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Dept. of Anatomy
Fac. Vet. Med. South Valley University

STIFLE JOINT IN THE OSTRICH

(With 17 Figures)

By

K.E.H. ABDALLA; SALMA, A. MOHAMED and M. ABDEL SABOUR

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مفصل الركبة في النعام

كمال الدين هاشم عبد الله، سلمى أحمد محمد، محمد عبد الصبور

يتكون مفصل الركبة من المفصل الفخذى الرضفى والمفصل الفخذى القصبي. تمثل الرضفة في النعام بعظمة صغيرة محاطة من كلا الجانبين ومن اسفل بغضروف ليفي كبير. الرضفة الثانية علي شكل عمود عظمي طويل الجزء الخلفي لنهايتها القاصية يكون مفصل زلالى مع الحيد القصبي الأمامي ويدعم هذا المفصل ثلاث أربطة منحرفة. الرباط الرضفي منقسم إلي جزء انسي وآخر وحشي. يستقبل كل جزء منهما مساهمات من الجزء المقابل له للعضلة الفخذية القصبية. يختلف قرصا المفصل الفخذي القصبي عن بعضهما في الحجم والشكل والموقع والإتصال.وقد لوحظ أن كل قرص يتصل بالتراكيب المحيطة به من خلال خمسة أربطة قرصية. للمفصل الفخذي القصبي ستة أربطة منهم اثنان جانبيان واثنان متصالبان واثنان قصبي شظي.الكيس خارج مفصلي للمفصل الفخذي الرضفي منقسم بحاجز سهمي من الغشاء الزلالي الي جزء انسي واخر وحشي . ينقسم كل من الكيس الأنسي والوحشي للمفصل الفخذي القصبي الي قسمين. قد أوضح البحث من الناحية الإكلنيكية أن التجويف المفصلي للمفصل الفخذي الرضفي يتصل بالكيس الأنسي والكيس الوحشي للمفصل الفخذي القصبي. ولقد تبين أن انسب مكان لحقن مفصل الركبة يقع علي جانبه الأمامي أعلي الرضفة.

SUMMARY

The stifle joint consists of two joints, femoropatellar and femorotibial. The patella in ostrich is represented by small bone surrounded in both sides and distally by large fibrocartilage. The second patella is in the form of long bony column, the caudal part of its distal extremity forms synovial joint with cranial cnemial crest, this joint is supported by three oblique ligaments. The patellar ligament is divided into medial and lateral parts, each receives contributions from the corresponding part of the femorotibial muscle. The two menisci of the femorotibial joint differ from each other in size, shape, position and attachments. Each meniscus connects with the surrounding structures through five meniscial ligaments. The femorotibial joint has six ligaments; two collateral, two cruciate and two tibiofibular. The extraarticular pouch of the femoropatellar joint is divided by a sagittal septum of the synovial membrane into medial and lateral parts. Each of the lateral and medial sacs of the femorotibial joint is divided into two compartments. From the clinical point of view the articular cavity of the femoropatellar joint communicates with the medial and lateral sacs of the femorotibial joint. The suitable site for injection of the stifle joint is located on its cranial aspect proximal to the patella.

Key words: *Stifle joint, ostrich*

INTRODUCTION

The ostriches are birds of many uses; their skin is considered top quality leather. Their meat has high protein contents, low cholesterol contents and practically no fat. The feather are used for fashion garments and decoration. Accessories are made from their toes. The fertile eggs are of high commercial value (Al-Gohary, 2001). Therefore in the last few years the ostriches began to spread in Egypt. The stifle joint of the ostrich may be exposed to many affections which need medical or surgical interference based upon the anatomical knowledge. The available data on the anatomy of this joint of the ostrich are meagre compared with the importance of this bird. Therefore it becomes necessary to carrying out the present work to give more information about the anatomy of the stifle joint in the ostrich as well as its site of injection.

MATERIALS and METHODS

The materials used in this work were 16 right and left stifle joints from both sexes of normal adult ostriches (Struthio camelus), in addition to 6 joints from young ostriches, their ages were ranging from 5-12 months. The joints were treated by several procedures according to the scopes under investigation, which are the articular surface, articular capsule, ligaments and articular cavity. The general morphology and attachment of the articular capsule were studied after injection with the gum milk latex coloured by carmine. In order to study the joint cavity, contrast arthrographs were made using radioopaque substance, barium sulphate 40%.

RESULTS

The stifle joint consists of two joints, femoropatellar and femorotibial.

Femoropatellar joint:

The femoropatellar joint is formed between the trochlea of the femur and the articular surface of the patella (Fig.1).

Articular surfaces:

The trochlea (Fig.2) is smooth pulley shaped surface on the cranial aspect of the distal extremity of the femur. It consists of two ridges separated by patellar groove; sulcus patellaris. The two ridges are asymmetrical, the lateral ridge is much wider and more prominent than the medial one. Each ridge continues with the corresponding condyle. The patellar groove is wide and deep, it is continuous caudally with the intercondyloid fossa.

The patella (Fig.3) is represented by small bone surrounded on both sides and distally by large fibrocartilage. Therefore it is partially bony and partially cartilaginous. The patella has the form of a curved plate with the convexity directed cranially. Its caudal articular surface is divided by a sagittal thick ridge into two unequal concave areas, a small medial and large lateral. In addition to the previous patella, the ostrich has a second patella in the form of a long bony column. It is triangular in shape in cross section with the base directed caudally. It measures 83.50 mm long, 20.26 mm wide and 18.93 mm thick. Its proximal end attaches to the lower part of the patella. Its distal end is divided into two parts cranial and caudal. The cranial part is rough and attaches to the cranial part of the cranial cnemial crest of the proximal extremity of the tibiotarsus. The caudal part has a concave articular surface which articulates with the caudal part of the cranial cnemial crest forming a small synovial joint. This joint is supported cranially by three oblique ligaments, which are closely adherent to the joint capsule cranially. They arise from the distal extremity of the second patella and directed distally and medially to terminate in the cranial cnemial crest.

Articular capsule:

The articular capsule of the femoropatellar joint is thin and large. It attaches around the margin of the articular surface of the patella, while its line of attachment on the sides of the femur is at varying distance (3-5 mm) from the articular surface. The articular capsule extends proximally as far as the articular margins of the ridges of the trochlea. On both sides, the fibrous layer is strengthened by transversely disposed fibers, the majority of which originate from the corresponding side of the patella. In addition to some fibers arise from adjacent part of the second patella. At first these fibers are intimately adherent to the fibrous layer then become lost as they are traced toward the caudal part of the femoropatellar joint. Distal to the patella the fibrous layer is separated from the synovial layer by a relatively thick pad of the fat. At this area the synovial layer of the femoropatellar joint is in contact with that of the femorotibial joint. The synovial layer extends proximally forming a large extraarticular pouch, which is divided by a sagittal septum of synovial membrane into medial and lateral parts (Fig.4).

The articular cavity of the femoropatellar joint communicates with the lateral sac of the femorotibial joint at a level where the lateral ridge of the trochlea continues with the lateral condyle of the femur (Fig.5). It also communicates with the medial sac at the lower part of the medial ridge of the trochlea where it continues with the medial condyle of the femur.

Ligaments:

The femoropatellar joint has one ligament; the patellar ligament which is divided by the longitudinally placed second patella into; medial and lateral parts (Fig.6). Generally the patellar ligament is flat and its fibers converge distally, therefore it is triangular in shape. The medial part arises from the medial edge and the adjacent cranial aspect of the patella. It receives few contributions from the tendon of insertion of the pars internus of the femorotibial muscle. It terminates in the medial aspect of the cranial cnemial crest of the tibiotarsus. The lateral part of the patellar ligament is shorter than the medial one. It arises from the lateral and ventral edges of lateral part of the patella, in addition it receives large contributions from the dense aponeurotic tendon of the pars externus of the femorotibial muscle. It terminates in the lateral cnemial crest of the tibiotarsus.

Femorotibial joint:

The femorotibial joint results from the articulation between the condyles of the femur with those of the tibiotarsus and the head of the fibula in addition to the interposed articular menisci.

Articular surfaces:

The distal extremity of the femur (Figs.7, 8) has medial and lateral condyles separated by intercondyloid fossa. The medial condyle is small and convex in both transverse and sagittal directions. It is narrow cranially but wide caudally. It continues cranially with the medial ridge of the trochlea. The lateral condyle is much wider, longer and extends further distally than the medial one. It is wide cranially where it continues with the corresponding ridge of the trochlea but narrow caudally. The lateral condyle is divided into two medial and lateral ridges. The medial ridge is larger and projects more caudally and proximally than the lateral one. The intercondyloid fossa is large and somewhat deep.

The proximal extremity of the tibiotarsus (Fig.9) bears medial and lateral condyles. The medial condyle is triangular in outline but the lateral condyle is nearly quadrilateral in outline. The medial condyle is much larger than the lateral one. The intercondyloid eminence is divided into medial and lateral parts. Cranial and caudal to this eminence are present intercondyloid fossae. The caudal is deeper than the cranial one. The head of the fibula has two articular surfaces; proximal and medial. The proximal surface articulates with the lateral ridge of the lateral condyle of the femur, while the medial surface articulates with the medial ridge of this condyle.

The medial and lateral menisci (Figs.10, 11) are plates of fibrocartilage, which produce congruence in the articular surfaces. They differ from each other in size, shape, position and attachments. The medial meniscus is cresentic in shape, lying between the medial condyle of the femur and that of the tibiotarsus. It has two surfaces, two borders and two ends. The proximal surface is adapted to the condyle of the femur while the distal surface is adapted to the condyle of the tibiotarsus. The peripheral border is thick and convex. The central border is thin and concave. The cranial and caudal ends lie near each other. The medial meniscus connects with the surrounding structures through a number of meniscial ligaments which are medial meniscocollateral, cranial meniscofemoral, genicular transverse, caudal meniscofemoral and caudal meniscotibial (Figs.10, 12).

From the peripheral border of the medial meniscus springs the medial mensicocollateral ligament which extends cranioventrally to terminate in the medial collateral ligament of the femorotibial joint. From the cranial end of the medial meniscus arise two ligaments, the cranial meniscofemoral and genicular transverse. The former ligament extends proximally and laterally to terminate in the lateral wall of the intercondyloid fossa lateral to the areas of attachment of both the caudal meniscofemoral and the caudal cruciate ligaments. The genicular transverse ligament extends laterally to attach the craniomedial angle of the lateral meniscus. From the caudal end of the medial meniscus arise two ligaments, the caudal meniscofemoral and the caudal meniscotibial.

The former ligament extends proximally and laterally to terminate in the intercondyloid fossa of the femur between the areas of attachment of the cranial meniscofemoral and caudal cruciate ligaments. The caudal meniscotibial ligament runs cranially to terminate in the caudal intercondyloid fossa of the tibiotarsus.

The lateral meniscus (Figs. 10, 11) is larger than the medial one. It intervenes between the medial ridge of the lateral condyle of the femur and the lateral condyle of the tibiotarsus. It is roughly quadrangular in shape with its long axis directed craniocaudally. It has two surfaces, four borders and four angles. The proximal surface is concave and adapted to the medial ridge of the lateral condyle of the femur. While the distal surface is convex and is adapted to the lateral condyle of the tibiotarsus. The cranial and caudal borders are thick while the peripheral and central borders are thin. The caudal border is grooved by tendon of origin of the femoral head of the tabialis cranialis muscle. The lateral meniscus connects with the surrounding structures, through a number of meniscial ligaments which are genicular transverse, cranial meniscotibial, lateral meniscocollateral, cranial meniscofibular and caudal meniscofibular (Figs.10, 12).

From the craniomedial angle of the lateral meniscus spring two ligaments, the previously described genicular transverse ligament and the cranial meniscotibial ligament, which passes medially and slightly cranially to terminate in the medial condyle of the tibiotarsus near its edge. From the craniolateral angle of the lateral meniscus arise two ligaments, the lateral meniscocollateral and the cranial meniscofibular. The former ligament extends caudodistally to connect the lateral collateral ligament of the femorotibial joint, while the second ligament extends distally and slightly caudally to terminate in the caudolateral aspect of the fibula distal to its articular margin. The caudomedial angle of the lateral meniscus sends thin long fibrous band, attaching the cranial cruciate ligament (Fig.13). From the caudolateral angle of the lateral meniscus arises the caudal meniscofibular ligament, which directed laterally to terminate in the caudal aspect of the head of the fibula.

Articular capsule:

The femorotibial joint has extensive articular capsule. On the femur, the line of attachment of the articular capsule extends for the greater part about 5 mm proximal to the margin of the articular surface of the distal extremity. On the tibiotarsus, it is attached to the margin of the articular surface of the proximal extremity cranially and caudally. However medially and laterally the line of attachment extends about

12.20 mm distal to the margin of the articular surfaces of the medial condyle of the tibiotarsus and the head of the fibula respectively. The articular capsule attaches also to the peripheral border of the medial meniscus and to the cranial and caudal borders of the lateral meniscus.

The fibrous layer of the articular capsule is closely attached in both sides to the collateral ligaments. Caudally it is related to the M.flexor hallucis longus and M.flexor perforatus complex, in addition to the popliteal artery and tibial nerve. The synovial layer forms two synovial sacs; medial and lateral, which are separated from each other by the cruciate ligaments. The lateral sac is larger than the medial one (Fig.4). Each sac is partially divided into proximal and distal compartments by the corresponding meniscus (Fig.5). The two compartments of the medial sac communicate with each other at the concave central border of the medial meniscus. While those of the lateral sac communicate lateral to the thin peripheral border of the lateral meniscus where it is related to the medial surface of the head of the fibula. The lateral sac invests the tendon of origin of the femoral head of the cranial tibial muscle, it pouches slightly distally where it encircles this tendon. Moreover, this sac sends short prolongation distally between the tibiotarsus and the fibula.

Ligaments:

The femorotibial joint has six ligaments (Figs. 12-16), which are two collateral; medial and lateral, two cruciate; cranial and caudal as well as two tibiofibular; cranial and caudal. The medial collateral ligament is a flat band measuring 99.18 mm long, 13.04 mm wide and 1.24 mm thick. It arises from the medial epicondyle of the femur and runs distally to terminate in a rough area on the medial border of the tibiotarsus about 21.07 mm distal to the margin of the articular surface. The lateral collateral ligament is shorter, broader and thicker than the medial one, measuring 73.29 mm long, 18.54 mm wide and 1.93 mm thick. It arises from the lateral epicondyle of the femur and extends distally to terminate in a rough depression on the lateral aspect of the fibula and also in its adjacent caudal border about 15.53 mm distal to the margin of the articular surface.

The cranial cruciate ligament is short, narrow and thin fibrous band, measuring 43.5 mm long, 5.37 mm wide and 2.79 mm thick. It arises from the cranial intercondyloid fossa. It extends proximally and caudally to terminate in a rough area just lateral to the popliteal fossa of the femur. This ligament receives some fibers from the lateral meniscus. The caudal cruciate ligament is longer, wider and thicker than the cranial one, measuring 59.8 mm long, 19.9 mm wide and 4.03 mm thick. It arises from the caudolateral side of the medial condyle of the tibiotarsus. It consists of two layers, which extend proximally and cranially crossing the medial aspect of the cranial cruciate ligament to terminate in the lateral part of the intercondyloid fossa of the femur medial to the areas of attachment of the cranial and caudal meniscofemoral ligaments.

The cranial tibiofibular ligament arises from the lateral aspect of the patellar crest. It extends laterally and caudally to attach the cranial border of the head of the fibula just distal to its articular margin. The caudal tibiofibular ligament is longer than the cranial one and lies proximal to it. It arises also from the lateral aspect of the patellar crest directly proximal to the attachment of the cranial tibiofibular ligament. It runs caudally and slightly laterally to attach the medial aspect of the head of the fibula just distal to its articular margin.

Movements:

The stifle joint, when taken as a whole, may be classed as a ginglymus articulation. In conformity with the disposition of the strong collateral ligaments the chief movements, which can be displayed are those of angular type; flexion and extension. The articular surface of the patella glides proximodistally on the femoral trochlea. The patella moves proximally in extension and distally in flexion. In normal standing position the stifle joint is partially flexed. The over extension of the stifle joint is prevented mainly by tension of the collateral and cruciate ligaments.

Site of injection:

It has already been mentioned, on dealing with the articular capsule, that the articular cavity of the femoropatellar joint communicates with that of the femorotibial joint. Thus the injection made into the former joint reaches the latter one. The suitable site for injection of the stifle joint is located on its cranial aspect in the area proximal to the patella (Fig.17). From the clinical point of view this area is bounded by three palpated structures which are the medial and lateral ridges of the femoral trochlea proximally and the patella distally. The needle is introduced obliquely distocaudally through the extraarticular pouch of the femoropatellar joint. It is observed that the injection is best performed with the stifle joint in the slightly flexed position. In this case the patella glides distally providing a large space for injection. Moreover, the cranial part of articular capsule becomes tense thus makes an easier penetration for the needle. The capacity of the stifle joint is about 200 ml.

DISCUSSION

According to Nickel *et al* (1977) in the birds and as shown in the present investigation in the ostrich, the stifle joint consists of two joints, femoropatellar and femorotibial. The femoropatellar joint is formed between the patella and the trochlea of the femur. The distal extremity of the femur has; on its cranial aspect, a smooth pulley shaped trochlea which consists of two ridges separated by the patellar groove; sulcus patellaris. These ridges continue with the corresponding femoral condyles, which articulate with the bones of the leg. This result was also given in the birds (Bradley and Grahame, 1960; Ede, 1964 and Nickel *et al*, 1977) as well as in the domestic animals (Evans and Delahunta, 1971; Sisson, 1975; Frandson and Whitten, 1981; Skerritt and Mclelland, 1984 and Adams, 1996). However, Bezuidenhout (1999) in the ostrich pointed out that the distal extremity of the femur has two condyles for the articulation with the tibia. Cranially the condyles are separated by a wide intercondylar groove for the articulation with the patella. In the examined ostrich the sulcus patellaris is wide and deep, it is continuous caudally with the intercondyloid fossa. This sulcus was termed fossa patellaris (Lambrecht, 1933), rotular groove (Howard, 1929 and Feduccia, 1975) intercondylar groove (Bezuidenhout, 1999) and central groove (Ede, 1964).

The avian patella shows different degrees of variation. Typically, a patella is present, joined to the tibia by a patellar ligament. In some birds the patella is absent but a large bony process, the tibial crest, extends proximally from the front of the tibial articular surface (Barnett and Lewis, 1958). According to Bezuidenhout (1999) and the present result the patella is present in ostrich and also in most birds as recorded by Weichert (1970) as well as by King and Mclelland (1984). On the other hand, it is absent in the ostrich as mentioned by Shanawany and Dingle (1999). In some birds (pigeon, duck and goose) the patella is replaced with a tendinous structure as reported by Koch (1973) and Bone (1982). The former author added that the chicken has a hyaline cartilage patella. In the pigeon it is completely enclosed by the patellar tendon as described by Chiasson (1984). On the other hand, the recent findings indicate that, the patella in the ostrich is partially bony and partially cartilaginous.

The present study shows that the patella has the form of a curved plate. It is thicker proximally than distally. Its caudal articular surface is divided by a sagittal ridge into small medial and a large lateral areas. In the ostrich, the patella is attached proximally to muscle whereas distally it is attached to the tibiotarsus by means of a wide tendon (Bezuidenhout, 1999), it is large and flattish with medial and lateral articular surfaces (MacAlister, 1864). In this position, King and Mclelland (1984) described a large patella in aquatic species which is associated with the tendon of the femorotibialis muscle. However, Nickel *et al* (1977) clearified that the patella in the birds is small, ovoid sesamoid bone, enclosed in the tendon of muscle quadriceps femoris. Similar to the statement of Bezuidenhout (1999) the ostrich has a second patella in the form of long bony column. The recent findings reveal that this patella measures about 83 mm long and is triangular in shape in cross section. The caudal concave articular part of its distal end articulates with the caudal part of the cranial cnemial crest forming synovial joint.

The patellar ligament of the ostrich is flat and triangular in shape. It is divided by the second patella into medial and lateral parts, each of them arises from the corresponding part of the patella and receives contributions from the femorotibial muscle. On the contrary, Bezuidenhout (1999) in the same bird recorded that the patella is attached distally to the tibiotarsus by means of wide tendon. The patellar tendon in pigeon is penetrated by the insertion tendon of the muscle ambiens as given by Chiasson (1984). The patella itself is grooved, sometimes perforated, by tendon of the previous muscle in the different avian species as recorded by Baumel *et al* (1979). This muscle is characteristic of reptiles and birds, but has been considered a homologue of the pectinus in mammals (Vaden Berge, 1975). Baumel *et al* (1979) clearified that the so-called patellar ligament is actually the tendon of the femorotibialis muscle that extends from the distal border of the patella to the crista patellaris of the tibiotarsus. Petrak (1982) supported this opinion and mentioned in the cage and aviary birds that the distal part of the tendon of insertion of the femorotibialis plus iliotibialis muscles, called the patellar ligament, is firm and keeps the patella at a fixed distance from the tibiotarsus. He added that in some aquatic birds the patellar ligament ossifies, fuses with the patella, and acts as a proximal extension of the cnemial crest, providing for greater leverage.

In the ostrich the fibrous layer of the femoropatellar joint which is represented cranially by the patellar ligament is separated from the synovial layer by a relatively thick pad of fat. Thus here this synovial layer is in contact with the synovial layer of the femorotibial joint. The previous pad of fat corresponds to so called infrapatellar fat body of the stifle (knee) joint in mammals (Zuckerman, 1961; Davies and Coupland, 1969; Ibrahim and Moustafa, 1977; El-Bakary *et al,* 1989 and Evans, 1993). This pad of fat assists in the flow of the synovial fluid during movement of the joint (Mac Conaill, 1960b).

The present investigation shows that the medial and lateral menisci of the femorotibial joint are plates of fibrocartilage which produce congruence in the articular surfaces. They differ from each other in size, position, shape and attachments. The medial meniscus is smaller than the lateral one similar to the description of Bezuidenhout (1999). The medial meniscus is cresentic in shape, lying between the medial condyle of the femur and the medial condyle of the tibiotarsus. The lateral meniscus intervenes between the lateral condyle of the femur and the lateral condyle of the tibiotarsus. It is roughly quadriangular in shape. Its caudal border is grooved by the femoral head of the tibialis cranialis muscle. The lateral meniscus in birds is usually a solid, oblong disc that separates the lateral condyle of the femur from the tibiotarsus; it only partially intervenes between the lateral condyle of the femur and the caput fibulae (Baumel *et al,* 1979). They added that this meniscus is perforated or grooved by the aforementioned muscle. The stifle joint in birds has control over various ligaments and two menisci of which the lateral is more of a disc (Koch, 1973). The lateral meniscus is synonymy to femorofibular disc (Haines, 1942).

Regarding the attachments of the menisci, the present study shows that each meniscus connects with the surrounding structures (femur, tibiotarsus, fibula and collateral ligaments) through five meniscial ligaments, which differ from each other in their dimensions, directions and attachments. On the other hand, Bezuidenhout (1999) pointed out that the menisci of the ostrich are attached to the tibiotarsus and fibula. The medial meniscus of the examined ostrich connects with the medial collateral ligament through the medial meniscocollateral ligament and the lateral meniscus connects with the lateral collateral ligament through the lateral meniscocollateral ligament. Similar result was obtained in birds by Koch (1973). However, Haines (1942), Cracraft (1971) and Baumel *et al* (1979) mentioned only one meniscocollateral ligament associated to the lateral meniscus. The menisci in birds are held in position by the collateral ligaments as reported by Nickel *et al* (1977). The two menisci of the stifle joint in birds are fastened by a cranial transverse ligament (Koch, 1973 and Bezuidenhout, 1999) or by cranial oblique ligament (Nickel *et al,* 1977). The present work indicates that the fibers of this ligament run transversely and its area of attachment at the lateral meniscus is larger than at the medial one.

In accordance to the Bezuidenhout (1999) the medial and lateral collateral ligaments of the femorotibial joint in the ostrich extend from the epicondyles of the femur to tibiotarsus and fibula. The lateral collateral ligament is shorter, thicker and broader than the medial one. The present study shows also that the cranial and caudal cruciate ligaments differ from each other in dimensions, directions and attachments. The cranial cruciate ligament is shorter, narrower and thinner than the caudal one. The cruciate ligaments in birds permit a passive holding of the stifle joint in flexed state (Kock, 1973). The stifle joint in birds has some remarkable similarities to that of man, it is stabilised by lateral, medial and cruciate ligaments and contains pair of lunate cartilage or menisci (Young, 1983).

In conformity with the disposition of the strong collateral ligaments the chief movements of the stifle joint in the ostrich are flexion and extension. Similar to that reported in birds by Young (1983) as well as King and Mclelland (1984). In the normal standing position the stifle joint of the ostrich is partially flexed, its over extension is prevented mainly by tension of the collateral and cruciate ligaments. The patella moves proximally in extension and distally in flexion. The extensor action of the muscle quadriceps (femorotibialis) on the stifle joint of the birds is transmitted to the tibiotarsus through the patella and its straight ligament (ligamentum patellare) as the former slides up and down over the patellar trochlea of the femur in the femoropatellar joint (Nickel *et al,* 1977).

From the clinical point of view the suitable site for injection of the stifle joint in the ostrich lying on its cranial aspect and is bounded by three palpated structures; the medial and lateral ridges of the femoral trochlea as well as the patella. The injection through the femoropatellar joint is enough for injection the whole stifle joint due to the communication between the articular cavities of the femoropatellar and femorotibial joints. It is evident that the anatomical features of the stifle joint help in determination the optimum site for the injection. In this respect, Van Pelt (1965) stated that the fundamental knowledge and familiarity with the anatomic structure of the stifle joint is essential if any degree of success is to be attained with the procedure involved in arthrocentesis and injection of its joint cavities.

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LEGENDS

Fig. 1: Radiograph of the left stifle joint (mediolateral view) showing; distal extremity of the femur (1), proximal extremity of the tibiotarsus (2), patella (3) and second patella (4).

Fig. 2: Photograph of the distal extremity of the left femur (cranial view) showing the trochlea; medial ridge (1), lateral ridge (2) and patellar groove (3).

Fig. 3: Photograph of the patella and second patella (caudal view) showing; sagittal ridge of patella (1), medial area of patella (2), lateral area of patella (3) and caudal part of distal end of second patella (4).

Fig. 4: Radiograph of the left stifle joint (craniocaudal view) after injection with the barium sulphate (40%) showing; lateral part (1) and medial part of extraarticular pouch (2), lateral sac (3) and medial sac of femorotibial joint (4).

Fig. 5: Radiograph of the left stifle joint (mediolateral view) after injection with the barium sulphate (40%) showing; extraarticular pouch of femoropatellar joint (1), proximal (2) and distal compartments of lateral sac of femorotibial joint (3).

Fig. 6: Photograph of the patella and patellar ligament (caudal view) showing; patella (1), second patella (2), medial part (3) and lateral part of patellar ligament (4).

Fig. 7: Photograph of the distal extremity of the left femur (medial view) showing; medial condyle (1), lateral condyle (2), medial ridge (3) and lateral ridge of the trochlea (4).

Fig. 8: Photograph of the distal extremity of the left femur (caudal view) showing; medial condyle (1), medial ridge (2) and lateral ridge of lateral condyle (3), intercondyloid fossa (4) and popliteal fossa (5).

Fig. 9: Photograph of the proximal extremity of the left tibiotarsus (end view) showing; medial condyle (1), lateral condyle (2), intercondyloid eminence (3), cranial intercondyloid fossa (4), caudal intercondyloid fossa (5), patellar crest (6), cranial cnemial crest (7), lateral cnemial crest (8) and head of the fibula (9).

Fig. 10: Photograph of the proximal surface of the right menisci showing; medial meniscus (1), lateral meniscus (2), genicular transverse (A), cranial meniscofemoral (B), caudal meniscofemoral(C), medial meniscocollateral(D), lateral meniscocollateral (E) and caudal meniscofibular ligaments (F).

Fig. 11: Photograph of the proximal aspect of the menisci attaching the proximal extremity of the right tibiotarsus showing; medial meniscus (1), lateral meniscus (2), medial condyle of the tibiotarsus (3), head of the fibula (4), genicular transverse (A), cranial meniscofemoral (B), caudal meniscofemoral (C), caudal meniscotibial (D), lateral meniscocollateral (E), caudal meniscofibular (F), lateral collateral (G),cranial cruciate (H) and caudal cruciate ligaments (I).

Fig. 12: Photograph of the proximal extremity of the right tibiotarsus (end view) showing; medial condyle (1), lateral condyle (2), patellar crest (3), head of the fibula (4), lateral collateral (A), cranial meniscotibial (B), caudal meniscotibial (C), cranial cruciate (D), caudal cruciate (E), patellar (F), cranial tibiofibular (G) and caudal tibiofibular ligaments (H).

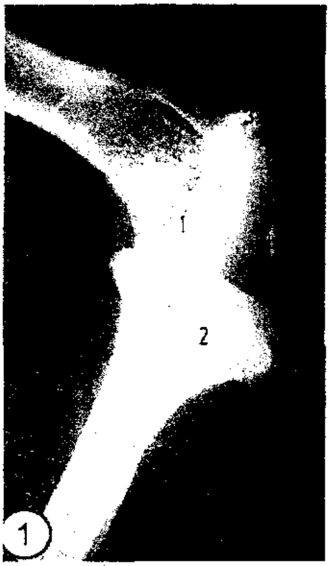
Fig. 13: Photograph of the right stifle joint (caudal view) showing; medial condyle (1) and lateral condyle of the femur (2), medial condyle (3) and lateral condyle of the tibiotarsus (4), head of the fibula (5), lateral meniscus (6), medial meniscus (7), popliteal fossa (8), medial collateral (A), caudal meniscofibular (B) and cranial cruciate ligaments (C), some fibbers extend from lateral meniscus to cranial cruciate ligament (D).

Fig. 14: Photograph of the distal extremity of the right femur (end view) showing; medial ridge (1) and lateral ridge of trochlea (2), medial condyle (3), lateral condyle (4), cranial cruciate (A), caudal cruciate (B), cranial meniscofemoral (C) and caudal meniscofemoral ligaments (D) and femoral head of tibialis cranialis muscle (E).

Fig. 15: Photograph of the right stifle joint (cranial view) showing; distal extremity of the femur (1), proximal extremity of the tibiotarsus (2), head of the fibula (3), medial meniscus (4), lateral meniscus(5), cranial meniscofemoral (A), genicular transverse (B), cranial meniscotibial (C), cranial meniscofibular (D), lateral meniscocollateral (E) and lateral collateral ligaments (F).

Fig. 16: Photograph of the right stifle joint (medial view) showing; medial condyle of the femur (1), medial condyle of the tibiotarsus (2), medial meniscus (3), medial collateral (A) and medial meniscocollateral ligament (B).

Fig. 17: Photograph of the left stifle joint (cranial view) showing the site of injection (arrow).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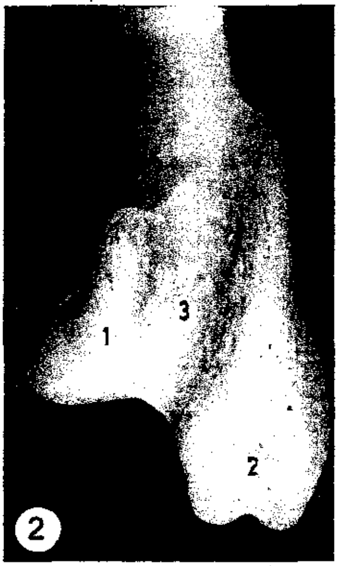
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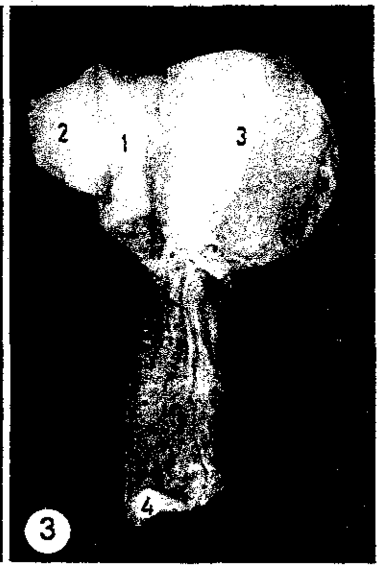
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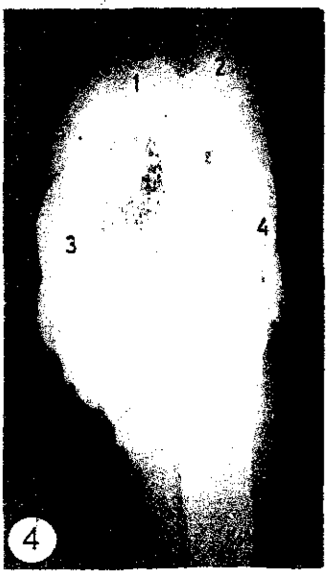
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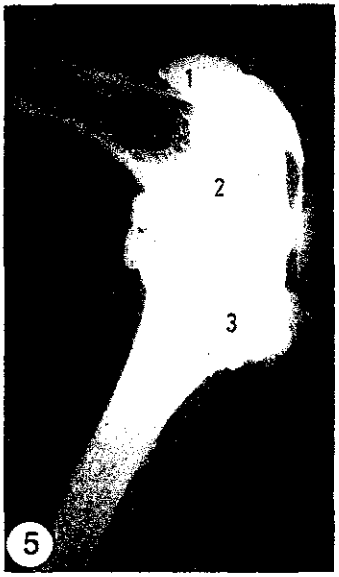
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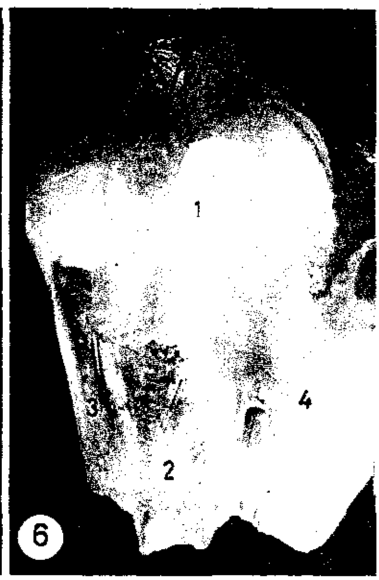
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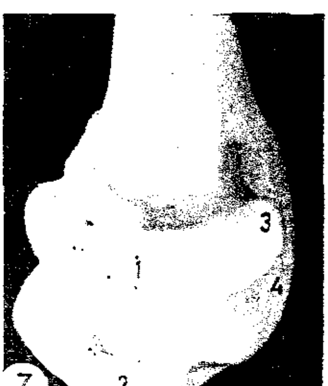
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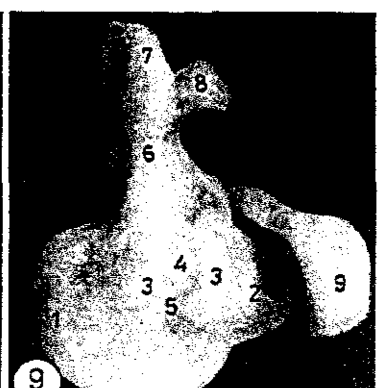
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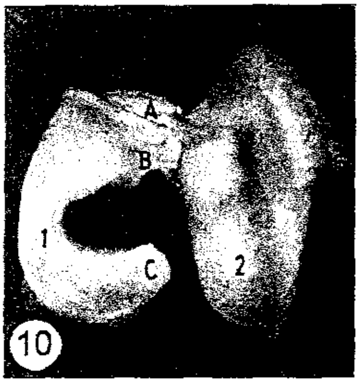
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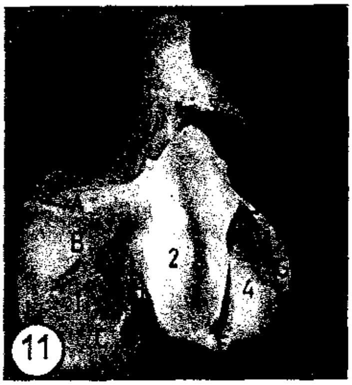
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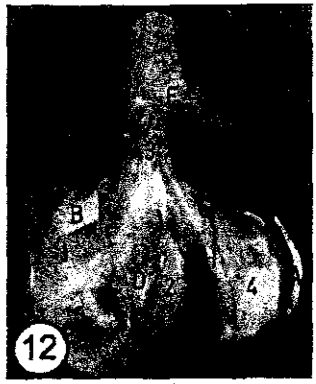
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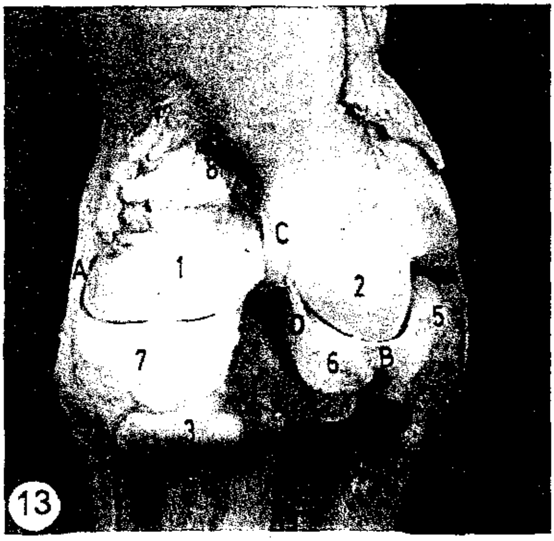
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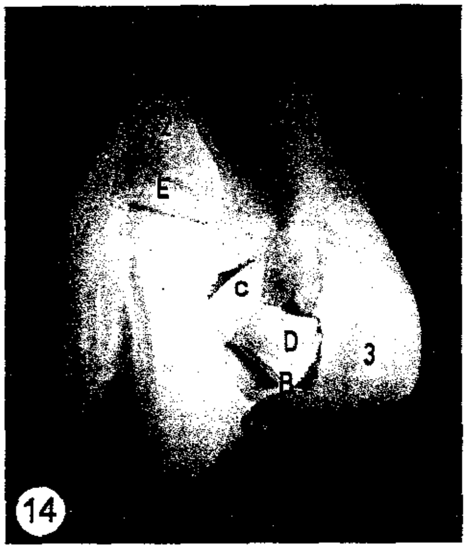
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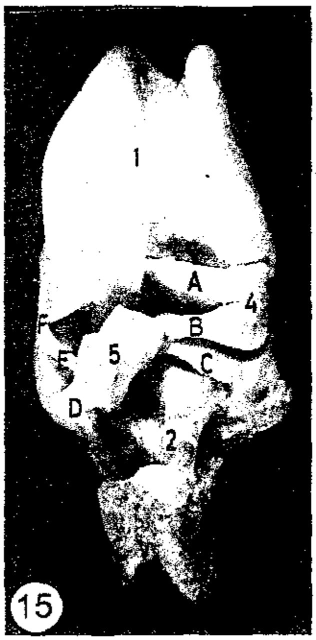
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