualis	*	*	*	*
Submandibularis	*	*	*	
Lingua				
Apex	*	*	*	*
Aponeurosis linguae				
Corpus	*	*	*	*
Dorsum	*	*	*	*
Ductus thyroglossus				
Facies inferior linguae				
Folliculi linguales				
Foramen caecum linguae	*	*		*
Frenulum				
Papillae linguales	*	*	*	*
Radix				
Septum linguae				
Sulcus medianus linguae				
Sulcus terminalis				
Tonsilla lingualis				
Tunica mucosa linguae				
Fauces				
Fossa supratonsillaris				
Fossa tonsillaris				
Isthmus faucium				
Plica salpingopalatina				
Plica semilunaris				
Plica triangularis				
Tonsilla palatina	*	*		
Cavitas pharyngis				
Fascia buccopharyngealis				
Fascia pharyngobasilaris			*	
Fornix pharyngis				
Pars laryngea pharyngis				
Pars oralis pharyngis				
Raphe pharyngis				
Raphe pterygomandibularis				
Recessus piriformis				
Tela submucosa	*			*
Tonsilla pharyngealis				
Tunica mucosa				
Vallecula epiglottica				
Oesophagus				
Pars abdominalis	*		*	
Pars cervicalis	*	*	*	
Pars thoracica				
Tela submucosa				
Tunica adventitia				
Tunica mucosa				
Tunica muscularis	*	*	*	*
Gaster				
Corpus gastricum				
Curvatura gastrica major				
Curvatura gastrica minor				
Fornix gastricus				
Fundus gastricus				
Paries anterior				
Paries posterior				
Pars cardiaca				
Pars pylorica				
Pylorus				
Tela submucosa				
Tela subserosa				
Tunica mucosa				
Tunica muscularis				
Tunica serosa	*	*	*	*
Intestinum tenue				
Tela submucosa				
Tela subserosa				
Tunica mucosa				
Tunica muscularis				
Tunica serosa	*	*	*	
Duodenum				
Jejunum	*	*	*	
Ileum				
Intestinum crassum				
Caecum	*	*	*	*
Appendix vermiformis				
Frenulum valvae ilealis				
Ostium ileocaecale				
Ostium valvae ilealis				
Papilla ileocaecalis	*		*	
Valva ileocaecalis				
Colon	*			
Appendices epiploicae	*	*	*	
Colon ascendens	*	*	*	
Colon descendens	*	*	*	
Colon sigmoideum	*	*	*	
Colon transversum				
Flexura coli sinistra				

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
Haustra coli	*	*	*	
Plicae semilunares coli				
Stratum circulare				
Taeniae coli	*	*	*	*
Tunica muscularis				
Rectum	*	*		
Ampulla recti				
Flexura perinealis				
Flexura sacralis				
Plicae transversales recti				
Tunica muscularis				
Canalis analis	*	*		
Anus				
Columnae analis	*	*		
Linea anocutanea				
Linea anorectalis				
Pecten analis				
Sinus anales		*		
Valvulae anales	*			
Hepar	*	*	*	
Arteriae interlobulares				
Ductuli biliferi				
Ductuli interlobulares				
Ductus hepaticus communis				
Ductus hepaticus dexter				
Ductus hepaticus sinister				
Ductus lobi caudati dexter				
Ductus lobi caudati sinister				
Facies diaphragmatica				
Area nuda				
Fissura ligamenti venosi				
Impressio cardiaca				
Ligamentum venosum				
Sulcus venae cavae				
Fascies visceralis				
Fissura ligamenti teretis				
Fossa vesicae biliaris				
Impressio colica				
Impressio duodenalis				
Impressio gastrica				
Impressio oesophageale				
Impressio renalis				
Impressio suprarenalis				
Ligamentum teres hepatis				
Porta hepatis				
Tuber omentale				
Lobi hepatis dexter	*	*		
Segmentum anterius				
Segmentum posterius				
Lobi hepatis sinister		*		
Lobus caudatus	*	*	*	
Lobus quadratus	*	*		
Pars quadratus				
Processus caudatus	*	*		
Processus papillaris				
Segmentum laterale				
Margo inferior				
Incisura ligamenti teretis				
Tela subserosa				
Tunica fibrosa				
Tunica subserosa				
Venae centrales				
Venae interlobulares				
Vesica bilaris	*	*		
Ampulla hepatopancreatica				
Collum vesicae biliaris				
Corpus vesicae biliaris				
Ductus choledochus				
Ductus cysticus		*		
Fundus vesicae biliaris				
Tela subserosa vesicae biliaris				
Tunica mucosa vesicae biliaris				
Tunica muscularis vesicae biliaris				
Tunica serosa vesicae biliaris				
Pancreas	*	*		*
Caput pancreatis	*	*		*
Incisura pancreatis				
Processus uncinatus				
Cauda pancreatis	*	*		*
Corpus pancreatis				
Ductus pancreaticus	*	*	*	*
Ductus pancreaticus accessorius	*			*
Tuber omentale				
ARTERIES				
Alveolaris inferior (H)	*		*	
Alveolares superiores anteriores (H)				
Alveolaris superior posterior (H)	*		*	
Aorta (T)	*	*	*	
Arcus aortae (T)	*	*	*	
Ascendens (T)	*	*	*	
Descendens (T)				
Thoracica (T)	*	*	*	
Abdominalis (T)	*	*	*	*
Appendicularis (T)				
Arcus palmaris profundus (F)	*	*	*	*
Arcus palmaris superficialis (F)	*	*	*	*
Arcus plantaris profundus (HL)	*	*	*	*
Auricularis posterior (H)	*		*	
Auricularis profunda (H)				
Axillaris (F)	*	*	*	*
Basilaris (H)	*		*	*
Brachialis (F)	*	*	*	*
Buccalis (H)	*		*	
Bulbi penis (T)				
Bulbi vestibulae (T)				
Caecalis anterior (T)				
Caecalis posterior (T)				
Callosomarginalis (H)				
Canalis pterygoidei (H)				
Caroticotympanicae (H)				
Carotis communis (H)	*	*	*	*
Carotis externa (H)	*	*	*	
Carotis interna (H)	*		*	*

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
Carpalis dorsalis (radialis) (F)		*	*	
Carpalis dorsalis (ulnaris) (F)	*	*	*	*
Carpalis palmaris (radialis) (F)		*	*	*
Carpalis palmaris (ulnaris) (F)	*		*	*
Caudae pancreatis (T)				
Centrales anterolaterales (H)				
Centrales anteromediales (H)				
Centrales posterolaterales (H)				
Centrales posteromediales (H)				
Centralis brevis (H)				
Centralis longa (H)				
Centralis retinae (H)				
Cerebri anterior (H)	*	*	*	*
Cerebri media (H)				
Cerebri posterior (H)	*		*	*
Cervicalis ascendens (H)				
Cervicalis profunda (H)				
Choroidea anterior (H)				
Ciliares anteriores (H)				
Ciliares posteriores breves/ongae (H)			*	
Circulus arteriosus cerebri (H)	*		*	*
Circumflexa anterior/posterior humeri (F)	*	*	*	*
Circumflexa femoris lateralis (HL)	*	*	*	*
Circumflexa femoris medialis (HL)	*	*	*	*
Circumflexa iliaca profunda (T)				
Circumflexa iliaca superficialis (T)	*	*	*	
Circumflexa scapulae (F)				
Colica dextra (T)				
Colica media (T)		*		
Colica sinistra (T)	*			
Collateralis media (F)				
Collateralis radialis (F)				
Collateralis ulnaris inferior (F)	*	*	*	*
Collateralis ulnaris superior (F)	*	*	*	*
Comitans nervi ischiadici (HL)				
Comitans nervi mediani (F)				
Communicans anterior (H)	*		*	*
Communicans posterior (H)			*	
Conjunctivales anteriores (H)				
Conjunctivales posteriores (H)				
Coronaria dextra (T)	*	*	*	
Coronaria sinistra (T)	*	*	*	
Cremasterica (T)				
Cystica (T)	*	*		*
Descendens genicularis (HL)	*		*	
Digitales dorsales (foot) (HL)				
Digitales dorsales (hand) (F)				
Digitales palmares communes (F)	*	*	*	*
Digitales palmares propriae (F)				
Digitales plantares communes (HL)				
Digitales plantares propriae (HL)				

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
Dorsalis clitoridis (T)				
Dorsalis nasi (H)			*	
Dorsalis pedis (HL)	*	*	*	
Dorsalis penis (T)				
Dorsalis scapulae (F)				
Ductus deferentis (T)				
Epigastrica inferior (T)				
Epigastrica superficialis (T)	*	*	*	
Epigastrica superior (T)				
Episclerales (H)				
Ethmoidalis anterior (H)				
Ethmoidalis posterior (H)				
Facialis (H)				
Femoralis (HL)	*	*		*
Fibularis (HL)				
Frontobasalis lateralis (H)				
Frontobasalis medialis (H)				
Gastrica dextra (T)	*			
Gastrica posterior (T)				
Gastrica sinistra (T)	*	*		
Gastricae breves (T)	*	*		
Gastroduodenalis (T)				
Gastro-omentalis dexter (T)	*			
Gastro-omentalis sinistra (T)	*			
Glutea inferior (HL)	*	*	*	
Glutea superior (HL)	*	*	*	
Gyri angularis (H)				
Hepatica communis (T)				
Hepatica propria (T)				
Hypophysialis inferior (H)				
Hypophysialis superior (H)				
Ileales (T)				
Ileocolica (T)				
Iliaca communis (T)				
Iliaca externa (T)				
Iliaca interna (T)	*			
Iliolumbalis (T)	*	*	*	
Inferior anterior cerebelli (H)			*	
Inferior lateralis genus (HL)				
Inferior medialis genus (HL)				
Inferior posterior cerebelli (H)			*	
Infraorbitalis (H)	*		*	
Insulares (H)				
Intercostales (T)	*	*	*	
Interossea anterior (F)	*	*	*	*
Interossea communis (F)	*	*	*	*
Interossea posterior (F)	*	*	*	*
Interossea recurrens (F)				
Jejunales (T)				
Labialis inferior (H)	*		*	
Labialis superior (H)	*		*	
Labyrinthi (H)			*	
Lacrimalis (H)	*	*	*	
Laryngea inferior (H)				
Laryngea superior (H)	*	*		
Ligamenti teretis uteri (T)				
Lingualis (H)	*		*	
Lobi caudati (T)				
Lumbales (T)	*	*		
Lumbales imae (T)				

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
Malleolaris anterior lateralis (HL)				
Malleolaris anterior medialis (HL)				
Masseterica (H)			*	
Maxillaris (H)	*		*	
Media genus (HL)				
Meningea media (H)	*	*	*	
Meningea posterior (H)				
Mesencephalicae				
Mesenterica inferior (T)	*	*		
Mesenterica superior (T)	*	*		
Metacarpales dorsales (F)				
Metacarpales palmares (F)	*	*	*	*
Metatarsales dorsales (HL)				
Metatarsales plantares (HL)	*	*		*
Musculophrenica (T)	*			
Nasales posteriores laterales (H)				
Nutriciae femoris (HL)				
Nutriciae fibulae (HL)				
Nutriciae humeri (F)				
Nutriciae tibiae (HL)				
Obturatoria (HL)	*	*	*	
Occipitalis (H)	*		*	
Occipitalis lateralis (H)				
Occipitalis medialis (H)				
Ophthalmica (H)	*		*	
Ovarica (T)	*			
Palatina ascendens (H)				
Palatina descendens (H)	*		*	
Palatina major (H)				
Palatinae minores (H)				
Palmaris profundus (F)	*	*	*	*
Palmaris superficialis (F)	*	*	*	*
Palpebrales laterales (H)				
Palpebrales mediales (H)				
Pancreatica dorsalis/inferior/ magna (T)	*			
Pancreaticoduodenalis inferior (T)				
Pancreaticoduodenalis superior anterior (T)				
Pancreaticoduodenalis superior posterior (T)				
Paracentralis (H)				
Parietales anterior et posterior (H)				
Parieto-occipitalis (H)				
Pericardiacophrenica (T)				
Perinealis (T)				
Peronealis (HL)	*	*	*	*
Pharyngea ascendens (H)	*		*	
Phrenica inferior (T)	*		*	
Phrenicae superiores (T)				
Plantaris lateralis (HL)	*	*	*	*
Plantaris medialis (HL)	*	*	*	*
Plantaris profundus (HL)				
Pontis (H)			*	
Poplitea (HL)	*	*	*	*
Precunealis (H)				
Princeps pollicis (F)	*	*	*	*
Profunda brachii (F)	*	*	*	*
Profunda clitoridis (T)				
Profunda femoris (HL)	*	*	*	*
Profunda linguae (H)				
Profunda penis (T)				
Pterygomeningea (H)				
Pudenda externae (T)	*	*	*	
Pudenda interna (T)	*	*	*	
Pulmonalis dextra (T)	*		*	*
Pulmonalis sinistra (T)	*		*	*
Radialis (F)	*	*	*	*
Radialis indicis (F)	*	*	*	*
Rectalis inferior (T)				
Rectalis media (T)	*			
Rectalis superior (T)	*			
Recurrens radialis (F)	*	*	*	*
Recurrens tibialis anterior (HL)				
Recurrens tibialis posterior (HL)				
Recurrens ulnaris (F)	*	*	*	*
Renalis (T)	*	*		
Rete articulare cubitii (F)				
Rete articulare genus (HL)				
Rete malleolare laterale (HL)				
Rete patellae (HL)				
Retroduodenales (T)				
Sacrales laterales (T)	*			
Sacralis mediana (T)	*		*	
Saphena (HL)	*	*	*	*
Segmenti anterioris (H)				
Segmenti anterioris superioris (H)				
Segmenti anterioris inferioris (H)				
Segmenti lateralis (H)				
Segmenti medialis (H)				
Segmenti posterioris (H)				
Segmenti superioris (H)				
Sigmoideae (T)				
Sphenopalatina (H)	*		*	
Spinalis anterior (T)			*	
Spinalis posterior (T)				
Splenica (T)	*	*	*	
Stylomastoidea (H)				
Subclavia (T)	*	*	*	
Subcostalis (T)	*		*	
Sublingualis (H)				
Submentalis (H)	*			
Subscapularis (F)	*	*	*	*
Sulci centralis (H)				
Sulci postcentralis (H)				
Sulci precentralis (H)				
Superior cerebelli (H)			*	
Superior lateralis genus (HL)				
Superior medialis genus (HL)				
Suprarenalis inferior (T)	*	*		
Suprarenalis media (T)	*	*	*	
Suprarenales superiores (T)				
Suprascapularis (F)	*	*	*	

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
Supratrochlearis (H)				
Surales (HL)				
Tarsalis lateralis (HL)				
Tarsalis medialis (HL)				
Temporalis anterior (H)				
Temporalis media (H)				
Temporalis posterior (H)				
Temporalis profunda anterior/posterior (H)	*		*	
Temporalis superficialis (H)	*		*	
Testicularis (T)	*			*
Thoracica interna (T)	*	*		
Thoracica lateralis (T)	*	*	*	*
Thoracica superior (T)	*	*	*	*
Thoracoacromialis (T)	*	*	*	*
Thoracodorsalis (T)				
Thyrocervicalis (T)				
Thyroidea inferior (H)				
Thyroidea superior (H)	*	*	*	
Tibialis anterior (HL)	*	*	*	
Tibialis posterior (HL)	*	*	*	*
Transversa cervicis (T)	*		*	
Transversa facialis (H)	*		*	
Truncus brachiocephalicus (T)	*	*	*	
Truncus coeliacus (T)	*	*		
Truncus costocervicalis (T)				
Truncus pulmonalis (T)				
Tympanica anterior (H)				
Tympanica inferior (H)				
Tympanica posterior (H)				
Tympanica superior (H)				
Ulnaris (F)	*	*	*	*
Umbilicalis (T)				
Urethralis (T)				
Uterina (T)	*	*	*	
Vaginalis (T)	*			
Vertebralis (T)	*	*	*	*
Vesicales inferior/superiores (T)	*	*	*	
Zygomatic-orbitalis (H)				
BURSAE				
Bicipitoradialis				
Infrahyoidea				
Infrapatellaris profunda				
Intermusculares musculorum gluteorum				
Ischiadica musculi glutei maximi				
Ischiadica musculi obturatoris interni				
Musculi bicipitis femoris superior				
Musculi piriformis				
Musculi semimembranosi				
Musculi tensoris veli palatini				
Retrohyoidea				
Subacromialis				
Subcutanea infrapatellaris				
Subcutanea malleoli lateralis				
Subcutanea malleoli medialis				
Subcutanea olecrani				
Subcutanea prepatellaris				
Subcutanea prominentiae laryngealis				
Subcutanea trochanterica				
Subcutanea tuberositatis tibiae				
Subdeltoidea				
Subtendinea calcanea				
Subtendinea iliaca				
Subtendinea musculi gastrocnemius lateralis				
Subtendinea musculi gastrocnemius medialis				
Subtendinea musculi infraspinatus				
Subtendinea musculi latissimus dorsi				
Subtendinea musculi obturatoris interna				
Subtendinea musculi subscapularis				
Subtendinea musculi teretis majoris				
Subtendinea musculi trapezii				
Subtendinea musculi tricipitis brachii				
Subtendinea prepatellaris				
Suprapatellaris				
Tendinis calcanei				
Trochanterica musculi glutei maximi				
Trochanterica musculi glutei medii				
Trochanterica musculi glutei minimi				
COR				
Annuli fibrosi				
Apex cordis	*	*	*	*
Atrium dextrum	*		*	
Auricula dextra			*	
Crista terminalis	*		*	
Foramina venarum minimarum				
Fossa ovalis	*		*	
Limbus fossae ovalis				
Musculi pectinati	*		*	
Ostium sinus coronarii				
Ostium venae cavae inferioris	*		*	
Ostium venae cavae superioris				
Sinus venarum cavarum				
Sulcus terminalis				
Tuberculum intervenosum				
Valvula venae cavae inferioris	*		*	
Valvula sinus coronarii			*	
Atrium sinistrum	*		*	
Auricula sinistra	*		*	

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
Musculi pectinati	*		*	
Ostia venarum pulmonalium				
Valvula foraminis ovalis				
Endocardium				
Myocardium				
Septum atrioventriculare				
Septum interatriale				
Septum interventriculare				
Sulcus coronarius				
Sulcus interventricularis anterior				
Sulcus interventricularis posterior				
Tendo infundibulum				
Trigonum fibrosum dextrum				
Trigonum fibrosum sinistrum				
Ventriculus dexter	*		*	
Conus arteriosus	*		*	
Crista supraventricularis	*		*	
Musculus papillaris anterior				
Musculus papillaris posterior				
Ostium atrioventriculare dextrum	*		*	
Ostium trunci pulmonalis				
Trabecula septomarginalis	*			
Trabeculae carneae				
Valva atrioventricularis dextra	*		*	
Valva trunci pulmonalis	*			
Ventriculus sinister	*		*	
Musculus papillaris anterior				
Musculus papillaris posterior				
Ostium aortae				
Ostium atrioventriculare sinistrum			*	
Trabeculae carneae	*			
Valva aortae				
Vortex cordis				
ENDOCRINE GLANDS				
Corpus pineale	*	*	*	
Glandula parathyroidea inferior/superior	*	*		
Glandula suprarenalis	*	*		
Cortex				
Facies anterior				
Facies posterior				
Facies renalis				
Hilum				
Margo medialis				
Margo superior				
Medulla				
Glandula thyroidea	*	*	*	
Hypophysis	*	*	*	*
Thymus	*	*	*	
INTEGUMENT				
Cornu				
Dermis				
Epidermis				

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
Glandulae cutis	*	*	*	*
Glandula mammaria				
Mamma	*	*	*	*
Pilus	*	*	*	*
Tela subcutanea				
Unguis	*		*	
LYMPHATICS				
Ductus				
Cisterna chyli (T)				
Ductus lymphaticus dexter (T)				
Ductus thoracicus (T)				
Pars thoracica (T)	*	*		
Pars abdominalis (T)	*		*	
Nodes				
Aortici laterales (T)				
Appendiculares (T)				
Axillaris (F)	*		*	
Buccinatorius (H)				
Cavales laterales (T)				
Cervicales anteriores superficiales/profundi (H)	*	*	*	
Cervicales laterales superficiales/profundi (H)	*	*	*	
Coeliaci (T)				
Colici (T)				
Epigastrici inferiores (T)				
Gastrici (T)	*			
Gastro-omentales (T)				
Gluteales (T)				
Hepatici (T)				
Ileocolici (T)				
Iliaci communes (T)	*			
Iliaci externi (T)		*		
Iliaci interni (T)				
Infra-auriculares (H)				
Inguinales (T)	*			
Intercostales (T)				
Interiliaci (T)				
Intraglandulares (T)				
Jugulares anteriores (H)				
Jugulares laterales (H)				
Jugulodigastricus (H)				
Jugulo-omohyoideus (H)				
Juxta-esophageales pulmonales (T)				
Lumbales dextri (T)				
Lumbales intermedii (T)				
Lumbales sinistri (T)				
Malaris (H)				
Mandibularis (H)				
Mastoidei (H)				
Mediastinales anteriores (T)				
Mediastinales posteriores (T)		*		
Mesenterici (T)	*			
Mesocolici (T)				
Nasolabialis (H)				
Obturatorii (T)				
Occipitales (H)	*		*	
Pancreatici (T)				

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
Pancreaticoduodenales (T)				
Paramammarii (T)				
Paracolici (T)				
Pararectales (T)				
Parasternales (T)				
Paratracheales (T)				
Para-uterini (T)				
Paravaginalis (T)				
Paravesiculares (T)				
Parotidei superficialis/ profundi (H)	*	*	*	
Phrenici inferiores (T)				
Phrenici superiores (T)				
Popliteales (HL)	*	*	*	
Postaortici (T)				
Postcavales (T)				
Postvesiculares (T)				
Pre-aortici (T)				
Preauriculares (H)				
Precaecales (T)				
Precavales (T)				
Prelaryngeales (H)	*		*	
Prepericardiales laterales (T)				
Pretracheales (H)		*		
Prevertebrales (H)				
Prevesiculares (T)				
Promontorii (T)				
Pylorici (T)				
Rectales superiores (T)				
Retrocaecales (T)				
Retropharyngeales (H)	*		*	
Sacrales (T)				
Sigmoidei (T)				
Splenici (T)				
Subaortici (T)				
Submandibulares (H)				
Submentalis (H)	*		*	
Supraclaviculares (H)				
Thyroidei (H)				
Tracheobronchiales (T)				
Vesicales laterales (T)				
Splen	*	*	*	
Extremitas anterior				
Extremitas posterior				
Facies diaphragmatica				
Facies visceralis				
Folliculi lymphatici splenici				
Hilum splenicum				
Margo inferior				
Margo superior				
Penicilli				
Pulpa splenica				
Rami splenici				
Sinus splenicus				
Splen accessorius	*		*	
Trabeculae splenicae				
Tunica fibrosa				
Tunica serosa				

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
Trunks				
Bronchomediastinales dexter/ sinister (T)				
Intestinales (T)				
Jugularis dexter/sinister (H)				
Lumbaris dexter/sinister (T)				
Subclavius dexter/sinister (T)				
MUSCLES				
Abductor digiti minimi (foot) (HL)	*	*	*	*
Abductor digiti minimi (hand) (F)	*	*	*	*
Abductor hallucis (HL)	*	*	*	*
Abductor os metatarsi digiti minimi (HL)	*	*	*	
Abductor pollicis brevis (F)	*	*	*	*
Abductor pollicis longus (F)	*	*	*	*
Adductor brevis (HL)	*	*	*	*
Adductor hallucis (HL)	*	*	*	*
Adductor longus (HL)	*	*	*	*
Adductor magnus (HL)	*	*	*	*
Adductor minimus (HL)	*	*	*	*
Adductor pollicis (F)				
Anconeus (F)	*	*	*	*
Antitragicus (H)				
Arrectores pilorum (NA)				
Articularis genus (HL)	*	*	*	*
Aryepiglotticus (H)	*			
Arytenoideus obliquus/ transvs. (H)	*	*	*	
Auriculares (H)	*	*	*	
Biceps brachii (F)	*	*	*	*
Biceps femoris (F)	*	*	*	*
Brachialis (F)	*	*	*	*
Brachioradialis (F)	*	*	*	*
Bronchooesophageus (T)				
Buccinator (H)	*	*	*	
Bulbospongiosus (T)	*	*	*	*
Chondroglossus (H)				
Coccygeus (T)	*	*	*	*
Compressor urethrae (T)				
Constrictor pharyngis inferior (H)	*			
Constrictor pharyngis medius (H)	*			
Constrictor pharyngis superior (H)	*	*	*	
Coracobrachialis (F)	*	*	*	*
Corrugator supercilii (H)	*	*	*	
Cremaster (T)	*	*	*	*
Cricoarytenoideus lateralis (H)	*		*	
Cricoarytenoideus posterior (H)	*		*	
Cricothyroideus (H)	*	*	*	*
Dartos (T)				
Deltoid (F)	*	*	*	*
Depressor anguli oris (H)	*	*	*	
Depressor labii inferioris (H)	*	*	*	
Depressor septi (H)				
Depressor supercilii (H)	*	*	*	

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
Detrusor vesicae (T)				
Diaphragm (T)	*	*		*
Digastric (H)	*	*	*	*
Dilator pupillae (H)				
Dorso-epitrochlearis (F)	*	*	*	*
Extensor carpi radialis brevis (F)	*	*	*	*
Extensor carpi radialis longus (F)	*	*	*	*
Extensor carpi ulnaris (F)	*	*	*	*
Extensor digiti minimi (F)	*	*	*	*
Extensor digitorum (F)	*	*	*	*
Extensor digitorum brevis (HL)	*	*	*	*
Extensor digitorum longus (HL)	*	*	*	*
Extensor hallucis brevis (HL)	*	*	*	*
Extensor hallucis longus (HL)	*	*	*	*
Extensor indicis (F)	*	*	*	*
Extensor pollicis brevis (F)	*	*	*	*
Extensor pollicis longus (F)	*	*	*	*
Flexor carpi radialis (F)	*	*	*	*
Flexor carpi ulnaris (F)	*	*	*	*
Flexor digiti minimi(foot) (HL)	*	*	*	
Flexor digiti minimi brevis (F)	*	*	*	*
Flexor digitorum brevis (HL)	*	*	*	*
Flexor digitorum longus (HL)	*	*	*	*
Flexor digitorum profundus (F)	*	*	*	*
Flexor digitorum superficialis (F)	*	*	*	*
Flexor hallucis brevis (HL)	*	*	*	*
Flexor hallucis longus (HL)	*	*	*	*
Flexor pollicis brevis (F)	*	*	*	*
Flexor pollicis longus (F)	*	*	*	*
Galea aponeurotica (H)				
Gastrocnemius (HL)	*	*	*	*
Gemellus inferior (HL)	*	*	*	*
Gemellus superior (HL)	*	*	*	*
Genioglossus (H)	*			
Geniohyoideus (H)	*	*		
Gluteus maximus (HL)	*	*	*	*
Gluteus medius (HL)	*	*	*	*
Gluteus minimus (HL)	*	*	*	*
Gracilis (HL)	*	*	*	*
Helicis major (H)				
Helicis minor (H)				
Hyoglossus (H)	*		*	
Iliococcygeus (T)	*	*	*	*
Iliocostalis (T)	*	*	*	
Infraspinatus (F)	*	*	*	*
Inguinal canal (T)	*	*	*	*
Intercostales externi (T)	*	*		
Intercostales interni (T)				
Intercostales intimi (T)				
Interossei dorsales(hand) (F)	*	*	*	*
Interossei palmares (F)	*	*	*	*
Interossei dorsales(foot) (HL)	*	*	*	*
Interossei plantares (HL)	*	*	*	
Interspinales (T)		*		
Intertransversarii (T)	*	*	*	
Ischiocavernosus (T)	*	*		
Latissimus dorsi (F)	*	*	*	*
Levator anguli oris (H)	*	*	*	
Levator ani (T)	*	*	*	
Levator claviculae (F)	*	*	*	
Levatores costarum (T)	*	*		
Levator labii superioris (H)	*	*	*	
Levator labii superioris alaeque nasi (H)	*	*	*	
Levator palpebrae superioris (H)	*		*	
Levator prostatae [pubovaginalis] (T)				
Levator scapulae (T)	*	*	*	
Levator veli palatini (H)	*	*	*	
Longissimus (T)	*	*	*	
Longitudinalis inferior (H)				
Longitudinalis superior (H)				
Longus capitis (H)	*	*	*	
Longus colli (H)	*	*	*	
Lumbricales (foot) (HL)	*	*	*	*
Lumbricales (hand) (F)	*	*	*	*
Masseter (H)	*	*	*	*
Mentalis (H)	*	*	*	
Multifidus (T)	*	*		
Mylohyoideus (H)	*	*	*	
Nasalis (H)	*	*	*	
Obliquus auriculae (H)				
Obliquus capitis inferior (H)	*	*	*	
Obliquus capitis superior (H)	*	*		
Obliquus externus abdominis (T)	*	*	*	*
Obliquus inferior (H)	*		*	
Obliquus internus abdominis (T)	*	*	*	*
Obliquus superior (H)	*		*	
Obturator externus (HL)	*	*	*	*
Obturator internus (HL)	*	*	*	*
Occipitofrontalis (H)	*	*	*	
Omohyoideus (H)	*	*	*	*
Opponens digiti minimi(foot) (HL)	*	*	*	
Opponens digiti minimi(hand) (F)	*	*	*	*
Opponens hallucis (HL)	*	*	*	*
Opponens pollicis (F)	*	*	*	*
Orbicularis oculi (H)	*	*	*	
Orbicularis oris (H)	*	*	*	
Orbitalis (H)				
Palatoglossus (H)	*			
Palatopharyngeus (H)				
Palmaris brevis (F)	*	*	*	*
Palmaris longus (F)	*	*	*	*
Pectineus (T)	*	*	*	*
Pectoralis major (F)	*	*	*	*
Pectoralis minor (F)	*	*	*	*
Peroneus brevis (HL)	*	*	*	*
Peroneus longus (HL)	*	*	*	*
Peroneus tertius (HL)	*	*	*	*
Piriformis (T)	*	*	*	*
Plantaris (HL)	*	*	*	*
Platysma (H)	*	*	*	
Pleurooesophageus (T)				

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
Popliteus (HL)	*	*	*	*
Procerus (H)	*	*		
Pronator quadratus (F)	*	*	*	*
Pronator teres (F)	*	*	*	*
Psoas major (HL)	*	*	*	*
Psoas minor (HL)	*	*	*	*
Pterygoideus lateralis (H)		*	*	
Pterygoideus medialis (H)		*	*	
Pubococcygeus (T)	*	*	*	*
Puboprostaticus (T)		*		
Puborectalis (T)	*	*	*	
Pubovaginalis (T)				
Pubovesicalis (T)		*		
Pyramidalis (T)	*	*		
Pyramidalis auriculae (H)				
Quadratus femoris (HL)	*	*	*	*
Quadratus lumborum (T)	*	*		
Quadratus plantae (HL)	*	*	*	*
Quadriceps femoris (HL)	*	*	*	*
Rectococcygeus (T)		*		
Rectourethralis (T)		*		
Rectouterinus (T)				
Rectovesicalis (T)				
Rectus abdominis (T)	*	*		*
Rectus capitis anterior (H)	*	*	*	
Rectus capitis lateralis (H)	*	*	*	
Rectus capitis posterior major (H)	*	*	*	
Rectus capitis posterior minor (H)	*	*	*	
Rectus femoris (HL)	*	*	*	*
Rectus inferior (H)	*		*	
Rectus lateralis (H)	*		*	
Rectus medialis (H)				
Rectus superior (H)			*	
Rhomboideus major and minor (F)	*	*	*	
Risorius (H)	*	*	*	
Rotatores (T)	*	*		
Salpingopharyngeus (H)				
Sartorius (HL)	*	*	*	*
Scalenus anterior (T)	*	*	*	*
Scalenus medius (T)	*	*	*	
Scalenus minimus (T)				
Scalenus posterior (T)	*	*	*	
Scansorius (HL)	*	*	*	*
Semimembranosus (HL)	*	*	*	*
Semispinalis (T)	*	*	*	
Semitendinosus (HL)	*	*	*	*
Serratus anterior (T)	*	*	*	*
Serratus posterior inferior (T)	*	*	*	
Serratus posterior superior (T)	*	*	*	
Soleus (HL)	*	*	*	*
Sphincter ani externus (T)	*	*	*	*
Sphincter ani internus (T)				
Sphincter ductus choledochi (T)				
Sphincter ductus pancreatici (T)				
Sphincter pupillae (H)				
Sphincter pyloricus (T)				
Sphincter urethrae (T)		*		

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
Spinalis (T)	*	*		
Splenius capitis (H)	*	*	*	
Splenius cervicis (T)	*	*	*	
Stapedius (H)				
Sternalis (T)	*		*	
Sternocleidomastoideus (T)	*	*	*	*
Sternohyoideus (T)	*	*	*	
Sternothyroideus (T)	*	*		
Styloglossus (H)	*	*	*	
Stylohyoideus (H)	*	*	*	
Stylopharyngeus (H)	*		*	
Subclavius (F)	*	*	*	*
Subcostales (T)				
Subscapularis (F)	*	*	*	*
Supinator (F)	*	*	*	*
Supraspinatus (F)	*	*	*	*
Suspensorius duodeni (T)				
Tarsalis inferior (H)				
Tarsalis superior (H)				
Temporalis (H)	*	*	*	
Temporoparietalis (H)	*			
Tendo calcaneus (HL)				
Tensor fasciae latae (HL)	*	*	*	*
Tensor linea semilunaris (T)		*		
Tensor tympani (H)				
Tensor veli palatini (H)	*	*	*	
Teres major (F)	*	*	*	*
Teres minor (F)	*	*	*	*
Thyroarytenoideus (H)	*		*	
Thyroepiglotticus (H)	*			
Thyrohyoideus (H)	*	*	*	
Tibialis anterior (HL)	*	*	*	*
Tibialis posterior (HL)	*	*	*	*
Tracheales (T)				
Tragicus (H)	*		*	
Transvs. abdominis (T)	*	*	*	*
Transvs. auriculae (H)				
Transvs. linguae (H)				
Transvs. perinei profundus (T)	*	*		
Transvs. perinei superficialis (T)	*	*		
Transvs. menti (H)				
Transvs. thoracis (T)	*	*		
Trapezius (F)	*	*	*	*
Triceps brachii (F)	*	*	*	*
Uvulae (H)	*		*	
Vasti (HL)	*	*	*	*
Verticalis linguae (H)				
Vocalis (H)	*			
Zygomaticus major (H)	*	*	*	
Zygomaticus minor (H)	*	*	*	
NERVES				
Abducens (VI) (H)	*			
Accessorius (XI) (H)	*	*		
Alveolares superiores (H)				
Alveolaris inferior (H)				
Ampullaris anterior (H)				
Ampullaris lateralis (H)				
Ampullaris magnus (H)				
Ampullaris posterior (H)				

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
Auriculares anteriores (H)				
Auricularis magnus (H)		*		
Auricularis posterior (H)			*	
Auriculotemporalis (H)				
Autonomica				
Plexus aorticus abdominalis (T)				
Plexus aorticus thoracicus (T)				
Plexus hypogastricus superior (T)				
Axillaris (F)	*	*	*	*
Buccalis (H)				
Canalis pterygoidei (H)				
Caroticotympanici (H)				
Cervicales (H)				
Chorda tympani (H)	*		*	
Ciliares breves (H)	*			
Ciliares longi (H)				
Clunium inferiores (HL)				
Clunium medii (HL)				
Cochlearis (H)				
Cutanei cruris mediales (HL)				
Cutaneous antebrachii lateralis (F)	*	*	*	*
Cutaneous antebrachii medialis (F)	*	*	*	*
Cutaneous antebrachii posterior (F)				
Cutaneous brachii lateralis inferior (F)				
Cutaneous brachii lateralis superior (F)				
Cutaneous brachii medialis (F)	*	*	*	*
Cutaneous brachii posterior (F)				
Cutaneous dorsalis intermedius (T)				
Cutaneous dorsalis lateralis (T)				
Cutaneous dorsalis medialis (T)				
Cutaneous femoris lateralis (HL)	*	*	*	*
Cutaneous femoris posterior (HL)	*	*	*	*
Cutaneous surae lateralis (HL)				
Cutaneous surae medialis (HL)				
Digitales dorsales manus (F)				
Digitales dorsales pedis (HL)				
Digitales palmares communes/proprii (F)	*	*	*	*
Digitales plantares communes (HL)				
Digitales plantares proprii (HL)				
Dorsalis clitoridis (T)				
Dorsalis penis (T)				
Dorsalis scapulae (F)		*		
Ethmoidalis anterior (H)				
Ethmoidalis posterior (H)				
Facialis (VII) (H)	*		*	
Femoralis (HL)	*	*	*	*
Fibularis communis [peroneus] (HL)	*	*	*	*

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
Fibularis profundus (HL)	*	*	*	
Fibularis superficialis (HL)	*	*	*	*
Frontalis (H)				
Ganglion caudalis (T)				
Ganglion ciliare (H)	*		*	
Ganglion cochleare (H)				
Ganglion geniculi (H)				
Ganglion oticum (H)				
Ganglion pterygopalatinum (H)			*	
Ganglion rostralis (H)				
Ganglion submandibulare (H)				
Ganglion trigeminale (H)			*	
Ganglion vestibulare (H)				
Genitofemoralis (HL)	*	*	*	*
Glossopharyngeus (IX) (H)	*			
Gluteus inferior (HL)	*		*	
Gluteus superior (HL)	*	*	*	*
Hypoglossus (XII) (H)	*	*	*	
Iliohypogastricus (T)	*	*		
Ilio-inguinalis (T)	*	*		*
Infraorbitalis (H)	*			
Infratrochlearis (H)				
Intercostales (T)	*	*		
Intercostobrachialis (F)	*	*	*	*
Intermedius (H)				
Interosseous anterior (F)	*	*	*	*
Interosseous cruris (HL)				
Interosseous posterior (F)	*	*	*	*
Ischiadicus[sciatic] (HL)	*	*	*	*
Labiales anteriores (H)				
Labiales posteriores (H)				
Lacrimalis (H)				
Laryngeus inferior (H)	*			
Laryngeus recurrens (H)				
Laryngeus superior (H)	*			
Lingualis (H)	*			
Lumbales (T)				
Mandibularis (H)			*	
Massetericus (H)				
Maxillaris (H)	*		*	
Meatus acustici externi (H)				
Medianus (F)	*	*	*	*
Mentalis (H)				
Musculi quadrati femoris (HL)	*	*	*	*
Musculi tensoris tympani (H)				
Musculi tensoris veli palatini (H)				
Mylohyoideus (H)				
Musculocutaneous (F)	*	*	*	*
Nasociliares (H)				
Obturatorius (HL)	*	*	*	*
Obturatorius accessorius (HL)				
Obturatorius internus (HL)	*	*	*	*
Occipitalis major (H)				
Occipitalis minor (H)	*	*		
Occipitalis tertius (H)				
Oculomotorius (III) (H)	*		*	
Olfactorii (I) (H)				
Opthalmicus (H)			*	
Opticus (II) (H)	*		*	
Palatinus major (H)				

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
Palatini minores (H)				
Parasympathica (H) (T)				
Pectoralis lateralis/medialis (F)	*	*	*	*
Perineales (T)				
Petrosus major (H)				
Petrosus minor (H)				
Petrosus profundus (H)				
Phrenicus (T)	*	*	*	
Piriformis (T)	*	*	*	
Plantaris lateralis (HL)	*	*	*	*
Plantaris medialis (HL)	*	*	*	*
Plexus brachialis (F)	*	*	*	*
Plexus dentalis inferior (H)				
Plexus dentalis superior (H)				
Plexus intraparotideus (H)				
Plexus lumbalis (T)	*	*	*	*
Plexus lumbosacralis (T)	*	*	*	*
Plexus oesophageus (T)				
Plexus pharyngeus (H)				
Plexus sacralis (T)	*	*	*	*
Plexus tympanicus (H)				
Pterygoideus lateralis (H)				
Pterygoideus medialis (H)				
Pudendus (T)	*	*		
Radialis (F)	*	*	*	*
Rectales inferiores (T)				
Saccularis (H)				
Saphenus (HL)				
Scrotales anteriores (T)				
Scrotales posteriores (T)				
Stapedius (H)				
Subclavius (F)				
Subcostalis (T)	*	*		
Sublingualis (H)				
Suboccipitalis (H)				
Subscapulares (H)	*	*	*	*
Supraclaviculares (H)	*	*		
Supraorbitalis (H)				
Suprascapularis (F)	*	*	*	*
Suralis (HL)				
Sympathetica				
Ganglion cervicale medium (H)	*			
Ganglion cervicale superius (H)				
Ganglion cervicothoracicum (T)	*			
Ganglion lumbalia (T)				
Ganglion sacralia (T)	*	*	*	*
Ganglion thoracica (T)				
Plexus caroticus internus (H)	*			
Temporalis profundi (H)				
Thoracici (T)				
Thoracicus longus (T)	*	*	*	*
Thoracodorsalis (F)		*		
Tibialis (HL)	*	*	*	*
Transvs. colli (T)	*	*		
Trigeminus (V) (H)			*	
Trochlearis (IV) (H)	*			
Tympanicus (H)				

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
Ulnaris (F)	*	*	*	*
Utricularis (H)				
Utriculoampullaris (H)				
Vagus (X) (H) (T)	*	*	*	
Vestibularis (H)				
Vestibulocochlearis (VIII) (H)				
Zygomaticus (H)				
PERICARDIUM	*	*	*	*
Cavitas pericardialis				
Sinus obliquus pericardii		*		
Sinus transvs. pericardii		*		
Pericardium fibrosum				
Ligamenta sternopericardiaca				
Pericardium serosum				
Lamina parietalis				
Lamina visceralis				
PERITONEUM				
Bursa omentalis				
Cavitas peritonealis				
Foramen omentale				
Ligamenta hepatis				
Ligamentum coronarium				
Ligamentum falciforme				
Ligamentum hepatorenale				
Ligamentum triangulare dextrum				
Ligamentum triangulare sinister				
Mesenterium				
Mesocolon				
Omentum majus				
Ligamentum gastrocolicum				
Ligamentum gastrophrenicum				
Ligamentum gastrosplenicum				
Ligamentum splenorenale				
Omentum minus				
Ligamentum hepatogastricum				
Ligamentum hepatoduodenale				
Peritoneum parietale anterius				
Fossa inguinalis lateralis				
Fossa inguinalis medialis				
Fossa paravesicalis				
Fossa supravesicalis				
Plica umbilicis lateralis				
Plica umbilicis medialis				
Plica umbilicis mediana				
Plica vesicalis transversa				
Trigonum inguinal				
Peritoneum urogenitale				
Fossa ovarica				
Fossa paravesicales				
Excavatio rectouterine				
Excavatio rectovesicalis				
Excavatio vesicouterina				
Ligamenta latum uteri	*	*	*	*

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
Mesometrium				
Mesovarium				
Mesosalpinx	*	*		*
Ligamenta supensorium ovarii				
Peritoneum viscerale				
Plicae et fossae				
Fascia retinens rostralis				
Plica caecalis vascularis				
Plicae caecales				
Plica duodenalis inferior				
Plica duodenalis superior				
Plica ileocaecalis				
Recessus duodenalis inferior				
Recessus duodenalis superior				
Recessus hepatorenalis				
Recessus ileocaecalis inferior				
Recessus ileocaecalis superior				
Recessus intersigmoideus				
Recessus retrocaecalis				
Recessus subhepatici				
Recessus subphrenici				
Sulci paracolici				
Spatium extraperitoneale				
RESPIRATORY SYSTEM				
Bronchi				
Bronchus principalis		*		
Bronchi lobares et segmentales				
Rami bronchiales segmentorum				
Tela submucosa				
Tunica mucosa				
Tunica muscularis				
Cavitas nasi				
Agger nasi				
Atrium meatus medii				
Bulla ethmoidalis				
Choanae				
Hiatus semilunaris				
Infundibulum ethmoidale				
Limen nasi				
Meatus nasi inferior				
Meatus nasi medius				
Meatus nasi superior				
Meatus nasopharyngeus				
Nares				
Organum vomeronasale				
Plexus cavernosi concharum				
Recessus sphenoethmoidalis				
Septum nasi	*	*	*	*
Sulcus olfactorius				
Cavitas laryngis				
Aditus laryngis				
Cavitas infraglottica				
Conus elasticus				
Glottis				
Ligamentum vestibulare	*	*	*	
Ligamentum vocale	*		*	*

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
Membrana quadrangularis	*			
Rima glottidis	*			
Rima vestibuli				
Sacculus laryngis				
Tunica mucosa				
Ventriculus laryngis				
Vestibulum laryngis				
Larynx				
Cartilago arytenoidea	*		*	
Capsula articularis cricoarytenoidea				
Ligamentum cricoarytenoideum posterius				
Ligamentum cricopharyngeum				
Cartilago corniculata	*		*	
Cartilago cricoidea	*	*	*	
Ligamentum ceratocricoideum				
Ligamentum cricothyroideum medianum	*		*	
Ligamentum cricotracheale	*		*	
Cartilago cuneiformis	*	*	*	*
Cartilago thyroidea	*	*	*	*
Cartilago triticea	*		*	
Membrana thyrohyoidea	*		*	
Epiglottis				
Ligamentum hyoepiglotticum	*			
Ligamentum thyroepiglotticum				
Nasus externus				
Alae nasi				
Apex nasi				
Cartilago alares minores				
Cartilago alaris major	*	*	*	*
Cartilago nasales accessoriae	*	*	*	
Cartilago nasi lateralis				
Cartilago septi nasi	*	*	*	*
Cartilago vomeronasalis				
Pars mobilis septi nasi				
Radix nasi				
Pulmones				
Apex pulmonis				
Basis pulmonis				
Bronchioli				
Facies costalis				
Facies diaphragmatica				
Facies interlobaris				
Facies mediastinalis				
Fissura horizontalis				
Fissura obliqua				
Hilum pulmonis				
Incisura cardiaca				
Lingula pulmonaris sinistri				
Lobus inferior				
Lobus medius				
Lobus superior				

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
Margo anterior				
Margo inferior				
Pleura		*		
Pulmo dexter	*	*	*	*
Pulmo sinister	*	*	*	*
Radix pulmonalis				
Recessus costodiaphragmaticus				
Recessus costomediastinalis				
Recessus phrenicomediastinalis				
Segmenta bronchopulmonalia				
Trachea				
Bifurcatio trachea		*		
Carina trachea				
Cartilagines tracheales		*		
Lig. annularia				
Paries membranaceus				
Pars cervicalis				
Pars thoracica				
Tunica mucosa				
SENSORY ORGANS				
Ear				
Auricula	*	*	*	*
Labyrinthus cochlearis				
Labyrinthus membranaceus				
Labyrinthus vestibularis				
Ligamenta auricularia				
Ligamentum ossiculorum auditus				
Meatus acusticus externus				
Membrana tympani	*			
Pars cartilaginea tubae auditive				
Tunica mucosa cavitatis tympani				
Vasa auris internae				
Eye				
Apparatus lacrimalis	*		*	
Camera anterior bulbi				
Camera posterior bulbi				
Camera vitrea bulbi				
Choroidea	*			
Cornea	*	*	*	
Corpus ciliare				
Iris				
Lens				
Ligamentum palpebrale laterale				
Ligamentum palpebrale mediale				
Palpebra inferior/superior	*		*	
Pupilla				
Raphe palpebralis lateralis				
Retina	*			
Sclera				
Tarsus				
Tunica conjunctiva	*		*	

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
Tunica fibrosa bulbi				
Tunica interna bulbi				
Tunica vasculosa bulbi				
Vasa sanguinea retinae				
UROGENITAL SYSTEM				
Ren	*	*	*	*
Area cribrosa				
Arteriae renis				
Capsula adiposa				
Capsula fibrosa				
Columnae renales				
Cortex renalis				
Extremitas inferior				
Extremitas superior				
Facies anterior				
Facies posterior				
Fascia renalis				
Hilum renale				
Margo lateralis				
Margo medialis				
Medulla renalis				
Lobi renales				
Papillae renales	*	*	*	*
Pelvis renalis				
Pyramides renales	*	*	*	*
Segmenta renalia				
Sinus renalis				
Venae renis				
Ureter		*	*	
Pars abdominalis				
Pars pelvica				
Tunica adventitia				
Tunica mucosa				
Tunica muscularis				
Vesica urinaria		*		
Apex vesicae				
Cervix vesicae				
Corpus vesicae				
Fundus vesicae				
Ligamentum umbilicale medianum				
Tela submucosa				
Tela subserosa				
Trigonum vesicae				
Tunica mucosa				
Tunica muscularis				
Tunica serosa				
Uvula vesicae				
Organa genitalia masculina Interna				
Ductus deferens	*	*	*	*
Ampulla ductus deferens				
Ductus ejaculatorius	*	*		
Tunica adventitia				
Tunica mucosa				
Tunica muscularis				
Epididymis		*		*
Caput epididymidis		*		*
Cauda epididymidis		*		*

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
Corpus epididymidis				
Ductulis aberrantes				
Ductus epididymidis				
Lobuli epididymidis				
Paradidymis				
Funiculus spermaticus		*		*
Fascia cremasterica				
Fascia spermatica externa				
Fascia spermatic interna				
Glandula bulbourethralis	*	*	*	*
Prostata	*	*	*	*
Apex prostatae		*		*
Basis prostatae				*
Capsula prostatici				
Ductuli prostatici				
Facies anterior				
Facies inferolateralis				
Facies posterior				
Isthmus prostatae	*			*
Lobus dexter/sinister/medius				
Parenchyma				
Substantia muscularis				
Testis	*	*	*	*
Ductuli efferentes testis				
Lobuli testis				
Mediastinum testis				
Parenchyma testis				
Rete testis				
Septula testis				
Tubuli seminiferi contorti				
Tubuli seminiferi recti				
Tunica albuginea				
Tunica vaginalis testis	*	*	*	*
Vesicula seminalis		*	*	*
Ductus excretorius				
Tunica adventitia				
Tunica mucosa				
Tunica muscularis				
Organa genitalia masculina				
Externa				
Penis	*	*	*	*
Arteriae helicinae				
Bulbus penis				
Cavernae corporis spongiosi				
Cavernae corporum cavernosum				
Corpus cavernosum penis	*	*		*
Corpus penis	*	*	*	*
Corpus spongiosum penis				
Crus penis				
Dorsum penis				
Facies urethralis				
Fascia penis profunda				
Fascia penis superficialis				
Glandulae preputiales				
Glans penis	*	*	*	*
Preputium penis	*	*	*	*
Tunica albuginea corporis spongiosi				
Tunica albuginea corporum cavernosorum				
Trabeculae corporis spongiosi				
Trabeculae corporum cavernosorum				
Venae cavernosae				
Urethra masculina	*	*		*
Lacunae urethrales				
Ostium urethrae externum	*	*		*
Pars membranacea				
Pars prostatica				
Pars spongiosa				
Scrotum	*	*	*	*
Raphe scroti	*	*	*	*
Septum scroti				
Tunica dartos				
Organa genitalia feminina				
Interna				
Epoöphoron				
Ovarium	*	*	*	*
Corpus albicans				
Corpus luteum				
Cortex ovarii				
Extremitas tubaria				
Extremitas uterina				
Facies lateralis				
Facies medialis				
Folliculi ovarici primarii				
Folliculi ovarici vesiculosi				
Hilum ovarii				
Ligamentum ovarii proprium	*	*	*	*
Margo liber				
Margo mesovaricus				
Medulla ovarii				
Stroma ovarii				
Tunica albuginea				
Paroöphoron				
Tuba uterina	*	*		*
Ampulla tubae uterinae	*	*		
Fimbriae tubae	*	*		*
Infundibulum tubae uterinae				
Isthmus tubae uterinae				
Ostium abdominale tubae uterinae		*		
Ostium uterinum tubae		*		
Pars uterina				
Plicae tubariae				
Tela subserosa				
Tunica mucosa				
Tunica muscularis		*		
Tunica serosa				
Uterus	*	*	*	*
Canalis cervicis uteri				
Cavitas uteri				
Cervix uteri	*	*	*	*
Cornu uteri				
Corpus uteri				
Facies intestinalis				
Facies vesicalis				

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
Fundus uteri	*	*		*
Isthmus uteri				
Ligamentum teres uteri	*	*		*
Margo uteri				
Ostium uteri				
Paracervix				
Parametrium				
Tela subserosa				
Tunica mucosa [Endometrium]				
Tunica muscularis [Myometrium]	*	*		
Tunica serosa [Perimetrium]				
Vagina	*	*	*	*
Fornix vaginae	*	*		*
Hymen	*	*		
Tunica mucosa				
Tunica muscularis				
Tunica spongiosa				
Organa genitalia feminina Externa				
Bulbus vestibuli	*	*	*	
Clitoris	*	*		*
Corpus cavernosum clitoridis	*			*
Corpus clitoridis	*	*		*
Crus clitoridis				
Fascia clitoridis				
Frenulum clitoridis	*	*		*
Glans clitoridis	*	*		*
Preputium clitoridis	*	*		*
Septum corporum cavernosorum				
Labium majus pudendi	*	*	*	*
Commissura labiorum anterior				
Commissura labiorum posterior				
Labium minus pudendi	*	*	*	*
Frenulum labiorum pudendi				
Mons pubis	*	*	*	*
Ostium vaginae				
Urethra feminina	*			
Crista urethralis				
Ostium urethrae externum	*	*	*	*
Tunica mucosa				
Tunica muscularis				
Tunica spongiosa				
Perineum				
Arcus tendineus fasciae pelvis				
Centrum tendineum perinei				
Diaphragma pelvis				
Fascia diaphragmatis pelvis				
Fascia diaphragmatis pelvis superior				
Fascia pelvis parietalis				
Fascia obturatoria				
Fascia pelvis visceralis				
Fascia peritoneoperinealis				
Fascia prostatae				

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
Fascia perinei superficialis				
Ligamentum anococcygeum				
Ligamentum puboprostaticum				
Ligamentum transversum perinei				
Membrana perinei				
Musculi perinei				
Raphe perinealis				
Veins				
Anastomotica inferior (H)				
Anastomotica superior (H)				
Angularis (H)				
Anterior septi pellucidi (H)				
Anteriores cerebri (H)				
Appendicularis (T)				
Aqueductus cochleae (H)				
Arcus venae azygos (T)				
Arcus venosus dorsalis pedis (HL)	*	*	*	
Arcus venosus jugularis (H)				
Arcus venosus palmaris profundus (F)				
Arcus venosus palmaris superficialis (F)				
Arcus venosus plantaris (HL)				
Articulares anteriores (H)				
Atriales (T)				
Atrioventriculares (T)				
Auricularis posterior (H)				
Axillaris (F)				
Azygos (T)	*	*	*	*
Basilica (F)	*	*	*	*
Basilis (H)				
Basilis communis (H)				
Basilis inferior (H)				
Basilis superior (H)				
Basivertebrales (T)				
Brachialis (F)	*	*	*	*
Brachiocephalica (T)				
Bronchiales (T)				
Bulbi penis (T)				
Bulbi vestibuli (T)				
Bulbus inferior venae jugularis (H)				
Bulbus superior venae jugularis (H)				
Canalis pterygoideus (H)				
Cardiaca magna (T)		*		
Cardiaca media (T)		*		
Cardiaca parva (T)		*		
Cardiacae anteriores (T)		*		
Cardiacae minimiae (T)				
Centralis retinae (H)				
Cephalica (F)	*	*	*	*
Cervicalis profundus (T)				
Choroidea inferior (H)				
Choroidea superior (H)				
Ciliares (H)				
Ciliares anteriores (H)				
Circumflexa iliac profunda (T)				

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
Circumflexa superficialis ilium (T)				
Circumflexae mediales femoris (HL)				
Circumflexae laterales femoris (HL)				
Colica dextra (T)				
Colica media (T)				
Colica sinistra (T)				
Comitans nervi hypoglossi (H)				
Conjunctivales (H)				
Cystica (T)				
Digitales palmares (F)				
Digitales plantares (HL)				
Diploica frontalis (H)				
Diploica occipitalis (H)				
Diploica temporalis anterior (H)				
Diploica temporalis posterior (H)				
Directae laterales (H)				
Dorsales superficiales clitoridis (T)				
Dorsales superficiales penis (T)				
Dorsalis corporis callosi (H)				
Dorsalis linguae (H)				
Dorsalis profunda clitoris (T)				
Dorsalis profunda penis (T)				
Emissaria condylaris (H)				
Emissaria mastoidea (H)				
Emissaria occipitalis (H)				
Emissaria parietalis (H)				
Epigastrica inferior (T)				
Epigastrica superficialis (T)				
Epigastricae superioris (T)				
Episclerales (H)				
Ethmoidales (H)				
Facialis (H)			*	
Femoralis (HL)				
Fibulares (HL)				
Frontales (H)				
Gastrica dextra (T)				
Gastrica sinistra (T)				
Gastricae breves (T)				
Gastro-omentalis dextra (T)				
Gastro-omentalis sinistra (T)				
Geniculares (HL)				
Gluteae inferioris (HL)				
Gluteae superioris (HL)				
Gyri olfactorii (F)				
Hemiazygos (T)	*	*	*	*
Hemiazygos accessoria (T)	*	*		
Hepaticae dextrae (T)				
Hepaticae intermediae (T)				
Hepaticae sinistrae (T)				
Ileales (T)				
Ileocolica (T)				
Iliaca communis (T)				
Iliaca externa (T)				
Iliaca interna (T)				

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
Iliolumbalis (T)				
Inferior vermis (H)				
Inferiores cerebri (H)				
Inferiores hemispherii cerebelli (H)				
Insulares (H)				
Intercapitulares (T)				
Intercostales anteriores (T)				
Intercostales posteriores (T)				
Intercostalis superior dextra (T)				
Intercostalis superior sinistra (T)				
Intercostalis suprema (T)				
Intermedia antebrachii (F)				
Intermedia basilica (F)				
Intermedia cephalica (F)				
Intermedia cubitii (F)				
Internae cerebri (H)				
Intervertebralis (T)				
Jejunales (T)				
Jugularis anterior (H)			*	
Jugularis externa (H)	*		*	
Jugularis interna (H)	*	*	*	
Labiales anteriores (H)				
Labiales posteriores (H)				
Labialis inferiores (H)				
Labialis superiores (H)				
Labyrinthi (H)				
Lacrimalis (H)				
Laryngea inferior (H)				
Laryngea superior (H)				
Lateralis atrii (T)				
Lingualis (H)				
Lumbales (T)				
Lumbalis ascendens (T)				
Magna cerebri (H)				
Marginalis lateralis (HL)	*	*	*	
Marginalis medialis (HL)	*	*	*	
Maxillares (H)				
Mediastinales (T)				
Media profunda cerebri (H)				
Mediae superficiales cerebri (H)				
Medialis atrii (T)				
Mediastinales (T)				
Medulla oblongatae (H)				
Meningeae (H)				
Meningeae mediae (H)				
Mesenterica inferior (T)				
Mesenterica superior (T)				
Metacarpales dorsales (F)				
Metacarpales palmares (F)				
Metatarsales plantares (HL)				
Musculophrenicae (T)				
Nasales externae (H)				
Nuclei caudati (H)				
Obliqua atrii sinistri (T)				
Obturatoriae (HL)				
Occipitales (H)				
Occipitalis (H)				
Oesophageales (T)				
Opthalmica inferior (H)				

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
Ovarica dextra (T)				
Palatina externa (H)				
Palpebrales (H)				
Palpebrales inferiores (H)				
Palpebrales superiores (H)				
Pancreaticae (T)				
Pancreaticoduodenales (T)				
Paraumbilicales (T)				
Parietales (H)				
Parotideae (H)				
Pectorales (T)				
Pedunculares (H)				
Perforantes (HL)	*	*	*	*
Pericardiacae (T)				
Pericardiacophrenicae (T)				
Pericardiales (T)				
Petrosa (H)				
Pharyngeales (H)				
Phrenicae inferiores (T)				
Phrenicae superiores (T)				
Plexus pampiniformis (T)				
Plexus pharyngeus (H)				
Plexus pterygoideus (H)	*			
Plexus venosus areolaris (T)				
Plexus venosus canalis hypoglossi (H)				
Plexus venosus caroticus internus (H)				
Plexus venosus foraminis ovalis (H)				
Plexus venosus prostaticus (T)				
Plexus venosus rectalis (T)				
Plexus venosus sacralis (T)				
Plexus venosus subobccipitali (H)				
Plexus venosus uterinus (T)				
Plexus venosus vaginalis (T)				
Plexus venosus vertebralis externus anterior (T)				
Plexus venosus vertebralis externus posterior (T)				
Plexus venosus vertebralis internus anterior (T)				
Plexus venosus vertebralis internus posterior (T)				
Plexus venosus vesicalis (T)				
Pontis (H)				
Pontomesencephalica anterior (H)				
Porta hepatis (T)	*	*		
Posterior corporis callosi (H)				
Posterior septi pellucidi (H)				
Posterior ventriculi sinistri (T)		*		
Precentralis cerebelli (H)				
Prefrontales (H)				
Prepylorica (T)				
Profunda faciei (H)				
Profunda femoris (HL)				
Profunda linguae (H)				
Profundae cerebri (H)				
Profundae clitoridis (T)				

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
Profundae penis (T)				
Pudenda externae (T)				
Pudenda interna (T)				
Pulmonalis dextra inferior (T)	*		*	*
Pulmonalis dextra superior (T)	*		*	*
Pulmonalis sinistra inferior (T)	*		*	*
Pulmonalis sinistra superior (T)	*		*	*
Radiales (F)	*	*	*	*
Recessus lateralis ventriculi quarti (H)				
Rectales inferiores (T)				
Rectales mediae (T)				
Rectalis superior (T)				
Rete venosum dorsale manus (F)				
Rete venosum dorsale pedis (HL)				
Sacralis laterales (T)				
Sacralis mediana (T)				
Saphena accessorius (HL)				
Saphena parva (HL)	*	*	*	
Saphena magna (HL)	*	*	*	
Scapularis dorsalis (F)				
Scrotales anteriores (T)				
Scrotales posteriores (T)				
Sigmoideae (T)				
Sinus cavernosus (H)	*		*	*
Sinus coronarius (T)		*		
Sinus occipitalis (H)				
Sinus petrosquamosus (H)	*		*	*
Sinus petrosus inferior (H)				
Sinus rectus (H)				
Sinus sagittalis inferior (H)				
Sinus sagittalis superior (H)				
Sinus sigmoideus (H)				
Sinus sphenoparietalis (H)	*	*	*	*
Sinus transvs. (H)				
Spinales anteriores/ posteriores (H)				
Splenica (T)				
Sternocleidomastoidea (T)				
Stylomastoidea (H)				
Subclavia (F)				
Subcostalis (T)				
Subcutaneae abdominis (T)				
Sublingualis (H)				
Submentalis (H)				
Superficialis cerebri (H)				
Superior vermis (H)				
Superiores cerebri (H)				
Superiores hemispherii cerebelli (H)				
Supraorbitalis (H)				
Suprarenalis dextra (T)				
Suprarenalis sinistra (T)				
Suprascapularis (F)				
Supratrochleares (H)				
Temporales profundae (H)				
Temporales superficiales (H)				
Temporalis media (H)				

Structure	*Pan*	*Gorilla*	*Pongo*	*Hylobates*
Testicularis dextra (T)				
Thalamostriatae inferiores (H)				
Thalamostriatae superior (H)				
Thoracica lateralis (T)				
Thoracicae internae (T)				
Thoracicoepigastricae (T)				
Thoracoacromialis (T)				
Thymicae (T)				
Thyroidea inferior (T)				
Thyroidea mediae (T)				
Thyroidea superior (T)	*		*	
Thyroideus impar (T)				
Tibialis anteriores (HL)				
Tibialis posteriores (HL)				
Tracheales (H)				
Transversa faciei (H)				
Transversae cervicis (T)				
Tympanicae (H)				
Ulnares (F)	*	*	*	*
Umbilicalis sinistra (T)				
Unci (H)				
Uterinae (T)				
Vena cava inferior (T)	*		*	
Vena cava superior (T)	*		*	
Ventriculares (T)				
Ventricularis inferior (H)				
Vertebralis (T)				
Vertebralis anterior (T)				
Vesicales (T)				
Vorticosae (H)				

Appendix 2 Details of the 171 soft-tissue characters used in the phylogenetic analysis. Characters are classified by system (e.g. muscles) and then, where relevant, by region. The description of each character is followed by the key to the character states ('States') and the character type ('Type'), the distribution of character states among the taxa ('Dist'), and the reference(s) for allocating the character states to the taxa ('Refs')

MUSCLES

Head, Neck and Tongue (Characters 1–8)

1. Omohyoid has three bellies in some specimens
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 0
Refs: Bischoff (1870), Chapman (1879), Sonntag (1923, 1924a), Raven (1950), Miller (1952), Warwick & Williams (1973), Hilloowala (1980)

2. Anterior bellies of digastric in contact in midline
States: 0 = yes, 1 = no
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 0, *Homo* 1
Refs: Parsons (1898), Sonntag (1923), Raven (1950), Miller (1952)

3. Cricothyroid insertion onto external surface of posterior thyroid lamina
States: 0 = yes, 1 = no
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 0, *Homo* 1
Refs: Körner (1884), Duckworth (1912), Kelemen (1948), Avril (1963), Jordan (1971a, 1971b), Warwick & Williams (1973)

4. Shape of apex of tongue
States: 0 = rounded, 1 = square
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 0
Refs: Sonntag (1921), Warwick & Williams (1973)

5. Presence/absence of apical lingual gland
States: 0 = absent, 1 = variable, 2 = present
Type: Ordered
Dist: *Hylobates* 0, *Pongo* 2, *Gorilla* 1, *Pan* 1, *Homo* 2
Refs: Sonntag (1921, 1924a), Oppenheimer (1931), Schneider (1958), Hofer (1970), Warwick & Williams (1973), Rommel (1981)

6. Presence/absence of filiform papillae on posterior third of tongue
States: 0 = present, 1 = absent
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 0, *Homo* 1
Refs: Flower (1872), Sonntag (1921), Hosokawa & Kamiya (1961), Warwick & Williams (1973)

7. Conical filiform predominate over cylindrical filiform
States: 0 = yes, 1 = no
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 1
Refs: Sonntag (1921)

8. Sublingual fold is triangular
States: 0 = yes, 1 = no
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 0, *Homo* 1
Refs: Flower (1872), Sonntag (1921, 1923)

Forelimb (Characters 9–64)

9. Abductor pollicis brevis divides into slips in some specimens
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 0
Refs: Brooks (1887), Dwight (1895), Sonntag (1923), Raven (1950), Aziz & Dunlap (1986)

10. Occasional reinforcement of abductor pollicis brevis by slips from flexor pollicis brevis
States: 0 = yes, 1 = no
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 0, *Homo* 1
Refs: Brooks (1887), Dwight (1895)

11. Abductor pollicis brevis inserts into MI
States: 0 = yes, 1 = no
Type: Unordered
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 0, *Homo* 1
Ref: Aziz & Dunlap (1986), Hepburn (1892), Raven (1950), Landsmeer (1986)

12. Radial head of flexor pollicis brevis originates from flexor retinaculum and trapezium only
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 1
Refs: Brooks (1887), Sonntag (1923), Sullivan & Osgood (1927), Raven (1950), Miller (1952), Tuttle (1969), Warwick & Williams (1973)

13. Site of origin of the humeral head of pronator teres
State: 0 = medial humeral epicondyle, 1 = medial humeral epicondyle and medial intermuscular septum
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: MacAlister (1871), Chapman (1878), Hepburn (1892), Beddard (1893), Sonntag (1923, 1924a), Sullivan & Osgood (1927), Raven (1950), Warwick & Williams (1973)

14. Humeral head of pronator teres fuses with flexor carpi radialis
State: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 0
Refs: Beddard (1893), Sonntag (1923, 1924a)

15. Humeroulnar head of flexor digitorum superficialis takes origin from intermuscular septum
State: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 1
Refs: Beddard (1893), Dwight (1895), MacDowell (1910), Warwick & Williams (1973)

16. Flexor carpi radialis origin from intermuscular septum
State: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 1, *Pongo* 0, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Beddard (1893), Warwick & Williams (1973)

17. Flexor carpi radialis fused with flexor digitorum superficialis
State: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 1, *Homo* 0
Refs: Sonntag (1923, 1924a), Raven (1950)

18. Flexor carpi radialis insertion into palmar surface of base of MIII
State: 0 = variable, 1 = yes
Type: Binary
Dist: *Hylobates*?, *Pongo* 0, *Gorilla* 1, *Pan* 0, *Homo* 1
Refs: Hepburn (1892), Sonntag (1923, 1924a), Raven (1950), Ziegler (1964), Warwick & Williams (1973)

19. Palmaris longus present in all specimens
State: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 1, *Pongo* 1, *Gorilla* 0, *Pan* 0, *Homo* 0
Refs: Vrolik (1841), Duvernoy (1855–6), Rolleston (1868), Chapman (1878, 1879, 1880), Champneys (1872), Hepburn (1892), Keith (1894), Dwight (1895), Fick (1895a, 1895b), Le Double (1897), Adachi (1900), Michaëlis (1903), Sonntag (1923), Sullivan & Osgood (1927), Raven (1950), Ziegler (1964), Machado & Didio (1967), Landsmeer (1986)

20. Flexor carpi ulnaris originates from intermuscular septum
State: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Beddard (1893), Warwick & Williams (1973)

21. Flexor carpi ulnaris gives origin to some fibres of flexor digitorum superficialis
State: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 0
Refs: Dwight (1895), Sonntag (1924a), Sullivan & Osgood (1927)

22. Orientation of pronator quadratus
State: 0 = strongly oblique, 1 = moderately oblique, 2 = weakly oblique
Type: Ordered
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 2
Refs: Chapman (1878), Dwight (1895), Hepburn (1892), Raven (1950)

23. Origin of flexor digitorum profundus extends to medial coronoid process and/or medial humeral condyle
State: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 1, *Pongo* 0, *Gorilla* 1, *Pan* 0, *Homo* 1
Refs: Hepburn (1892), Raven (1950), Tuttle (1969), Warwick & Williams (1973)

24. Flexor pollicis longus originates from anterior radius and interosseous membrane
State: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 1
Refs: Hepburn (1892), Beddard (1893), Sonntag (1923), Raven (1950), Mangini (1960), Day & Napier (1963), Warwick & Williams (1973)

25. Flexor pollicis longus takes origin from palmar fascia
State: 0 = no, 1 = yes
Type: Unordered
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 0
Refs: Huxley (1864), Humphry (1866–7), Ziegler (1964), Landsmeer (1986)

26. Flexor pollicis longus gives origin to tendon to digit II
State: 0 = no, 1 = occasionally, 2 = often
Type: Ordered
Dist: *Hylobates* 1, *Pongo* 0, *Gorilla* 0, *Pan* 2, *Homo* 1
Refs: Champneys (1872), Hepburn (1892), Beddard (1893), Keith (1894), MacDowell (1910), Ziegler (1964)

27. Extensor carpi radialis brevis originates from radial collateral ligament
State: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Hepburn (1892), Sonntag (1923, 1924a), Straus (1941a), Warwick & Williams (1973)

28. Extensor carpi radialis brevis originates from intermuscular septum
State: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 0, *Homo* 1
Refs: Beddard (1893), Sonntag (1924a), Warwick & Williams (1973)

29. Extensor carpi radialis brevis inserts into MII
States: 0 = yes, 1 = variable, 2 = no
Type: Ordered
Dist: *Hylobates* 0, *Pongo* 2, *Gorilla* 0, *Pan* 2, *Homo* 1
Refs: Wood (1864, 1865, 1866, 1867a, 1867b, 1868), Kohlbrügge (1890/1), Wagenseil (1936), Straus (1941a), Raven (1950), Ziegler (1964), Warwick & Williams (1973)

30. Accessory tendon of extensor carpi radialis longus to MI
States: 0 = no, 1 = sometimes present (~10% specimens), 2 = often present (~50% specimens)
Type: Ordered
Dist: *Hylobates* 2, *Pongo* 0, *Gorilla* 0, *Pan* 0, *Homo* 1
Refs: Wood (1864, 1865, 1866, 1867a, 1867b, 1868), Hepburn (1892), Le Double (1897), Straus (1941a)

31. Fusion of brachioradialis with brachialis
State: 0 = yes, 1 = variable, 2 = no
Type: Ordered
Dist: *Hylobates* 0, *Pongo* 2, *Gorilla* 2, *Pan* 0, *Homo* 1
Refs: Hepburn (1892), Sonntag (1923), Miller (1952), Warwick & Williams (1973)

32. Extensor digitorum originates from intermuscular septum
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Beddard (1893), MacDowell (1910), Sonntag (1923, 1924a), Warwick & Williams (1973)

33. Extensor digitorum commonly originates from forearm bones
States: 0 = radius and ulna, 1 = ulna only, 2 = neither forearm bone
Type: Unordered
Dist: *Hylobates* 1, *Pongo* 1, *Gorilla* 0, *Pan* 0, *Homo* 2
Refs: Aziz & Dunlap (1986), MacDowell (1910), Sonntag (1924a), Straus (1941a) Sullivan & Osgood (1927), Warwick & Williams (1973)

34. Extensor digitorum originates from antebrachial fascia
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Beddard (1893), Sonntag (1923), Warwick & Williams (1973)

35. Slips from extensor digitorum tendon for digit IV to digits III and V
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 1
Refs: Champneys (1872), Hepburn (1892), Beddard (1893), Dwight (1895), MacDowell (1910), Sonntag (1923), Straus (1941a), Miller (1952), Raven (1950), Warwick & Williams (1973)

36. Coracobrachialis origination from intermuscular septum
States: 0 = no, 1 = variable, 2 = yes
Type: Ordered
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 2, *Pan* 2, *Homo* 1
Refs: Hepburn (1892), Sonntag (1923), Warwick & Williams (1973)

37. Coracobrachialis fused with brachialis
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 1, *Homo* 0
Refs: Beddard (1893), Sonntag (1924a), Raven (1950)

38. Anterior extension of insertion of coracobrachialis present in most specimens
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 1
Refs: Humphry (1866/7), Hepburn (1892), Beddard (1893), Dwight (1895), Raven (1950), Miller (1952), Warwick & Williams (1973)

39. Brachialis originates from septa
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 0, *Homo* 1
Refs: Raven (1950), Beddard (1893), Warwick & Williams (1973)

40. Lateral head of triceps brachii originates from lateral intermuscular septum
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Beddard (1893), Warwick & Williams (1973)

41. Extensor digitorum insertion extends into middle or distal phalanges in some specimens
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 1, *Homo* 0
Refs: Beddard (1893), Sonntag (1923), Raven (1950), Miller (1952), Sullivan & Osgood (1927)

42. Extensor digitorum inserts into interphalangeal joints
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 0
Refs: Sonntag (1923), Sullivan & Osgood (1927), Warwick & Williams (1973)

43. Extensor digiti minimi absent in some specimens
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Champneys (1872), Beddard (1893), Le Double (1897), Straus (1941a)

44. Extension of extensor carpi ulnaris to first phalanx of digit V in some specimens
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Wood (1864, 1865, 1866, 1867a, 1867b, 1868), MacAlister (1871), Le Double (1897), Loth (1912)

45. Supinator origination from ligaments of elbow
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 0, *Homo* 1
Refs: Beddard (1893), Raven (1950), Warwick & Williams (1973)

46. Abductor pollicis longus origination from intermuscular septum
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 0
Refs: Beddard (1893), MacDowell (1910)

47. Extensor pollicis brevis origination from ulna and interosseous membrane
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 1
Refs: Beddard (1893), Sonntag (1923), Straus (1941a), Raven (1950), Warwick & Williams (1973)

48. Extensor pollicis brevis insertion onto base of proximal phalanx of digit I
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 0, *Homo* 1
Refs: Beddard (1893), Sonntag (1923), Straus (1941a), Raven (1950), Warwick & Williams (1973)

49. Extensor indicis origination from interosseous membrane
States: 0 = yes, 1 = no
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 0
Refs: Beddard (1893), Sullivan & Osgood (1927), Straus (1941a, 1941b), Warwick & Williams (1973)

50. Most common pattern of insertion of extensor indicis
States: 0 = digits II, III and IV, 1 = digits II and III, 2 = digit II
Type: Ordered
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 2, *Pan* 2, *Homo* 2
Refs: Wilder (1862), Humphry (1866/7), Hepburn (1892), Beddard (1893), Dwight (1895), MacDowell (1910), Sonntag (1923, 1924a), Straus (1941a, 1941b), Raven (1950), Miller (1952), Warwick & Williams (1973)

51. Deltoid origination from infraspinous fascia
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 0
Refs: Wilder (1862), Sonntag (1923, 1924a), Sullivan & Osgood (1927), Miller (1952)

52. Teres minor insertion extends onto shaft below greater tubercle
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 1
Refs: Hepburn (1892), Beddard (1893), Sonntag (1923, 1924a), Sullivan & Osgood (1927), Larson & Stern (1986), Warwick & Williams (1973)

53. Teres minor shares origin from intermuscular septum with teres major
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Beddard (1893), Warwick & Williams (1973)

54. Latissimus dorsi may originate from inferior scapular angle
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Hepburn (1892), Sonntag (1923, 1924a), Sullivan & Osgood (1927), Miller (1952)

55. Extent of costal origin of latissimus dorsi
States: 0 = three or four ribs, 1 = three, four or five ribs, 2 = five ribs, 3 = six ribs
Type: Ordered
Dist: *Hylobates* 2, *Pongo* 3, *Gorilla* 3, *Pan* 1, *Homo* 0
Refs: Champneys (1872), Hepburn (1892), Beddard (1893), MacDowell (1910), Sonntag (1923, 1924a), Sullivan & Osgood (1927), Miller (1952), Warwick & Williams (1973)

56. Extent of origin of teres major from lateral scapular border
States: 0 = 30%, 1 = 50%, 2 = more than 50%
Type: Ordered
Dist: *Hylobates* 2, *Pongo* 0, *Gorilla* 0, *Pan* 1, *Homo* 0
Refs: Hepburn (1892), Beddard (1893), Sonntag (1923, 1924a), Miller (1952), Warwick & Williams (1973)

57. Subscapularis insertion extends onto shaft below lesser humeral tubercle
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Hepburn (1892), Beddard (1893), Sonntag (1923, 1924a), Sullivan & Osgood (1927), Raven (1950), Ziegler (1964), Warwick & Williams (1973)

58. Accessory bundles of subscapularis present in some individuals
States: 0 = no, 1 = yes
Type Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Sullivan & Osgood (1927), Ziegler (1964), Warwick & Williams (1973)

59. Subclavius takes origin on first rib only
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 1
Refs: Hepburn (1892), MacDowell (1910), Sonntag (1923), Sullivan & Osgood (1927), Raven (1950), Miller (1952), Warwick & Williams (1973)

60. Costal origin of serratus anterior extends to rib 12
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 1, *Homo* 0
Refs: Wilder (1862), MacAlister (1871), Beddard (1893), Sonntag (1923), Raven (1950), Miller (1952), Warwick & Williams (1973), Andrews & Groves (1976), Larson et al. (1991)

61. Cranial extent of costal origin of pectoralis major
States: 0 = ribs one and two, 1 = rib two only, 2 = none
Type: Ordered
Dist: *Hylobates* 2, *Pongo* 0, *Gorilla* 1, *Pan* 0, *Homo* 1
Refs: Champneys (1872), Chapman (1879, 1880), Beddard (1893), MacDowell (1910), Sonntag (1923, 1924a), Sullivan & Osgood (1927), Raven (1950), Miller (1952), Warwick & Williams (1973)

62. Caudal extent of costal origin of pectoralis major
States: 0 = none, 1 = rib eight
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 0
Refs: Champneys (1872), Chapman (1879), MacDowell (1910), Sonntag (1923), Sullivan & Osgood (1927), Miller (1952), Warwick & Williams (1973)

63. Extent of clavicular origin of pectoralis major
States: 0 = two-thirds, 1 = half, 2 = third
Type: Ordered
Dist: *Hylobates* 0, *Pongo* 2, *Gorilla* 2, *Pan* 1, *Homo* 1
Refs: Champneys (1872), Keith (1896), MacDowell (1910), Sonntag (1923, 1924a), Raven (1950), Miller (1952), Warwick & Williams (1973), Stern et al. (1980)

64. Pectoralis major may divide into three parts
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Owen (1830/1), MacAlister (1871), Champneys (1872), Chapman (1880), Duvernoy (1855/6), Hepburn (1892), Beddard (1893), Fick (1895a, 1895b), MacDowell (1910), Sonntag (1923, 1924a), Sullivan & Osgood (1927), Sutton (1883), Vrolik (1841), Warwick & Williams (1973)

Trunk (Characters 65–67)

65. Origin of psoas major extends to S1
States: 0 = yes, 1 = variable, 2 = no
Type: Ordered
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 2
Refs: Hepburn (1892), Sigmon (1974)

66. Coccygeus insertion into anococcygeal raphe
States: 0 = yes, 1 = no
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Elftman (1932), Miller (1952), Warwick & Williams (1973)

67. Coccygeus insertion into sacrum
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 0, *Homo* 1
Refs: Elftman (1932), Miller (1952), Warwick & Williams (1973)

Hindlimb (Characters 68–110)

68. Piriformis normally fused with gluteus medius
States: 0 = yes, 1 = no
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 1
Refs: Champneys (1872), Hepburn (1892), Beddard (1893), Dwight (1895), Boyer (1935), Sigmon (1974), Sonntag (1924a), Warwick & Williams (1973)

69. Origin of gluteus minimus is continuous
States: 0 = yes, 1 = variable, 2 = no
Types: Ordered
Dist: *Hylobates* 0, *Pongo* 2, *Gorilla* 2, *Pan* 2, *Homo* 1

Refs: Champneys (1872), Beddard (1893), Boyer (1935), Raven (1950), Warwick & Williams (1973), Sigmon (1974)

70. Gluteus medius origination from fascia lata
States: 0 = no, 1 = yes
Types: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 1, *Homo* 0
Refs: Champneys (1872), Beddard (1893), Boyer (1935), Raven (1950), Warwick & Williams (1973), Sigmon (1974)

71. Gluteus medius is bipennate
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 0
Refs: Beddard (1893), Raven (1950)

72. Tensor fascia latae normally fused proximally with gluteus maximus
States: 0 = yes, 1 = no
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Hepburn (1892), Swindler & Wood (1973), Sigmon (1974)

73. Tensor fascia latae fused laterally with gluteus medius and minimus
States: 0 = yes, 1 = no
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 0, *Homo* 1
Refs: Champneys (1872), Sigmon (1974)

74. Gluteus maximus fused with biceps femoris
States: 0 = no fusion, 1 = at origin, 2 = more distally
Type: Ordered
Dist: *Hylobates* 1, *Pongo* 2, *Gorilla* 1, *Pan* 1, *Homo* 0
Refs: Champneys (1872), Sonntag (1924a), Stern (1972), Sigmon (1974)

75. Gluteus maximus insertion into hypotrochanteric fossa
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 1, *Homo* 0
Refs: Appleton (1922)

76. Superior gemellus
States: 0 = present, 1 = variable, 2 = absent
Type: Ordered
Dist: *Hylobates* 2, *Pongo* 1, *Gorilla* 1, *Pan* 0, *Homo* 1
Refs: Wood (1867a), Champneys (1872), Hepburn (1892), Beddard (1893), Dwight (1895), Loth (1931), Terry (1942), Raven (1950), Sigmon (1974)

77. Quadratus femoris split at insertion
States: 0 = yes, 1 = variable, 2 = no
Type: Ordered
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 2, *Pan* 1, *Homo* 2
Refs: Champneys (1872), Hepburn (1892), Dwight (1895), Sonntag (1924a), Boyer (1935), Sigmon (1974), Warwick & Williams (1973)

78. Obturator externus fused at insertion with obturator internus
States: 0 = yes, 1 = variable, 2 = no
Type: Ordered
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 0, *Homo* 2
Refs: Hepburn (1892), Beddard (1893), Sonntag (1924a), Warwick & Williams (1973)

79. Gracilis origin extends to whole pubic body
States: 0 = yes, 1 = no
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 0, *Homo* 1
Refs: Hepburn (1892), Sonntag (1924a), Boyer (1935), Robinson et al. (1972)

80. Adductor brevis origination from superior pubic ramus
States: 0 = no, 1 = yes
Type Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 1, *Homo* 0
Refs: Boyer (1935), Sigmon (1974)

81. Adductor brevis inserted between pectineus and upper part of adductor magnus
States: 0 = yes, 1 = no
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 1, *Homo* 0
Refs: Hepburn (1892), Beddard (1893), Raven (1950), Warwick & Williams (1973)

82. Adductor magnus insertion into inferior border of quadratus femoris insertion
States: 0 = yes, 1 = no
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 1
Refs: Champneys (1872), Beddard (1893), Raven (1950), Warwick & Williams (1973)

83. Rectus femoris has two heads
States: 0 = no, 1 = variable, 2 = yes
Type: Ordered
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 1, *Homo* 2
Refs: Vrolik (1841), Hepburn (1892), Dwight (1895), Boyer (1935), Sigmon (1974), Warwick & Williams (1973)

84. Vastus medialis origination from intermuscular septa
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 0, *Homo* 1
Refs: Beddard (1893), Sonntag (1924a), Sigmon (1974), Warwick & Williams (1973)

85. Vastus medialis insertion onto medial patellar surface
States: 0 = no, 1 = variable, 2 = yes
Type: Ordered
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 0, *Homo* 2
Refs: Hepburn (1892), Beddard (1893), Sonntag (1924a), Boyer (1935), Raven (1950), Sigmon (1974), Warwick & Williams (1973)

86. Vastus lateralis origination from iliofemoral ligament
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 1, *Homo* 0
Refs: Beddard (1893), Boyer (1935), Hepburn (1892), Raven (1950), Sigmon (1974), Sonntag (1924a), Warwick & Williams (1973)

87. Articularis genus present
States: 0 = yes, 1 = variable
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 1, *Homo* 1
Refs: Champneys (1872), Hepburn (1892), Sonntag (1924a), Warwick & Williams (1973)

88. Origin of short head of biceps femoris
States: 0 = posterolateral femur and lateral intermuscular septum, 1 = posterolateral femur only
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 0, *Homo* 0

Refs: Owen (1830/1), Beddard (1893), Raven (1950), Sigmon (1974), Sonntag (1924a), Prejzner-Morawska & Urbanowicz (1971), Warwick & Williams (1973), Hamada (1985), Kumakura (1989)

89. Long head of biceps femoris may insert into iliotibial tract
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 1, *Homo* 0
Refs: Beddard (1893), Raven (1950), Sigmon (1974), Hamada (1985)

90. Insertion of short head of biceps femoris onto lateral intermuscular septum
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 0
Refs: Boyer (1935), Prejzner-Morawska & Urbanowicz (1971), Warwick & Williams (1973), Sigmon (1974)

91. Semitendinosus may share common origin with semimembranosus
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Champneys (1872), Hepburn (1892), Beddard (1893), Owen (1830/1), Warwick & Williams (1973), Sigmon (1974)

92. Semimembranosus inserts into popliteal fascia and posterior wall of knee capsule via oblique popliteal ligaments
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 0, *Homo* 1
Refs: Champneys (1872), Hepburn (1892), Beddard (1893), Sonntag (1924a), Boyer (1935), Warwick & Williams (1973), Sigmon (1974)

93. Tibialis anterior originates from crural fascia
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 0, *Homo* 1
Refs: Sutton (1883), Beddard (1893), MacDowell (1910), Sonntag (1924a), Owen (1830/1), Boyer (1935), Raven (1950), Miller (1952), Lewis (1966), Warwick & Williams (1973)

94. Extensor digitorum longus originates from crural fascia
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Beddard (1893), MacDowell (1910), Sonntag (1924a), Boyer (1935), Miller (1952), Kaplan (1958a), Lewis (1966), Warwick & Williams (1973)

95. Incidence of peroneus tertius
States: 0 = low incidence (0–5% of specimens), 1 = moderate incidence (30–50% of specimens), 2 = high incidence (~95% of specimens)
Type: Ordered
Dist: *Hylobates* 1, *Pongo* 0, *Gorilla* 1, *Pan* 0, *Homo* 2
Refs: Owen (1830/1), Rolleston (1868), Chapman (1880), Hepburn (1892), Beddard (1893), Eisler (1895), Sommer (1907), Hecker (1922), Morton (1922), Keith (1923), Sonntag (1924a), Loth (1931), Boyer (1935), Kimura & Takahashi (1985), Kaneff (1986), Jungers et al. (1993)

96. Peroneus longus origination from lateral tibial condyle
States: 0 = yes, 1 = no
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 0, *Homo* 0
Refs: Owen (1830/1), Ruge (1878a), Beddard (1893), MacDowell (1910), Sonntag (1924a), Boyer (1935), Raven (1950), Miller (1952), Lewis (1966), Warwick & Williams (1973)

97. Peroneus brevis may insert onto first and second phalanges of digit V
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 1
Refs: Vrolik (1841), Champneys (1872), MacDowell (1910), Raven (1950)

98. Soleus often has tibial origin
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 1
Refs: Owen (1830/1), Vrolik (1841), Duvernoy (1855/6), Church (1861/2), Humphry (1866/7), Champneys (1872), MacAlister (1873), Chapman (1878, 1879), Hepburn (1892), Michäelis (1903), MacDowell (1910), Frey (1913), Rózycki (1922), Boyer (1935), Raven (1950), Lewis (1962, 1964a), Urbanowicz & Prejzner-Morawska (1972), Warwick & Williams (1973)

99. Plantaris often present
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Sandifort (1840), Duvernoy (1855/6), Church (1861/2), Chapman (1878, 1880), Hartmann (1885), Hepburn (1892), Beddard (1893), Le Double (1897), Duckworth (1898), Primrose (1899), Michäelis (1903), Frey (1913), Boyer (1935), Raven (1950), Tappen (1955), Warwick & Williams (1973)

100. Extensor digitorum brevis tendon to digit V normally present
States: 0 = yes, 1 = no
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 0, *Homo* 0
Refs: Lewis (1966), Michäelis (1903), Warwick & Williams (1973)

101. Slip from abductor hallucis into base of MI
States: 0 = yes, 1 = no
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Church (1861/2), Brooks (1887), Hepburn (1892), Sonntag (1924a), Raven (1950)

102. Both heads of flexor hallucis brevis fused with abductor hallucis
States: 0 = yes, 1 = no
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 0, *Homo* 1
Refs: Bischoff (1870), Champneys (1872), Ruge (1878b), Brooks (1887), Beddard (1893), Raven (1950), Miller (1952), Warwick & Williams (1973)

103. Two heads of adductor hallucis fused
States: 0 = yes, 1 = variable, 2 = no
Type: Ordered

Dist: *Hylobates* 0, *Pongo* 2, *Gorilla* 2, *Pan* 1, *Homo* 0
Refs: Vrolik (1841), Duvernoy (1855/6), Champneys (1872), Brooks (1887), Dwight (1895), Primrose (1899), Boyer (1935), Raven (1950), Warwick & Williams (1973)

104. Oblique head of adductor hallucis origination from sheath of peroneus longus
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Champneys (1872), Sutton (1883), Brooks (1887), Beddard (1893), Dwight (1895), Sonntag (1924a), Miller (1952), Warwick & Williams (1973)

105. Abductor hallucis may insert onto medial cuneiform
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Owen (1830/1), Brooks (1887), Hepburn (1892), Beddard (1893), Sonntag (1924a), Boyer (1935), Raven (1950), Miller (1952), Warwick & Williams (1973)

106. Medial and lateral heads of flexor hallucis brevis separated by septum
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 0, *Homo* 0
Refs: Brooks (1887), Raven (1950), Warwick & Williams (1973)

107. Origin of transverse head of adductor hallucis
States: 0 = second and third metatarsophalangeal joints and ligaments, 1 = second, third and fourth metatarsophalangeal joints and ligaments, 2 = third, fourth and fifth metatarsophalangeal joints and ligaments
Type: Ordered
Dist: *Hylobates* 1, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 2
Refs: Vrolik (1841), Champneys (1872), Sutton (1883), Brooks (1887), Beddard (1893), Dwight (1895), Boyer (1935), Raven (1950), Miller (1952), Warwick & Williams (1973)

108. First dorsal interosseous originates from MI and MII
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Champneys (1872), Brooks (1887), Dwight (1895), Sonntag (1924a), Boyer (1935), Raven (1950), Miller (1952), Warwick & Williams (1973)

109. Flexor digitorum brevis originates from plantar aponeurosis
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Chapman (1878), Warwick & Williams (1973)

110. Flexor digitorum brevis may fuse with abductor hallucis
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 0
Refs: Champneys (1872), Sonntag (1924a), Sutton (1883)

VESSELS

Forelimb (Characters 111–124)

111. Perforating veins in cubital fossa
States: 0 = present, 1 = variable, 2 = absent
Type: Ordered
Dist: *Hylobates* 0, *Pongo* 2, *Gorilla* 0, *Pan* 1, *Homo* 0
Refs: Sonntag (1924a), Thiranagama et al. (1989a), Warwick & Williams (1973)

112. Basilic vein
States: 0 = absent, 1 = variable, 2 = present
Type: Ordered
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 0, *Homo* 2
Refs: Chapman (1878), Sonntag (1923, 1924a), Raven (1950), Thiranagama et al. (1989b, 1991), Warwick & Williams (1973)

113. Cephalic vein limited to forearm
States: 0 = no, 1 = low incidence (20–25% of specimens), 2 = high incidence (80–100% of specimens)
Type: Ordered
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 2, *Pan* 2, *Homo* 1
Refs: Berry & Newton (1908), Sonntag (1923), Raven (1950), Platzer (1971), Bouchet (1973), Singh et al. (1982), Thiranagama et al. (1989b, 1991)

114. Palmar metacarpal arteries originate from deep palmar arch
States: 0 = yes, 1 = no
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 0
Refs: Manners-Smith (1910b), Glidden & De Garis (1936) Warwick & Williams (1973)

115. Origin of radialis indicus may include first palmar metacarpal artery
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 1
Refs: Manners-Smith (1910b), Sonntag (1924a), Warwick & Williams (1973)

116. Origin of posterior interosseous artery
Style: 0 = brachial artery, 1 = common interosseous
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Müller (1903, 1905), Glidden & De Garis (1936), Warwick & Williams (1973), Marzke et al. (1992)

117. Dorsalis indicis and dorsal metacarpal branches of ulnar artery
States: 0 = absent, 1 = present
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 0, *Homo* 0
Refs: Manners-Smith (1910b)

118. Termination of superficial palmar artery
States: 0 = thenar muscles, 1 = superficial palmar arch
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Müller (1903, 1905), Manners-Smith (1910b), Sonntag (1923, 1924a), Glidden & De Garis (1936), Warwick & Williams (1973)

119. Superficial palmar artery may pass over thenar muscles
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 0, *Pan* 1, *Homo* 1

Refs: Manners-Smith (1910b), Sonntag (1923), Glidden & De Garis (1936), Warwick & Williams (1973)

120. Origin of radial recurrent artery
States: 0 = radial artery, 1 = variable, 2 = brachial artery
Type: Ordered
Dist: *Hylobates* 0, *Pongo* 2, *Gorilla* 0, *Pan* 1, *Homo* 0
Refs: Müller (1903, 1905), Manners-Smith (1910a, 1910b), Sonntag (1923), Warwick & Williams (1973)

121. Dorsalis pollicis
States: 0 = present, 1 = absent
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Manners-Smith (1910b), Warwick & Williams (1973)

122. Point at which radial artery enters palm
States: 0 = dorsum of second interosseous space, 1 = dorsum of first interosseous space
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 1
Refs: Champneys (1872), Manners-Smith (1910b), Sonntag (1923, 1924a), Glidden & De Garis (1936), Warwick & Williams (1973)

123. Superior ulnar collateral artery may originate from brachial artery
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 1
Refs: Manners-Smith (1910a), Glidden & De Garis (1936), Warwick & Williams (1973)

124. Profunda brachii may originate from brachial artery
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 1, *Pongo* 0, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Dwight (1895), Müller (1903, 1905), Manners-Smith (1910a), Sonntag (1923), Glidden & De Garis (1936), Warwick & Williams (1973)

Trunk (Characters 124–129)

125. Lateral thoracic artery normally an independent branch of axillary artery
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 1
Refs: Müller (1903, 1905), Manners-Smith (1910a), Glidden & De Garis (1936), Warwick & Williams (1973)

126. Pectoral branch of thoracoacromial artery
States: 0 = absent, 1 = variable, 2 = present
Type: Ordered
Dist: *Hylobates* 0, *Pongo* 2, *Gorilla* 0, *Pan* 1, *Homo* 2
Refs: Manners-Smith (1910a), Glidden & De Garis (1936), Warwick & Williams (1973)

127. Superior thoracic artery
States: 0 = absent, 1 = present
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 1
Refs: Müller (1903, 1905), Manners-Smith (1910a), Warwick & Williams (1973)

128. Thyroidea ima may arise from left common carotid
States: 0 = yes, 1 = no
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 0, *Homo* 1
Refs: Sutton (1883), Keith (1895), Sonntag (1923, 1924a), Glidden & De Garis (1936), Swindler & Wood (1973), Warwick & Williams (1973)

129. Most common form of branches from aortic arch is E (Keith, 1895)
States: 0 = yes, 1 = no
Type: Binary
Dist: *Hylobates* 1, *Pongo* 1, *Gorilla* 0, *Pan* 0, *Homo* 0
Refs: Owen (1830/1), Chapman (1879, 1880), Sutton (1883), Deniker (1885/6), Dwight (1895), Keith (1895), Sonntag (1923, 1924a), Glidden & De Garis (1936), De Garis (1941), Washburn (1950), Steiner (1954), Wright (1969), Swindler & Wood (1973), Warwick & Williams (1973)

Hindlimb (Characters 130–138)

130. Perforating branch of peroneal artery anastomoses with anterior lateral malleolar artery
States: 0 = yes, 1 = no
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 0, *Homo* 0
Refs: Manners-Smith (1912), Warwick & Williams (1973)

131. Peroneal artery takes origin from posterior tibial artery
States: 0 = yes, 1 = no
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 0
Refs: Manners-Smith (1912), Glidden & De Garis (1936), Warwick & Williams (1973)

132. Digital branches of deep plantar arch to adjacent sides of digits II and III
States: 0 = present, 1 = variable, 2 = absent
Type: Ordered
Dist: *Hylobates* 0, *Pongo* 2, *Gorilla* 0, *Pan* 1, *Homo* 0
Refs: Manners-Smith (1912), Glidden & De Garis (1936), Warwick & Williams (1973)

133. Lateral plantar artery dominant
States: 0 = no, 1 = variable, 2 = yes
Type: Ordered
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 2, *Pan* 1, *Homo* 2
Refs: Popowsky (1895), Manners-Smith (1912), Sonntag (1924a), Warwick & Williams (1973)

134. Inferior medial and inferior lateral genicular branches of popliteal artery
States: 0 = present, 1 = absent
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 0, *Homo* 0
Refs: Popowsky (1895), Manners-Smith (1912), Sonntag (1923), Glidden & De Garis (1936), Warwick & Williams (1973)

135. Medial femoral circumflex artery may originate from profunda femoris
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Brown (1881), Eisler (1890), Popowsky (1895), Manners-Smith (1912), Glidden & De Garis (1936), Swindler & Wood (1973), Warwick & Williams (1973)

136. Three or more perforating branches of profunda femoris
States: 0 = no, 1 = yes
Type: Binary

Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 0, *Homo* 1
Refs: Manners-Smith (1912), Pira (1914), Sonntag (1924a), Glidden & De Garis (1936), Warwick & Williams (1973)

137. Muscular branches of profunda femoris for hamstrings
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Sonntag (1923), Warwick & Williams (1973)

138. Muscular branches of profunda femoris for quadriceps
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Dwight (1895), Manners-Smith (1908), Sonntag (1923, 1924a), Glidden & De Garis (1936), Warwick & Williams (1973)

NERVES

Forelimb (Characters 139–147)

139. Number of digits supplied by median nerve
States: 0 = normally two and a half, 1 = normally three and a half
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 1
Refs: Chapman (1878), Hepburn (1892), Sonntag (1924a), Raven (1950), Warwick & Williams (1973)

140. Number of digits supplied by radial nerve
States: 0 = normally one and a half, 1 = normally two and a half
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 0, *Homo* 1
Refs: Hepburn (1892), Sonntag (1924a), Raven (1950), Warwick & Williams (1973)

141. Gangliform enlargement at junction of radial and posterior interosseous nerves
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Champneys (1872), Warwick & Williams (1973)

142. Axillary nerve innervates subscapularis
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 0, *Homo* 0
Refs: Hepburn (1892), Sonntag (1924a)

143. Origin of axillary nerve
States: 0 = C5-7, 1 = C5-8, 2 = C5-8 and T1
Type: Ordered
Dist: *Hylobates* 1, *Pongo* 1, *Gorilla* 2, *Pan* 2, *Homo* 0
Refs: Champneys (1872), Miller (1934), Glidden & De Garis (1936), Raven (1950), Warwick & Williams (1973)

144. Number of lumbricals innervated by ulnar nerve
States: 0 = normally one, 1 = normally two, 2 = normally three
Type: Ordered
Dist: *Hylobates* 1, *Pongo* 1, *Gorilla* 2, *Pan* 0, *Homo* 1
Refs: Hepburn (1892), Sonntag (1924a), Warwick & Williams (1973)

145. Ulnar nerve may innervate flexor pollicis brevis
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Hepburn (1892), Warwick & Williams (1973)

146. Ulnar nerve normally supplies hypothenar muscles
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Sonntag (1923, 1924a), Warwick & Williams (1973)

147. Origin of subscapular nerves
States: 0 = C5, C6, 1 = C5-7, 2 = C5-8, 3 = C5-8 and T1
Type: Ordered
Dist: *Hylobates* 2, *Pongo* 1, *Gorilla* 3, *Pan* 3, *Homo* 0
Refs: Sonntag (1923), Miller (1934), Glidden & De Garis (1936), Raven (1950), Warwick & Williams (1973)

Trunk (Character 148)

148. Psoas minor innervated by femoral nerve
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 1
Refs: Champneys (1872), Hepburn (1892), Sigmon (1974), Warwick & Williams (1973)

Hindlimb (Characters 149–158)

149. Lateral cutaneous nerve of thigh may originate from L1 and L2
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 0
Refs: Champneys (1872), Hepburn (1892), Bolk (1921), Sonntag (1923, 1924a), Warwick & Williams (1973)

150. Femoral nerve origination
States: 0 = L2-4, 1 = variable (L2-4 or L1-3), 2 = L1-3
Type: Ordered
Dist: *Hylobates* 0, *Pongo* 2, *Gorilla* 0, *Pan* 1, *Homo* 0
Refs: Champneys (1872), Hepburn (1892), Bolk (1921), Sonntag (1923, 1924a) Warwick & Williams (1973)

151. Genitofemoral nerve origination from L2
States: 0 = yes, 1 = no
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 0
Refs: Bischoff (1879/1880), Kohlbrügge (1892, 1897), Kubik (1967), Jacobs et al. (1984), Dixson (1987)

152. Genitofemoral nerve may pass lateral to psoas major
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 0
Refs: Bischoff (1879/1880), Machida & Giacometti (1967), Jacobs et al. (1984), Dixson (1987)

153. Obturator nerve origination from L1
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 0
Refs: Champneys (1872), Hepburn (1892), Bolk (1921), Sonntag (1923, 1924a), Raven (1950), Warwick & Williams (1973)

154. Muscular branches of obturator nerve may include pectineus
States: 0 = no, 1 = yes
Type: Binary

Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Champneys (1872), Hepburn (1892), Sonntag (1923), Raven (1950), Warwick & Williams (1973), Sigmon (1974), Hamada (1985)

155. Muscular branches of medial plantar nerve
States: 0 = one medial lumbrical, 1 = two medial lumbricals, 2 = two medial lumbricals and adductor hallucis
Type: Ordered
Dist: *Hylobates* 1, *Pongo* 2, *Gorilla* 0, *Pan* 2, *Homo* 0
Refs: Champneys (1872), Hepburn (1892), Sonntag (1923, 1924a), Raven (1950), Warwick & Williams (1973)

156. Number of digital branches of lateral plantar nerve
States: 0 = one and a half, 1 = two and a half
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 1, *Homo* 0
Refs: Hepburn (1892), Raven (1950), Warwick & Williams (1973)

157. Muscular branches of tibial nerve includes flexor digitorum longus
State: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 1
Refs: Hepburn (1892), Sonntag (1924a), Raven (1950), Miller (1952), Warwick & Williams (1973)

158. Superficial peroneal nerve supplies medial side of digit II
States: 0 = yes, 1 = no
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Ruge (1878a), Hepburn (1892), Sonntag (1923, 1924a), Raven (1950), Warwick & Williams (1973)

MISCELLANEOUS

Skin (Characters 159–162)

159. Average body hair density
States: 0 = high, 1 = moderate, 2 = low
Type: Ordered
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 2, *Homo* 2
Refs: Schultz (1921)

160. Sternal glands
States: 0 = present, 1 = absent
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 1
Refs: Schultz (1921), Pocock (1925), Pocock (1944), Wislocki & Schultz (1925), Weber & Abel (1928), Brandes (1939), Parakkal et al. (1962), Sprankel (1962), Montagna & Ellis (1963), Montagna & Yun (1963), Montagna (1972, 1985), Geissmann (1986, 1987)

161. Ratio of nipple position to horizontal height index of nipple position
States: 0 = 2.6, 1 = 1.7–1.8, 2 = 1.0–1.1
Type: Ordered
Dist: *Hylobates* 0, *Pongo* 2, *Gorilla* 1, *Pan* 1, *Homo* 2
Refs: Schultz (1936)

162. Axillary organ
States: 0 = absent, 1 = present
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 1
Refs: Brinkman (1909, 1923/4), Schiefferdecker (1922), Klaar (1924), Van Gelderen (1926), Straus (1950), Parakkal et al. (1962), Montagna (1985), Geissmann (1987)

Urogenital System (Characters 163–171)

163. Bulbospongiosus origination from ischial ramus
States: 0 = yes, 1 = no
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 0, *Homo* 1
Refs: Elftman (1932), Delrich (1978)

164. Bulbospongiosus origination from perineal body
States: 0 = no, 1 = variable, 2 = yes
Type: Ordered
Dist: *Hylobates* 0, *Pongo* 2, *Gorilla* 1, *Pan* 0, *Homo* 2
Refs: Elftman (1932), Raven (1950)

165. Penile spines normally present
States: 0 = yes, 1 = no
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 1, *Pan* 0, *Homo* 1
Refs: De Pousargues (1895), Pohl (1928), Harrison-Matthews (1946), Hill (1946/7), Hill & Harrison-Matthews (1949, 1950), Warwick & Williams (1973), Dahl (1988)

166. Ventral groove in glans penis
States: 0 = present, 1 = absent
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Duvernoy (1855/6), Raven (1950), Hill & Kanagasuntheram (1959), Sonntag (1924a)

167. Scrotum normally postpenial
States: 0 = no, 1 = yes
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Selenka (1903), De Beaux (1917), Miller (1933), Wislocki (1936), Harrison-Matthews (1946), Hill & Harrison-Matthews (1949), Hill (1958), Hill & Kanagasuntheram (1959), Warwick & Williams (1973)

168. Dependency of scrotum
States: 0 = nondependent, 1 = nondependant or semidependent, 2 = semidependent or dependent, 3 = dependent
Type: Ordered
Dist: *Hylobates* 1, *Pongo* 0, *Gorilla* 0, *Pan* 2, *Homo* 3
Refs: Hartmann (1885), Chapman (1878), Ehlers (1881), Klaatsch (1890), Kohlbrügge (1892), Welch (1911), de Beaux (1917), Sonntag (1924a, 1924b), Pocock (1925), Wood-Jones (1929), Wislocki (1933, 1936), Goss (1947), Miller (1947), Hill & Harrison-Matthews (1949), Raven (1950), Steiner (1954), Warwick & Williams (1973)

169. Relative testes size (ratio of observed/predicted body testes size)
States: $0 \leq 0.4$, $1 \geq 0.4$
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Schultz (1938)

170. Urethral papilla

States: 0 = present, 1 = absent
Type: Binary
Dist: *Hylobates* 0, *Pongo* 1, *Gorilla* 0, *Pan* 1, *Homo* 1
Refs: Bolk (1907), Wislocki (1932), Harrison-Matthews (1946), Atkinson & Elftman (1950), Hill (1951), Machida & Giacometti (1967), Dahl & Nadler (1992a, 1992b)

171. Transverse rugae of vagina

States: 0 = little developed, 1 = well developed
Type: Binary
Dist: *Hylobates* 0, *Pongo* 0, *Gorilla* 1, *Pan* 1, *Homo* 1
Refs: Deniker (1885), Gerhardt (1906), Sonntag (1923), Wislocki (1932), Dempsey (1940), Atkinson & Elftman (1950)