*J. Anat.* (2002) **200**, pp3–49

**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*

Accepted for publication *8 August 2001*

**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

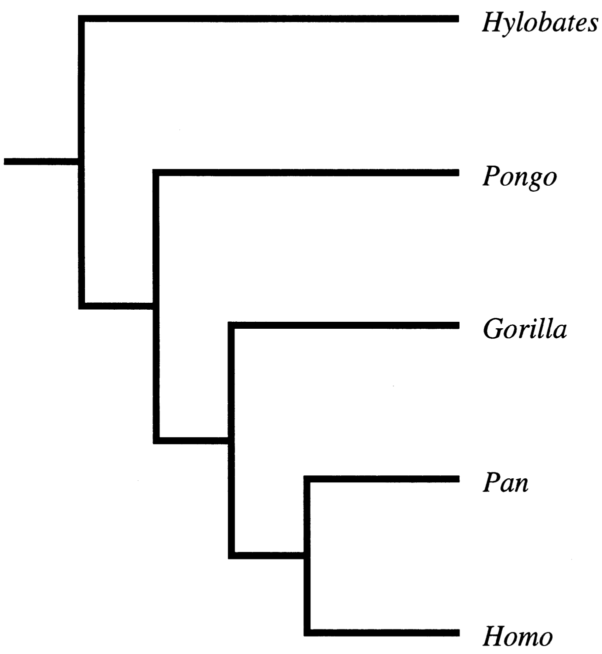


**Fig. 1** Hominoid molecular relationships.

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.

## Acknowledgements

This study would not have been possible without the award of an Anatomical Society of Great Britain and Ireland studentship to S.G. M.C. was funded by a Wellcome Trust Bioarchaeology Fellowship award. B.W.'s initial participation was supported by The Leverhulme Trust, and is now funded by The Henry Luce Foundation. We thank Michael Günther, John Shaw-Dunn, David Pilbeam and an anonymous referee for their advice and comments. Lastly, we would like to express our gratitude to Matt Cartmill, whose meticulous reviewing did much to improve the paper.

## References

**Adachi B** (1900) Anatomische Untersuchungen an Japanern. III. Muskelvarietaten. *Z. Anthropol*. **2**, 211–222.

**Anderton JC** (1988) Anomalies and atavisms in appendicular myology. In: *Orang-Utan Biology* (ed. Schwartz JH), pp. 331–345. Oxford: Oxford University Press.

**Andrews P** (1987) Aspects of Hominoid phylogeny. In: *Molecules and Morphology in Evolution: Conflict or Compromise?* (ed. Patterson C), pp. 23–53. Cambridge: Cambridge University Press.

**Andrews P, Martin L** (1987) Cladistic relationships of extant and fossil hominoids. *J. Human Evol*. **16**, 101–118.

**Andrews P** (1992) Evolution and environment in the Hominoidea. *Nature* **360**, 641–646.

**Andrews P, Groves CP** (1976) Gibbons and brachiation. In: *Gibbon and Siamang*, Vol. 4 (ed. Rumbaugh DM), pp. 167–218. Basel: Karger.

**Appleton AB** (1922) On the hypotrochanteric fossa and accessory adductor groove of the primate femur. *J. Anat. Physiol*. **56**, 295–306.

**Atkinson WB, Elftman H** (1950) Female reproductive system of the gorilla. In: *The Anatomy of the Gorilla* (ed. Gregory WK), pp. 205–211. New York: Columbia University Press.

**Avril C** (1963) cited in Jordan (1971b).

**Aziz MA, Dunlap SS** (1986) The human extensor digitorum profundus muscle with comments on the evolution of the primate hand. *Primates* **27** (3), 293–319.

**Baillie J, Groombridge B, eds** (1996) *IUCN Red List of Threatened Animals*. Washington, DC: IUCN Conservation International.

**Barriel V** (1997) *Pan paniscus* and hominoid phylogeny: morphological data, molecular data and 'total evidence'. *Folia Primatologica* **68**, 50–56.

**Beddard FE** (1893) Contributions to the anatomy of the anthropoid apes. *Trans. Zool. Soc. London* **13**, 177–218.

**Berry RJA, Newton HAS** (1908) A study of the superficial veins of the superior extremity in 300 living subjects. *Anat. Anzeiger* **33**, 591–601.

**Bischoff TLW** (1870) Beiträge zur Anatomie des *Hylobates leuciscus* and zu einer vergleichenden Anatomie der Muskeln der Affen und des Menschen. *Abhandlungen Baierische akademie der wissenschaften München. Mathematisch-Physikalische Klass* **10**, 197–297.

**Bischoff TLW** (1879/80) Vergleichende anatomische Untersuchungen über die äusseren weiblichen Geschlechts- und Begattungsorgane des Menschen und der Affen, insbesondere der Anthropoiden. *Abhandlungen Baierische akademie der wissenschaften München. Mathematisch-Physikalische Klass* **13**, 207–274.

**Blumenbach JF** (1795) *De Generis Humanii Varietate Nature*, 3rd edn. Gottingen: Vandenhoek and Ruprecht. Cited in Bendyshe T. (ed. transl.) The Anthropological Treatises of Johann Friedrich Blumenbach (1865), 69–143, London: Longman, Green, Longman, Roberts and Green.

**Bolk L** (1907) Beiträge zur Affen-Anatomie – VI. Zur Entwicklung und vergleichenden Anatomie des Tractus Urethrovaginalis der Primaten. *Z. Anthropol*. **10**, 250–316.

**Bolk L** (1921) The relations between the ductless glands and evolution of the Primates. *Lancet* 588–592.

**Bontius J** (1658) Historiae naturalis et medicae Indiae orientalis libri sex. In: *G. Piso, de Indiae Utriusque Re Naturali et Medica, Libri Quatuordecim*. Elzevirium: Amsterdam.

**Bouchet A** (1973) Contribution à l'étude anatomique de la veine céphalique du bras. *Compt. R. Assoc. Anat*. **154**, 971–985.

**Bowen-Jones E** (1998) A review of the commercial bushmeat trade with emphasis on Central/West Africa and the great apes. *African Primates* **3**, s1–s42.

**Boyer EL** (1935) The musculature of the inferior extremity of the orang-utan *Simia satyrus*. *Am. J. Anat* **56**, 192–256.

**Brandes G** (1939) *Buschi. Vom Orang-Säugling zum Backenwülster*. Leipzig: Quelle und Meyer.

**Brinkman A** (1923) cited in Straus (1950).

**Brinkmann A** (1909) Über das Vorkommen von Hautdrüsenorganen bei den anthropomorphen Affen. *Anat. Anzeiger* **34**, 513–520.

**Brooks HSJ** (1887) On the short muscles of the pollex and hallux of the anthropoid apes, with special reference to the opponens hallucis. *J. Anat. Physiol*. **22**, 78–95.

**Brown JM** (1881) The femoral artery in apes. *J. Anat. Physiol*. **15**, 523–535.

**Buffon GLL** (1780) *Natural History, General and Particular* (English translation of Buffon [1766] Histoire Naturelle, Générale et Particulière by W Smelbie), Vol. 8. Edinburgh: WM Creech.

**Camper P** (1782) *Naturkundige verhandelbingen over den Orang-Outang; en eenige andere Aapsoorten. Over den Ehinoceros met den dubbelen horen; en over het Rendierr*. Amsterdam: Meijer and Wamars.

**Camper P** (1799) Account of the organs of speech of the Orang Outang. *Phil. Trans. Roy. Soc*. **69**, 139–159.

**Champneys F** (1872) On the muscles and nerves of a chimpanzee (*Troglodytes niger*) and a cynocephalus anubis. *J. Anat. Physiol*. **6**, 176–211.

**Chapman HC** (1878) On the structure of the gorilla. *Proc. Zool. Soc. London*, 385–394.

**Chapman HC** (1879) On the structure of the chimpanzee. *Proc. Zool. Soc. London* 52–63.

**Chapman HC** (1880) On the structure of the orang outang. *Proc. Zool. Soc. London* 160–174.

**Church WS** (1861/2) On the myology of the orang utang (*Simia morio*). *Natural History Rev*. **1**, 510–516; 2, 89–94, 414–423.

**Collard M, Wood BA** (2000) How reliable are human phylogenetic hypotheses? *Proc. Natl Acad. Sci. USA* **97**, 5003–5006.

**Corruccini RS** (1994) How certain are hominoid phylogenies? The role of confidence intervals in cladistics. In: *Integrative Approaches to the Past: Paleoanthropological Advances in Honor of F. Clark Howell* (eds Corruccini RS, Ciochon RL), pp. 167–183. Englewood Cliffs, NJ: Prentice Hall.

**Dahl JF** (1988) External genitalia. In: *Orang-Utan Biology* (ed. Schwartz JH), pp. 133–144. New York: Oxford University Press.

**Dahl JF, Nadler RD** (1992a) Genital swelling in females of the monogamous gibbon, *Hylobates (H.) lar*. *Am. J. Phys. Anthropol*. **89**, 101–108.

**Dahl JF, Nadler RD** (1992b) The external genitalia of female gibbons, *Hylobates (H.) lar*. *Anat. Record* **232**, 572–578.

**Day MH, Napier J** (1963) The functional significance of the deep head of flexor pollicis brevis in primates. *Folia Primatologica* **1**, 122–134.

**De Beaux O** (1917) Sul pene digli antropomorfi. *Giornale Per Morfologia Dell' Uomo E Dei Primati* **1**, 222–227.

**De Garis CF** (1941) The aortic arch in primates. *Am. J. Phys. Anthropol*. **28**, 41–74.

**De Pousargues E** (1895) Note sur l'appareil génital male des orang-outans. *Nouvelles Arch. Muséum Natl D'histoire Naturelle (Paris)* **7**, 56–82.

**Delrich TM** (1978) Pelvic and perineal anatomy of the male gorilla: selected observations. *Anat. Record* **191**, 433–446.

**Dempsey EW** (1940) The structure of the reproductive tract in the female gibbon. *Am. J. Anat*. **57**, 229–254.

**Deniker J** (1885/6) Recherches anatomiques et embryologiques sur les singes anthropoides. Foetus de gorille et de gibbon. *Arch. Zool. Expérimentale Génerale* **3**, 1–265.

**Dixson HF** (1987) Observations on the evolution of the genitalia and copulatory behaviour in male primates. *J. Zool*. **213**, 423–443.

**Duckworth WLH** (1898) Note on a foetus of *Gorilla savagei*. *J. Anat* **33**, 82–90.

**Duckworth WLH** (1912) On some points in the anatomy of the plica vocalis. *J. Anat. Physiol*. **47**, 80–111.

**Duvernoy M** (1855/6) Des caractères anatomiques de grands singes pseudo-anthropomorphes. *Arch. Muséum Natl D'histoire Naturelle (Paris)* **8**, 1–248.

**Dwight T** (1895) Notes on the dissection and brain of the chimpanzee 'Gumbo'. *Mem. Boston Soc. Natural History* (A.K.A. Boston Journal of Natural History), **5**, 31–51.

**Ehlers E** (1881) Beiträge zur Kenntnis des Gorilla und Chimpanse. *K. Gesellschaft Wissenschaften Göttingen* **28**, 3–77.

**Eisler P** (1890) *Das Gefäss- und periphere Nervensystem des Gorilla*. Halle: Tausch and Grosse.

**Eisler P** (1895) Die Homologie der Extremitaeten. *Abhandlungen Naturforshcende Gesellschaft Halle* **19**, 87–346.

**Elftman HO** (1932) The evolution of the pelvic floor of primates. *Am. J. Anat*. **51**, 307–346.

**Elftman H, Atkinson WB** (1950) The abdominal viscera of the gorilla. In: *The Anatomy of the Gorilla* (ed. Gregory WK), pp. 197–201. New York: Columbia University Press.

**Felsenstein J** (1985) Confidence limits on phylogenetics: an approach using the bootstrap. *Evolution* **39**, 783–791.

**Fick R** (1895a) Vergleichend-anatomische Studien an einem erwachsenen Orang-utang. *Anatomische Abteilung des Archives für Anatomie und Physiologie* 1–100.

**Fick R** (1895b) Beobachtungen an einem zweiten erwachsenen Orang-utang und einem Schimpansen. *Anatomische Abteilung des Archives für Anatomie und Physiologie* 289–318.

**Flower WH** (1872) Lectures on the comparative anatomy of the organs of digestion of the Mammalia. *The Med. Times Gazette* **62**, 334–337, 392–394.

**Frey H** (1913) Der Musculus triceps surae in der Primatenreihe. *Morph. Jahrb*. **47**, 1–192.

**Geissmann T** (1986) Mate change enhances duetting activity in the siamang gibbon (*Hylobates syndactylus*). *Behaviour* **96**, 17–27.

**Geissmann T** (1987) A sternal gland in the Siamang gibbon. *Int. J. Primatol*. **8**, 1–15.

**Gerhardt U** (1906) Die Morphologie des Urogenitalsystems eines weiblichen Gorilla. *Z. Gesammten Naturewissenschaften* **41**, 632–654.

**Gibbs S** (1999) Comparative soft tissue morphology of the extant Hominoidea, including Man. Thesis, The University of Liverpool.

**Gibbs S, Collard M, Wood BA** (2000) Soft-tissue characters in higher primate phylogenetics. *Proc. Natl Acad. Sci. USA* **97**, 11130–11132.

**Glidden EM, De Garis CF** (1936) Arteries of the chimpanzee. I. The aortic arch; II. Arteries of the upper extremity; III. The descending aorta; IV. Arteries of the lower extremity. *Am. J. Anat* **58**, 501–527.

**Goodman M** (1963) Man's place in the phylogeny of the primates as reflected in serum proteins. In: *Classification and Human Evolution* (Washburn SL, ed.), pp. 204–234. Chicago: Aldine.

**Goodman M, Bailey WJ, Hayasaka K, Stanhope MJ, Slighton J, Czelusniak J** (1994) Molecular evidence on primate phylogeny from DNA sequences. *Am. J. Phys. Anthropol*. **94**, 3–24.

**Goss LJ** (1947) The external genitalia of the gorilla, *Gorilla gorilla gorilla* (Savage and Wyman). *Zoologica N.Y*. **32**, 97–98.

**Gray JE** (1825) Outline of an attempt at the disposition of the Mammalia into tribes and families with a list of the genera apparently appertaining to each tribe. *Ann. Phil. N. S*. **10**, 337–344.

**Groves CP** (1986) Systematics of the great apes. In: *Comparative Primate Biology*, Vol. 1*: Systematics, Evolution and Anatomy* (eds Swindler DR, Erwin J), pp. 187–217. New York: Alan R. Liss.

**Groves CP** (1987) Monkey business with Red Apes. *J. Human Evol*. **16**, 537–542.

**Hall LM, Slee E, Jones DS** (1995) Overcoming polymerase chain-reaction inhibition in old animal tissue using ethidium bromide. *Anal. Biochem*. **225**, 169–172.

**Hamada Y** (1985) Primate hip and thigh muscles: comparative anatomy and dry weights. In: *Primate Morphophysiology, Locomotor Analyses and Human Bipedalism* (ed. Kondo S), pp. 131–152. Tokyo: University of Tokyo Press.

**Harrison T** (1993) Cladistic concepts and the species problem in hominoid evolution. In: *Species, Species Concepts, and Primate Evolution* (eds Kimbel WH, Martin LB), pp. 346–371. New York: Plenum Press.

**Harrison-Matthews L** (1946) Notes on the genital anatomy and physiology of the gibbon (*Hylobates*). *Proc. Zool. Soc. London* **116**, 339–364.

**Hartman SE** (1988) A cladistic analysis of hominoid molars. *J. Human Evol*. **17**, 489–502.

**Hartmann R** (1885) *Anthropoid Apes*. London: Kegan Paul, Trench.

**Hecker P** (1922) Formation du peronier anterieur chez un chimpanzee. *Arch. Anat. Histol. Embryol*. **1**, 147–155.

**Hepburn D** (1892) The comparative anatomy of the muscles and nerves of the superior and inferior extremities of the anthropoid apes. *J. Anat. Physiol*. **26**, 149–186, 324–356.

**Hill WCO** (1946/7) Note on the male external genitalia of the chimpanzee. *Proc. Zool. Soc. London* **116**, 129–133.

**Hill WCO** (1949) Some points in the enteric anatomy of the great apes. *Proc. Zool. Soc. London* **119**, 19–32.

**Hill WCO, Harrison-Matthews L** (1949) The male external genitalia of the gorilla, with remarks on the os penis of other Hominoidea. *Proc. Zool. Soc. London* **119**, 363–378.

**Hill WCO, Harrison-Matthews L** (1950) Supplementary note on the male external genitalia of *Gorilla*. *Proc. Zool. Soc. London* **120**, 311–316.

**Hill WCO** (1951) The external genitalia of the female chimpanzee; with observations on the mammary apparatus. *Proc. Zool. Soc. London* **121**, 133–145.

**Hill WCO** (1958) Pharynx, oesophagus, stomach, small and large intestine: form and position. *Primatologia* **3**, 139–207.

**Hill WCO, Kanagasuntheram R** (1959) The male reproductive organs in certain gibbons (Hylobatidae). *Am. J. Phys. Anthropol*. **17**, 227–241.

**Hillis DM, Bull. JJ** (1993) An empirical test of bootstrapping as a method for assessing confidence in phylogenetic analysis. *Syst. Biol*. **42**, 182–192.

**Hilloowala RA** (1980) The migrating omohyoid muscle – its significance? *J. Human Evol*. **9**, 165–172.

**Hofer HO, Schultz AH, Starck D, eds** (1956) Primatologia. *Handbuch der Primatenkunde*. Basel: Karger.

**Hofer HO** (1970) The glandula apicis linguae in *Pan troglodytes*. *Folia Primatologica* **12**, 38–41.

**Hosokawa H, Kamiya T** (1961) Anatomical sketches of visceral organs of the mountain gorilla (*Gorilla gorilla beringei*). *Primates* **3**, 1–28.

**Humphry GM** (1866/7) On some points in the anatomy of the chimpanzee. *J. Anat. Physiol*. **1**, 254–268.

**Hunter JP, Jernvall J** (1995) The hypocone as a key innovation in mammalian evolution. *Proc. Natl Acad. Sci. USA* **92**, 10718–10722.

**Huxley TH** (1864) Lectures on the structure and classification of the Mammalia. *The Med. Times Gazette* **1**, 564–565.

**Jacobs SC, Beehler BA, Boese G, Story MT, Clowry LJ, Lawson RK** (1984) The prostate of the gorilla. *Prostate* **5**, 597–603.

**Jernvall J** (2000) Linking development with generation of novelty in mammalian teeth. *Proc. Natl Acad. Sci. USA* **97**, 2641–2645.

**Jordan J** (1971a) Studies on the structure of the organ of voice and vocalization in the chimpanzee. Part 1. *Folia Morph*. **30**, 99–117.

**Jordan J** (1971b) Studies on the structure of the organ of voice and vocalization in the chimpanzee. Part 3. *Folia Morph*. **30**, 323–340.

**Jungers WL, Meldrum DJ, Stern Jnr JT** (1993) The functional and evolutionary significance of the human peroneus tertius muscle. *J. Hum. Evol*. **25**, 377–386.

**Kaneff A** (1986) Die Aufrichtung des Menschen und die morphologisches Evolution der Musculi extensores digitorum pedis unter dem Gesichtpunkt der evolutiven Myologie. Teil I. *Morph Jahrb* **132**, 375–419.

**Kaplan EB** (1958) The iliotibial tract. Clinical and morphological significance. *J. Bone Jt. Surg*. **40A**, 817–832.

**Keith A** (1894) Notes on a theory to account for the various arrangements of the flexor profundus digitorum in the hand and foot of primates. *J. Anat. Physiol*. **28**, 335–339.

**Keith A** (1895) The modes of origin of the carotid and subclavian arteries from the arch of the aorta in some of the higher primates. *J. Anat. Physiol*. **29**, 453–458.

**Keith A** (1896) A variation that occurs in the manubrium sterni of higher primates. *J. Anat. Physiol*. **30**, 275–279.

**Keith A** (1923) The adaptational machinery concerned in the evolution of man's body. *Nature* **112**, 257–268.

**Kelemen G** (1948) The anatomical basis of phonation in the chimpanzee. *J. Morph*. **82**, 229–256.

**Kimura K, Takahashi Y** (1985) The peroneus tertius muscle in the crab-eating monkey (*Macaca fascicularis*). *Okajimas Folia Anat. Jpn*. **62**, 173–186.

**Klaar J** (1924) Über die axillaren Knäueldrüsen der Affen. *Z Anat Entwicklungsgeschichte* **72**, 609–627.

**Klaatsch H** (1890) Über den Descensus testiculorum. *Morph. Jahrb*. **16**, 587–646.

**Kluge AG** (1983) Cladistics and the classification of the great apes. In: *New Interpretations of Ape and Human Ancestry* (eds Ciochon RL, Corruccini RS), pp. 151–171. New York: Plenum Press.

**Kohlbrügge JHF** (1890/91) Versuch einer anatomie des Genus *Hylobates*. Muskeln und periphere Nerven. *Zool. Ergebnisse Einer Reise Niederländisch Ost-Indien* **1**, 211–354; 2, 138–206.

**Kohlbrügge JHF** (1892) Versuch einer Anatomie des Genus *Hylobates*. *Zool. Ergebnisse Einer Reise Niederländisch Ost-Indien* **2**, 185–186.

**Kohlbrügge JHF** (1897) Muskeln und Periphere Nerven der Primaten, mit besonderer Berücksichtigung ihrer Anomalien. *Verhandelingen der K. academie van wetenschappen* Section 2, **5**, 1–246.

**Köntges G, Lumsden A** (1996) Rhombencephalic neural crest segmentation is preserved throughout craniofacial ontogeny. *Development* **122**, 3229–3242.

**Körner O** (1884) Beiträge zur vergleichenden Anatomie und Physiologie des Kehlkopfes der Säugethiere und des Menschen. *Wissenschafteiche Mitt Senckenbergischen Naturforschenden* **13**, 147–261.

**Kubik W** (1967) The pancreatic ducts in lower primates. *Folia Morph*. **26**, 226–242.

**Kumakura H** (1989) Functional analysis of the biceps femoris muscle during locomotor behavior in some primates. *Am. J. Phys Anthropol*. **79**, 379–391.

**Landsmeer JMF** (1986) A comparison of fingers and hand in *Varanus*, opposum and primates. *Acta Morph. Neerlando-Scandinavica* **24**, 193–221.

**Larson SG, Stern JT** (1986) EMG of scapulohumeral muscles in the chimpanzee during reaching and 'arboreal' locomotion. *Am. J. Anat*. **176**, 171–190.

**Larson SG, Stern JT, Jungers WL** (1991) EMG of serratus anterior and trapezius in the chimpanzee: scapular rotators revisited. *Am. J. Phys Anthropol*. **85**, 71–84.

**Le Comte LD** (1697) *Noveaux Mémores sur L'état Présent de la China*, II, pp. 361–364. Amsterdam.

**Le Double F** (1897) *Traité des variations du système musculaire de l'homme et de leur signification au point de vue de l'anthropologie zoologique*, I et II. Paris: Librairie C.Reinwald.

**Lewis OJ** (1962) The comparative morphology of M. flexor accessorius and the associated long flexor tendons. *J. Anat*. **96**, 321–333.

**Lewis OJ** (1964a) The evolution of the long flexor muscles of the leg and foot. In: *International Review of General and Experimental Zoology* (eds Felts WJL, Harrison RJ), pp. 165–185. New York: Academic Press.

**Lewis OJ** (1966) The phylogeny of the cruropedal extensor musculature with special reference to the primates. *J. Anat*. **100**, 865–880.

**Lieberman DE** (2000) Ontogeny. homology and phylogeny in the hominid craniofacial skeleton: the problem of the browridge. In: *Development, Growth and Evolution* (eds O'Higgins P, Cohn MJ), pp. 85–122. London: Linnean Society.

**Loth E** (1912) Beiträge zur Anthropologie der Negerweichteile (Muskelsystem). *Studien Forschen zur Menschen-Völkerkunde, Stuttgart* **9**, 1–254.

**Loth E** (1931) *Anthropologie des parties molles (muscles, intestins, vaisseaux, nerfs peripheriques)*. Paris: Mianowski-Masson et Cie.

**MacAlister A** (1871) On some points in the myology of the chimpanzee and of the primates. *Annu. Magazine Natural History* **7**, 341–351.

**MacAlister A** (1873) The muscular anatomy of the gorilla. *Proc. Royal Irish Acad*. **11**, 501–506.

**MacDowell EC** (1910) Notes on the myology of *Anthropopithecus niger* and *Papio-thoth ibeanus*. *Am. J. Anat*. **10**, 431–460.

**MacHado AB, Didio LJ** (1967) Frequency of the musculus palmaris longus studied *in vivo* in some Amazon indians. *Am. J. Phys Anthropol*. **27**, 11–20.

**MacHida H, Giacometti L** (1967) The anatomical and histochemical properties on the skin of the external genitalia of the primates. *Folia Primatol*. **6**, 48–69.

**Mangini U** (1960) Flexor pollicis longus muscle. Its morphology and clinical significance. *J. Bone Jt. Surg*. **42A**, 467–470.

**Manners-Smith T** (1908) A study of the cuboid and os peroneum in the primate foot. *J. Anat. Physiol*. **42**, 397–414.

**Manners-Smith T** (1910a) The limb arteries of primates. (Part I). *J. Anat. Physiol*. **44**, 271–302.

**Manners-Smith T** (1910b) The limb arteries of primates. (Part I Cont.). *J. Anat. Physiol*. **45**, 23–64.

**Manners-Smith T** (1912) The limb arteries of primates. (Part I Concl.) *J. Anat. Physiol*. **46**, 95–172.

**Marzke MW, Wullstein KL, Viegas SF** (1992) Evolution of the power ('squeeze') grip and its morphological correlates in hominids. *Am. J. Phys. Anthropol*. **89**, 283–298.

**Michaëlis P** (1903) Beiträge zur vergleichenden Myologie des *Cynocephalus babuin*, *Simia satyrus*, *Troglodytes niger*. *Archiv Anat. Physiol*. 205–256.

**Miller GS Jr** (1933) The classification of gibbons. *J. Mammal* **14**, 158–159.

**Miller RA** (1934) Comparative studies upon the morphology and distribution of the brachial plexus. *Am. J. Anat*. **54**, 143–175.

**Miller RA** (1947) The inguinal canal of primates. *Am. J. Anat*. **76**, 67–87.

**Miller RA** (1952) The musculature of *Pan paniscus*. *Am. J. Anat*. **91**, 182–232.

**Montagna W, Ellis RA** (1963) New approaches to the skin of primates. In: *Evolutionary and Genetic Biology of Primates*, Vol. 1 (ed. Buettnner-Jansch J), pp. 179–196. New York: Academic Press.

**Montagna W, Yun JS** (1963) The skin of primates. XV. The skin of the chimpanzee (*Pan satyrus*). *Am. J. Phys Anthropol*. **21**, 189–204.

**Montagna W** (1972) The skin of nonhuman primates. *Am. Zool*. **12**, 109–121.

**Montagna W** (1985) The evolution of human skin. *J. Human Evol*. **14**, 3–22.

**Morton DJ** (1922) Evolution of the human foot. Part 1. *Am. J. Phys. Anthropol*. **5**, 305–336.

**Müller E** (1903) Beiträge zur Morphologie des Gefasssystems. I. Die Armarterien des Menschen. *Anat. Hefte. 1. Abt. Arbeiten Aus Anat Instn*. **22**, 279–574.

**Müller E** (1905) Beiträge zur Morphologie des Gefasssystems. II. Die Armarterien des Säugetiere. *Anat Hefte. 1. Abt. Arbeiten Aus Anat Instn*. **27**, 73–241.

**Nowak RM** (1991) *Walker's Mammals of the World*, 5th edn. Baltimore: Johns. Hopkins University Press.

**Nuttall GHF** (1904) *Blood Immunity and Blood Relationship*. Cambridge: Cambridge University Press.

**Oppenheimer W** (1931) Die Zunge des Orang-Utan. *Morph. Jahrb*. **69**, 62–97.

**Owen R** (1830/1) On the anatomy of the orangutan (*Simia satyrus*, L.). *Proc. Zool. Soc. London* **1**, 4–5, 9–10, 28–29, 66–72.

**Owen R** (1843) Notes of the dissection of a female orang-utan (*Simia satyrus*, Linn.). *Proc. Zool. Soc. London* **11**, 123–124.

**Owen R** (1846) Notes on the dissection of a female chimpanzee. *Proc. Zool. Soc. London* **14**, 2–3.

**Owen R** (1849) Osteological contributions to the natural history of the chimpanzees (*Troglodytes*, Geoffroy) including the description of the skull of a large species (*Troglodytes gorilla*, Savage) discovered by Thomas S. Savage, MD in the Gabon country, West Africa. *Trans. Zool. Soc. Lond*. **3**, 381–422.

**Owen R** (1859) On the gorilla (*Troglodytes gorilla*, Sav.). *Proceedings of the Zool. Soc. Lond*. 1–23.

**Owen R** (1865) *Memoir on the gorilla (Troglodytes gorilla, Savage)*. London: Taylor, Francis.

**Oxnard CE** (1987) *Fossils, Teeth and Sex: New Perspectives on Human Evolution*. Hong Kong: Hong Kong University Press.

**Page SL, Goodman M** (2001) Catarrhine phylogeny: noncoding DNA evidence for a diphyletic origin of the mangabeys and for a human-chimpanzee clade. *Mol. Phylo. Evol*. **18**, 14–25.

**Parakkal P, Montagna W, Ellis RA** (1962) The skin of primates. XI. The skin of the white-browed gibbon (*Hylobates hoolock*). *Anat. Record* **143**, 169–177.

**Parsons FG** (1898) The muscles of mammals, with special relation to human myology. Lecture 1 – The skin muscles and muscles of the head and neck. *J. Anat. Physiol*. **32**, 428–450.

**Patterson C, ed.** (1987) *Molecules and Morphology in Evolution. Conflict or Compromise?* Cambridge: Cambridge University Press.

**Pilbeam DR** (1996) Genetic and morphological records of the Hominoidea and hominid origins: a synthesis. *Mol. Phylogeny Evol*. **5**, 155–168.

**Pira A** (1914) Beiträge zur Anatomie des Gorilla. I. Das Extremitätenmuskelsystem. *Morph. Jahrb*. **48**, 167–238.

**Platzer W** (1971) The blood vessels of the chimpanzee. In: *Behaviour, Growth, and Pathology of Chimpanzees* (ed. Bourne GH), pp. 325–348. Basel: Karger.

**Pocock RI** (1925) The external characters of the Catarrhine monkeys and apes. *Proc. Zool. Soc. London*, 1479–1579.

**Pocock RI** (1944) Pectoral gland in apes and monkeys. *Nature* **153**, 381.

**Pohl L** (1928) Zur Morphologie der männlichen Kopulationsorgane der Säugetiere; inbesondere der Versuch einer vergleichend-anatomischen Studie über den Penis der Primaten. *Einschliesslich des Menschen. Z Anat Entwicklungsgeschichte* **86**, 71–119.

**Popowsky J** (1895) Das Arteriensystem der unteren Extremitäten bei den Primaten. *Anat. Anzeiger* **10**, 55–80, 99–114.

**Prejzner-Morawska A, Urbanowicz M** (1971) The biceps femoris muscle in lemurs and monkeys. *Folia Morph*. **30**, 465–482.

**Primrose A** (1899) The anatomy of the Orang-outang (*Simia satyrus*), an account of some of its external characteristics; and the myology of the extremities. *Trans. Royal Can. Inst*. **6**, 507–594.

**Raven HC** (1950) Regional anatomy of the Gorilla. In: *The Anatomy of the Gorilla* (ed. Gregory WK), pp. 15–188. New York: Columbia University Press.

**Robinson JT, Freedman L, Sigmon BA** (1972) Some aspects of pongid and hominid bipedality. *J. Human Evol*. **1**, 361–369.

**Rolleston G** (1868) On the homologues of certain muscles. *Trans. Linnean Soc. London* **26**.

**Rommel C** (1981) Sublingual structures of primates. II. Hominoidea, review, summary and literature. *Morph. Jahrb*. **127**, 421–251.

**Rózycki S** (1922) Cited in Urbanowicz and Prejzner-Morawska (1972).

**Ruch TC** (1941) *Bibliographia Primatologica. A Classified Bibliography of Primates other than Man. Part 1*. Springfield: Charles C. Thomas.

**Ruge G** (1878a) Zur vergleichenden Anatomie der tiefen Muskeln in der Fussohle. *Morph. Jahrb*. **4**, 644–659.

**Ruge G** (1978b) Zur vergleichenden Anatomie der tiefen Muskeln in der Fussohle. *Morphol. Jahrb*. **4**, 644–659.

**Ruvolo M** (1997) Molecular phylogeny of the hominoids: inference from multiple independent DNA sequence data sets. *Mol. Biol. Evol*. **14**, 248–265.

**Sanderson MJ** (1995) Objections to bootstrapping phylogenies: a critique. *Syst. Biol*. **44**, 299–320.

**Sandifort G** (1840) Ontleedkundige beschouwing van een′ volwassen Orang-oetan (*Simia satyrus*, Linn.) van het mannelijk geslacht. Verhandelingen over de Natuurlijke geschiedenis der Nederlandische overzeesche bezittingen, door de leden der Natuurkundige commissie in Indië en andere. *Schrijvers (Zoologie)* **3**, 29–56.

**Sarich VM** (1967) Rates of albumin evolution in primates. *Proc. Natl. Acad. Sci*. **58**, 142–148.

**Sarich VM** (1968) Immunological time scale for hominid evolution. *Science* **158**, 1200.

**Savage TS, Wyman J** (1847) Notice of the external characters and habits of *Troglodytes gorilla*, a new species of orang from the Gaboon River. *Mem. Boston Soc. Natural History* (A.K.A. Boston Journal of Natural History), **5**, 417–443.

**Schiefferdecker P** (1922) Die Hautdrüsen des Menschen und der Säugetiere, ihre biologische und rassenanatomische Bedeutung, sowie die Muscularis sexualis. *Zool. New York* **27**, 1–154.

**Schneider R** (1958) Zunge und weicher Gaumen. *Primatologia* **III/1**, 61–126.

**Schultz AH** (1921) The occurrence of a sternal gland in orang-utan. *J. Mammal* **2**, 194–196.

**Schultz AH** (1936) Characters common to higher primates and characters specific for man. *Q. Rev. Biol*. **11**, 259–283, 425–455.

**Schultz AH** (1938) The relative weight of the testes in primates. *Anat. Record* **72**, 387–394.

**Schwartz JH** (1984a) On the evolutionary relationships of humans and orang-utans. *Nature* **308**, 501–505.

**Schwartz JH** (1984b) Hominoid evolution: a review and a reassessment. *Current Anthropol*. **25**, 655–672.

**Schwartz JH** (1988) *Orang-Utan Biology*. New York: Oxford University Press.

**Selenka E** (1903) *Zur vergleichenden Keimgeschichte der Primaten*. Studien über Entwicklungsgeschichte, Heft 10. Menschenaffen, Entwicklung des Gibbon (*Hylobates* und *Siamang*), 163–201.

**Shoshani J, Groves CP, Simons EL, Gunnell GF** (1996) Primate phylogeny: morphological vs. molecular results. *Mol Phylogeny Evol*. **5**, 101–153.

**Sigmon BA** (1974) A functional analysis of pongid hip and thigh musculature. *J. Human Evol*. **3**, 161–185.

**Singh SP, Ekandem GJ, Bose S** (1982) A study of the superficial veins of the cubital fossa in Nigerian subjects. *Acta Anat*. **114**, 317–320.

**Sommer A** (1907) Das Muskelsystem des Gorilla. *Jena Z. Naturwiss*. **42**, 181–308.

**Sonntag CF** (1921) The comparative anatomy of the tongues of the Mammalia. II. Family 1. Simiidae. *Proc. Zool. Soc. London* **20**, 1–29.

**Sonntag CF** (1923) On the anatomy, physiology, and pathology of the chimpanzee. *Proc. Zool. Soc. London* **23**, 323–429.

**Sonntag CF** (1924a) On the anatomy, physiology, and pathology of the orang-outan. *Proc. Zool. Soc. London* **24**, 349–450.

**Sonntag CF** (1924b) *The Morphology and Evolution of the Apes and Man*. London: John Bale Sons and Danielsson, Ltd.

**Sperino G** (1897) *Anatomia Del Cimpanzè (Anthropopithecus Troglodytes)*. Torino: Unione Tipografica.

**Sprankel H** (1962) Histologie und biologische Bedeutung eines jugulo-sternalen Duftdrüsenfeldes bei *Tupaia glis* Diard 1820. *Verh. Dtsch. Zool. Ges. Saarbrucken* 198–206.

**Steiner PE** (1954) Anatomical observations in a *Gorilla gorilla*. *Am. J. Phys. Anthropol*. **12**, 145–165.

**Stern JT** (1972) Anatomical and functional specializations of the human gluteus maximus. *Am. J. Phys. Anthropol*. **36**, 315–340.

**Stern JT, Wells JP, Jungers WL, Vangor AK, Fleagle JG** (1980) An electromyographic study of the pectoralis major in atelines and *Hylobates* with special reference to the evolution of a pars clavicularis. *Am. J. Phys. Anthropol*. **52**, 13–25.

**Straus WL Jr** (1941a) The phylogeny of the human forearm extensors. *Human Biol*. **13**, 23–50.

**Straus WL** (1941b) The phylogeny of the forearm extensors (concluded). *Human Biol*. **13**, 203–238.

**Straus WL Jr** (1950) Microscopic anatomy of the gorilla skin. In: *The Anatomy of the Gorilla* (ed. Gregory WK), pp. 213–227. New York: Columbia University Press.

**Sullivan WE, Osgood CW** (1927) The musculature of the superior extremity of the orang-utan, *Simia satyrus*. *Anat. Record* **35**, 193–239.

**Sutton JB** (1883) On some points in the anatomy of the chimpanzee (*Anthropopithecus troglodytes*). *J. Anat. Physiol*. **18**, 66–85.

**Swindler DR, Wood CD** (1973) *An Atlas of Primate Gross Anatomy; Baboon, Chimpanzee, and Man*. Seattle: University of Washington Press.

**Swofford DL** (1998) *PAUP*. Phylogenetic Analysis Using Parsimony (*and Other Methods)*, Version 4. Sunderland, MA: Sinauer.

**Tappen NC** (1955) Relative weights of some functionally important muscles of the thigh, hip and leg in a gibbon and in man. *Am. J. Phys. Anthropol*. **13**, 415–420.

**Terry RJ** (1942) Absence of the superior gemellus muscle in American whites and Negroes. *Am. J. Phys. Anthropol*. **29**, 47–56.

**Thiranagama R, Chamberlain AT, Wood BA** (1989a) Valves in superficial limb veins of humans and nonhuman primates. *Clin. Anat*. **2**, 135–145.

**Thiranagama R, Chamberlain AT, Wood BA** (1989b) The comparative anatomy of the forelimb veins of primates. *J. Anat*. **164**, 131–144.

**Thiranagama R, Chamberlain AT, Wood BA** (1991) Character phylogeny of the primate forelimb superficial venous system. *Folia Primatologica* **57**, 181–190.

**Thorpe SKS, Crompton RH, Günther MM, Ker RF, Alexander RM** (1999) Dimensions and moment arms of the hind- and forelimb muscles of common chimpanzees (*Pan troglodytes*). *Am. J. Phys. Anthropol* **110**, 179–199.

**Traill TS** (1818) Observations on the anatomy of the orang outang. *J. Phys. Chim. Nat. Hist. Nat*. **86**, 313–314.

**Traill TS** (1821) Observations on the anatomy of the orang outang. *Mem. Wernerian Natural History Society, Edinburgh* **3**, 1–49.

**Tulp N** (1641) *Observationum Medicarum, Libre Tres*, pp. 274–279. Cited in Yerkes and Yerkes (1929).

**Tuttle RH** (1969) Quantitative and functional studies on the hands of the Anthropoidea. *J. Morph*. **128**, 309–364.

**Tyson E** (1699) *Orang-utan, sive Homo Sylvestris: or, The anatomy of a pygmie compared with that of a monkey, an ape and a man. To which is added, a philological essay concerning the pygmies, the cynocephali, the satyrs, and sphinges of the ancients. Wherein It Will Appear That They Are All Either Apes or Monkeys, and Not Men, as Formerly Pretended*. London: Bennet.

**Urbanowicz M, Prejzner-Morawska A** (1972) The triceps surae muscle in chimpanzees. *Folia Morph*. **31**, 433–440.

**Van Gelderen JJ** (1926) Einige Mitteilungen über das Achselhöhlenorgan des Chimpanse. *Anat. Anzeiger* **61**, 407–409.

**Vesalius A** (1543) *De Humani Corporis Fabrica Libri Septem* (Book 1, translated by WF Richardson and JB Carman, 1998, pp. 1–416). San Francisco: Norman Publishing.

**Vrolik W** (1841) *Recherches D'anatomie Comparée, Sur le Chimpansé*. Amsterdam: Johannes Miller.

**Wagenseil F** (1936) Untersuchungen über die Muskulatur der Chinesen. *Z. Morph. Anthropologie* **36**, 39–150.

**Warwick P, Williams PL** (1973) *Gray's Anatomy*, 35th British Edition. Philadelphia: Saunders Co.

**Warwick R, Brookes M** (1989) *Nomina Anatomica*, 6th edn, pp. A4–A94. Edinburgh: Churchill Livingstone.

**Washburn SL** (1950) Thoracic viscera of the gorilla. In: *The Anatomy of the Gorilla* (ed. Gregory WK), pp. 189–195. New York: Columbia University Press.

**Weber M, Abel O** (1928) *Die Säugetiere. Einführung in die Anatomie und Systematik der recenten und fossilen Mammalia*. 2, Systematischer Teil, 2nd edn. Jena: Fischer.

**Welch FD** (1911) Observations on different gibbons of the genus *Hylobates* now or recently living in the Society's Gardens, and on *Symphalangus syndactylus*, with notes on skins in the Natural History Museum, S. Kensington. *Proc. Zool. Soc. London* 353–358.

**Wilder B** (1862) Contributions to the comparative myology of the chimpanzee. *Boston J. Natural History* **6**, 352–384.

**Wislocki GB, Schultz AH** (1925) On the nature of modifications of the skin in the sternal region of certain primates. *J. Mammal* **6**, 236–244.

**Wislocki GB** (1932) On the female reproductive tract of the gorilla with a comparison with that of other primates. *Contributions Embryol*. **23**, 163–204.

**Wislocki GB** (1933) Observations on the descent of the testes in the Macaque and in the chimpanzee. *Anat. Record* **57**, 133–148.

**Wislocki GB** (1936) The external genitalia of the simian primates. *Human Biol*. **8**, 309–347.

**Wood J** (1864) On some varieties in human myology. *Proc. Royal Soc*. **13**, 299–303.

**Wood J** (1865) Additional varieties in human myology. *Proc. Royal Soc*. **14**, 379–393.

**Wood J** (1866) Variations in human myology observed during the Winter Session of 1865–6 at King's College. *London. Proc. Royal Soc*. **15**, 229–244.

**Wood J** (1867a) On human muscular variations and their relation to comparative anatomy. *J. Anat. Physiol*. **1**, 44–59.

**Wood J** (1867b) Variations in human myology observed during the Winter Session of 1866–7 at King's College London. *Proc. Royal Soc*. **15**, 518–545.

**Wood J** (1868) Variations in human myology observed during the Winter Session of 1867–8 at King's College London. *Proc. Royal Soc*. **16**, 483–525.

**Wood-Jones F** (1929) *Man's Place Among the Mammals*. London: Longman, Green.

**Wright NL** (1969) Dissection study and mensuration of the human aortic arch. *J. Anat*. **104**, 377–385.

**Yerkes RM, Yerkes AW** (1929) *The Great Apes. A Study of Anthropoid Life*. New Haven: Yale University Press.

**Ziegler AC** (1964) Brachiating adaptations of chimpanzee upper limb musculature. *Am. J. Phys. Anthropol*. **22**, 15–32.

**Zuckerkandl E, Jones RT, Pauling L** (1960) A comparison of animal hemoglobins by tryptic peptide pattern analysis. *Proc. Natl Acad. Sci. USA* **46**, 1349–1360.

**Zuckerkandl E** (1963) Perspectives in molecular anthropology. In: *Classification and Human Evolution* (ed. Washburn SL), pp. 243–272. Chicago: Aldine.

**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 | | | | |

| Structure | *Pan* | *Gorilla* | *Pongo* | *Hylobates* |
|---|---|---|---|---|
| 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) | | | | |
| 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) | * | * | * | * |

| Structure | *Pan* | *Gorilla* | *Pongo* | *Hylobates* |
|---|---|---|---|---|
| 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) | * | * | * | |

| Structure | *Pan* | *Gorilla* | *Pongo* | *Hylobates* |
|---|---|---|---|---|
| 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) | | * | | |
| 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 | * | | * | * |
| 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) | | | | |
| 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)