THE COMPARATIVE ANATOMY OF THE COXOFEMORAL ARTICULATION OF THE DOG, OX AND HORSE

by

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INTRODUCTION

Observance of the gross anatomical descriptions of the coxofemoral articulation of the dog and ox and to a more limited degree of the horse in the more commonly used veterinary anatomy texts indicated a need for a more detailed investigation of this area. This was particularly evident when compared to the detailed anatomical description of the coxofemoral articulation of man. The outstanding deficiency of the veterinary anatomical literature was a detailed description of the blood and nerve supply of the coxofemoral articulation.

The need for investigation in the dog was augmented by the frequent luxations of the coxofemoral articulation sustained by dogs as a result of collisions with automobiles. Many of these luxations required surgical repair. The vulnerability of the ox to luxation of the articulation previous to and during parturition encouraged the investigation in this species.

The comparison of the anatomy of the coxofemoral articulation of the dog, ox and horse was initiated because these were the three principal domestic species attended by the veterinarian. Until recently the horse was the basic species studied in anatomy in the veterinary colleges. Consequently, in most veterinary texts the anatomy of the coxofemoral articulation of the horse was more completely described as compared to the dog and ox. For this reason most veterinarians were more familiar with the anatomical description of the coxofemoral articulation of the horse. This was an additional motive for inclusion of the horse in this investigation on a comparative basis with the dog and ox. Including the horse in this comparative study helped to utilize the knowledge and information already acquired in this species to bring about a more instructive understanding of this same area in the dog and ox.

MATERIALS AND METHODS

Thirty specimens, ten of the dog, ten of the ox and ten of the horse were investigated. The dog specimens were procured from the Department of Veterinary Physiology. These were selected from specimens used in the student physiology laboratory in which the area desired for investigation was not molested. All ox and some horse specimens were secured from the necropsy laboratory of the Department of Veterinary Pathology. These were obtained from special selected necropsy cases. The remaining horse specimens were obtained from the Department of Veterinary Anatomy of Kansas State University and the Hill Packing Company of Topeka, Kansas. All macerated bones consisting of the os coxae and femur were secured from the Department of Anatomy.

The specimens were prepared in the following manner. The abdomen was eviscerated by incising the abdominal wall at the linea alba and caudal to the costal arches and the last rib. The mesentery ventral to the sublumbar region was severed and the descending colon was cut transversely at the pelvic inlet. The specimens were completely separated transversely at the junction of the thoracic and lumbar regions. The following procedures were executed in the order listed to prepare the caudal portion of each specimen. The abdominal aorta was canulated cranial to the external iliac arteries. The specimens were irrigated with water by gravitation to remove the excess blood in the vascular system. After the irrigation the postcava was ligated near the center of the lumbar region. The specimens were preserved with a solution containing thirty-five per cent isopropyl alcohol and two per cent phenol. Some specimens were injected with red latex via the abdominal aorta into the arterial system.

The coxofemoral articulation was exposed for investigation in the following manner. The skin was removed and the specimens were divided in two halves by splitting them in the median plane in the region of vertebrae and the pelvic symphysis. The biceps femoris, gluteus medius and gluteus superficialis muscles were cut at their insertions and reflected proximad. A detailed dissection was made of the muscles, vessels, nerves and other structures associated with the articulation. This was followed by a detailed examination and dissection of the coxofemoral articulation.

The acetabulum of the os coxae and the head of the femur of all macerated osseous specimens were observed and described.

Stained microscopic sections were cut transversely through the acetabular, middle and femoral portions of some of the round ligaments of the dog. These sections were examined microscopically for the presence of blood vessels in the ligament.

Photographs were taken of selected dissected areas. Macerated osseous specimens were also photographed. Special areas of nerves and vessels were drawn and photographed.

REVIEW OF LITERATURE

The literature reviewed did not reveal any complete anatomical descriptions of the coxofemoral articulation in the domestic animals as compared with the more complete description in man (Gray 1954).

Sisson and Grossman (1953) presented an anatomical description of the coxofemoral articulation in the horse except for the blood and nerve supply.

They briefly compared the coxofemoral articulation of the ox to that of the horse; however, they did not describe or compare the coxofemoral articulation of the dog.

Ellenberger and Baum (1943) and Nickel et al. (1954) gave a brief anatomical description of the coxofemoral articulation of the domestic animals.

Vaughan (1907) and Chauveau (1901) presented a brief anatomical description of the coxofemoral articulation of the horse. They did not describe the coxofemoral articulation of the dog and ox.

M'Fadyean (1909) presented, in his anatomy text of the horse, only a brief anatomical description of the coxofemoral articulation.

McLeod (1958) and Habel (1955) gave partial descriptions of the anatomy of the coxofemoral articulation of the ox.

Murphey (1922) directed his brief discussion to anatomical factors which caused a craniodorsal dislocation of the coxofemoral articulation of the ox.

Miller (1952) and Bradley (1948) gave a partial anatomical description of the coxofemoral articulation of the dog.

Kitchell et al. (1957) described the blood supply and origins of the round ligament of the coxofemoral articulation of the pig.

Dibbell (1934), Schroeder (1936) and Mayer et al. (1957) reported the most commonly observed luxation in the dog was that of the coxofemoral articulation.

Schroeder (1933), Ehmer (1934) and Knowles et al. (1953) reported that luxations were the most common injury which involved the coxofemoral articulation of the dog.

Roberts (1956) associated luxation of the coxofemoral articulation of the ox with advanced pregnancy. A factor causing the luxations was excessive relaxation of the pelvic ligaments. Williams (1943) noted that luxation of the coxofemoral articulation of the ox was usually associated with dystocia.

OBSERVATIONS

The observations were written in a comparative manner. Generally under each portion of the coxofemoral articulation the first anatomical observations were applicable to all three species. Following these anatomical similarities the special anatomical observations were described for the dog, ox and horse.

The Coxofemoral Articulation

The coxofemoral articulation was an enarthrodial joint formed by the acetabulum of the os coxae and the proximal end of the femur. It has been commonly called the "hip" joint and more technically has been termed the articulatio coxae. The articulation consisted of the acetabulum and the head of the femur, the articular surfaces and cartilages, the articular cavity and synovial membrane and the fibrous capsule and ligaments. The articular muscular relations, the articular vessels and the articular nerves were observed.

The Acetabulum and the Head of the Femur

The acetabulum was a cotyloid cavity located at the junction of the ilium, ischium and pubis. The acetabulum was hemispherical in shape and was directed ventrolaterally. In the fresh state it received the head of the femur. The acetabulum consisted of an articular part, the facies lunata and a nonarticular part, the acetabular fossa and the acetabular notch. In general the articular surface was semilunar in shape.

The articular surface of the acetabulum of the dog was uniform in width except dorsolaterally where it was narrower (Plate I). The nonarticular surface located medioventrally was depressed forming the acetabular fossa. The surface of the fossa was rough and foramina could usually be observed in the fossa. The ischium formed almost the entire acetabular fossa. The bone in the area of the acetabular fossa was translucent due to its thinness. The wide acetabular notch was located ventromedially. The notch was cut into caudally by a deep subpelvic groove which continued caudally on the ventral surface of the acetabular branch of the ischium (Plate I). The acetabular notch was continuous dorsolaterally with the acetabular fossa. Ventromedially, adjacent to the acetabular notch and acetabular fossa, the margin was cylindrical (Plate I). This portion of the margin was very straight and lacked the general curvature of the margin bounding the articular surface. The caudal portion of the cylindrically shaped margin formed the medial boundary of the deep subpelvic groove of the acetabular notch. This margin was located almost entirely on the ischial bone.

The acetabulum of the ox was shaped like a shallow hemisphere. The acetabular margin was notched. A deep notch, the acetabular notch, was located caudomedially and a shallower notch was located craniomedially (Plate I). The deep narrow acetabular notch completely separated the articular surface. The acetabular notch was continuous craniodorsally with the centrally located acetabular fossa. The acetabular notch was continuous with a caudally directed subpelvic groove located craniolateral to the obturator foramen on the ischial bone (Plate I). The shallower craniomedial notch was quite variable and was either present as a notch, converted into a foramen, or completely absent. The margin or rim was very concave dorsolaterally and could be described as a possible third notch. The articular surface formed a complete circle except caudomedially where it was separated by the acetabular notch. The notches and the concavity of the margin of the acetabulum caused the articular surface to be variable in width. The greatest width of the articular surface occurred cranially. The margin of the acetabulum was rounded especially caudolaterally. The margin was sharp ventromedially between the two notches. Foramina were observed in the acetabular fossa in some specimens. The central portion of the acetabular fossa was translucent.

The articular surface of the acetabulum in the horse was narrow dorsolaterally. The acetabulum had a sharp and distinct margin or rim which bounded the entire articular surface. The acetabular fossa was near the center and was bounded on all sides by the articular surface except ventromedially in the region of the acetabular notch (Plate I). The wide deep acetabular notch provided a means for the acetabular fossa to be continued with the medially directed subpubic groove. This groove was located on the ventral surface of the symphyseal branch of the pubic bone (Plate I). Numerous foramina were located in the acetabular fossa. The bone which formed the acetabular fossa was not translucent.

The head of the femur, which was located on the medial side of the proximal extremity of the bone, articulated with the acetabulum. It was attached to the proximal extremity by a short neck. Numerous foramina were observed on the neck. The head was nearly hemispherical in shape. It consisted mainly of a smooth convex articular surface and a nonarticular fossa, the fovea capitis, to which the round ligament was attached.

The head of the femur of the dog faced in a dorsomedial and slightly cranial direction. The head was slightly more than a hemisphere. The articular surface of the head was bounded by a sharp distinct margin except for that portion which was nearest the trochanteric fossa and extended for a short distance on the neck. The fovea capitis was slightly roughened, elongated and depressed (Plate II). It extended on the medial side of the head from near the center to the ventral margin of the articular surface. Foramina were observed in the fovea capitis in a few specimens. The neck was distinct, narrow and constricted.

The head of the femur of the ox faced in a dorsomedial direction. The neck was distinct except dorsally. The articular surface extended on the dorsal part of the neck (Plate II). This arrangement gave the dorsal part of the head and neck a slightly saddle shaped articular surface. The margin of the articular surface was distinct except dorsally where the surface extended on the neck. A small shallow slightly circular fovea capitis was present near the center of the head (Plate II). Foramina were not observed in the fovea capitis.

The head of the femur of the horse faced in a dorsomedial and slightly cranial direction. The neck was distinct craniomedially but was indistinct caudodorsally. The articular surface was bounded by a sharp distinct margin. The fovea capitis was a deep depression which was located on the medial surface of the head (Plate II). It extended from near the center of the head to the ventral margin. The fovea capitis was pointed dorsally and wide ventrally. Its surface was slightly rough and a few foramina were observed.

The Articular Surfaces and Cartilages

The articular surfaces were described with the acetabulum and the head of the femur of the dog, ox and horse. The articular cartilage formed a cover over the articular surfaces of the acetabulum and the head of the femur in the fresh state. No great difference was observed grossly in the variation of the thickness of the articular cartilage when comparing the cartilage near the margin with the cartilage at the center. This was true of the articular cartilages of both the acetabulum and the head of the femur.

The Articular Cavity and Synovial Membrane

The joint cavity was spacious. The joint cavity contained a portion of the round ligament, fat and vessels. It was lined by the synovial membrane or stratum synoviale and the articular cartilages. The synovial membrane was coextensive with the inner surface of the fibrous capsule reflecting at the point of attachment of the fibrous capsule. In the acetabular region the synovial membrane reflected over most of the outer surface and all of the inner surface of the cotyloid ligament and ended at the margin of the articular cartilage which it did not cover. In the region of the femur the synovial membrane reflected at the point of attachment of the fibrous capsule. It continued to reflect over the portion of the neck of the femur contained within the joint and ended at the margin of the articular cartilage of the femur. A few fibers of the fibrous capsule attached more closely to the articular cartilage of the femur when observed from the inside of the joint cavity. These were easily seen when tension was placed on the capsule. One frequently observed fold was on the ventral surface of the neck of the femur. The synovial membrane covered all of the round ligament which was intraarticular. It also covered the acetabular fossa, vessels and fat passing through the acetabular notch and the fat and vessels passing through the craniomedial notch of the ox.

The Fibrous Capsule and Ligaments

The fibrous capsule, or stratum fibrosum, was the dense external stratum of the joint capsule which completely enveloped the joint. It covered the internal stratum, the synovial membrane or stratum synoviale. The fibrous capsule in the region of the acetabulum continued unattached over the outer surface of the cotyloid ligament and attached to the os coxae near the bony margin of the acetabulum except in the cranioventral region where it attached to the outer margin and surface of the cotyloid ligament. The acetabular attachment of the fibrous capsule allowed most of the outer surface of the cotyloid ligament to be free and to be covered by the synovial membrane. This was particularly conspicuous in the dog and ox. In the region of the femur the fibrous capsule was attached to the neck a short distance from the margin of the articular surface. Circular fibers, or zona orbicularis, were observed in the fibrous capsule of the dog, ox and horse. The zona orbicularis in the dog formed a thick band in the dorsal part of the fibrous capsule (Plate X). In the ventral region the zona orbicularis was not well developed in the dog. The circular fibers were more uniformly distributed in the fibrous capsule of the ox and horse and did not form a definite band (Plate III). Many of the longitudinal and oblique fibers were concentrated in certain areas of the fibrous capsule and formed three periarticular ligaments in the dog, ox and horse. One periarticular ligament was the iliofemoral ligament. A second periarticular ligament was the pubofemoral ligament or the pubocapsular ligament. This ligament was more commonly called the accessory ligament in the horse. A third periarticular ligament was the ischiofemoral ligament or ischiocapsular ligament. The zona orbicularis and periarticular ligaments of the fibrous capsule made the joint capsule vary in thickness.

The fibrous capsule of the dog was the thickest in the craniodorsal region and in the dorsolateral region where the zona orbicularis was well developed (Plate X). The fibrous capsule was the thinnest ventrally and dorsally medial to the zona orbicularis. In the craniodorsal region the fibrous capsule was crossed obliquely by the capsularis coxae muscle and it was closely attached to the fibrous capsule (Plate X). The muscle was directed ventrolaterally across the fibrous capsule from its origin at the iliopubic eminence to its insertion on the neck of the femur. In the region of the femur the attachment of the fibrous capsule was approximately one-half of a centimeter from the margin of the articular cartilage in a medium sized dog.

The fibrous capsule of the ox was the thickest craniodorsally in the region of the iliofemoral ligament. The capsularis coxae muscle was absent. The attachment to the femur was approximately one to one and a half centimeters from the margin of the articular cartilage except dorsolaterally where it was attached about two or three centimeters from the margin of the articular cartilage. The distance varied depending on the age and size of the specimens examined.

The fibrous capsule of the horse was thickest craniodorsally in the region of the iliofemoral ligament. Circular fibers were well developed, especially dorsally in the fibrous capsule (Plate III). Cranial to the iliofemoral ligament the capsularis coxae muscle crossed the external surface of the fibrous capsule (Plate III). It originated on the ilium dorsal to the lateral tendon of the rectus femoris muscle. Its tendon of insertion passed between the vastus intermedius and vastus lateralis muscles and attached to the anterior lateral border of the femur beneath the proximal extremity. A few fibers of the capsularis coxae muscle attached to the fibrous capsule. The fibrous capsule of the horse was attached to the femur approximately one centimeter from the margin of the articular cartilage except dorsolaterally where it was about two to three centimeters from the margin of the articular cartilage.

The best developed periarticular ligament in the ox was the iliofemoral ligament. It was located on the dorsocranial surface of the joint. The iliofemoral ligament crossed the joint obliquely in a lateroventral direction. It originated from the acetabular part of the ilium and inserted on the femur beneath the cranial portion of the greater trochanter and the tendon of the deep gluteal muscle. A second periarticular ligament, the pubofemoral ligament, was located on the ventral surface of the joint capsule (Plate IV). It originated from the ventrolateral portion of the prepubic tendon, passed laterally, blended with the joint capsule and inserted on the lesser trochanter of the femur with the tendon of the iliopsoas muscle. The ligament was observed more clearly when the femur was abducted, thus tensing the ligament. A third periarticular ligament, the ischiofemoral ligament, was located on the dorsocaudal surface of the joint capsule. The ligament originated from the ventral surface of the acetabular branch of the ischium caudal to the acetabulum. It passed laterad in a fan-shaped manner and blended with the fibrous capsule of the joint. This ligament could more readily be observed when the joint was extended, making the ligament tense. The latter two ligaments were poorly developed.

The iliofemoral ligament of the horse was similar to the same ligament in the ox (Plate III). The accessory ligament or the pubofemoral ligament was a thick round cord-like ligament (Plate VI). It was approximately one and a half centimeters in diameter and about eight centimeters in length. The accessory ligament originated from the lateral part of the prepubic tendon and passed laterally through the origin of the pectineus muscle ventral to the pubis. A second origin was at the pubis medial to the origin of the round ligament in the subpubic groove (Plate VI). As the accessory ligament continued laterally it blended with and was located ventral to the round ligament (Plate VI). It passed through the acetabular notch and inserted in the ventral part of the fovea capitis. A bursa was located between the dorsal part of the accessory ligament and pubis about midway between its origin and insertion. In the specimens examined the bursa did not communicate with the joint cavity. The ischiofemoral ligament was similar to the same ligament in the ox. The ischiofemoral ligament of the horse was poorly developed and in some specimens it was absent.

The periarticular ligaments of the dog were similar to the periarticular ligaments of the ox. The iliofemoral ligament was the best developed periarticular ligament in the dog. The ischiofemoral and pubofemoral ligaments were poorly developed and were absent in some specimens.

Intermuscular septa of the ox attached and blended with the fibrous capsule. The intermuscular septum which was attached to the lateral border of the shaft, wing, and tuber coxae of the ilium separated the gluteal muscles from the tensor fascia lata muscle and the origin of the rectus femoris muscle (Plate V). This septum blended caudally with the dorsocranial surface of the fibrous capsule. A second intermuscular septum attached to the craniomedial surface of the fibrous capsule caudal to the medial tendon of origin of the rectus femoris muscle. It had a common origin with the previously described septum but was directed ventrally between the iliopsoas muscle medially and the tensor fascia lata and the origin of the rectus femoris muscles laterally. Similar intramuscular septa were observed in the dog and horse.

A tendinous sheet covered the superficial surface of the gemellus muscle in all ox specimens examined (Plate V). The sheet blended with the dorsocaudal surface of the fibrous capsule and attached to the medial surface of the trochanteric ridge of the femur. The fibers of the tendinous sheet approached a radial course particularly dorsally as they blended with the fibrous capsule. This tendinous sheet was not observed in the dog and horse. The tendon of insertion of the gemellus muscle in the horse blended with the fibrous capsule.

In the ox the common tendon of insertion of the obturator internus and obturator externus muscles detached a tendinous band to the caudal surface of the fibrous capsule (Plate IV). A similar arrangement of the tendon of insertion of the obturator externus muscle in the horse was observed.

The lateral and medial tendons of origin of the rectus femoris muscle of the ox were separated by a bursa cranial to the ilium. There was no communication between the bursa and the joint cavity in the specimens which were examined. The lateral tendon of the rectus femoris muscle was bound down by a ligamentous band which arose from the fibrous capsule and traversed the lateral tendon obliquely in a craniodorsal direction and attached to the shaft of the ilium and an intermuscular septum (Plate V). The lateral tendon originated not only from a small depression dorsocranial to the acetabulum, but also approximately half of it originated from the cotyloid ligament of the acetabulum (Plate VIII). This caused the cotyloid ligament and the lateral tendon of the rectus femoris muscle to fuse with each other dorsolaterally. The medial tendon of the rectus femoris muscle had only a minor connection with the fibrous capsule and no attachment occurred with the cotyloid ligament.

In the horse the tendons of origin of the rectus femoris muscle were similar to that of the ox, except the lateral tendon did not have an origin from the cotyloid ligament. A bursa associated with these tendons was also observed in the horse.

In the dog the rectus femoris muscle had a single tendon of origin which originated from the iliopubic eminence. The tendon did not blend with the cotyloid ligament as in the ox.

The cotyloid ligament, often called the labrum glenoidale or marginal cartilage, deepened the acetabulum. It was generally triangular in shape when cut transversely. The base was attached to the bony rim of the acetabulum and the opposite edge was sharp. The inner surface of the cotyloid ligament was in contact with the head of the femur in the fresh state. The portion of the cotyloid ligament which crossed the acetabular notch became the transverse acetabular ligament. The latter ligament converted the acetabular notch into a foramen.

The cotyloid ligament of the dog was not well developed. The greatest development occurred on the caudal and cranial portions of the joint. The transverse acetabular ligament was well developed in the dog.

The shallow acetabulum of the ox was considerably deepened by the well developed, flexible, cotyloid ligament (Plate VIII). The ligament was loosely attached to the margin of the acetabulum and varied in width and thickness. The greatest width occurred dorsolaterally in the region of the recessed osseous margin. The greatest thickness with considerable width occurred caudodorsally. The cotyloid ligament was less prominent ventromedially. The transverse acetabular ligament was well developed and was associated with the caudomedially located acetabular notch. In the specimens in which the craniomedial notch was present a similar transverse ligament was formed by the cotyloid ligament. This notch was also converted into a foramen by a transverse ligament.

The cotyloid ligament of the horse was similar to that of the dog. Its greatest development occurred cranially (Plate VII). The transverse acetabular ligament was well developed in the horse (Plate VII).

The round ligament or ligamentum teres was a short, round band. It originated from or near the acetabulum and was directed to its insertion in the fovea capitis of the femur.

The round ligament of the dog was a well developed strong band and had three major origins. One was from the center of the acetabular fossa and the medial and lateral borders of the acetabular fossa and notch. A second was from the transverse acetabular ligament. A third was from the subpelvic groove located just caudal from the acetabular notch along the lateral border of the obturator foramen. The latter origin was extraarticular. The round ligament inserted into the upper part of the fovea capitis.

The round ligament of the ox was not well developed. A minor origin of the ligament was from the lateral border of both the acetabular notch and the acetabular fossa (Plate VIII). A major origin came from the transverse acetabular ligament which bridged the notch (Plate VIII). Another major origin came from the subpelvic groove caudal to the acetabular notch (Plate IV). This origin was extraarticular. The latter two origins of the round ligament were the strongest. The insertion of the round ligament completely filled the fovea capitis. In one specimen the insertion was ruptured. A very small fragment of bone had broken from the fovea capitis and was still attached to the free end of the ligament.

The round ligament of the horse had three major origins (Plate VII). One was from the subpubic groove. A second was from the dorsal cranial portion of the transverse acetabular ligament. A third was from the acetabular fossa. The latter origin had its greatest attachment to the cranial portion of the acetabular fossa. The first and third origins were the strongest. The round ligament inserted into the upper part of the fovea capitis dorsal to the insertion of the accessory ligament (Plate VI).

The Articular Muscular Relations

The coxofemoral joint was a deeply located joint. The joint was closely invested by numerous muscles in the dog, ox and horse (Plate IX). The muscles which surrounded the joint were easily divided into superficial and deep layers. The superficial layer of muscles was comprised primarily of larger muscles which did not contact the joint capsule directly. The deep layer of muscles was comprised primarily of smaller muscles which laid directly over the joint capsule. Most of the muscles in the deep layer were closely adhered to the joint capsule. The muscles which comprised the superficial layer in the ox were dorsocranially the gluteus medius muscle; dorsally the vertebral head of the biceps femoris muscle; caudolaterally the biceps femoris and the semitendinosus muscles; caudomedially the semimembranosus and adductor muscles; craniomedially the sartorius muscle and craniolaterally the tensor fascia lata muscle. The muscles which comprised the deep layer in the ox were dorsolaterally the deep gluteal muscle; caudolaterally the gemellus, quadratus femoris muscles and the common tendon of insertion of the obturator internus and externus muscles; caudomedially the obturator externus and the adductor longus muscles; craniomedially the pectineus and the iliopsoas muscles and cranially the tendon of origin of the rectus femoris muscle. The origin of the vastus muscles of the quadriceps femoris muscle came in contact with the cranial half of the femoral attachment of the joint capsule. The muscles which comprised the superficial and deep layers in the dog and horse were similar to the muscles which formed comparable layers in the ox. The muscles in the gluteal region in the horse were comparatively better developed than the muscles in the same region in the dog and ox.

The Articular Vessels

The blood supply of the joint capsule and ligaments of the coxofemoral articulation was the deep femoral, obturator, caudal gluteal, cranial gluteal, lateral circumflex femoral and medial circumflex femoral arteries.

The medial and caudal regions of the joint capsule were supplied by the deep femoral and obturator arteries. The deep femoral artery originated from the femoral artery and was directed caudally to supply the medial portion of the joint. The deep femoral artery was located medial to the joint capsule and dorsal to the tendon of insertion of the iliopsoas muscle in the ox and horse. In the dog the iliopsoas muscle was between the deep femoral artery and the joint capsule. In the dog and ox the deep femoral artery was lateral to the pectineus and adductor longus muscles. In the horse in the region of the joint the vessel was lateral to only the pectineus muscle. The nutrient artery or acetabular artery varied in its origin. In all three species it passed through the acetabular notch and supplied the round ligament and a pad of fat which occupied the notch. The round ligament received from the nutrient artery an abundant blood supply. Branches from the nutrient artery continued into the acetabular fossa and passed through foramina in the fossa into the bone. In the horse the nutrient artery also supplied the accessory ligament.

The deep femoral artery in the dog supplied a small articular branch or branches to the craniomedial surface of the joint (Plate XII). Near these articular branches the deep femoral artery divided into the obturator artery and the medial circumflex femoral artery (Plate XII). The medial circumflex femoral artery supplied the medial surface of the joint in some specimens. The obturator artery passed caudad in the dorsal portion of the adductor muscle. In some specimens the division of the deep femoral artery into the two preceding named arteries occurred just medial to the joint while in others the division occurred further caudad. In the caudomedial region of the joint the obturator artery gave origin to a large branch which ascended in a dorsal and slightly caudad direction through the obturator foramen (Plate XII). This ascending branch terminated in the obturator internus muscle within the pelvic cavity. In many specimens the nutrient artery and other small articular branches to the joint originated from the ascending branch of the obturator artery (Plate XII). In other specimens the nutrient artery and small articular branches originated from the obturator artery cranial to the ascending branch. Caudal to the ascending branch the obturator artery supplied articular branches which were directed laterally to the caudolateral portion of the joint (Plate XII). Microscopic examination of stained sections of the acetabular, middle and femoral portions of the round ligament of the dog revealed vessels in all three portions. The vessels were more numerous in the acetabular and middle parts. Small arteries were more numerous on the surface of the acetabular and middle portions of the round ligament as compared to the femoral portion when observed grossly.

The deep femoral artery in the ox gave origin to an articular branch near the cranial border of the pectineus muscle. The branch passed in an upward direction to supply the craniomedial portion of the joint. The branch continued through the craniomedial notch (not the acetabular notch) converted into a foramen by a transverse ligament of the acetabulum. It supplied this area and a small pad of fat in the notch. The round ligament was not supplied by this vessel. In one specimen an articular branch from the deep femoral artery originated cranial to the previously described branch.

It passed craniolaterally under the iliopsoas muscle and supplied the cranial region of the joint. This same area was also supplied by the lateral circumflex femoral artery. Caudal to the preceding articular branches one or two articular branches originated from the deep femoral artery and supplied the ventromedial portion of the joint. Further caudally the obturator artery originated from the deep femoral artery, ascended in a dorsal direction through the obturator foramen and terminated in the obturator internus muscle within the pelvic cavity. The obturator artery gave origin to the nutrient artery and other articular branches to the caudomedial portion of the joint. In one ox specimen a direct anastomosis was observed between a branch of the obturator artery and a branch from the iliolumbar artery. This occurred in the pelvic cavity on the acetabular extremity of the ilium. Caudal to the obturator artery the deep femoral artery supplied one or two articular branches to the caudal and caudolateral portions of the joint.

The deep femoral artery in the horse gave origin to articular branches which supplied the medial portion of the joint. Caudal to these it gave origin to one branch between the insertions of the obturator externus and quadratus femoris muscles. The branch passed dorsally on the caudal surface of the femur and terminated in the caudal surface of the joint. In the horse the obturator artery was one of the terminal branches of the internal iliac artery. The obturator artery descended through the lateral portion of the obturator foramen and passed caudally beneath the ischium in the obturator externus and adductor muscles (Plate VI). As it passed through the obturator foramen it supplied a large articular branch to the caudal part of the joint. This articular branch was directed caudoventrally and gave origin to the nutrient artery.

The caudodorsal region of the joint capsule was supplied by the caudal gluteal artery in the dog and ox. The caudal gluteal artery originated from the internal iliac artery. The former artery passed caudolaterally through the lesser sciatic foramen. The large branch from the caudal gluteal artery supplied the joint (Plate IX). The branch descended ventrolaterally at the junction of the deep gluteal and gemellus muscles to reach the joint. In the horse the caudodorsal portion of the joint was not supplied by the caudal gluteal artery. This area was supplied in the horse by the obturator artery.

The craniodorsal region of the joint capsule was supplied by numerous branches of the cranial gluteal artery in the dog, ox and horse. These branches reached the joint by passing through the deep gluteal muscle. Some of these branches supplied the capsularis coxae muscle in the dog and horse.

The cranial region of the joint capsule was supplied by the lateral circumflex femoral artery. The lateral circumflex femoral artery in the dog and ox originated from the cranial femoral artery between the rectus femoris and vastus intermedius muscles. It was directed toward the cranial portion of the greater trochanter and the dorsal portion of the vastus lateralis muscle. Along its course the artery supplied articular branches to the joint and a large area of fat located cranial to the joint in a space between the rectus femoris muscle and the other three parts of the quadriceps femoris muscle. In the dog it also supplied a portion of the capsularis coxae muscle. In the horse the lateral circumflex femoral or iliacofemoral artery was one of the terminal branches of the internal iliac artery. The lateral circumflex femoral artery of the horse passed laterally beneath the shaft of the ilium between an intramuscular septum dorsally and the iliopsoas muscle ventrally. The artery continued caudolaterally over the rectus femoris muscle and supplied branches to the cranial aspect of the joint and the capsularis coxae muscle. The lateral circumflex femoral artery of the horse also supplied an articular branch to the cranial portion of the femoral attachment of the fibrous capsule.

The Articular Nerves

The coxofemoral articulation was innervated by articular branches from the cranial gluteal, sciatic, femoral and obturator nerves.

The craniodorsal region of the joint was innervated by the cranial gluteal nerve. The long lateral branch of the cranial gluteal nerve passed laterad and innervated the tensor fascia lata muscle. From this branch originated an articular nerve in the dog and horse (Plate X). The articular nerve continued in a ventrocaudal direction between the rectus femoris and vastus lateralis muscles and terminated by innervating the capsularis coxae muscle and the joint.

Branches from the cranial gluteal nerve in the ox which innervated the deep gluteal muscle supplied twigs to the craniodorsal portion of the joint. These nerve twigs were observed after they had passed through the muscle and were located between the deep surface of the muscle and the bone. In one specimen the nerves were more on the superficial surface of the deep gluteal muscle. In this case no articular branches from the small muscular branch of the sciatic nerve could be observed.

The dorsocaudal region of the joint was innervated by the sciatic nerve in the dog, ox and horse. The articular branch which supplied the joint was derived from the small muscular branch of the sciatic nerve which innervated the gemellus, quadratus femoris and also the obturator internus muscles in the dog and horse (Plate X). The articular branch of the small muscular branch of the sciatic nerve was given off either before or after the latter nerve entered the gemellus muscle. The branch from the above source was directed lateral toward the joint between the gemellus and the caudal edge of deep gluteal muscles. In some specimens articular branches were located in the gemellus muscle. The nerve to the quadratus femoris muscle located beneath the gemellus muscle supplied additional articular branches in the horse.

The cranioventral region of the joint was innervated by the femoral nerve. The femoral nerve of the dog and ox innervated the joint by a continuation from a muscular branch of the femoral nerve which supplied the iliopsoas muscle (Plate XI). The branch to the joint continued in a caudoventral direction through the iliopsoas muscle. It emerged from the iliopsoas muscle on its lateral surface and descended in the same direction between the iliopsoas muscle and an intermuscular septum (Plate XI). The nerve terminated in the joint. The branch to the joint came directly from the radicular origin of the femoral nerve from the fifth and sixth lumbar spinal nerves in the dog (Plate XI).

An additional route of the femoral nerve which supplied the joint was observed in the ox. The pectineal branch of the femoral nerve which innervated the pectineus muscle gave twigs to the joint in all ox specimens except two.

The femoral nerve of the horse had a similar pattern to the femoral nerve of the dog and ox. Many of the branches, which supplied the quadriceps femoris and iliopsoas muscles, of the femoral nerve were in close proximity of the joint. Nerve twigs from these branches could not be traced to the joint in the horse.

The caudoventral region of the joint capsule was supplied by the obturator nerve in the dog, ox and horse (Plate XII). The articular branch originated from the obturator nerve dorsal to the obturator foramen. Nerve twigs from the articular branch entered the acetabular notch and supplied the round ligament of the dog, ox and horse (Plate XII). These nerve twigs also innervated the accessory ligament of the horse.

DISCUSSION

The Acetabulum and the Head of the Femur

The articular surface of the acetabulum was very similar in the dog and horse (Plate I). The acetabulum of the dog and horse was deep compared to the shallow acetabulum of the ox. Roberts (1956) described the shallow acetabulum as a factor in the luxation of the coxofemoral articulation in the ox.

Sisson and Grossman (1953) and Miller (1955) did not specifically locate the acetabular notch of the dog. They described a small notch which was located on the caudomedial portion of the acetabulum. This notch compared to the subpelvic groove (Plate I).

Two notches of the acetabulum of the ox were described. The craniomedial notch was variable in size and existence (Plate I). This was in agreement with Sisson and Grossman (1953) and Habel (1955). McLeod (1958) did not describe the craniomedially located notch. A subpelvic groove located on the ventral surface of the ischium caudal to the acetabular notch of the ox was comparable to the subpelvic groove of the acetabular notch of the dog (Plate I). The margin of the acetabulum of the ox was concave dorsolaterally and could be described as a notch. Murphey (1922) called this concavity of the margin the lateral notch of the acetabulum and listed it as an anatomical factor in the luxation of the coxofemoral articulation of the ox.

The head of the femur of the dog and horse was very similar except for the fovea capitis which was very deep in the horse (Plate II). The articular surface of the head of the femur of the ox extended for a considerable distance on the neck of the femur (Plate II). The fovea capitis was more centrally located in the ox as compared to the dog and horse. These anatomical descriptions of the head of the femur were in agreement with Miller (1955), Bradley (1948) and Sisson and Grossman (1953). Foramina were often observed in the fovea capitis of the horse but only occasionally were they observed in the fovea capitis in the dog. They were absent in the ox.

The Articular Surfaces, Cartilages, Cavity and Synovial Membrane

Articular cartilages covered the articular surfaces of the acetabulum and the head of the femur in the fresh state in the dog, ox and horse. A great variation in the thickness of the articular cartilages was not observed.

The inner surface of the fibrous capsule and the acetabular fossa were lined by the synovial membrane which with the articular cartilages formed a complete closed cavity. Most of the outer surface and all of the inner surface of the cotyloid ligament was covered by the synovial membrane. The synovial membrane covered all of the intraarticular round ligament, fat and vessels. These structures were thus excluded from the true joint cavity.

The Fibrous Capsule and Ligaments

A great part of the fibrous capsule in the region of the acetabulum in the dog, ox and horse attached to the os coxae near the bony margin of the acetabulum. The fibrous capsule attached to the margin and outer surface of the cotyloid ligament in the cranioventral region. The remainder of the margin and outer surface of the cotyloid ligament was free. The free part of the ligament was covered by the synovial membrane. This portion of the cotyloid ligament projected into the joint cavity. This compared with the description in man. According to Gray (1954) the cotyloid ligament projected into the joint cavity in man and the outer surface of the ligament was covered by the synovial membrane, except in front where the fibrous capsule attached to it. In the region of the femur in the dog, ox and horse the fibrous capsule was attached to the neck of the femur a short distance from the articular surface of the head of the femur.

Circular fibers, or zona orbicularis, were present in the fibrous capsule of the dog, ox and horse. The circular fibers in the dog formed a thick but narrow band especially in the dorsal part of the fibrous capsule (Plate X). The circular fibers were more uniformly distributed in the fibrous capsule of the ox and horse and they did not form a thick narrow band (Plate III). These circular fibers blended with periarticular ligaments in the dog, ox and horse. Gray (1954) described a well developed zona orbicularis in man which was comparable to the zona orbicularis of the dog. Circular fibers of the fibrous capsule were not described by Bradley (1948), Habel (1955), McLeod (1958), Miller (1952) and Sisson and Grossman (1953).

Many of the longitudinal and oblique fibers were concentrated in certain areas of the fibrous capsule and formed the iliofemoral, pubofemoral and ischiofemoral, periarticular ligaments in the dog, ox and horse.

The iliofemoral ligament of the dog, ox and horse was similar. This study was in agreement with the description of the iliofemoral ligament of the horse as described by Sisson and Grossman (1953) and of the ox as described by Habel (1955).

The pubofemoral ligament of the ox and horse varied considerably (Plate IV) and (Plate VI). The pubofemoral ligament, or accessory ligament, in the horse was not a periarticular ligament embedded in the fibrous capsule. The ligament in the horse could be more adequately described as an accessory round ligament. Chauveau (1901) divided the round ligament of the horse into cotyloid and pubic parts. The cotyloid portion compared to the round ligament and the pubic portion compared to the accessory ligament as described by Sisson and Grossman (1953). The pubofemoral ligament of the ox was truly a periarticular ligament embedded in the fibrous capsule (Plate IV). The location and attachments of the pubofemoral ligament of the ox compared favorably with the descriptions of Habel (1955). This was not in accord with Murphey (1922) in which he reported the absence of the pubofemoral ligament in the ox. The pubofemoral ligament of the dog was similar to the pubofemoral ligament of the ox. It was poorly developed and was absent in some specimens.

The ischiofemoral ligament of the dog, ox and horse was a feebly developed periarticular ligament. This ligament was absent in some dog and horse specimens. The ischiofemoral ligament was not described by Habel (1955), McLeod (1958) and Sisson and Grossman (1953). No periarticular ligaments were described for the coxofemoral articulation of the dog by Bradley (1948) and Miller (1952).

The fibrous capsule of the ox and horse was the thickest in the region of the iliofemoral ligament. The fibrous capsule of the dog was the thickest in the region of the iliofemoral ligament and zona orbicularis. The presence of these structures accounted for the variation in the thickness of the fibrous capsule of the dog, ox and horse. This was not in agreement with Miller (1952) in which he reported no appreciable thickenings of the fibrous capsule of the dog.

The three previously described periarticular ligaments were all present in man, Gray (1954) and Spalteholz (1944). Apparently they were much better developed in man which was a biped as compared to the domestic animals which were quadripeds. The greater development of the periarticular ligaments in the biped was probably due to the greater comparative weight that this articulation must support as compared to the quadriped. The iliofemoral ligament of man was very essential in checking the backward inclination of the body and was described as the strongest ligament in the entire human body according to Gray (1954).

Intermuscular septa, the tendons of insertion of the obturator internus and externus muscles and the tendinous sheet which covered the gemellus muscle in the ox, all attached to the fibrous capsule of the joint. The lateral tendon of origin of the rectus femoris muscle partially originated from the cotyloid ligament in the ox (Plate VIII).

Generally the cotyloid ligament was very similar in shape and function in the dog, ox and horse. The cotyloid ligament of the dog, ox and horse was triangular in shape when cut transversely. Gray (1954) reported the same shape of the cotyloid ligament in man. The cotyloid ligament of the dog and horse was very small compared to the cotyloid ligament of the ox

(Plate VII and Plate VIII). The large wide cotyloid ligament of the ox deepened the shallow acetabulum. The cotyloid ligament of the ox was loosely attached to the margin of the acetabulum. Murphey (1922) described the weak attachment of the cotyloid ligament as an anatomical factor in the luxation of the coxofemoral articulation in the ox. The part of the cotyloid ligament which crossed the acetabular notch formed a well developed transverse acetabular ligament in all three species.

The round ligament extended from the acetabulum to the fovea capitis of the head of the femur in the dog, ox and horse. The round ligament was the strongest in the dog and horse. It was comparatively smaller and weaker in the ox. Sisson and Grossman (1953) and McLeod (1958) stated that the round ligament was sometimes absent in the ox. In this investigation the round ligament had apparently ruptured antemortem from the fovea capitis in one ox specimen. This ligament may have completely disappeared in time. Murphey (1922) reported the small round ligament as an anatomical factor in luxation of the coxofemoral articulation of the ox.

The round ligament had three major origins which were similar in the dog, ox and horse (Plate VII and Plate VIII). The origins of the round ligament of the dog and ox were almost identical. One origin was from the acetabular fossa. A second origin was from the transverse ligament and a third was from a subpelvic groove. The latter origin varied in its location. The subpelvic groove, which furnished origin for the round ligament in the dog and ox, was located caudal to or associated with the caudal part of the acetabular notch (Plate I). The subpubic groove furnished an origin for the round ligament of the horse. The subpubic groove was located on the ventral surface of the pubis medial to the acetabular notch (Plate I). Two of the origins of the round ligament of the dog compared with those described by Miller (1952) but he failed to describe the origin from the subpelvic groove. The origins of the round ligament of the ox compared favorably with those described by Habel (1955). McLeod (1958) described only the origin from the acetabular fossa in the ox. Sisson and Grossman (1953) described only the origin from the subpubic groove of the round ligament of the horse. The portion of the round ligament in the dog, ox and horse which originated from the subpelvic groove was extraarticular. The other origins and major portion of the round ligament were intraarticular. Even the latter described parts of the round ligament were not intraarticular if one considered the synovial membrane covered this portion of the round ligament and excluded it from the joint cavity in the live state. This was not in agreement with Sisson and Grossman (1953) and McLeod(1958) in which the round ligament in the ox was reported to be entirely intraarticular. Schroeder (1936) reported the round ligament of the dog to be intraarticular.

The Articular Muscular Relations

The muscles which composed the deep and superficial layers which surrounded the joint were very similar in the dog, ox and horse. Comparatively the muscles in the gluteal region were poorly developed in the dog and ox as compared to the muscles in the same region in the horse. Roberts (1956) and Murphey (1922) stated that the weak muscles in the gluteal region in the ox were a factor in luxation of the coxofemoral articulation.

The capsularis coxae muscle was present in the dog and horse and absent in the ox. The capsularis coxae muscle in the dog was closely attached to the fibrous capsule. The same muscle in the horse had only a few muscle fibers attached to the fibrous capsule. Gray (1954) did not report the presence of a capsularis coxae muscle in man.

The Articular Vessels

The blood supply of the coxofemoral articulation was the deep femoral, obturator, caudal gluteal, cranial gluteal, lateral circumflex femoral and medial circumflex femoral arteries. All of these arteries supplied the coxofemoral articulation of the dog. There were some exceptions in the ox and horse. An artery, which compared to the medial circumflex femoral artery of the dog, did not supply the coxofemoral articulation of the ox. The medial circumflex femoral artery was absent in the horse. The caudal gluteal artery did not supply the coxofemoral articulation of the horse. The probable reason the caudal gluteal artery did not supply the coxofemoral articulation in the horse was because the artery was dorsal in location and origin. The caudal gluteal artery in the horse originated from the lateral sacral artery and in the dog and ox it originated from the internal iliac artery. The area of the coxofemoral articulation supplied by the caudal gluteal artery in the dog and ox was supplied by the obturator artery in the horse.

Sisson and Grossman (1953) described the deep femoral and obturator arteries as supplying the coxofemoral articulation of the horse. Chauveau (1901) stated that the deep femoral artery was the principal blood supply to the coxofemoral articulation. Bradley (1948), Habel (1955) and McLeod (1958) did not name or describe a blood supply of the coxofemoral articulation. Miller (1952) reported only that a nutrient artery entered the acetabular notch but he did not indicate its source. According to Gray (1954) the obturator, medial circumflex femoral, superior gluteal and inferior gluteal arteries supplied the coxofemoral articulation of man.

The nutrient or acetabular artery either originated directly from or by way of a branch from the obturator artery of the dog, ox and horse (Plate XII).

The nutrient artery supplied the round ligament and a pad of fat in the region of the acetabular notch and joint cavity in the dog, ox and horse. It also supplied the accessory ligament of the horse. The nutrient artery furnished an abundant blood supply to the round ligament of the dog, ox and horse. Arteries were abundant on the surface of the round ligament particularly on the middle and acetabular portions. Some of these arteries left the round ligament and entered foramina located in the acetabular fossa and proceeded into the os coxae.

Kitchell et al. (1957) reported that the round ligament of the coxofemoral articulation of the pig was supplied by the acetabular branch of the obturator artery. On microscopic examination arteries were noted which coursed the full length of the round ligament of the pig. This compared favorably with observations made in this study in which a microscopic examination of sections of the acetabular, middle and femoral portions of the round ligament of the dog revealed vessels in all three portions. The vessels were more numerous in the acetabular and middle parts.

Schroeder (1936) described a small artery in the round ligament which acted as a nutrient artery of the head of the femur in young growing dogs. Presumably this artery entered the femur by way of a foramen in the fovea capitis. This artery was not observed, but small arteries were noted in the round ligament which reached the fovea capitis. Foramina in macerated specimens were observed occasionally in the fovea capitis of the head of the femur of the dog.

The Articular Nerves

The coxofemoral articulation was innervated by articular branches from the cranial gluteal, sciatic, femoral and obturator nerves in the dog, ox and horse. Articular branches from the sacral plexus, sciatic, obturator, accessory obturator and a filament from the branch of the femoral supplying the rectus femoris muscle were described by Gray (1954) as the nerves which innervated the coxofemoral articulation of man.

The accessory obturator nerve of man may have compared with the pectineal branch of the femoral nerve in the ox. The pectineal branch of the femoral nerve innervated the pectineus muscle and coxofemoral articulation of the ox. According to Gray (1954) the accessory obturator nerve of man also supplied the pectineus muscle and the coxofemoral articulation. He indicated that the nerve was present only in twenty-nine per cent of the cases. An additional articular branch to the coxofemoral articulation was supplied by the obturator nerve in man when the accessory obturator nerve was absent.

The branch from the femoral nerve was consistently observed to supply the coxofemoral articulation of the dog.

Twigs of the articular branch of the obturator nerve of the dog, ox and horse entered the acetabular notch and innervated the round ligament. These nerve twigs also innervated the accessory ligament of the horse. Miller (1952) reported nerves entering the acetabular notch of the dog but he did not indicate their source.

Chauveau (1901), Vaughan (1907), M'Fadyean (1909), Bradley (1948), Habel (1955) and McLeod (1958) did not name or describe a nerve supply of the coxofemoral articulation. Sisson and Grossman (1953) stated that the capsularis coxae muscle of the horse was innervated by the cranial gluteal nerve, but they did not mention a nerve supply of the joint. Miller (1952) described the capsularis coxae muscle of the dog as being innervated by the femoral nerve. This was not in agreement with observations made in this study in which the cranial gluteal nerve innervated the capsularis coxae muscle of the dog.

SUMMARY

The anatomy of the coxofemoral articulation of the dog, ox and horse was presented.

The acetabulum of the dog, ox and horse had many similarities but was comparatively shallower in the ox. Foramina were detected in the acetabular fossa in the dog, ox and horse. The head of the femur in the dog and horse were similar except for the fovea capitis which was deeper in the horse. The articular surface of the head of the femur of the ox extended on to the dorsal surface of the neck of the femur.

An acetabular notch was present in the acetabulum of the dog, ox and horse. A second notch and a possible third notch was observed in the ox. A subpelvic groove was associated with the acetabular notch of the dog, ox and horse. The subpelvic groove in the dog and ox was located on the ventral surface of the ischium caudal to the acetabular notch. The subpelvic groove, called a subpubic groove in the horse, was located medial to the acetabular notch on the ventral surface of the pubis.

The synovial membrane covered all of the intraarticular round ligament, fat and vessels. These structures were thus excluded from the true joint cavity.

The fibrous capsule of the dog, ox and horse varied in thickness due to the presence of periarticular ligaments and the zona orbicularis. The iliofemoral, pubofemoral and ischiofemoral, periarticular ligaments were present in the dog, ox and horse. The iliofemoral ligament of the dog, ox and horse was the best developed periarticular ligament. The pubofemoral or accessory ligament of the horse was more like an accessory round ligament than a periarticular ligament. The pubofemoral ligament in the dog and the ischiofemoral ligament in the dog and horse were poorly developed or absent. The zona orbicularis formed a thick but narrow band in the dorsal part of the fibrous capsule of the dog. In the ox and horse the zona orbicularis was more uniformly distributed throughout the fibrous capsule.

The cotyloid ligament was present in the dog, ox and horse. It was triangular in shape when cut transversely. The cotyloid ligament of the ox was much larger when compared to the same ligament in the dog and horse. The cotyloid ligament in the ox deepened the acetabulum considerably. It was loosely attached to the rim of the acetabulum in the ox. The loose attachment of the cotyloid ligament and the shallow osseous acetabulum in the ox were anatomical factors which made the coxofemoral articulation more vulnerable to luxation. The lateral tendon of origin of the rectus femoris muscle in the ox partially originated from the cotyloid ligament. The cotyloid ligament formed the transverse acetabular ligament as it crossed the acetabular notch. This converted the notch into a foramen in the dog, ox and horse.

The round ligament passed from the acetabulum to the fovea capitis of the head of the femur. Three origins of the round ligament were described in the dog, ox and horse. One origin was from the acetabular fossa, a second from the transverse ligament and a third from a subpelvic groove. The round ligament was supported by the pubofemoral or accessory ligament in the horse.

The muscles which composed the deep and superficial layers surrounding the joint were similar in the dog, ox and horse. The muscles in the gluteal region in the dog and ox were not well developed. This was an additional anatomical factor which contributed to luxation of the coxofemoral articulation in the dog and ox. The capsularis coxae muscle was present in the dog and horse. It was absent in the ox.

The coxofemoral articulation was supplied by the deep femoral, obturator, caudal gluteal, cranial gluteal, lateral circumflex femoral and medial circumflex femoral arteries. All of these arteries supplied the coxofemoral articulation in the dog. There were some exceptions in the ox and horse. The nutrient artery originated from the obturator artery in the dog, ox and horse. It supplied the round ligament and fat. The nutrient artery also supplied the accessory ligament in the horse. It entered the joint by passing through the acetabular notch. The nutrient artery furnished an abundant blood supply to the round ligament, particularly to the middle and acetabular portions. Some branches of the nutrient artery entered foramina in the acetabular fossa and continued into the os coxae.

The coxofemoral articulation was innervated by articular branches of the cranial gluteal, sciatic, femoral and obturator nerves in the dog, ox and horse. Twigs of the articular branch of the obturator nerve of the dog, ox and horse entered the acetabular notch and innervated the round ligament. These nerve twigs also innervated the accessory ligament of the horse.

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APPENDIX

EXPLANATION OF PLATE I

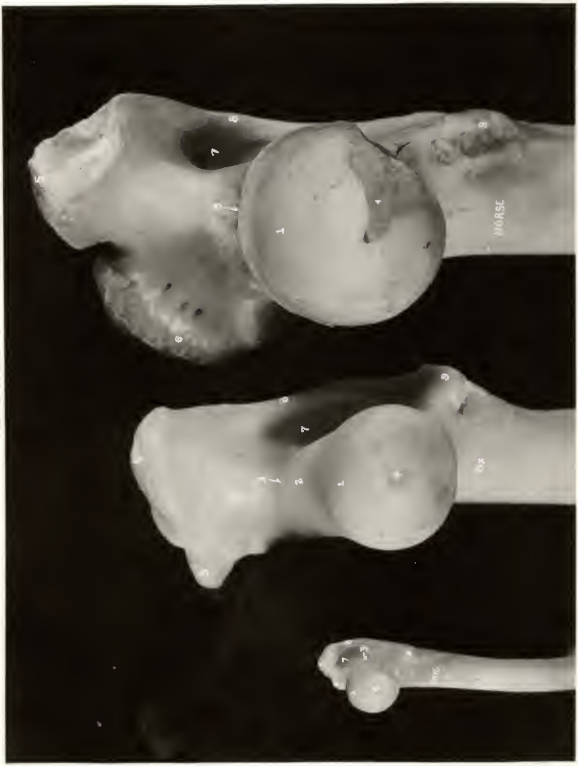
The ventrolateral view of the os coxae of the dog, ox and horse showing the acetabulum. 1, Articular surface; 2, acetabular fossa; 3, acetabular notch; 4, craniomedial notch; 5, recessed dorsolateral margin; 6, subpelvic groove (subpubic groove in the horse); 7, cylindrical margin; 8, obturator foramen; 9, iliopectineal eminence; 10, tuber sacrale; 11, tuber ischii.

PLATE I

EXPLANATION OF PLATE II

A dorsomedial view of the proximal extremity of the femur of the dog, ox and horse showing the head of the femur. 1, Articular surface; 2, articular surface extending on dorsal surface of the neck in the ox; 3, articular margin; 4, fovea capitis; 5, summit of the greater trochanter; 6, convexity of greater trochanter; 7, trochanteric fossa; 8, trochanteric ridge; 9, lesser trochanter.

PLATE II



EXPLANATION OF PLATE III

The dorsolateral view of the coxofemoral articulation of the horse demonstrating the iliofemoral ligament and circular fibers of the fibrous capsule. 1, Iliofemoral ligament; 2, circular fibers; 3, capsularis coxae muscle; 4, intermuscular septum projecting laterally from shaft of ilium; 5, gemellus muscle; 6, tendon of insertion of the obturator internus muscle; 7, greater trochanter; 8, gluteus medius muscle; 9, gluteus profundus muscle; 10, rectus femoris muscle.

PLATE III

EXPLANATION OF PLATE IV

Ventral view of the coxofemoral articulation of the ox showing the pubofemoral ligament, the acetabular notch and origin of the round ligament from the subpelvic groove. 1, Prepubic tendon; 2, pubofemoral ligament; 3, ventral surface of ilium; 4, rectus femoris muscle; 5, vastus medialis muscle; 6, tendon of insertion of the iliopsoas muscle; 7, quadratus femoris muscle; 8, common tendon of the obturator externus and internus muscles; 9, attachment of the tendon of the obturator muscles to the fibrous capsule; 10, acetabular notch; 11, origin of round ligament from the subpelvic groove.

PLATE IV

EXPLANATION OF PLATE V

The dorsolateral view of the coxofemoral articulation of the ox showing an intermuscular septum and the tendinous sheet of the gemellus muscle. 1, Ilium; 2, cranial gluteal nerve; 3, deep gluteal muscle; 4, intermuscular septum between the deep gluteal muscle and the tensor fascia lata muscle; 5, tensor fascia lata muscle, most of which has been removed; 6, rectus femoris muscle; 7, medial tendon of origin of rectus femoris muscle; 8, lateral tendon of origin of the rectus femoris muscle; 9, ligamentous band binding down the lateral tendon of origin of rectus femoris muscle; 10, cotyloid ligament; 11, fibrous capsule; 12, tendinous sheet covering gemellus muscle; 13, insertion of gluteus medius muscle; 14, tendon of insertion of gluteus accessorius muscle; 15, tendon of insertion of the deep gluteal muscle; 16, vastus lateralis muscle.

PLATE V

EXPLANATION OF PLATE VI

Ventromedial view of coxofemoral articulation of the horse showing the pubofemoral ligament or accessory ligament and the round ligament. 1, Prepubic tendon; 2, acetabular branch of pubis; 3, pubofemoral ligament or accessory ligament; 4, origin of accessory ligament from prepubic tendon; 5, origin of accessory ligament from the pubis, medial to the round ligament; 6, origin of round ligament from subpubic groove; 7, insertion of accessory ligament into fovea capitis; 8, insertion of round ligament into fovea capitis; 9, transverse acetabular ligament (cut and reflected); 10, articular cartilage of head of the femur; 11, joint capsule (cut and reflected to show joint cavity); 12, rectus femoris muscle; 13, acetabular branch of ischium; 14, obturator artery; 15, obturator foramen; 16, gemellus muscle; 17, quadratus femoris muscle; 18, tuber ischii.

PLATE VI

EXPLANATION OF PLATE VII

Ventral view of the acetabulum of the horse showing the cotyloid, round, transverse acetabular and accessory ligaments. Femoral end of the round ligament has been cut and a string attached to it. 1, Rectus femoris muscle; 2, cotyloid ligament; 3, articular cartilage of acetabulum; 4, acetabular fossa; 5, acetabular notch; 6, origin of round ligament from acetabular fossa; 7, origin of round ligament from transverse acetabular ligament; 8, origin of round ligament from subpubic groove; 9, transverse acetabular ligament (cut and reflected); 10, accessory ligament (reflected cranially away from round ligament); 11, prepubic tendon; 12, pubis; 13, obturator foramen; 14, ischium.

PLATE VII

EXPLANATION OF PLATE VIII

Ventrolateral view of the acetabulum of the ox showing the round ligament, cotyloid ligament and transverse acetabular ligament. 1, Ilium; 2, medial tendon of origin of the rectus femoris muscle; 3, lateral tendon of origin of the rectus femoris muscle; 4, cotyloid ligament; 5, acetabular fossa showing some vessels in the fossa; 6, origin of round ligament from the acetabular fossa; 7, origin of round ligament from the transverse acetabular ligament; 8, transverse acetabular ligament; 9, pubis; 10, obturator foramen; 11, ischium.

PLATE VIII

EXPLANATION OF PLATE IX

Dorsolateral view of the coxofemoral articulation of the ox showing the muscular relations to the joint. A source of some of the articular blood supply and nerve supply is also demonstrated. 1, Gluteus medius muscle (reflected); 2, vertebral head of the biceps femoris muscle (reflected); 3, greater sciatic foramen; 4, cranial gluteal nerve; 5, cranial gluteal artery; 6, sciatic nerve; 7, lesser sciatic foramen; 8, caudal gluteal nerve; 9, caudal gluteal artery; 10, branch from caudal gluteal artery which supplies the joint; 11, small muscular branch of the sciatic nerve; 12, deep gluteal muscle; 13, gemellus muscle; 14, obturator externus muscle; 15, quadratus femoris muscle; 16, adductor muscle; 17, greater trochanter; 18, vastus lateralis muscle; 19, tensor fascia lata muscle; 20, accessory gluteal muscle.

PLATE IX

EXPLANATION OF PLATE X

Dorsolateral view of the joint capsule of the coxofemoral articulation of the dog showing the articular nerves of the cranial gluteal nerve and the sciatic nerve. 1, Gluteus medius muscle (insertion cut and reflected); 2, deep gluteal muscle (insertion cut and reflected); 3, cranial gluteal nerve (long lateral branch); 4, articular branch of cranial gluteal nerve; 5, tensor fascia lata muscle; 6, rectus femoris muscle; 7, vastus lateralis muscle; 8, capsularis coxae muscle; 9, joint capsule (the light band below 9 is the zona orbicularis); 10, greater trochanter; 11, tendon of insertion of the obturator internus muscle; 12, gemellus muscle; 13, sciatic nerve; 14, muscular branch of sciatic nerve to the gemellus, obturator internus and quadratus femoris muscles; 15, articular branch of sciatic nerve; 16, sacrotuberous ligament; 17, caudal gluteal vessels; 18, superficial gluteal muscle (insertion cut and reflected); 19, biceps femoris muscle (reflected).

PLATE X

EXPLANATION OF PLATE XI

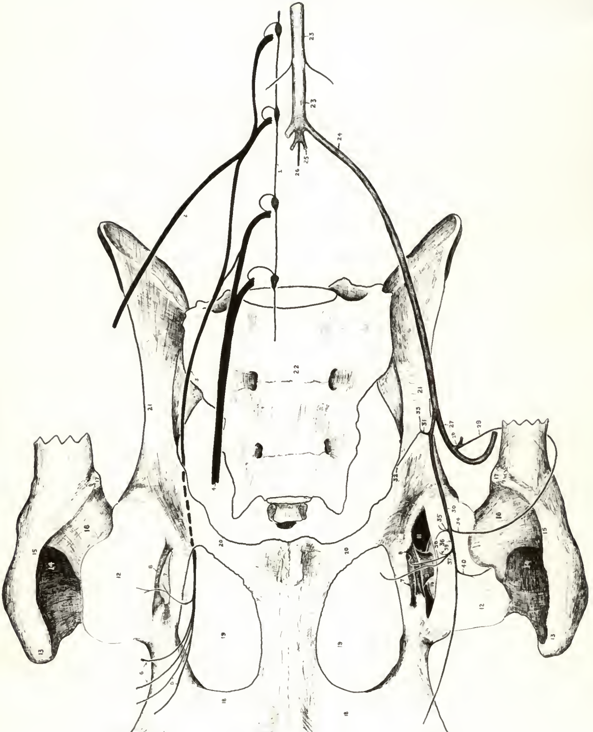
Medial view of the iliolumbar region and the cranial portion of the coxofemoral articulation of the dog. 1, Lumbar vertebrae; 2, sympathetic trunk; 3, iliopsoas muscle (cut); 4, psoas minor muscle (reflected ventrally); 5, abdominal wall; 6, quadriceps femoris muscle; 7, intermuscular septum; 8, craniomedial portion of the coxofemoral joint capsule; 9, femoral nerve with radicular origins from fifth and sixth lumbar spinal nerves; 10, branch of femoral nerve to the iliopsoas muscle and the coxofemoral articulation; 11, radicular origins of obturator nerve from the fifth and sixth spinal nerves; 12, iliopsoas muscle (cut and reflected dorsally over the ilium).

PLATE XI

EXPLANATION OF PLATE XII

Ventral view of pelvic region showing the distribution of the obturator nerve on the right and the deep femoral artery on the left. 1, Sympathetic trunk; 2, femoral nerve; 3, obturator nerve; 4, sciatic nerve; 5, articular branch of obturator nerve; 6, muscular branches of obturator nerve; 7, acetabular notch; 8, transverse acetabular ligament; 9, round ligament; 10, head of the femur; 11, joint cavity; 12, joint capsule (left joint capsule has a window cut in it); 13, greater trochanter; 14, trochanteric fossa; 15, trochanteric ridge; 16, neck of femur; 17, lesser trochanter; 18, ischium; 19, obturator foramen; 20, pubis; 21, ilium; 22, sacrum; 23, aorta; 24, external iliac artery; 25, internal iliac artery; 26, middle sacral artery; 27, femoral artery; 28, cranial femoral artery; 29, lateral circumflex femoral artery; 30, deep femoral artery; 31, pudendoepigastric trunk; 32, external pudendal artery; 33, caudal deep epigastric artery; 34, medial circumflex femoral artery; 35, articular branch; 36, obturator artery; 37, branch of obturator artery passing through the obturator foramen; 38, nutrient artery; 39, articular branch; 40, articular branch.

PLATE XII



THE COMPARATIVE ANATOMY OF THE COXOFEMORAL
ARTICULATION OF THE DOG, OX AND HORSE

by

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Investigation of the anatomy of the coxofemoral articulation of the dog, ox and horse was undertaken because of the incomplete anatomical descriptions of this articulation in these domestic animals as compared with the more complete description in man. A comparative investigation was made because the dog, ox and horse were the three principal domestic species attended by the veterinarian. The frequency of luxations of the coxofemoral articulation and fractures of the bones involved in this joint further indicated the need for a basic anatomical description.

Ten specimens of the coxofemoral articulation of the dog, ten of the ox and ten of the horse were investigated. Some of these were preserved and the arterial system injected with red latex. This was followed by a detailed dissection of the area. Microscopic sections were prepared of the acetabular, middle and femoral portion of some of the round ligaments of the dog. Photographs and schematic drawings were made of special dissected areas.

The acetabulum of the ox was comparatively shallower. An acetabular notch was present in the acetabulum of the dog, ox and horse. A second notch and a possible third notch was also present in the ox. A subpelvic groove was associated with the acetabular notch of the dog, ox and horse. Foramina were detected in the acetabular fossa in the dog, ox and horse.

The fovea capitis of the head of the femur of the horse was very deep. The articular surface of the head of the femur extended on the dorsal surface of the neck of the femur of the ox.

The synovial membrane covered the intraarticular round ligament, fat and vessels. This anatomical arrangement excluded these structures from the true joint cavity.

The iliofemoral, pubofemoral and ischiofemoral, periarticular ligaments were observed in the fibrous capsule of the dog, ox and horse. The fibrous capsule of the dog, ox and horse varied in thickness because of the periarticular ligaments and zona orbicularis.

The cotyloid ligament of the ox was comparatively the best developed. It deepened the acetabulum of the ox but it was loosely attached to the acetabular margin. The lateral tendon of origin of the rectus femoris muscle partially originated from the cotyloid ligament in the ox.

The round ligament of the dog, ox and horse had three origins, one from the acetabular fossa, a second from the transverse ligament and a third from a subpelvic groove. The round ligament was supported by the pubofemoral or accessory ligament in the horse.

The muscles which surrounded the joint in the gluteal region of the ox and dog were not well developed. This anatomical factor contributed to luxation of the coxofemoral articulation in the ox and dog. The capsularis coxae was present in the dog and horse and absent in the ox.

The coxofemoral articulation was supplied by the deep femoral, obturator, caudal gluteal, cranial gluteal, lateral circumflex femoral and medial circumflex femoral arteries. All of these arteries supplied the coxofemoral articulation in the dog. There were some exceptions in the ox and horse.

The nutrient artery originated from the obturator artery, passed through the acetabular notch and supplied the round ligament in the dog, ox and horse. The nutrient artery furnished an abundant blood supply to the round ligament, particularly to the middle and acetabular portions. Branches of the nutrient artery entered foramina in the acetabular fossa and continued into the os coxae.

The coxofemoral articulation was innervated by articular branches of the cranial gluteal, sciatic, femoral and obturator nerves in the dog, ox and horse. The articular branch of the obturator nerve innervated the round ligament of the dog, ox and horse.

The coxofemoral articulation was innervated by articular branches of the cranial gluteal, sciatic, femoral and obturator nerves in the dog, ox and horse. The articular branch of the obturator nerve innervated the round ligament of the dog, ox and horse.