
Chapter 4

APPENDICULAR SKELETON

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- Digits

OVERVIEW OF APPENDICULAR SKELETON

THORACIC LIMB		PELVIC LIMB	
Part of Limb	Bones	Part of Limb	Bones
Thoracic (shoulder) girdle	Scapula, clavicle, coracoid	Pelvic girdle	Sacrum, os coxae, few coccygeal vertebrae
Brachium (arm)	Humerus	Thigh	Femur
Antebrachium (forearm)	Radius, ulna	Crus (true leg)	Tibia, fibula

Carpus (knee)	Carpal bones	Tarsus (hock)	Tarsal bones
Metacarpus (cannon and splint bones)	Metacarpal bones	Metacarpus (cannon and splint bones)	Metatarsal bones
Phalanges (digits)	Proximal, middle, and distal phalanges	Phalanges (digits)	Proximal, middle, and distal phalanges
	Proximal and distal sesamoid bones		Proximal and distal sesamoid bones

INTRODUCTION TO THE THORACIC LIMB

The thoracic limb consists of four chief segments, viz., the shoulder girdle, the arm, the forearm, and the manus.

1. SHOULDER GIRDLE

The shoulder girdle, when fully developed, consists of three bones__ i) **Scapula** (or shoulder-blade) ii) **Coracoid** iii) **Clavicle**.

In the domesticated mammals only the scapula, a large flat bone, is well developed, and the small coracoid element has fused with it, while the clavicle is either absent or is a small rudiment embedded in the brachiocephalic muscle. Therefore, there is no articulation of the shoulder with the axial skeleton.

2. ARM

The arm contains a single large bone, the **humerus** (or arm bone).

3. FOREARM

In the forearm are two bones, the **radius** and **ulna**. These vary in relative size and mobility.

4. MENUS

The manus, the homologue of the hand in man, consists of three subdivisions;

a) CARPUS

It is popularly termed the “knee” in animals. It contains a group of short bones, the ossa *carpi*. These are typically seven in number and are arranged in two transverse rows __ a proximal and a distal row.

b) METACARPUS

It contains typically three metacarpal bones; of which third and fourth metacarpals are fused to form a large bone and the fifth one is a separate small bone (splint bone).

c) DIGITS

In goat, four digits are present. Out of these four, only two; **THIRD (III)** and **FOURTH (IV)** are fully developed and has three *phalanges* and three *sesamoids* each.

BONES OF THE THORACIC LIMB

Scapula

CLASSIFICATION: Flat bone

LOCATION: The scapula covers the cranial part of the lateral thoracic wall.

DESCRIPTION

Scapula is roughly triangular in outline. It is wider at dorsal end and narrow at ventral end. It has two surfaces, three borders, and three angles.

THE SURFACES

The **LATERAL SURFACE** has a spine of scapula and two fossae. The *spine* increases gradually in height dorso-ventrally and inclines cranially. Its free edge is rough and is in the greater part subcutaneous. Spine divides the lateral surface into two unequal fossae i.e. supraspinous and infraspinous. The *supraspinous fossa* is located cranially and is narrower. The *infraspinous fossa* is situated caudally and is wider. The *acromion process* is short and blunt and is opposite to the neck of scapula.

The **COSTAL OR MEDIAL SURFACE** is hollowed in its length by the *subscapular fossa*, which is deep and has a rough area. The rough triangular area dorsal to it is, the *facies serrata*, which are not distinct. However it larger and quadrilateral cranially, narrow and marginal caudally.

THE BORDERS

The **CRANIAL (ANTERIOR) BORDER** is thin and sharp. It is convex dorsally and concave distally.

The **CAUDAL (POSTERIOR) BORDER** is straight and thick proximally while the slight concave distally. The *nutrient foramen* is usually in the ventral third of the caudal border.

The **DORSAL BORDER** is rough, thick, straight, and porous and bears a band of scapular cartilage.

THE ANGLES

The **CRANIAL ANGLE** lies at the junction of the cranial and dorsal border and is opposite to the first thoracic spine.

The **CAUDAL ANGLE** is formed by the junction of the caudal and dorsal border. It lies dorsal to the vertebral end of the fourth rib.

The **GLENOID ANGLE** is long and thick. It lies at a point just cranial to the sternal end of the first rib in the ordinary standing position. The *neck* is well-defined and narrow. The *glenoid cavity* is continued cranially upon the ventral surface of the *supra-glenoid tubercle*. It is bent & bears a small *coracoid process* projecting from its medial surface.

MUSCLE ATTACHMENT

Bony Feature	Muscles originated	Muscles inserted
Tuber spinae	----	Trapezius Omo-transversarius
Serrated facies	----	Serratus ventralis
Scapular cartilage	----	Rhomboideus
Subscapular fossa	Subscapularis	----
Acromion process	Deltoideus	----
Coracoid process	Coracobrachialis	----
Supraspinous fossa	Supraspinatus	----
Infraspinous fossa	Infraspinatus	----
Caudal border	Teres major Teres minor Tensor fascia antibrachii Triceps brachii (long head)	----
Supraglenoid tubercle	Biceps brachii	----

Humerus

CLASSIFICATION: Long bone

LOCATION: It lies between the scapula and the radius, ulna.

DESCRIPTION

Humerus is a long and slender bone which extends from the shoulder proximally where it articulates with the scapula to the elbow distally, where it articulates with the radius and ulna.

It is directed obliquely, distally and caudally. It consists of a shaft (body) and two extremities.

THE SHAFT

It is irregularly cylindrical and has a twisted appearance. It may describe as having four surfaces.

The **LATERAL SURFACE** is smooth and spirally curved forming the *musculo-spiral (brachialis) groove*, which contains the brachialis muscle. The groove is continuous with the caudal surface proximally and distally where it winds around cranially.

The **MEDIAL SURFACE** is nearly straight in its length, rounded from side to side and blends with the cranial and caudal surfaces. Just proximal to its middle is the *teres major tuberosity*.

The **CRANIAL SURFACE** is triangular wide and smooth proximally, narrow and smooth distally. It is separated from the lateral surface by a distinct border, the *crest of the humerus*, which bears proximal to its middle, the *deltoid tuberosity*.

The **CAUDAL SURFACE** is rounded from side to side and smooth in its length. It is concave in proximal half and convex in distal half along its long axis.

THE PROXIMAL EXTREMITY

It consists of the head, neck, two tuberosities and inter-tuberal groove.

The **HEAD** presents an almost circular convex articular surface, which is twice as extensive as the glenoid cavity of the scapula, with which it articulates.

The **NECK** is well-defined caudally but is practically absent elsewhere.

The **GREATER TUBERCLE** (lateral tuberosity) is placed cranio-laterally and consists of two parts; the cranial part forms the lateral boundary of the inter-tuberal groove, which curves medially over the inter-tuberal groove. The caudal part gives attachment to the short insertion of infraspinatus.

The **LESSER TUBERCLE** (medial tuberosity) is less salient and consists of cranial and caudal parts. The cranial part forms the medial boundary of the inter-tuberal groove. The caudal part gives attach-ment to the subscapularis M.

The **INTER-TUBERAL OR BICIPITAL GROOVE** is deflected cranio-medially; it is bounded by the cranial parts of the tubercles. The groove is covered in the fresh state by cartilage and lodges the tendon of origin of the biceps brachii muscle.

THE DISTAL EXTREMITY

The **DISTAL EXTREMITY** or **HUMERAL CONDYLE** in conformity is decidedly oblique; it consists of the lateral and medial epicondyles, the olecranon and radial fossae. It has sagittal surface for articulation with the radius and ulna, which consists of the trochlea medially and the capitulum laterally.

The **DISTAL GROOVES** and **RIDGES** are very well marked.

The **TROCHLEA** is much the larger, on the cranial part of which there is usually a synovial fossa. Caudally the groove extends proximally, considerably proximal to the rest of the articular surface and reaches the olecranon fossa. This part articulates with the trochlear notch of the ulna.

The lateral portion of the **CAPITULUM** is larger and is placed somewhat more proximal and further caudally.

The **RADIAL FOSSA** is situated cranially, proximal to the groove on the trochlea.

The **OLECRANON FOSSA** is quite deep and situated caudally between the epicondyles; in to which the anconeal process of the ulna projects. Both the fossae (radial and olecranon) are deep and wide.

The **LATERAL** and **MEDIAL EPICONDYLES** are two thick ridges present caudally proximal to the trochlea. The medial epicondyle is more salient. The lateral epicondyle bears laterally, the epicondyloid crest, which forms the lateral boundary of the musculo-spiral groove. The nutrient foramen is usually present on the said crest, at the junction of the middle and distal third of the shaft.

MUSCLE ATTACHMENT

Bony Feature	Muscles Originated	Muscles Inserted
Greater tubercle	---	Infraspinatus
Lesser tubercle	---	Subscapularis
		Superficial pectoral

Ant. part of proximal tuberosities.	---	Supraspinatus
Deltoid tuberosity	Triceps brachii (lateral head)	Deltoideus Teres major
Teres major tuberosity	---	Teres major Latissimus dorsi Coraco-brachialis
Crest of humerus	---	Deep pectoral Brachiocephalicus
Medial surface of shaft	Triceps brachii (medial head)	
Caudal surface of shaft	Brachialis	---
Lateral condyloid crest	Extensor carpi radialis	---
Olecranon fossa (bony edge)	Anconeus	---
Lateral epicondyle	Common digital extensor Lateral digital extensor Ulnaris lateralis	---
Medial epicondyle	Pronator teres Flexor carpi radialis Flexor carpi ulnaris Superficial digital flexor Deep digital flexor (humeral)	---

Radius

CLASSIFICATION: Long bone

LOCATION: It lies between the humerus and the carpus. It is fused to the ulna along with two interosseus spaces.

DESCRIPTION

The radius is smaller of the two bones of the forearm. It extends in an oblique direction from the elbow. The distal end or trochlea is being nearer the median plane than the proximal end. It is gently curved; the convexity is being the cranial. It consists of a shaft and two extremities.

THE SHAFT

It is curved in its length, somewhat flattened cranio-laterally and widened at its both ends. However, it is more wider distally. It presents for description two surfaces and two borders.

The **CRANIAL SURFACE**is smooth, slightly convex in its length & rounded from side to side.

The **CAUDAL SURFACE** is correspondingly concave in its length and is flat in transverse direction. At its proximal part there is a smooth shallow groove, which concurs with the ulna in the formation of the interosseous space. A groove extends from this space laterally. The **nutrient foramen** is in the proximal part of this groove. Distal to this, there is in the young subjects a narrow, rough triangular area to which the ulna is attached by an interosseous ligament; in the adult the two bones are fused here.

The **MEDIAL BORDER**is largely subcutaneous; at its proximal end there is a smooth area.

The **LATERAL BORDER**presents no special features.

THE PROXIMAL EXTREMITY

It is flattened cranio-caudally and wide transversally. The proximal articular surface presents the humeral articular circumference, which corresponds to that of the distal end of humerus; it is crossed by a sagittal ridge. There are two concave facets for articulation with the ulna and between these.

The **INTEROSSEOUS SPACE** is a quadrilateral rough area at which the two bones are united by an interosseous ligament. At the medial side of the dorsal surface is the radial tuberosity.

The **MEDIAL TUBEROSITY** is continuous with radial tuberosity and gives attachment to short ligament of elbow.

The **LATERAL TUBEROSITY** is more salient; it gives attachment to the lateral collateral ligament of the elbow.

THE DISTAL EXTREMITY

It is also compressed cranio-caudally. It presents the carpal articular surface which consists of three facets. The distal extremity is large and is thickest medially. The carpal articular surface is oblique. The medial facet is the large and articulates with the radial carpal, the middle one articulates with the intermediate carpal bone. The lateral facet is the smallest one and articulates distally with the ulnar carpal and caudally with the accessory carpal bones.

The **CRANIAL SURFACE** presents three shallow grooves, separated by ridges; the medial one is vertical and gives passage to the tendon of the extensor carpi radialis. The medial one contains the common digital extensor tendon, lateral one is small and oblique; lodges the tendon of abductor digital longus (extensor carpi obliquus).

The **CAUDAL SURFACE** is crossed by a rough transverse crest, distal to which are three depressions. On each side is a tuberosity to which the collateral ligament is attached; the lateral one is marked by a small vertical groove for the passage of the tendon of lateral digital extensor.

MUSCLE ATTACHMENT

Bony Feature	Muscles originated	Muscles inserted
Coronoid process	---	Brachialis
Radial tuberosity	---	Biceps brachii
Medial border of radius	---	Pronator teres
Lateral border of radius	Extensor carpi radialis	---
Proximal extremity of radius	Deep digital flexor (radial head)	---

Ulna

CLASSIFICATION: Long bone

LOCATION: It is attached to the caudo-lateral surface of the radius in the forearm.

DESCRIPTION

Ulna is situated caudal to the radius, with which it is partially fused. It consists of a shaft and two extremities.

THE SHAFT

It is three sided in proximal third, compressed cranio-caudally in the middle third, and is rounded and expanded in the distal third. It presents two surfaces.

The cranial surface is applied to the caudal surface of the radius and there are two interosseous spaces. The surface, which enters into the formation of the said space, is smooth and usually presents a nutrient foramen. It is attached to the radius by an interosseous ligament.

The **MEDIAL SURFACE**.....is smooth and slightly concave.

The lateral is convex and is roughened proximally.

The **BORDERS, MEDIAL and LATERAL**.....are thin and sharp except at the interosseous space.

The **CAUDAL BORDER**is slightly concave in its length and is rounded.

The olecranon is the major part of this bone. It projects proximally and somewhat caudally and forms a lever. The free end or summit is a rounded rough tuberosity.

TROCHLEAR NOTCH

The cranial border bears on its middle a pointed projection, the *anconeal process* or “beak” which overhangs the trochlear notch. The latter is triangle in outline, concave proximodistally, convex transversally. It articulates with humerus; in its distal part there is an

extensive *synovial fossa*. Just distal to the notch are two convex facets, which have their counterparts on the caudal aspect of the proximal end of the radius.

MUSCLE ATTACHMENT

The proximal end presents a rounded tubercle, olecranon which is the basic bony feature.

Bony Feature	Muscles originated	Muscles inserted
Olecranon tubercle	---	Anconeus Tensor fascia antibrachii Triceps brachii (all heads)

Carpal Bones

CLASSIFICATION: A group of short bones

LOCATION: The carpus lies between the radius, ulna and the metacarpals.

DESCRIPTION

The carpus consists of six bones, four in the proximal row and two in the distal row. It is commonly and incorrectly called the “*knee*” in the animals. The bones are named and numbered as follows:

PROXIMAL ROW



PROXIMAL ROW

It is oblique in conformity with the carpal articular surface of the radius. The long axis of the radial and intermediate carpals is directed oblique palmerly and medially.

PECULIARITIES

- The radial.....is narrow and palmerly it is curved proximally.
- The intermediate..... is constricted in its middle and is wider palmerly than dorsally.
- The ulnar carpal..... is larger and is very triangular. Its proximal surface is extensive and sinuous and form articulation with the radius. It has a large oval facet palmerly for articulation with the accessory carpal.
- The accessory carpal.....is short, thick and rounded. It articulates with the ulnar carpal only.

DISTAL ROW

PECULIARITIES

- The first carpal is absent.
- The second and third carpal is fused to form a large quadrilateral bone.
- The fourth carpal is a small quadrilateral bone.

MUSCLE ATTACHMENT

Bony Feature	Muscles originated	Muscles inserted
Proximal border of Accessory carpal	----	Ulnaris lateralis Flexor carpi ulnaris

Metacarpal Bones

CLASSIFICATION: Long bones

LOCATION: The metacarpals are located between the distal row of the carpals and the proximal phalanx.

DESCRIPTION

The metacarpus consists of a large and a small metacarpal bone.

- The **LARGE METACARPAL BONE** results from the fusion of the third and fourth metacarpus of the fetus and bears evidence of its double origin even in the adult state.
- The **FIFTH METACARPAL BONE** is small cylindrical bone known as “splint bone”.
- The **FIRST** and **SECOND METACARPALS** are absent.

LARGE METACARPAL BONE

It is formed by the fusion of the Third and Fourth Metacarpals (Mc: III + IV)

DESCRIPTION

It presents a shaft and two extremities/ends for description.

THE SHAFT

The shaft is wider. It presents two surfaces and two borders.

The **DORSAL SURFACE** is rounded & is marked by a shallow vertical vascular groove, *dorsal longitudinal sulcus*.

The **PALMER SURFACE**..... presents a deep vertical vascular groove, *palmer longitudinal sulcus*.

The **MEDIAL** and **LATERAL BORDERS**are rough in the proximal third.

THE PROXIMAL END

The proximal end or base bears two concave facets for articulation with the distal row of the carpal bones.

The medial facet is somewhat larger and is separated by a ridge medially and a notch palmerly.

The palmero-lateral angle has a facet palmerly for articulation with the small metacarpal bone.

The medial part of the extremity has dorsal and palmer tuberosities.

THE DISTAL END

The distal end is divided into two parts by a *sagittal notch*.

Each division bears an articular surface which is further divided by a ridge.

The *medullary cavity* is divided into two parts by a vertical septum, which is usually incomplete.

MUSCLE ATTACHMENT

Bony Feature	Muscles originated	Muscles inserted
Proximal end or base	----	Extensor carpi obliquus Flexor carpi radialis
Metacarpal tuberosity	----	Extensor carpi radialis

SMALL METACARPAL BONE

It is assembled as the fifth metacarpal bone and is known as small metacarpal or splint bone.

DESCRIPTION

It is a long cylindrical, rounded rod which lies against the proximal part of the lateral border of the large bone in the form of a ridge.

THE EXTREMITIES

The **PROXIMAL END** articulates with the later, but not with the carpus.

The **DISTAL END** is pointed elsewhere.

Digits

In goat, four digits are present. Out of these four, only two; **THIRD (III)** and **FOURTH (IV)** are fully developed and has three phalanges and three sesamoids each.

The other two; **SECOND (II)** and **FIFTH (V)** are vestiges and are placed palmer to the fetlock as “dew-claw”. Each of these contains one or two small bones, which don’t articulate with the rest of the skeleton.

The **FIRST** digit is absent. Hence, each digit articulates with the metacarpal bone proximally.

MUSCLE ATTACHMENT

Bony Feature	Muscles originated	Muscles inserted
Extensor process of distal phalanx	----	Common digital extensor
Flexor tubercle of distal phalanx	----	Deep digital flexor (all heads)
Middle and distal phalanx	----	Lateral digital extensor Superficial digital flexor

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INTRODUCTION TO THE PELVIC LIMB

The pelvic limb, like the thoracic, consists of four segments, viz., the pelvic girdle, thigh, leg, and the pes.

1. PELVIC GIRDLE

The pelvic girdle consists of the oss coxae (or hip bones), the sacrum and the first three or more coccygeal vertebrae. The oss coxae consists originally three flat bones, i.e. ilium, ischium and pubis, which meet at acetabulum, a large cotyloid cavity with which the head of femur articulates.

2. THIGH

The thigh, like the arm, contains a single bone, the femur (or thigh bone). This articulates with the acetabulum above and the tibia and patella below.

3. LEG

The skeleton of the leg comprises three bones, viz. the tibia, fibula and patella.

The tibia and fibula are the long bones of the true leg (crus).

The patella (or knee-cap) is a large sesamoid bone which articulates with the trochlea of the distal end of the femur.

4. PES

The pes, the homologue of the foot of man, consists of three subdivisions;

a) TARSUS (or Hock)

It contains a group of short bones, the ossa tarsi. It includes,

- i) tibial and ii) fibular tarsals, iii) central / fourth tarsal (or Centro-quarter bone), iv) second / third tarsal. (“/” indicates the fusion of the described bones)

b) METATARSUS

The metatarsus resemble in general those of the corresponding regions of the thoracic limb. It comprises a large and a small metatarsal bone. The large metatarsal bone is formed by the fusion of the third and fourth metatarsals of the fetus. On the other hand, the small metatarsal bone is numbered as the second metatarsal.

c) DIGITS

The digits resemble in general those of the corresponding regions of the thoracic limb.

BONES OF THE PELVIC LIMB

Os coxae

The os coxae (or hip bone) is the largest of the flat bones.

It consists primarily of three parts(bones), viz. the ilium, ischium and pubis, which meet to form the acetabulum, a large cotyloid cavity with which the head of femur articulates.

ILIUM

Classification: Modified long bone.

Location: Cranial component of the pelvic girdle.

DESCRIPTION

The ilium is the largest of the three bones. The wide part of the bone is the wing that presents two surfaces. The body, is the constricted portion of the bone and is three sided (prismatic)

THE SURFACES

The gluteal surface is wide and concave. The wide part is crossed by the curved i) gluteal line, which runs parallel to the lateral border of the ilium.

The sacro-plevic surface (of wing) is convex and consist of two distinct parts; the caudal circular facet called i) the auricular face, articulates with the sacrum, and the cranial rough part. In case of shaft, it is smooth. The arcuate or ilio-pectineal line begins ventral to the auricular surface.

The lateral surface (of body or shaft) is convex and rough for attachment of muscles

THE BORDERS

The cranial border (or iliac crest) is thick and rough at cranial end and thin at caudal end.

The medial border is deeply concave and its middle part forms the greater ischiatic notch which is continuous caudally with the ischiatic spine.

The lateral border is concave in its cranial half and straight in its caudal half.

THE ANGLES

The lateral angle is the *tuber coxae*, which forms the basis of the points of the hip. It is large, thick and more pronounced, roughened for muscular attachment.

The medial angle is termed the tuber sacrale; it is thin, rough and truncated.

ISCHIUM

Classification: Modified long bone.

Location: It forms the caudal part of the ventral floor of the pelvis.

DESCRIPTION

The ischium is irregularly quadrangular, and presents two surfaces, four borders, and four angles. It consists of a body (ramus) and a tuber.

THE SURFACES

The pelvic surface is smooth and slightly concave from side to side.

The ventral surface is nearly flat, and in its greater part is roughened for muscular attachment.

THE BORDERS

The cranial border is forms the caudal margin of the obturator foramen.

The caudal border is thick and rough. It slopes medially and cranially to meet the border of the other side, forming with it the *ischiatic arch*.

The medial border meets the opposite bone at the *symphysis ischii*.

The lateral border is thick and rounded but concave in its length, forming the lesser ischiatic notch.

THE ANGLES

The cranio-lateral angle joins the other two bones at the acetabulum, of which it forms more than two half.

The cranio-medial angle meets the pubis with which it forms the medial boundary of the obturator foramen.

The caudo-lateral angle is thick rounded mass, the ischiatic tuberosity for attachment of muscles.

The caudo-medial angle joins its fellow at the symphysis.

PUBIS

Classification: Modified long bone.

Location: It is located cranial to the ischium. It also forms the cranial part of the pelvic floor.

DESCRIPTION

The pubis is the smallest of three bones of the os coxae. It may be described as having, a body, two branches two surfaces and three borders.

THE SURFACES

The pelvic surface is convex.

The ventral surface is convex and in great part rough for muscular attachment. Near the cranial border it is crossed by a pubic groove,

THE BORDERS

The cranial border is thin, and forms the pectin. Laterally it bears the rough iliopubic eminence, which is continuous with the arcuate line. Near the symphysis, there is a variable prominence, the *pubic tubercle*.

The caudal border forms the cranial margin of the obturator foramen.

The medial border joins the opposite bone at the symphysis pubis.

THE BRANCHES

The cranial branch joins the ilium and ischium at the acetabulum.

The caudal branch joins the ischium, with which it forms the inner boundary of the obturator foramen.

ACETABULUM

It is a cotyloid cavity, which lodges the head of the femur. It faces ventro-laterally.

PARTS

It consists of an (i) articular and a (ii) non-articular part.

The articular part (facies lunata) is crescentic and is cut internally by a rough non-articular depression, *acetabulum fossa*. The caudal part of the rim is correspondingly cut into a acetabular notch.

OBTURATOR FORAMEN

It is situated between the pubis and ischium on the floor of the pelvis.

It is oval in outline, the long axis being directed cranio-lateral, grooved cranio-laterally for the obturator vessels and nerves.

MUSCLE ATTACHMENT ON OS COAXE

Bony Feature	Muscles originated	Muscles inserted
Tuber coxae	Tensor fascia latae	----
Tuber ischii	Biceps femoris	----
	Semitendinosus	
	Semimembranosus	
Gluteal surface of ilium	Deep gluteal	----
Body (or shaft) of ilium	Middle gluteal	----

	Sartorius	
	Rectus femoris	
Cranial part of pubis	Pectineus	----
Prepubic tendon	Gracilis	----
Ventral surface of ischium	Adductor	----
	Quadratus femoris	

Femur

CLASSIFICATION: Long bone

LOCATION: It lies between the pelvis and the tibia and fibula.

DESCRIPTION

The femur extends obliquely, distally and cranially, articulating with the acetabulum proximally and the tibia and patella distally. It presents for description a shaft (or body), and two extremities.

THE SHAFT

It is generally cylindrical, but is flattened caudally and is smaller proximally than distally. It presents four surfaces, two borders.

The Surfaces

The cranial, medial and lateral surfaces are smooth and strongly convex from side to side.

The caudal surface is wide, flat and smooth in proximal $\frac{1}{4}$. Distal to this part, there is rough elevation for attachment of muscles. The middle third is narrower and rough also.

The Borders

The medial border bears on its proximal part a thick rough ridge, the lesser tubercle.

The lateral border is prominent throughout in its length. At the distal part, there is the supracondyloid fossa, which is bounded laterally by a thick, rough margin, called supracondyloid tuberosity.

THE PROXIMAL EXTREMITY

It is large and consists of the head, neck, and greater trochanter.

The head is placed at the medial side and is directed medially proximally and somewhat cranially. It is approximately hemispherical and is cut medially by a deep notch, the fovea capitis, in which the accessory ligament and the ligament of head of the femur are attached.

The neck is situated laterally.

THE DISTAL EXTREMITY

It is large in both directions comprises the trochlea cranially, and two condyles laterally.

The **TROCHLEA** consists of two ridges separated by a groove and forms an extensive surface for articulation with the patella. It is very unsymmetrical, the medial ridge is much wider, more prominent and extends higher than the lateral one.

The **CONDYLES**; medial and lateral are separated by the deep inter-condyloid fossa, and articulate with the condyles of the tibia and the menisci of the stifle joint.

The extensor fossa is situated between the lateral condyle and trochlae.

The inter-condyloid fossa lodges the inter-condyloid eminence of the tibia.

The Epicondyles

The medial epicondyle is a rounded prominence on the medial surface of the distal extremity.

The lateral epicondyle is less distinct.

MUSCLE ATTACHMENT

Bony Feature	Muscles originated	Muscles inserted
Greater trochanter	Vastus lateralis	Middle gluteal

Lesser trochanter	----	Quadratus femoris
Neck of femur		Deep gluteal
Caudal surface of femur	Vastus medialis	Adductor
Cranial, medial & lateral faces	Vastus intermedialis	----
Medial epicondyle		Pectineus
Lateral epicondyle	Popliteus	----
Extensor fossa	Long digital extensor Medial digital extensor Proneus tertius	-----
Supracondyloid fossa	Superficial digital flexor	-----
Supracondyloid tuberosity	Gastrocnemius	

Patella

The patella is a large sesamoid bone.

DESCRIPTION

The patella is a large sesamoid bone which articulates with the trochlea of the femur. It presents for description two surfaces, which are quadrilateral, convex and rough for muscular and ligamentous attachment. The articular surface is quadrilateral but much less extensive.

The **BORDERS**, medial and lateral, converge to the apex distally and each forms an angle at base.

The **BASE** faces proximally and caudally and is convex transversally, concave cranio-caudally. The **APEX** point directed distally.

MUSCLE ATTACHMENT

Bony Feature	Muscles originated	Muscles inserted
Base of patella	-----	Rectus femoris
Cranio-medial surface	-----	Vastus medialis Vastus intermedialis
Lateral surface	-----	Vastus lateralis
Medial patellar ligament	-----	Gracilis Sartorius

Tibia

CLASSIFICATION: Long bone.

LOCATION: It extends obliquely distally and caudally from the stifle to the hock.

DESCRIPTION

The tibia articulates with the femur proximally, and the tarsus distally. It presents for description a shaft and two extremities.

THE SHAFT

It is large and three sided (prismatic) proximally and is compressed from before backward distally.

The shaft is distinctly curved so that the medial side is convex in proximal, & concave in distal half.

It presents for description three surfaces, and two borders.

THE SURFACES

The **MEDIAL SURFACE** is broad proximally, and presents rough prominence for muscular attachment.

The **LATERAL SURFACE** is smooth and somewhat spiral. It is wide and concave in its proximal fourth, distal to which it becomes narrower and convex and widens gradually to the cranial part of bone.

The **CRANIAL SURFACE** is very prominent in its proximal third, forming the crest of tibia, and distally reduced to a rough line.

The **CAUDAL SURFACE** is in general smooth, and flattened triangular rough area in proximal third. The nutrient foramen is situated on the caudal surface or near the lateral border in the proximal third.

THE BORDERS

The **MEDIAL BORDER** is rounded in its proximal half in the form of a tubercle which gives attachment to the muscles. The distal part is a rough line on well-marked bones.

The **LATERAL BORDER** is concave in its proximal part and concurs with the fibula in the formation of the interosseous space.

THE PROXIMAL EXTREMITY

It is large and three sided. It bears two articular eminences, the *medial* and *lateral condyles*. Each presents a somewhat saddle-shaped surface for articulation with the corresponding condyle of the femur. The *inter-condyloid eminence* (or spine) is the central eminence, on either side (cranial and caudal) of it, is the *inter-condyloid fossa*. The condyles are separated by caudally by a deep popliteal notch. A semicircular smooth notch, the *sulcus muscularis* separates the tibial tuberosity from the lateral condyle.

The **LATERAL CONDYLE** has an overhanging lateral margin, distal to which there is a facet for articulation with the fibula.

THE DISTAL EXTREMITY

It is much smaller than the proximal one; it is quadrangular in form and larger medially than laterally. It presents an articular surface which is adapted to the trochlea of the talus.

The ridges and grooves are directed sagittal and are bounded on either side by the malleoli. The *medial malleolus* is more prominent. A shallow *synovial fossa* is usually present on the articular angle.

MUSCLE ATTACHMENT

Bony Feature	Muscles originated	Muscles inserted
Tibial tuberosity	-----	Quadriceps femoris
Proximal end	-----	Popliteus
Lateral condyle	Proneus longus Lateral digital extensor Cranial tibial Deep digital flexor	-----

Fibula

DESCRIPTION

The fibula usually consists of two ends (extremities) only.

PROXIMAL END (HEAD)

It is fused with the lateral condyle of the tibia and is continued by a small, blunt-pointed prolongation distally.

DISTAL END

It remains separate from the tibia and forms the lateral malleolus. The lateral malleolus rests on the calcaneus (fibular tarsal bone), and the medial one articulates with the lateral ridge of the talus.

MUSCLE ATTACHMENT

Bony Feature	Muscles originated	Muscles inserted
Head of fibula	Soleus	----

Tarsal Bones (Pes)

CLASSIFICATION: A group of short bones.

LOCATION: The tarsus lies between the tibia and fibula, and the metatarsals.

DESCRIPTION

The tarsus consists of six pieces; the central and fourth, and the second and third tarsal bones are fused whereas the fibular and tibial tarsal bones are separate.

Tibial Tarsal (Talus)

The talus is long & narrow; somewhat flattened dorso-plantarly. It bears a trochlea on either end.

PROXIMAL TROCHLEA

The grooves and ridges of the proximal trochlea are not spiral, but almost sagittal; the lateral ridge is wider and articulates with both the tibia and fibula.

DISTAL TROCHLEA

The distal trochlea consists of two condyles divided by a groove and articulates with the combined central+fourth tarsal.

THE SURFACES

The **LATERAL SURFACE** presents two facets for articulation with the calcaneus, and is excavated and rough elsewhere. The **MEDIAL SURFACE** bears a tuberosity at its proximal part, and is flattened distally.

Fibular Tarsal (Calcaneus)

The calcaneus is a long and slender bone.

The calcaneal tuber (tuber calcanii) is marked plantarly by a wide shallow groove.

Central and Fourth Tarsals

The central and fourth tarsal bones are fused to form a large centro-quartal bone, which extends across the entire width of the tarsus and articulates with all the other bones.

Second and Third Tarsals

The second and third tarsals are fused to form a rhomboid piece.

The **PROXIMAL SURFACE** is concave-convex, and articulates with the central component.

The **DISTAL SURFACE** is undulating and rests on the metatarsus.

MUSCLE ATTACHMENT

Bony Feature	Muscles originated	Muscles inserted
Tuber calcanii	----	Biceps femoris Semitendinosus Semimebrinosus Gastrocnemius Superficial digital flexor Soleus

Roughened faces of tarsals -----

Proneus longus
Cranial tibial

Metatarsal Bones

CLASSIFICATION: Long bones

LOCATION: The metatarsals are located between the tarsus and the proximal phalanx.

DESCRIPTION

The metatarsals consist of a large and a small metatarsal bone.

- The **LARGE METATARSAL BONE** results from the fusion of the third and fourth metatarsal of the fetus and bears evidence of its double origin even in the adult state.
- The **SECOND METATARSAL BONE** is small cylindrical bone known as “splint bone”.
- The **FIRST and FIFTH METATARSALS** are absent.

LARGE METATARSAL BONE

The large metatarsal bone is about one-seventh longer than the corresponding metacarpal. It is formed by the fusion of the Third and Fourth Metatarsals (Mt: III + IV)

DESCRIPTION

It presents a shaft and two extremities/ends for description.

THE SHAFT

It is compressed transversally and is distinctly four sided.

The **DORSAL SURFACE** is rounded & is marked by a deep & wide vascular groove, *dorsal longitudinal sulcus*.

The **PLANTER SURFACE** presents a shallow vascular groove, *palmer longitudinal sulcus*. At this surface, there is proximal foramen which does not perforate the shaft, but passes obliquely through the extremity, opening on the caudal part of the proximal surface.

The **MEDIO-PLANTER ANGLE** presents a facet for articulation with the small metatarsal bone.

MUSCLE ATTACHMENT

Bony Feature	Muscles originated	Muscles inserted
Proximal end	-----	Proneus tertius Medial digital extensor

SMALL METATARSAL BONE

The small metatarsal bone is a quadrilateral disc a little less than an inch in width and height. Its cranial face bears a facet for articulation with the large metatarsal bone.

Digits

The phalanges and sesamoids resemble those of the thoracic limb so closely as to render separate description is unnecessary.

MUSCLE ATTACHMENT

Bony Feature	Muscles originated	Muscles inserted
Middle phalanx of third digit	----	Long digital extensor Lateral digital extensor
Flexor tubercle of third phalanx	-----	Deep digital flexor

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Chapter 5

ARTHROLOGY

Outline

- **Joint and uniting medium**
- **Classification of Joints**
- **Synarthroses**
 - **Classification**
- **Diarthroses**
 - **Structure of a Synovial joint**
 - **Movements of Synovial joints**
 - **Types of Synovial joints**
- **Amphiarthroses**
- **Joints of the Axial Skeleton**
- **Joints of the Appendicular Skeleton**

Syndesmology (arthrology) is the study of the articulations (unions) between bones, which are commonly called joints.

JOINT

An articulation or joint is formed by the union of two or more bones or cartilages or by other tissues.

Bone is the fundamental part of most of the joints. In some cases, a bone, and a cartilage, or two cartilages form a joint.

UNITING MEDIUM

The uniting medium is chiefly fibrous tissue or cartilage or a mixture of these.

CLASSIFICATION OF JOINTS

The joints may be classified;

- (a) **anatomically:**
 - according to their mode of development
 - nature of the uniting medium
 - form of the joint surfaces
- (b) **physiologically:**
 - with regard to the amount and kind of movement
 - with regard to the absence of motility in them.
- (c) by a combination of both (a) and (b) consideration.

There are three chief subdivisions are usually recognized;

- (i) Synarthrosis
- (ii) Diarthrosis
- (iii) Amphiarthrosis

SYNARTHROSES

They are often termed fixed or immovable joints

There is no joint cavity and most of the joints are temporary.

In this group, the segments are united by fibrous tissue or cartilage or both of these two.

CLASSIFICATION

The chief classes in this group of joints are as follows:

1. **Suture:** -----the term sutura is applied to those joints in skull in which the adjacent bones are closely united by fibrous tissue, called sutural ligament.
 - (i) *Sutura serrata*: In many cases, the edges of the bones have irregular interlocking margins. e.g. frontal suture
 - (ii) *Sutura squamosa*: the edges are beveled and overlap. e.g. parieto-temporal suture.
 - (iii) *Sutura hormonia*: the edges are plane or slightly roughened. e.g. nasal suture.
2. **Syndesmosis:** It refers to a joint united by a white fibrous or elastic tissue or a mixture.e.g. union of the shafts of the metacarpal bones, attachment of costal cartilages to each other.
3. **Symphysis:** It is an immovable joint in which the uniting medium is hyaline cartilage.e.g. joint between the basilar part of the occipital bone and the sphenoid bone. Very few of such joints are permanent.
4. **Symphysis:** the term is usually limited to a few median joints which connect symmetrical parts of the skeleton. e.g. symphysis pelvis, symphysis mandibulae
5. **Gomphosis:** The term is sometimes applied to the implantation of the teeth in the alveoli (socket). The gomphosis is not, properly considered a joint at all since the teeth are not the parts of the skeleton.

DIARTHROSIS

They are often called *movable, true joints* or *synovial joints*.

These joints are characterized by:

- (i) the presence of a joint cavity with a synovial membrane in the joint capsule
- (ii) their mobility.

STRUCTURE OF A SYNOVIAL JOINT

A simple joint is formed by two articular surfaces; whereas a composite joint formed by several articular surfaces. The following structures involve into their formation:

- 1) Articular surfaces
- 2) Articular cartilages
- 3) Articular or joint capsule
- 4) Ligaments
- 5) Articular discs or menisci
- 6) Marginal cartilage

1) Articular surfaces: are in most cases smooth, and very much in form.

- They are formed of especially dense bone, which differ histologically from ordinary compact substance.
- In certain cases, the surface is interrupted by non-articular cavities, known as *synovial fossa*.

2) Articular cartilages: are usually hyaline in type & form a covering over the articular surfaces of bones.

- They vary in thickness in different joints; thickest on these which are subjected to most pressure & friction.
- They usually tend to accentuate the curvature of the bone.
- They are non-vascular, very smooth and have a bluish tinge in the fresh state.
- They diminish the effects of the concussion and greatly reduce the friction.

3) Articular or Joint capsule: is in its simplest form, a tube, the ends of which are attached around the articulating surfaces.

- It consists of two layers. The deeper layer is the (i) *synovial membrane*, a delicate layer of specialized connective tissue extending from the edges of the articular cartilages of the

adjacent bones but not covering the articular cartilage. The membrane secretes a the *synovial fluid (synovia)*. It lubricates the normal joint. The surface of synovial membrane is increased by folds (*plicae synoviales*) and villi which contain fat pads and which project into the cavity. The superficial layer of the joint capsule is the (ii) *fibrous membrane*, a heavier fibrous sleeve adjacent to the synovial membrane.

4) Ligaments: are strong bands or membranes, usually composed of white fibrous tissue and function to bind the bones together. They are pliable, but practically inelastic.
- In a few cases, however, e.g. the *ligamentum nuchae*, they are composed of elastic tissue.

5) Menisci (Articular discs): are plates of fibrocartilage or dense fibrous tissue placed between the articular cartilages, and divided the joint cavity partially or completely into two compartments.

- They contribute to the congruency of the articular cartilages and probably play a role in complex joint movements. Prominent menisci are found in the stifle and the temporomandibular joint.

6) Marginal cartilage: is a ring of fibro-cartilage which encircles the rim of an articular cavity.

- It enlarges the cavity and tends to prevent the fracture of the margin.

TYPES OF MOVEMENTS

Synovial (formerly called diarthrodial) joints may exhibit one or more of the following movements;

- (i) **Gliding or sliding:** such type of movement refers to the sliding of one practically plane on the other. E.g. Joint between the articular surfaces of the cervical vertebrae.
- (ii) **Flexion:** is the movement that tends to decrease the angle segments making up a joint.
- (iii) **Extension:** is the reverse of flexion and is movement that tends to increase the angle between the segments forming the joints.
- (iv) **Circumduction:** combines the other type of rotation except rotation. It designates movement in which the distal end of the limb describing a circle.
- (v) **Rotation:** this term is reserved to indicate rotation of one segment around the longitudinal axis of the other segment forming the joint. E.g. Atlanto-axial joint.
- (vi) **Adduction:** it is the movement of an extremity towards the median plane.
- (vii) **Abduction:** is the movement of an extremity away from the median plane.

TYPES OF SYNOVIAL JOINTS

The synovial joints are classified according to the type of joint surface and movements. The following chief types may be recognized.

- (i) **Arthrodia (gliding) Joints:** in these, the surfaces are practically flat, admitting of gliding movement. E.g. (i) Carpo-metacarpal joint. (ii) Joint between articular processes of cervical and thoracic vertebrae.
- (ii) **Ginglymus (hinge) Joints:** the joint surfaces consist usually of two condyles, or of a segment of a cylinder or cone, which are received by corresponding cavities. E.g. (i) Atlanto-occipital joint (ii) Elbow joint.
- (iii) **Trochoid (pivot) Joints:** in these, the movement is limited to rotation of one segment around the longitudinal axis of the other. E.g. (i) Atlanto-axial joint.
- (iv) **Enarthrosis (ball and socket) Joints:** these are formed by a surface of approximately spherical curvature, received into a corresponding cavity. They are multiaxial and allow greatest variety of movement. E.g. (i) Hip joint (ii) Shoulder joint.

AMPHIARTHROSIS

These joints, as the name indicates, share some characters with both of the preceding groups.

In them, the segments are directly united by a plate of fibrocartilage and usually by ligaments also.

The amount and kind of the movement are determined by the shape of the joint surfaces and the amount and pliability of the uniting medium.

These joints are nearly all medial in position, and are best illustrated by the joints between the bodies of the vertebrae. There is typically no joint cavity, but in certain situations, only one exists.

JOINTS OF THE AXIAL SKELETON

Name	Formed by.....	Classified as.....
Symphysis mandibulae	The bodies of the rami of mandible	Synarthroses > Symphysis
Temporo-mandibular Joint	i) Mandible ii) Temporal bone of the skull	Diarthroses > Condylar joint
Atlanto-occipital Joint	i) Atlas (First cervical vertebra) ii) Occipital bone of the skull	Diarthroses > Ginglymus joint
Atlanto-axial Joint	i) Atlas (First cervical vertebra) ii) Axis (Second cervical vertebra)	Diarthroses>Trochoid joint
Intercentral articulations	Extremities of the bodies of two adjacent vertebrae	Amphiarthroses
Interneural articulations	Articular processes of two adjacent vertebrae	Diarthroses
Costo-central articulation	i) Head of the rib ii) Bodies of two adjacent vertebrae	Diarthrosis >Trochoid (pivot)joint
Costo-transverse articulation	i) Tubercle of the rib ii) transverse process of the vertebra	Diarthroses > Gliding joint
Costo-chondral articulation	i) Sternal end of the rib ii) Costal cartilage	Synarthroses
Chondro-sternal articulation	i) Cartilages of the asternal ribs ii) The sternum	Diarthroses

JOINTS OF THE APPENDICULAR SKELETON

Name	Formed by	Classified as
Shoulder (scapulo-humeral) Joint	i) distal end of the scapula ii) Proximal end of the humerus	Diarthroses > Ball and socket joint
Elbow Joint	i) Distal extremity of humerus ii) proximal end of radius & ulna	Diarthroses > Ginglymus
Carpal (knee) Joint	i) radio-carpal joint: the distal end of radius and proximal row of carpus ii) Intercarpal joint: between two rows of carpus iii) carpo-metacarpal joint: the distal row of carpus and proximal ends of metacarpus.	Diarthroses > i) & ii) Ginglymus and iii) Arthrodial (gliding) joint
Fetlock Joint	Distal end of the large metacarpal, the proximal end of first phalanx and the proximal sesamoid bones.	Diarthroses > Ginglymus

Pastern Joint	Distal end of first phalanx and proximal end of second phalanx.	Diarthroses > Ginglymus
Coffin Joint	Distal end of second phalanx, proximal end of third phalanx and distal sesamoid bones.	Diarthroses > Ginglymus
Sacro-iliac articulation	The auricular surfaces of the sacrum and ilium.	Diarthroses
Symphysis pelvis	The two ossa coxarum at ventral median line.	Synarthroses > Symphysis
Hip Joint	Proximal end of the femur and the acetabulum	Diarthroses > Ball and socket joint
Stifle Joint	i) femoro-patellar joint : trochlea of the femur and articular surface of patella. ii) femoro-tibial joint : condyles of the femur and proximal end of tibia.	Diarthroses > Ginglymus
Tarsus (Hock) Joint	Same as carpal joint, consists of three chief joints. I) tibio-tarsal joint ii) inter-tarsal joint iii) tarso-metatarsal	Diarthroses > Ginglymus

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Chapter 6

MYOLOGY

Outline

Introduction to Myology

Naming of Skeletal Muscles

Muscles of the thoracic limb

- Extrinsic muscles
- Muscles of shoulder
- Muscles of arm
- Muscles of forearm

Muscles of the pelvic limb

- Muscles of hip and thigh
- Muscles of leg and foot

Muscles of the face

- Mandibular muscles

Muscles of the neck

Muscles of the thorax

Muscles of the back and loin

Muscles of the abdomen

Muscles of the tail

INTRODUCTION TO MYOLOGY

Myology deals with the muscles and their structures.

PROPERTIES OF MUSCLES

- ▶ The muscles are highly specialized organs, which are characterized by their property of contracting in a definite manner when stimulated.
- ▶ They are the active organs of motion.
- ▶ The contractile part of the muscle is the muscular part.

KINDS OF MUSCULAR TISSUE

Three kinds of muscular tissue are recognized; viz.

1. Striated or striped:
2. Non-striated, unstriped or smooth:
3. Cardiac; which may be regarded as a specialized variety of striated muscle.

DESCRIPTION OF THE MUSCLES

The description of the muscles may be arranged under the following heads;

1. Name
2. Shape and position
3. Attachments
4. Action
5. Structure
6. Relations
7. Blood and nerve supply

BASIC TERMINOLOGY

1. Origin:

The term 'origin' is applied to the attachment which always or more commonly remains stationary when the muscle contracts.

2. Insertion:

The term 'insertion' is applied to the more movable attachment of the muscle.

3. Tendon:

A tendon is a band of dense white fibrous tissue by means of which a muscle is attached.

4. Aponeurosis:

It is a broad fibrous sheet which fulfils a similar function (as like that of tendon).

NAMING OF SKELETAL MUSCLES

Name	Shape	Size	Number of heads or bellies	Position	Attachment	Actions
Deltoideus	Triangular					
Teres	Round					
Rectus	Straight					
Major		Large				
Longissimus		Broadest				
Latissimus		Longest				
Biceps			Two heads			
Quadriceps			Four heads			
Digastricus			Two bellies			
Pectoral				Of chest		
Supraspinatus				Above spine		
Brachii				Of the arm		
Brachiocephalicus					From arm to skull	
Coracobrachialis					From coracoid process -arm	
Extensor						Extend
Flexor						Flex
Pronator						Pronate

These names are commonly used in combination; for example long digital extensor (Long extensor of digit).

MUSCLES OF THE THORACIC LIMB

EXTRINSIC MUSCLES

Name of the Muscle	Origin	Insertion
Trapezius	Spine of cervical and thoracic vertebrae.	Spine of scapula
Omo-transversarius	Wing of atlas	
Rhomboideus	Dorsal midline, both cranial and caudal to the scapula	Scapular cartilage

Serratus ventralis	(i) Transverse process of last 4-5	
(i) Cervical part	CV	Serrated facies of scapula
(ii) Thoracic part	(ii) lateral surface of first 8-9 ribs	
Latissimus dorsi	Thoraco-lumber fascia	Teres major tuberosity
Brachiocephalicus		
i) cleido-occipitalis	i) occipital bone of skull	
ii) cleido-mestoideus	ii) mastoid process	Crest of humerus
Superficial pectoral	Medial raphae and ventral	
Deep pectoral	surface of sternum	Fascia over lesser tubercle

MUSCLES OF THE SHOULDER

a) Lateral Muscles

Supraspinatus	Supraspinous fossa	Anterior part of proximal tuberosities of humerus
Infraspinatus	Infraspinous fossa	Greater tubercle of humerus
Deltoides	Acromion process of scapula	Deltoid tuberosity
Teres minor	Caudal border of scapula	Greater tubercle (caudal end)

b) Medial Muscles

Subscapularis	Subscapular fossa of humerus	Lesser tubercle of humerus
Teres major	Caudal border of scapula	Teres tuberosity of humerus
Coraco-brachialis	Coracoid process of scapula	

MUSCLES OF THE ARM

Biceps brachii	Supraglenoid tubercle of scapula	Radial tuberosity of radius
Brachialis	Posterior surface of humerus	Coronoid process of radius
Tensor fascia antibrachii	Caudal border of scapula	
Triceps brachii		
a) Long head	a) Caudal border of scapula	Olecranon
b) Medial head	b) Medial surface of humerus	
c) Lateral head	c) Deltoid tuberosity	
Anconeus	Olecranon fossa (bony edge)	

MUSCLES OF THE FOREARM

a) Extensor Division

Extensor carpi	Radial fossa and lateral	Metacarpal tuberosity
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radialis	epicondyle of humerus	
Common digital extensor		Extensor process of distal phalanx of 3 rd and 4 th digits.
Lateral digital extensor	Lateral epicondyle of humerus	2 nd and 3 rd phalanx of 4 th digit.
Extensor carpi obliquus	Lateral border of radius	Proximal end of large metacarpal

b) Flexor Division

Ulnaris lateralis	Lateral epicondyle of humerus	Accessory carpal bone
Pronator teres		Medial border of radius
Flexor carpi radialis	Medial epicondyle of humerus	Proximal end (large metacarpal)
Flexor carpi ulnaris		Accessory carpal bone
Superficial digital flexor		2 nd phalanx of 3 rd and 4 th digit
Deep digital flexor		
i) humeral head	i) medial epicondyle of humerus	Flexor tubercle of distal phalanx
ii) radial head	ii) proximal end of radius	
iii) ulnar head	iii) proximal end of ulna	

ACTION

Action	Name of Muscle
To draw the scapula cranially and caudally	Trapezius
To draw the scapula dorsally and ventrally	Rhomboideus
To pull the limb cranially and caudally	Serratus ventralis
To move the head and neck laterally	Omo-transversarius Brachiocephalicus
To adduct the forelimb	Superficial pectoral Deep pectoral Subscapularis
To abduct the forelimb	Deltoideus
Muscles Acting on Shoulder	
To extend the shoulder joint	Supraspinatus
To flex the shoulder joint	Latissimus dorsi Teres major et minor Infraspinatus Coraco-brachialis
Muscles Acting on Elbow	

To extend the elbow joint	Triceps brachii (all heads) Tensor fascia antibrachii Anconeus
To flexor the Elbow joint	Biceps brachii Brachialis Pronator teres
Muscles Acting on Carpal	
To extend the carpal joint	Extensor carpi radialis Extensor carpi obliquus
To flex the carpal joint	Flexor carpi radialis Flexor carpi ulnaris Ulnaris lateralis
Muscles Acting on Digit	
To extend the digit	Common digital extensor Lateral digital extensor
To flex the digit	Superficial digital flexor Deep digital flexor

MUSCLES OF THE PELVIC LIMB

MUSCLES OF HIP AND THIGH

a) Lateral Muscles

Name of the Muscle	Origin	Insertion
Tensor fascia latae	Tuber coxae	Indirectly to patella and tibia
Middle gluteal	Gluteal surface of ilium	Greater trochanter of femur
Deep gluteal	Body of the ilium and ischium	Neck of the femur
Biceps femoris		
Semitendinosus	Tuber ischii	Tuber calcanii
Semimebranosus		

b) Medial Muscles

Sartorius	Body of ilium	Medial patellar ligament
Gracilis	Prepubic tendon	
Pectineus	Pectin of pubis	Medial epicondyle of femur
Adductor	Ventral surface of ischium	Caudal surface of femur
Quadratus femoris		Lesser trochanter of femur

c) Cranial Muscles

Rectus femoris	Body of ilium	
Vastus lateralis	Greater trochanter of femur	
Vastus medialis	Neck & caudal surface of femur	Patella and tibial tuberosity
Vastus intermedialis	All surfaces except caudal of femur	

MUSCLES OF THE LEG AND FOOT

a) Dorso-lateral Muscles

Long digital extensor		Second phalanx of 3 rd digit
Proneus tertius	Extensor fossa of femur	Proximal end of large metatarsal
Medial digital extensor		
Lateral digital extensor		Second phalanx of 3 rd digit
Proneus longus	Lateral condyle of tibia	First tarsal bone
Cranial tibial		First to third tarsals

b) Planter Muscles

Gastrocnemius	Supracondyloid tuberosity	
Superficial digital extensor	Supracondyloid fossa of femur	Tuber calcanii
Soleus	Head of fibula	
Deep digital flexor	Lateral condyle of tibia	Flexor tubercle of distal phalanx
Popliteus	Lateral epicondyle of femur	Proximal end of tibia

ACTION

Action	Name of Muscle
To adduct the hind limb	Sartorius Gracilis Pectineus Adductor Quadratus femoris
To abduct the hind limb	Deep gluteal
Muscles Acting on Hip	
To extend the hip joint	Middle gluteal Biceps femoris Semitendinosus Semimembranosus

To flex the hip joint	Tensor fascia latae
Muscles Acting on Stifle	
To extend the stifle joint	Rectus femoris Vastus medialis Vastus intermedialis Vastus lateralis
To flex the stifle joint	Gastrocnemius
Muscles Acting on Hock	
To extend the hock joint	Gastrocnemius
To flex the hock joint	Proneus tertius Proneus longus Cranial tibial Popliteus
Muscles Acting on Digit	
To extend the digit	Long digital extensor Medial digital extensor Lateral digital extensor
To flex the digit	Superficial digital flexor Deep digital flexor
Muscle Assisting the other Muscle	
To assist the Gastrocnemius	Soleus

MUSCLES OF THE FACE

Name of Muscle	Origin	Insertion
Orbicularis oris	Margins of the lips	No direct attachment
Levator nasolabialis	Rostral part of frontal bone	Nostrils and maxillary lip
Caninus		Lateral walls of nostrils
Levator maxillaris	Facial tuberosity	Maxillary lip
Depressor labi maxillaris		
Depress. labi mandibularis	Alveolar border of maxilla	Mandibular lip
Buccinator	and mandible	Angle of the mandible
Dilator nares apicalis	Body of premaxilla	Ventral portion of nostrils
Zygomaticus	Masseteric fascia	Commissure of the lips
Mentalis	Body of mandible	Skin of the chin
Malaris	Lacrimal fascia	Buccal fascia
Orbicularis oculi	Skin of the eyelids	Medial canthus of the eye
Frontalis	Base of the horns	Forehead region

MANDIBULAR MUSCLES

Masseter	Facial tubercle and ventral surface of zygomatic arch	Masseteric fossa of mandible
Teemporalis	Temporal fossa	Coronoid process of mandible
Pterygoideus medialis	Pterygo-palatine fossa	Medial surface of mandible
Pterygoideus lateralis		
Digastricus	Paramastoid process	Medial surface of mandible

ACTION

Action	Name of Muscle
To dilate the nostrils	Levator nasolabialis Caninus Dilator nares apicalis
To retract the angle of the mouth	Buccinator Zygomaticus
To raise the skin to which it is attached	Mentalis
Muscles Acting on Lips	
To close the lips	Orbicularis oris
To retract the rostral lip	Depressor labii maxillaris
To retract the mandibular lip	Depressor labii mandibularis
Muscles Acting on Eyelids	
To close the eyelids	Orbicularis oculi
To elevate the upper eyelid	Frontalis
To depress the lower eyelid	Malaris
Muscles Acting on Mandible	
To bring the Jaws together	Masseter
To raise the lower jaw (mandible)	Temporalis
To depress the lower jaw (mandible)	Digastricus
To move the rami towards the median plane	Pterygoideus medialis
To move the rami towards the lateral side	Pterygoideus lateralis

MUSCLES OF THE NECK

VENTRAL CERVICAL MUSCLES

Name of Muscle	Origin	Insertion
Cutaneous colli	It is a ventral medial connective tissue strip of the neck	

Brachiocephalicus		
i) Cleido-occipitalis	i) occipital bone	Crest of humerus
ii) Cleido-mastoideus	ii) Mastoid process	
Sternocephalicus		
i) Sternomastoideus	Manubrium of sternum	i) Mastoid process
ii) Sternomandibularis	(first sternebrae)	ii) ventral border of mandible and zygomatic arch
Sternothyrohyoideus		
		Thyroid cartilage
Omohyoideus	Transverse process of 3 rd -4 th CV	Basihyoid bone
Scalenus	Transverse process of 3 rd -7 th CV	First and second rib

DORSO-LATERAL CERVICAL MUSCLES

Name of Muscle	Origin	Insertion
Longissimus capitis et atlantis	Transverse process of first 2 TV	Lateral borders of atlas
Rectus capitis dorsalis major	Spine of axis	Occipital bone
Rectus capitis dorsalis minor	Dorsal arch of atlas	
Rectus capitis lateralis	Dorsal arch of atlas	Mastoid and paramastoid processes
Obliquus capitis anterior	Cranial border of wing of atlas	
Obliquus capitis posterior	Spine of axis	Dorsal surface of wing of atlas
Splenius	Spinous process of first 4 TV	Transverse p. of 2 nd to 5 th CV
Multifidus cervicis	Articular processes of last 5 CV	Spinous & articular processes of CV

ACTION

Action	Name of Muscle
Muscles Acting on Neck and Head	
To elevate the head and neck	Splenius
To extend the head and neck	Longissimus capitis et atlantis Complexus Rectus capitis dorsalis major
To extend the head	Rectus capitis dorsalis minor Obliquus capitis anterior
To extend the atlanto-axial joint	Obliquus capitis posterior
To flex the head and neck	Sternocephalicus Rectus capitis ventralis major Longus colli Intertransversalis colli

To flex the neck	Scalenus
To flex the atlanto-occipital Joint	Multifidus cervicis Rectus capitis ventralis minor
Muscles Acting on Hyoid and Tongue	
To retract the hyoid bone and tongue	Sterno-thyrohyoideus Omo-hyoideus

MUSCLES OF THE THORAX

Name of Muscle	Origin	Insertion
Levator costarum	Transverse processes of TV	Cranial border of succeeding rib
External intercostals	Caudal border of all ribs	
Internal intercostals	Cranial border of all ribs	Caudal border of succeeding ribs
Retractor costae	Transverse process of first 3 LV	Caudal border of last rib
Rectus thoracis	Caudo-lateral surface of first rib	Costal cartilages
Transversus thoracis	Sternal ligament	
Serratus dorsalis cranialis	Thoraco-lumbar fascia	Cranio-lateral surface of 6-8 ribs
Serratus dorsalis caudalis		Caudal border of last 3 ribs

ACTION

These muscles are also called the *muscles of respiration*.

Action	Name of Muscle
To aid in inspiration	Levator costarum External intercostal Rectus thoracic
To aid in expiration	Internal intercostals Transverses thoracic
To aid in forced expiration (by retraction of last rib)	Retractor costae

MUSCLES OF BACK AND LOIN

Name of Muscle	Origin	Insertion
Serratus dorsalis cranialis	Thoracolumbar fascia	Cranio-lateral surface of 6-8 ribs
Serratus dorsalis caudalis		Caudal border of last 3 ribs
Longissimus dorsi	Ventral surface of ilium	Transverse and spinous p. of TV
Longissimus costarum	Lumbo-dorsal fascia	Caudal border of ribs
Multifidus dorsi	Lateral wings of sacrum	Spinous process of sacral, lumbar, thoracic and last CV.
Intertransversarii	Caudal border of last 3	-----

lumborum	ribs
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ACTION

Action	Name of Muscle
To aid in inspiration	Serratus dorsalis anterior Serratus dorsalis posterior
To aid in expiration (To retract and depress ribs)	Longissimus costarum (Ilio-costalis)
Most powerful extensor of back and loin	Longissimus dorsi
To flex the loin (lumbar region)	Intertransversalis lumborum
To extend the spine	Multifidus dorsi

MUSCLES OF THE ABDOMEN

Name of Muscle	Origin	Insertion
External abdominal obliquus	Caudo-lateral surface of ribs	Linea alba and prepubic tendon
Internal abdominal obliquus	Deep lumbar fascia	
Transverses abdominis	Deep para-lumbar fascia	Linea alba
Rectus abdominis	Ventral surface of sternum	Prepubic tendon

ACTION

Action	Name of Muscle
To support and compress the abdominal viscera	External abdominal obliquus Internal abdominal obliquus Transverses abdominis Rectus abdominis

MUSCLES OF THE TAIL

Name of Muscle	Origin	Insertion
Sacro-coccygeus dorsalis	Sacral spines	Dorsal surface of coccygeal vert.
Sacro-coccygeus lateralis	Caudal art. Processes of 5 th and Cranial art. Processes of 6 th LV	Spine of 3 rd coccygeal vertebrae
Sacro-coccygeus ventralis	Ventral surface of sacrum	Ventral surface of Cy vertebrae
Intertransversales caudae	Lateral edge of sacrum	Transverse process Cy vertebrae

Recto-coccygeus	Sacro-sciatic ligament	First 4 Cy vertebrae & Cy fascia
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ACTION

Action	Name of Muscle
To extend the tail	Sacro-coccygeus dorsalis Sacro-coccygeus lateralis
To flex the tail	Scaro-coccygeus ventralis Recto-coccygeus
To assist in lateral flexion of the tail	Intertrasversalis caudae

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