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Comparative skeletal anatomy of the Human, Rabbits and Horses

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Abstract : This paper looks upon the comparative skeletal difference between three different members of the class Mammalia. When different animals of the same class are looked upon, the bone positioning and count ratio are similar in some spheres. Human anatomy was taken as the primary reference in this study. The three mammals taken in the study are human (*Homo sapiens*), European Rabbits (*Oryctolagus cuniculus*) and Horse (*Equus caballus*). Despite being the members of the same class, evolution led to the current difference in three. Survival conditions and habitat have also played a dominant role in the bone count or number. The skeletal difference was majorly noticed in the bone number and density.

Key words: Bones, mammals, skeletal system, density

INTRODUCTION

The skeleton is the body part that provides support, shape, and protection to delicate organs and soft tissues of animals. There are many different skeletal types, the first being the exoskeleton (stable outer shell of an organism), the second one being the endoskeleton (the support structure inside the body), the hydro skeleton (flexible skeleton supported by fluid pressure) and the cytoskeleton which present in the cytoplasm of all the existent cells in the world. The skeletal system of mammals is divided into two planes namely axial plane bones and appendicular plane bones. Axial plane bones consist of all the bones in the head and trunk. It mainly consists of the braincase (cranium) and the backbone and ribs, and it serves primarily to protect the central nervous system. Appendicular plane bones consist of all the bones in upper and lower spheres mainly limbs and their girdles. The different planes have a different number of bones in each subcategory. All the 6,595 of the recognized mammalian species reflect common features including anatomy. The

animals referred to in the study reflect each plane in them clearly. The mammalian skeletal system shows several advances over that of lower vertebrates.

Bones develop and grow differently in mammals. Growth of bones happens in parts of cartilage between epiphyses (The rounded end of a long bone) and diaphysis (The tubular shaft that runs between the proximal and distal ends of the bone). Mammalian skeletal growth is definitive, once the actively growing part of cartilage degenerates, growth in length stops. Just like all bony vertebrates, of course, there is a continual renewal of bone throughout life. The epiphyseal ossification has an advantage because the bones have strong articular (joint correlating) surfaces before the skeleton becomes mature. In general, the skeleton of the adult mammal has less structural cartilage than that of a reptile. Besides, there are skeletal portions derived from the gills of primitive vertebrates, termed as the visceral skeleton. Visceral elements in the mammalian skeleton include the Hyoid Apparatus supporting the tongue, the auditory ossicles of the middle ear, and jaws. The axial skeleton under the cranium part in mammals generally has remained intact during the course of evolution. The vast majority of mammals have seven cervical vertebrae (in the neck), there are few exceptions like the

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Sloth (Folivora). Thoracic vertebrae consist of ribs and are variable in number. The anterior ribs converge toward the ventral midline to join with the sternum, breastbone, forming a semirigid thoracic cup for the protection of the lungs and heart. Behind the thoracic region are the lumbar vertebrae, they range from 3 to 21 in number. The two main cervical vertebrae are the atlas and axis. Joints of these two bones allow complex movements of the head on the trunk Mammals have no lumbar ribs. Caudal (tail) vertebrae range from 5 to 50 (fused elements of the human coccyx). The skull of mammals differs markedly from that of reptiles because of the size and functioning of the brain. This information makes our way further into the discussion.

DISCUSSION

Comparative study

The subcategories given below have detailed information on the endoskeletal structure of each considered species. After studying the comparative analysis of the animal's skeletal system a graph has been drafted to depict the difference clearly.

Human (*Homo sapiens*)

The skeletal system is our body's central framework. It consists of bones and connective tissue, including cartilage, tendons, and ligaments. But the main focus we're undertaking is on bones. Bones provide the structure to our body. The adult human skeleton is made up of 206 bones. These include the bones of the skull, spine (vertebrae), ribs, arms, and legs. Bones are made of connective tissue reinforced with calcium and specialized bone cells. Most bones also contain bone marrow, where blood cells are made. Bones work with muscles and joints to hold our bodies together and support freedom of movement. This is called the musculoskeletal system. The skeleton supports and shapes the body and protects delicate internal organs such as the brain, heart, and lungs. Bones contain most of our body's calcium supply. The normal ranges for bone mineral density are 0.96-1.39 g/cm³ for women and 0.92-1.35 g/cm³ for men. The skeleton makes up about 30-40% of an adult's body mass. The skeleton's mass is made up of a non-living bone matrix and many tiny bone cells. Roughly half of the bone matrix's mass is water, while the other half is collagen protein and solid crystals of calcium carbonate and calcium phosphate.

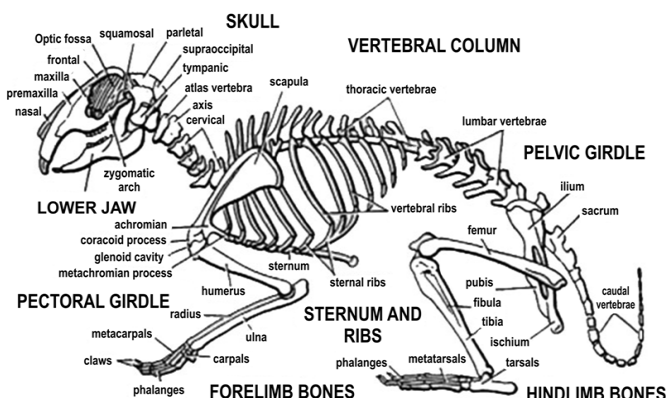
Table 1. The list of all the bones in human body with locations in their respective planes.

Human Body (206)			
Axial Skeleton (80)		Appendicular Skeleton (126)	
Skull 28	Torso 52	Upper Extremity 32 x 2 = 64	Lower Extremity 31 x 2 = 62
Paired Bones (11 x 2 = 22)	Paired Bones (12 x 2 = 24)	1. Scapula	1. Hip (Ilium, Ischium, Pubis)
1. Nasal	1. Rib 1	2. Clavicle	2. Femur
2. Lacrimal	2. Rib 2	3. Humerus	3. Patella
3. Inferior Nasal Concha	3. Rib 3	4. Radius	4. Tibia
4. Maxillary	4. Rib 4	5. Ulna	5. Fibula
5. Zygomatic	5. Rib 5	6. Scaphoid	6. Talus
6. Temporal	6. Rib 6	7. Lunate	7. Calcaneus
7. Palatine	7. Rib 7	8. Triquetrum	8. Navicular
8. Parietal	8. Rib 8 (False)	9. Pisiform	9. Medial Cuneiform
9. Malleus	9. Rib 9 (False)	10. Hamate	10. Middle Cuneiform
10. Incus	10. Rib 10 (False)	11. Capitate	11. Lateral Cuneiform
	11. Rib 11 (Floating)	12. Trapezoid	12. Cuboid
	12. Rib 12 (Floating)	13. Trapezium	13. Metatarsal 1
1. Frontal	1. Hyoid	14. Metacarpal 1	14. Proximal Phalange 1
2. Ethmoid	2. Sternum	15. Proximal Phalange 1	15. Distal Phalange 1
3. Vomer	3. Cervical Vertebrae 1 (atlas)	16. Distal Phalange 1	16. Metatarsal 2
4. Sphenoid	4. C2 (axis)	17. Metacarpal 2	17. Proximal Phalange 2
5. Mandible	5. C3	18. Proximal Phalange 2	18. Middle Phalange 2
6. Occipital	6. C4	19. Middle Phalange 2	19. Distal Phalange 2
	7. C5	20. Distal Phalange 2	20. Metatarsal 3
	8. C6	21. Metacarpal 3	21. Proximal Phalange 3
	9. C7	22. Proximal Phalange 3	22. Middle Phalange 3
	10. Thoracic Vertebrae 1	23. Middle Phalange 3	23. Distal Phalange 3
	11. T2	24. Distal Phalange 3	24. Metatarsal 4
	12. T3	25. Metacarpal 4	25. Proximal Phalange 4
	13. T4	26. Proximal Phalange 4	26. Middle Phalange 4
	14. T5	27. Middle Phalange 4	27. Distal Phalange 4
	15. T6	28. Distal Phalange 4	28. Metatarsal 5
	16. T7	29. Metacarpal 5	29. Proximal Phalange 5
	17. T8	30. Proximal Phalange 5	30. Middle Phalange 5
	18. T9	31. Middle Phalange 5	31. Distal Phalange 5
	19. T10	32. Distal Phalange 5	
	20. T11		
	21. T12		
	22. Lumbar Vertebrae 1		
	23. L2		
	24. L3		
	25. L4		
	26. L5		
	27. Sacrum		
	28. Coccyx		

Rabbit (*Oryctolagus cuniculus*)

The endoskeleton of the rabbit is chiefly formed of bone and the cartilaginous part is very little. Since there is a general tendency to increase in the size of the brain, the skull has a short posterior cranial part for lodging the brain and the long anterior facial part comprising mainly the jaws. In higher mammals, the facial part lies below the cranial part. A zygomatic arch on either side of the skull is formed by squamosal, jugal, and maxillary bones. The various bones constituting the cranium can be grouped into three segments, a posterior occipital segment, middle parietal segment, and anterior frontal segment. Basis phenoid is a flat, median triangular cartilage bone. Its apex joins anteriorly with the presphenoid and its broad posterior end is connected with the basioccipital by a thin plate of cartilage. It is a small, median wedge-like, triangular bone on the dorsal side in between parietals and supraoccipital. The parietal bones are a pair of thin, slightly arched bones protecting the dorsolateral brain. It is roughly a rectangular bone situated ventral to parietal on either side. The vertebral column of rabbit, like that of birds and lizards, is differentiated into the following five regions. The total number of vertebrae in the rabbit is about 45-47. The pectoral girdle consists of two separate halves placed dorsal to the anterior thoracic ribs in between the forelimbs, it supports forelimbs and protects the soft parts of the body from the ventral side. The bone of the upper arm is the humerus, which is a long bone having a proximal large rounded head for the articulation in the glenoid cavity of the scapula. The bones of the forearm are radius and ulna which are closely held together at the two ends so that they cannot move over each other. The wrist bones or carpals are 9 small bones arranged in two rows. The bone density of rabbits is around 1400 mg/cm³.

Rabbit Skeleton



Horse (*Equus caballus*)

The horse's body contains 205 bones. The smooth alignment of these bones decides the horse's speed, movement, mechanics, and efficiency. The bones of the horse skeleton are held together with ligaments, tendons, and muscles. When the skeleton structure is in true aligned proportioned the joints work smoothly. One bone works about another. If the angle at which these bones are working is compromised, the joint becomes overstressed and injury to the tendons and ligaments become more likely. There are two main parts to the horses' skeleton, axial and appendicular. The axial skeleton protects the horse's vital parts and includes the skull, the ribcage, and the backbone. The appendicular skeleton supports the body and consists of the shoulders, pelvis, hind legs, and forelegs. The vertebral column usually contains 54 bones. The skull consists of 34 bones and contains four cavities (the cranial cavity, the orbital cavity, oral, and the nasal cavity). Bones of the lower limb, present in both the front and hind legs, include the Cannon bone, Splint bones, proximal sesamoid bones, long pastern (proximal or 1st phalanx), short pastern (middle or 2nd phalanx), coffin bones (distal or 3rd phalanx), and navicular bones (distal sesamoid). This is of particular significance in young horses, which at birth have a bone density of about 17%. This increases to about 74% at a year of age. Furthermore, bone is continually remodelling and adapting to periods of exercise and rest until horses reach skeletal maturity at the age of five to six years.

Table 2. The difference chart

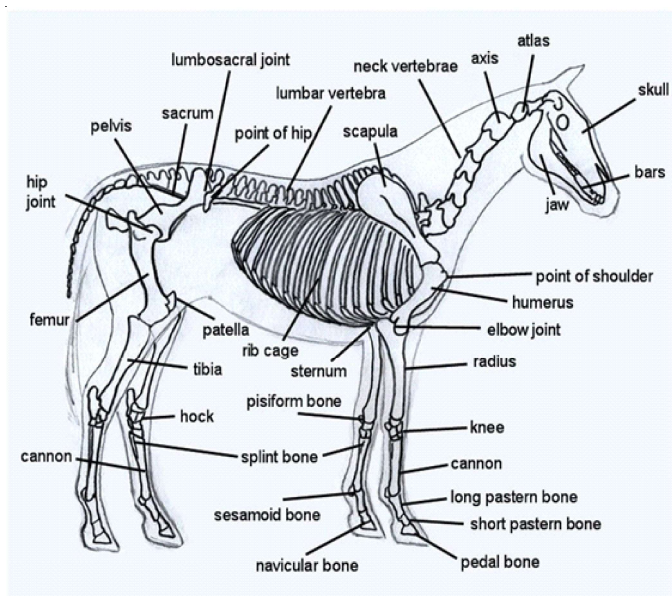
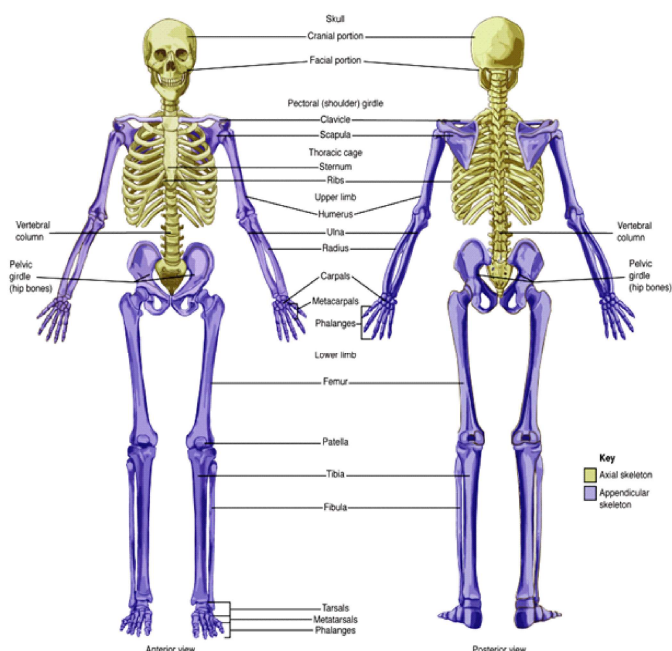
	Human	Rabbit	Horse
Number of Bones	206	260	205
Axial Plane Bones	80	132	88
Appendicular Plane Bones	126	128	117

Common features in all three:-

1. Skulls contain around 29 bones that make the cranium, face, and ears of mammals.
2. The rib cage of the mammalian skeleton protects the heart, lungs and in larger mammals it supports the abdomen.
3. The pelvis connects the spine to the legs and can be used to identify the sex of a mammal.
4. Arms include the humerus, radius, and ulna bones plus the bones of the wrist and hand.
5. The leg bones are the femur, tibia, and fibula plus the tassels, metatarsals, and phalanges of the ankle and foot.

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