International Journal of Anatomy and Research,
Int J Anat Res 2017, Vol 5(4.3):4760-69. ISSN 2321-4287
DOI: https://dx.doi.org/10.16965/ijar.2017.465

Original Research Article

ANATOMICAL, RADIOLOGICAL AND MAGNETIC RESONANCE IMAGING ON THE NORMAL STIFLE JOINT IN RED FOX (VULPES VULPES)

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ABSTRACT

Background and Aim: Our study was an attempt to study the normal anatomy of stifle joint in the fox, that's not recorded in any of available works of literature.

Material and Methods: using dissection of the stifle, latex injection for its arterial supply as well as studying the normal Radiology and Magnetic Resonance Imaging Technique were adopted. The obtained results were photographed using Nikon digital camera 20 megapixels, 16X and discussed with their corresponding features of authors who performed earlier studies in other species, especially canine.

Results: The articular surfaces, capsule, ligaments, and menisci of the stifle were described. The arterial blood supply of the joint also studied and mainly achieved through the descending genicular and popliteal arteries.

Conclusion: this study was an attempt to help the anatomists in comparative studies and surgeons in surgical operations.

KEY WORDS: Anatomy, Fox, Joints, Stifle.

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Access this Article online

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DOI: 10.16965/ijar.2017.465

Web site: International Journal of Anatomy and Research
ISSN 2321-4287
www.ijmhr.org/ijar.htm

Received: 28 Sep 2017
Peer Review: 28 Sep 2017
Revised: None

Accepted: 20 Oct 2017
Published (O): 01 Dec 2017
Published (P): 01 Dec 2017

INTRODUCTION

The present study described the gross anatomical structures of the stifle joint of Red Fox (Vulpes vulpes) by using the dissection technique and the diagnostic imaging techniques such as x-ray and magnetic resonance imaging (MRI).

The Red Fox (Vulpes vulpes) was the most geographically spread species of the Carnivores and represents as one of the most abundant carnivore in Egypt. It was taxonomy under Kingdom: Animalia, Phylum: Chordata, Class: Mammalia, Order: Carnivora, Family: Canidae, Tribe: Vulpini [1].

The stifle was a one of composite joint that allowed movement in three planes. It was built of numerous anatomical structures comprising from bones, articular cartilage, menisci, and ligaments. The aim of the present work applied for describing the normal anatomy of the stifle in fox, due to the stifle was a frequently injured joint, these injuries were such as cruciate ligament injury, meniscal tearing, gonitis, fracture, patellar luxation, and synovitis, so that the description of the normal anatomical was a trial to help surgeons and clinicians in the proper diagnosis and treatment, [2].

More over the available works of literature present and most of the authors described the stifle joint among large domestic animals, rather

than that of red fox which was not recorded by any author so this study considered a strong point in the field of comparative anatomy, especially in a wild animal.

MATERIALS AND METHODS

The current study was conducted on six fox hind limbs, the fox obtained from the Fayum desert. The foxes were euthanized using a chloroform inhalation.

Gross anatomical study: The hind limbs were dissected showing the muscles, ligaments, bones shared in the structure of the stifle joint. The obtained results were photographed using Nikon digital camera 20 mega pixels, 16X and The nomenclature used in this study was that given by the [3].

Latex injection [4]:

For studying the joint capsule: Two pelvic limbs were injected with gum milk latex colored green using Rotring Ink. The needle was inserted into the joint cavity at the middle of the lateral border of the patellar ligament.

For studying the arterial supply: the animal was cannulated through the common carotid artery and washing by using warm normal saline solution then, the animal was injected with latex colored red by using Rotring Ink. Specimens were then placed in a cold room (5ú C) for 3-5 days to allow the latex to harden, and then the animal was placed in a formalin solution before manual dissection.

Radiographic preparation: Two hind limb was subjected to X-rays. Radiographs were performed in the Al-ziraeyeen hospital.

The lateromedial (L-M) projection: The cassette is placed on the medial surface perpendicular to the table surface. The used exposure factors were Focal-film distance ranges between 24 and 28 inches, 76 kVp, and 1.6 mAs.

The horizontal dorsoplantar (HD-P) view: The beam orientation was parallel to the dorsal-plantar long axis of the foot on the median plane of the foot. For consistency, the x-ray beam was also centered 1.5 to 2 cm above the weight-bearing surface of the foot.

Magnetic Resonance Imaging preparation:

Two hind limbs were subjected to the MRI technique, The images were made in the transverse and sagittal planes., MRI was performed in the Al-Ziraeyeen hospital. MRI scanning of the stifle joint was performed with a High filed (Philips-Achieva 1.5 Tesla MRI systems. Closed High filed MRI, Japan) with a permanent magnet was used in the study A knee-quadrature coil (QD coil) 4 element phased array with a diameter of 15 cm and length of 18 cm was used.

Specimen preparation: The limbs were withdrawn from formalin 24 hours before imaging and washed before scanning with water and were double wrapped and taped in plastic wrap and Gauze.

RESULTS

Morphology of the fox stifle: The articular surfaces, capsule, ligaments, and menisci of the stifle were described.

Articulatio genus: Fox stifle formed of two types of articulations, according to bones included into these articulations; femoropatellar articulation and femorotibial one. Articulatio femoropatellaris was between the trochlea of the femur and the planter (caudal) surface of patella. Articulatio femorotibialis was involved the medial, lateral condyles of the femur, sesamoid bones, mensci and the condyles of the tibia.

Articular surfaces: The articular surfaces formed of a group of bones which shared in the formation of the stifle were the femur, tibia, fibula, patella, medial and lateral sesamoid bones. The femoropatellar articulation formed by the lateral and medial trochlea of femur, patella and tibial tuberosity. The femorotibial articulation formed of lateral and medial sesamoid, lateral and medial condyles of femur inbetween intercondyloid fossa, lateral and medial menisci, lateral and medial condyles of tibia separated by intercondyloid eminence. The patella (Fig. 6/C) was the largest sesamoid bone of the hind limb, oval in shape with blunt proximal base and pointed distal apex, it had two surfaces, and the cranial surface (Fig. 6/CP1) was convex and rough, while the caudal surface (Fig. 6/CP2) was smooth and slightly concave. The lateral and medial sesamoids (Fig. 6/A) placed on the supracondyloid facets, which gave origins of the medial and lateral heads gastroc-

nemius muscle. The lateral sesamoid (Fig. 6/5) was larger and more superior than the medial one (Fig. 6/4). Meniscus lateralis (Fig. 6/LM) and Meniscus medialis (Fig. 6/MM) were a semicircular, C- shaped fibro cartilages, and it had two surfaces, two curvatures, and two extremities. The two surfaces proximal and distal surfaces, the proximal surface more concave and faced the femoral condyle, while the distal one faced the tibial condyles. The two curvatures or borders, outer and inner, the outer had a thick peripheral margin, while the inner had a thin margin. The two extremities, cranial and caudal, the cranial (Fig. 6/17) and caudal extremities (Fig. 6/18) of the lateral meniscus were a close to each other.

Articular capsule (Capsula articularis): The articular capsule was composed of outer fibrous and inner synovial joint capsule, the outer fibrous capsule was surrounded the femoropatellar and femorotibial joint sacs, it was supported by the lateral collateral ligament, tendon of biceps femoris laterally , medial collateral ligament, aponeurosis of gracilis and Sartorius medially and patellar ligament cranially and reinforced proximally by the tendon of quadriceps muscle.

The synovial capsule: composed of three joint sacs; femoropatellar, medial and lateral femorotibial sacs. The three joint sacs communicated together. The femoropatellar sac was a large sac, extended proximally), medially and laterally filled the space between the margins of the trochlea of the femur and the tendon of the quadriceps muscle surrounding the patella as a proximal part (Fig. 2/1), medial part (Fig. 2/2) and lateral part (Fig. 2/3). The medial side of the femoropatellar sac was larger than the lateral side. It was joined distally with the cranial part of the medial femorotibial sac. The femoropatellar sac separated from the patellar ligament by a large amount of fat distributed laterally and medially to the patellar ligament called lateral (Fig. 3/6) and medial infrapatellar fat body (Fig. 12/F).

The femorotibial sac: was divided into lateral and medial femorotibial sacs; these sacs were extended caudally between the two condyles of femur, lateral and medial menici and the two condyles of the tibia, and then extended dorsally surrounding the lateral and medial sesamoids. the lateral femorotibial sac was extended proximally and distally, forming proximal sac and distal sac, the lateral proximal sac divided into lateral proximal cranial pouch (Fig. 2/4) and lateral proximal caudal pouch (Fig. 2/4*), also the lateral distal sac divided into lateral distal cranial pouch (Fig. 2/5) and lateral distal caudal pouch (Fig. 2/5*), The lateral femorotibial sac extended distally in the extensor groove to surrounding the tendons of long digital extensor and popliteus muscles. The medial femorotibial sac was distributed proximally and distally, each proximal sac divided into a medial cranial pouch (Fig. 2/2).and medial caudal pouch (Fig. 2/7)., the cranial pouch which fused with the medial femoropatellar sac, also the medial distal sac divided into a medial distal cranial pouch (Fig. 2/6) and medial distal caudal pouch (Fig. 2/6*).

Ligaments of Articulatio femoropatellaris

Lig.patellae: the patellar ligament (Fig. 3/1) formed the cranial boundary of the stifle along the fibrous joint capsule, extended between the distal extremity of the patella proximally and the tibial tuberosity distally, it bounded laterally by a large amount of fat called infrapatellar fat (Fig. 5/16A) which separate the ligament from the femoropatellar joint sac and there was a cartilage called suprapatellar fibrocartilage (Fig. 5/15A) laid dorsal to the base of the patella.

Lig. Femoropatellare mediale (Fig. 2/MF) **and Lig. Femoropatellare laterale** (Fig. 1/8): The medial femoropatellar and lateral femoropatellar ligaments were thin bands, considered as parts of the fibrous joint capsule, extended from the medial and lateral borders of the patella to the medial and lateral sesamoid bones at the gastrocnemial heads insertion.

Ligaments of Articulatio femorotibialis

Collateral ligaments

Lig. Collaterale mediale: (Fig. 3/2A) the medial collateral ligament originated from femur medial epicondyle to be inserted in the medial margin of the tibial medial condyle, attached to the medial surface of the fibrous capsule and the peripheral margin of the medial meniscus.

Lig. Collaterale laterale: (Fig. 3/3B) the lateral

collateral ligament extended from the lateral epicondyle of the femur to terminate in the lateral condyle of the tibia and head of the fibula, crossing the tendon of popliteus muscle and peripheral margin of the lateral meniscus. The lateral collateral ligament was a more prominent and longer than the medial one.

Cruciate ligaments

The cranial and caudal cruciate ligaments occupied the intercondylar fossa of the femur,

Lig. Cruciatum craniale: (Fig. 4/3B & 5/6B, C) originated from cranial part of the intercondylar area of the tibia adjacent to the cranial attachment of the medial meniscus, just caudal to the transverse ligament. to be terminated in the medial edge of the lateral condyle of the femur.

Lig. Cruciatum caudale: (Fig. 4/4B & 5/7B, C) originated from the caudal part of the intercondylar area of the tibia, just caudomedial to medial condyle of the tibia, near the popliteal notch, caudal to the caudal attachment of the medial meniscus, then extended cranially and proximally to be inserted into the medial surface of medial condyle of the femur.

Meniscal ligaments

Lig. Meniscofemorale: (Fig. 4, 5/8) originated from the caudal end of the lateral meniscus, passed craniomedially and proximally within the intercondyloid fossa of the femur, to be inserted in the dorsomedial part of the medial condyle of the femur.

Lig. Meniscotibiale: the meniscotibial ligaments were cranial, caudal of the medial meniscus and cranial, caudal of the lateral one**.**

The cranial meniscotibial ligament of the medial meniscus: (Fig. 5/3) extended from the cranial end of medial meniscus to be inserted in the intercondyloid area of the tibia, cranial to the transverse and cranial cruciated ligaments.

The caudal meniscotibial of the medial meniscus: (Fig. 5/10) extended from the caudal end of medial meniscus to be inserted in the intercondyloid area of the tibia.

The cranial meniscotibial of the lateral meniscus: (Fig. 5/5) extended from the cranial end of lateral meniscus to be inserted in the intercondyloid area of the tibia, close to the cranial cruciate ligament..

The caudal meniscotibial of the lateral meniscus: (Fig. 5/9) extended from the caudal end of lateral meniscus to be terminated just caudal to the caudal cruciate ligament at the popliteal notch.

Lig. Transversum genus: (Fig. 5/4) the transverse ligament lied between the cranial end of the medial meniscus and lateral one so called intermeniscal ligament, bounded by the cranial meniscotibial ligament of the medial meniscus cranialy, medial meniscus medially, lateral one laterally and the cranial meniscotibial ligament of lateral meniscus caudally

Arterial supply of the fox stifle: The arterial blood supply of the fox stifle joint was mainly achieved by the saphenous, descending genicular and popliteal arteries.

Saphena: (Fig. 11/11) the saphenous artery was originated from the femoral artery, it gave off a Ramus articularis genus and terminated as a cranial and caudal branch. Ramus articularis genus (Fig. 11/13), accompanied the saphenous vein as two branches; these branches distributed along the Sartorius muscle and supplied the fibrous layer of joint capsule at the medial surface of the stifle.

Genus descendens: (Fig. 11/10) the descending genicular artery arose from the femoral artery after emerging the saphenous artery, it gave off two branches, muscular and articular branches. The muscular branch (Fig. 11/10*) was ramified into the vastus medialis and semimembranosus muscles. The articular branch (Fig. 11/10**) passed along the medial surface of the stifle within the fibrous layer of the joint capsule, it divided into a proximal branch (Fig. 11/a) distributed to the femoropatellar sac and a distal one (Fig. 11/b) distributed to the femorotibial sac.

Poplitea: (Fig. 12/1) the popliteal artery was the direct continuation of the femoral artery in the leg region, it gave off three branches at the caudal surface of the stifle; Medial branch, lateral branch, intermediate branch (A.genus media) (Fig. 12/6). The medial branch divided into two branches, proximal branch (A.genus proximalis medialis) (Fig. 12/2)and distal branch (A. genus distalis medialis) (Fig. 12/3), it supplied the medial femorotibial sac, also the lateral branch

divided into two branches, proximal branch (A.genus proximalis lateralis) (Fig. 12/4) and distal branch (A. genus distalis lateralis) (Fig. 12/5), it supplied the lateral femorotibial sac. The lateral and medial branches distributed within the joint capsule, the two distal branches of lateral and medial anastomosed together at the cranial surface of the joint forming Rete articulare genus (Fig. 12/7), and also along the two borders of the patella forming Rete patellae. (Fig. 12/8).

Radiology of the fox stifles: Radiographic examination revealed the normal disposition of the bones forming the stifle that constituted joint cavity and the femur (F), tibia (T), patella (P), fibula (f) and sesamoids (S) were observed easily. But the ligament and menisci could not be identified by radiograph.

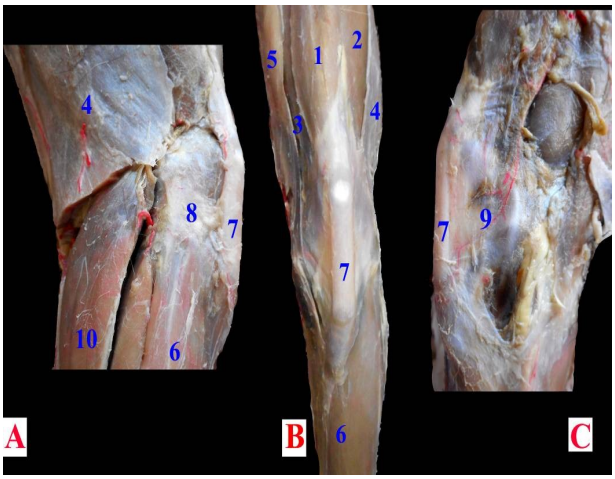
A radiograph was applied on three aspects of the joint, the lateral view (Fig. 7/A) the femoral condyles, tibial condyles, patella and the sesamoids could be comprising. Also in the medial aspect (Fig. 7/C). The cranial aspect (Fig. 7/B) the femoral trochlea, tibial tuberosity, patella and fibula

Magnetic resonance imaging findings (MRI): MRI was one of the most effective tools for identifying the normal anatomy of the joints. Ligaments, tendons, and menisci were seen by the MRI technique.

Transverse sections (TS) through the stifle joint: the transverse images began from the femur at the level higher than the patella and continued distally, selected 8 transverse images from 30 levels applied on the joint, these cross sections selected according to the stifle joint so 2 sections taken above the stifle called pre stifle (Fig.8/A, B), 4 sections on the level of stifle called true stifle (Fig.8/C, D & Fig.9/A, B) and 2 sections caudal to stifle called post stifle. (Fig.9/C, D). These levels aided in identifying the structures entering in the formation of the joint.

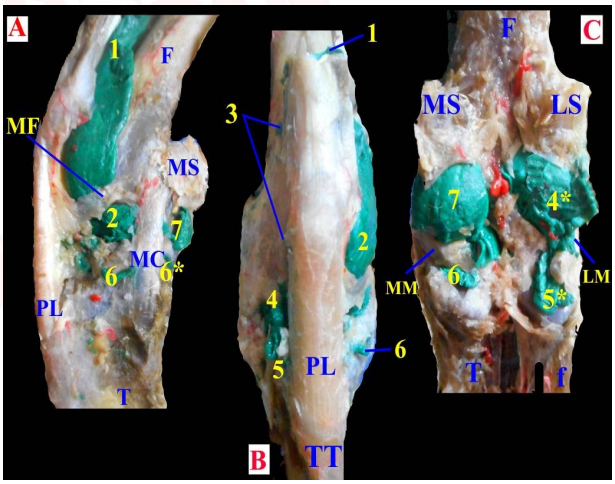
In the true stifle sections: four transverse sections were taken, the first section (Fig. 8/C) was taken at the level of 11/30 showing infrapatellar fat (FP), patellar ligament (PL), medial collateral (ML) and lateral collateral (LL). The second section (Fig. 8/D) was taken at 12/30 showing the cranial cruciate (Cr) and caudal cruciate (Cd).

Fig. 1: A photograph showing the muscles of left stifle joint in the fox. A- Lateral view, B- Cranial view, C- Medial view.



1- Rectus femoris M., 2- Vastus lateralis M., 3- Vastus medialis M., 4- Biceps femoris M., 5- Sartorius M., 6- Cranial tibial M., 7- Patellar ligament, 8- Lateral infrapatellar fat, 9- Medial femoropatellar lig, 10- Gastrocnemius M.

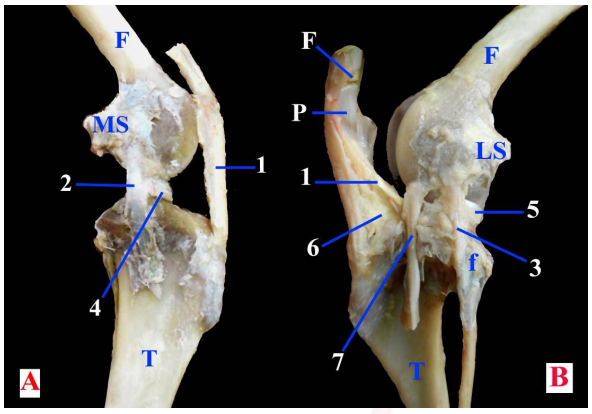
Fig. 2: A photograph showing the articular capsule of Right stifle joint in the fox injected with gum milk latex. A- Medial view, B- Cranial view, C- LCaudal view.



F- Femur, T- Tibia, f- Fibula, MS- Medial sesamoid, LS- Lateral sesamoid, TT- Tibial tuberosity, MM- Medial meniscus, LM- lateral meniscus PL- Patellar ligament, MF- Medial femoropatellar ligament, MC- Medial collateral ligament 1-Proximal pouch of femoropatellar sac, 2- Medial part of femoropatellar sac, 3- lateral part of femoropatellar sac, 4-Cranial pouch of proximal lateral femorotibial sac, 4*- Caudal pouch of proximal lateral femorotibial sac, 5- Cranial pouch of distal lateral femorotibial sac, 5*- caudal pouch of distal lateral femorotibial sac, 6- Cranial pouch of distal medial femorotibial sac, 6*- caudal pouch of distal medial femorotibial sac, 7- Caudal pouch of proximal medial femorotibial sac.

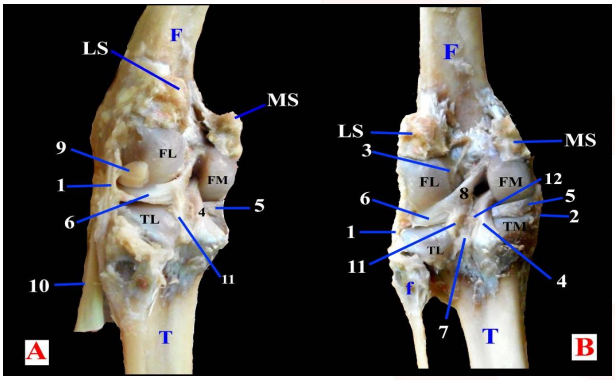
The third section (Fig. 9/A) was taken at 13/30 showing infrapatellar fat (FP), patellar ligament (PL), medial collateral (ML), lateral collateral (LL), long digital extensor tendon (LT), the

Fig. 3: A photograph of left stiûe joint showing associated ligaments and structures in fox. A- Medial view, B- Lateral view.



F- Femur, T- Tibia, S- Lateral and medial sesamoids- f- fibula, P- Patella, 1- Patellar ligament, 2- Medial collateral ligament, 3- Lateral collateral ligament, 4- Medial meniscus, 5- lateral meniscus 6- Infrapatellar fat, 7- Long digital extensor tendon.

Fig 4: A photograph of left stiûe joint showing associated ligaments and structures in fox. A- Caudolateral view, B- Caudal view.

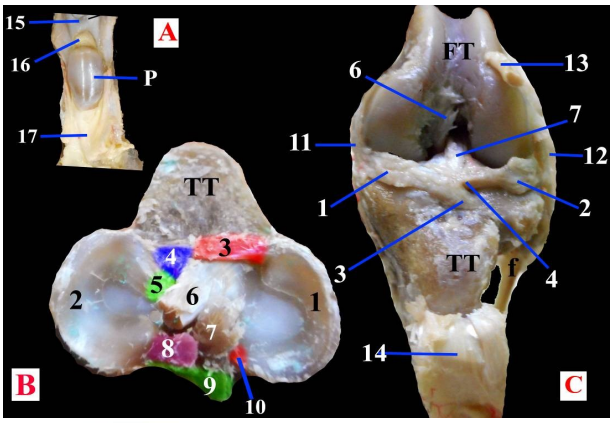


F- Femur, T- Tibia, SM- Medial sesamoid, SL- Lateral sesamoid, f- fibula, FM- Medial condyle of femur, FL- Lateral condyle of femur, TM- Medial condyle of tibia, TL- Lateral condyle of tibia, 1- Lateral collateral ligament, 2- Medial collateral ligament, 3- Cranial cruciate ligament, 4- Caudal cruciate ligament, 5- Medial meniscus, 6- lateral meniscus, 7- Caudal meniscotibial ligament of lateral meniscus, 8- Meniscofemoral 9- Popliteus tendon, 10- Long digital extensor tendon, 11- Caudal meniscotibial ligament of lateral meniscus, 12- Caudal meniscotibial ligament of medial meniscus.

cranial cruciate (Cr) and caudal cruciate (Cd). The fourth one (Fig. 9/B) was at 14⁄30 showing infrapatellar fat (FP), patellar ligament (PL), medial collateral (ML), lateral collateral (LL) and long digital extensor tendon.

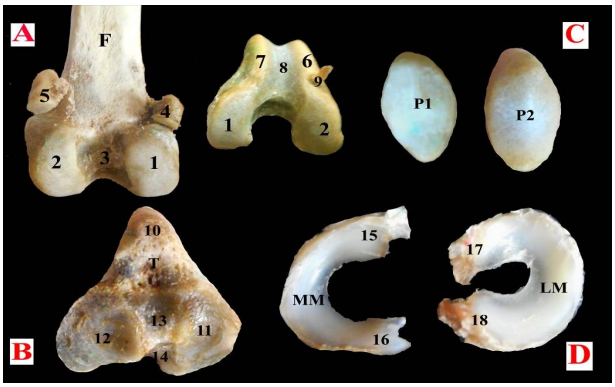
Sagittal sections (SS) through the stifle joint: The sagittal images of the stifle began medially and continued laterally, selected two sagittal images from 18 levels, the selected sagittal at 9/18 in the center of the joint, showing patellar ligament, infrapatellar fat pad, distal articular surface (Femur), distal articular surface (Tibia), articular cartilage (Femur) and articular cartilage (Tibia) (Fig. 10/A, B).

Fig. 5: A photograph of left stiûe joint showing associated ligaments and structures in fox. A- Patella and patellar ligament, B- Proximal view (colored), C- Cranial view.



FT- Femur trochlea, TT- Tibial tuberosity, f- fibula, P- Patella, 1- Medial meniscus, 2- lateral meniscus, 3- Cranial meniscotibial ligament of medial meniscus, 4- Intermeniscal ligament, 5- Cranial meniscotibial ligament of lateral meniscus, 6- Cranial cruciate ligament, 7 Caudal cruciate, 8- Menisicofemoral ligament, 9- Caudal meniscotibial ligament of lateral meniscus ligament, 10- Caudal meniscotibial ligament of medial meniscus ligament, 11- Medial collateral ligament, 12- Lateral collateral ligament, 13- Long digital extensor tendon, 14- Patellar ligament, 15- Quadriceps muscle tendon, 16- Suprapatellar cartilage, 17- Infrapatellar fat.

Fig 6: A photograph showing the bones included in the stifle of the fox. A- Distal extremity of the femur, B- Proximal articular surface of the tibia, C- Patella., D- Menisci (Proximal view).



F- Femur, T- Tibia, P1- Patella (cranial surface), P2- Patella (caudal surface), MM- Medial meniscus, LM- Lateral meniscus, 1- Medial condyle (Femur), 2- Lateral condyle (Femur), 3- intercondyloid fossa (Femur), 4- Medial sesamoid, 5- Lateral sesamoid, 6- Lateral trochlea (Femur), 7- Medial trochlea (Femur), 8- Sagittal groove, 9- Tendon of long digital extensor muscle, 10- Tibial tuberosity, 11- Medial condyle (Tibia), 12- Lateral condyle (Tibia), 13- Intercondyloid area (Tibia), 14- Popliteal notch, 15- Cranial end of MM, 16- Caudal end of MM, 17- Cranial end of LM, 18- Caudal end of LM.

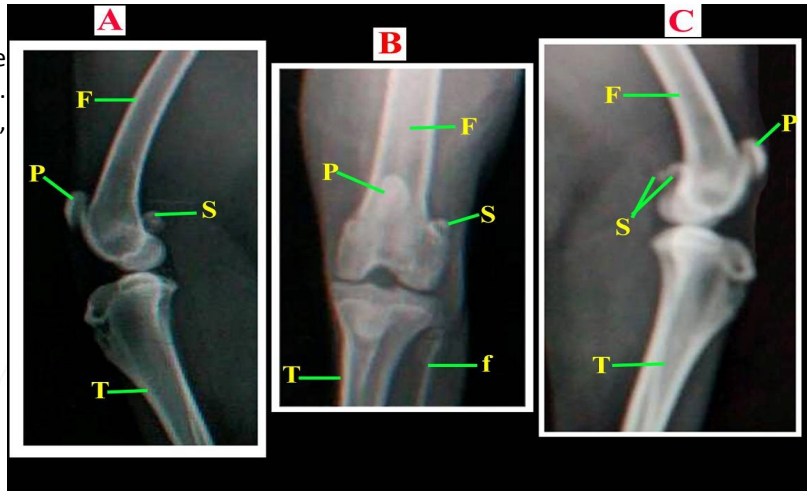
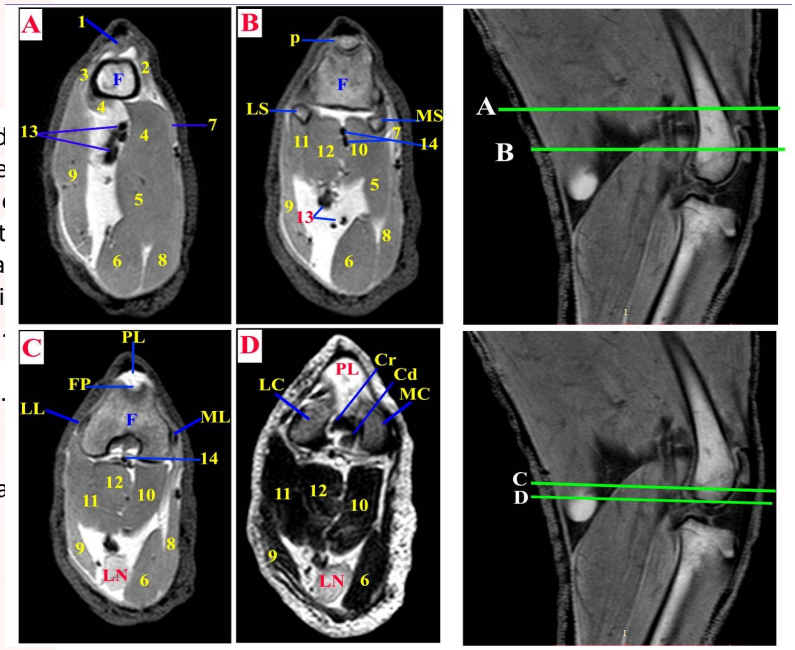


Fig. 7: A photograph of showing the radiograph of left stifle joint in fox. A- Lateral view, B- Cranial view, C- Medial view.

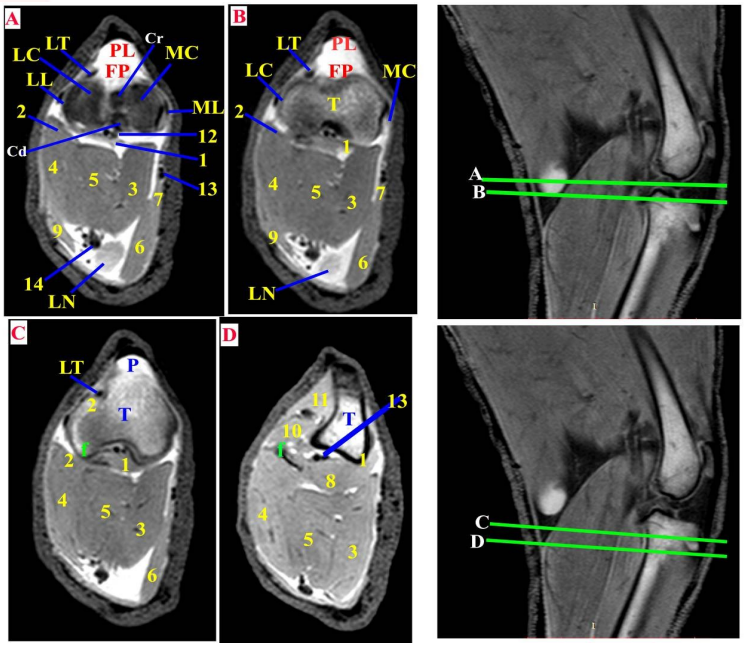
F- Femur, T- Tibia, P- Patella, S- Sesamoids, f- Fibula.

Fig. 8: A transverse sections in the left thigh and stifle joint in the fox (At Femur). A,B,C,D-Magnetic Resonance Images (MRI).



F- Femur, P- Patella, SM- Medial sesamoid SL- Lateral sesamoid, MC- Medial condyle LC- Lateral condyle, Cr- Cranial cruciate ligament, Cd- Caudal cruciate ligament PL- Patellar ligament, FP- Infrapatellar fa pad, 1- Rectus femoris M., 2- Vastus mediali M., 3- Vastus lateralis M., 4- Adductor M. 5- Semimembanosus M., 6- Semitendinosus M., 7- Sartorius M. 8- Gracilis M. 9- Biceps femoris M., 10- Medial gastrocnemius M., 11- Lateral gastrocnemius M., 12- Superficia digital flexor M., 13- femoral A, V, 14- Popliteal A, V.

Fig. 9: A transverse sections in the left stifle joint and leg in the fox (At Tibia). A,B,C,D-Magnetic Resonance Images (MRI).



T- Tibia, f- Fibula, MC- Medial condyle of tibia, LC- Lateral condyle of tibia, PL- Patellar ligament, ML- Medial collateral ligament, LL- Lateral collateral ligament, FP- Infrapatellar fat pad, LT- long digital extensor tendon, Cr- Cranial cruciate ligament, Cd- Caudal cruciate ligament, 1- Popliteus M., 2- Hallucis longus M., 3- Medial gastrocnemius M., 4- Lateral gastrocnemius M., 5- Superfacial digital flexor M., 6- Semitendnosus , 7- Gracilis, Adductor, 8- Long digital flexor, 9- Biceps femoris, 10- long digital extensor M., 11Cranial tibial M.,- Sartorous M., 12- Popliteal A, V, 13- Cranial tibial A, V.

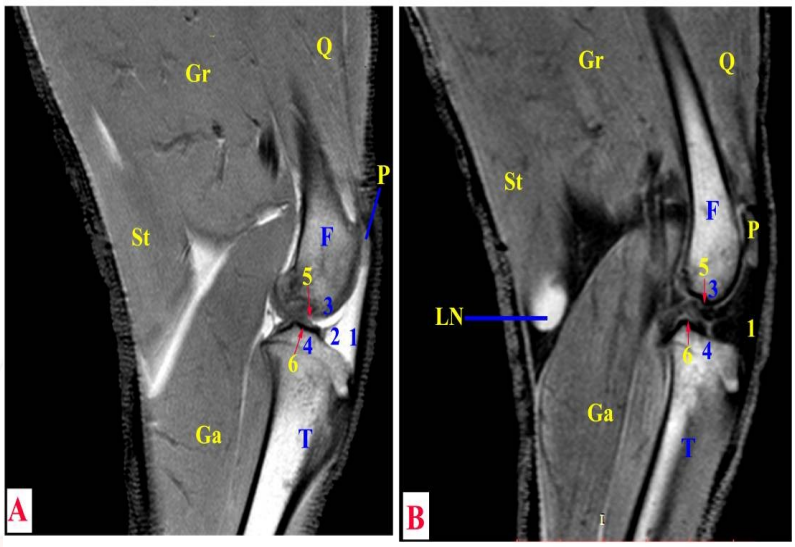
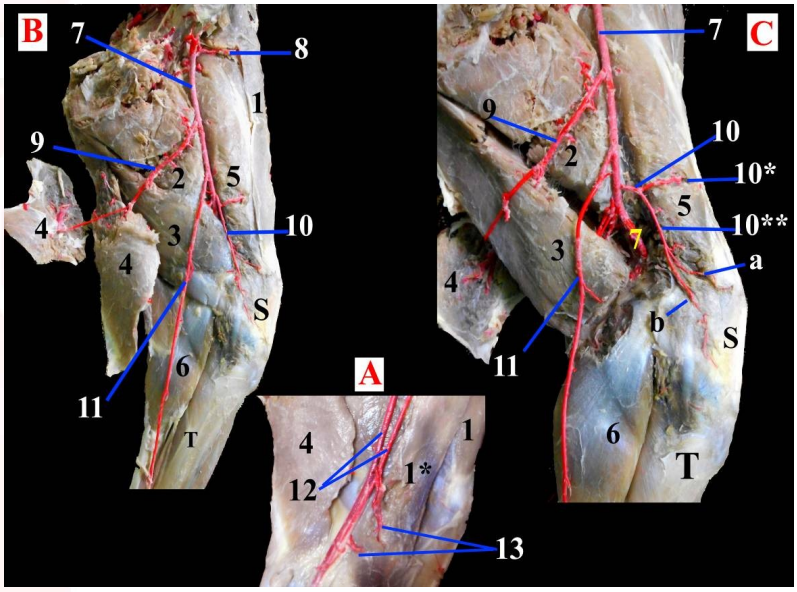


Fig. 10: A sagittal sections in the left thigh and stifle joint in the fox.

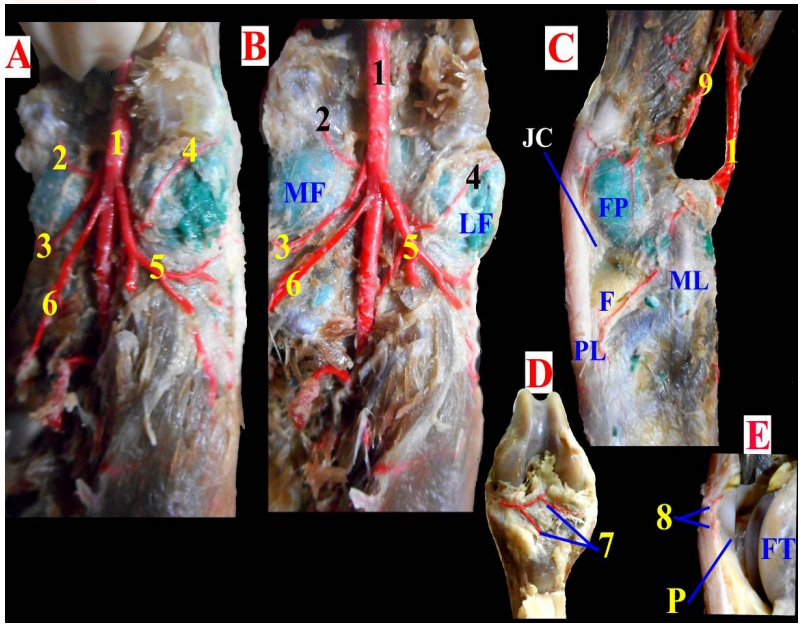
F- Femur, T- Tibia, P- Patella,
Q- Quadriceps femoris M., Gr- Gracilis M., St- Semitendinosus M. Ga- Gastrocnemius M.,1- Patellar ligament,
2- Infrapatellar fat pad
3- Distal articular surface (Femur),
4- Distal articular surface (Tibia),
5- Articular cartilage (Femur)
6- Articular cartilage (Tibia).

Fig. 11: A photograph showing the arterial supplies of the stifle joint in the fox (Medial view). A- Superficial, B- After removal of gracilis, C- After removal of gracilis and sartorius.



S- Superficial, T- Tibia, 1- Cranial Sartorius M., 1*- Caudal Sartorius M.,
2- Adductor M., 3- Semimembranosus M.,
4- Gracilis M., 5- Quadriceps femoris M.,
6- Medial gastrocnemiusM., 7- Femoral A., 8- Superficial circumflex femoral A.,
9- Proximal caudal femoral A.,
10- Descending genicular A., 10*- First muscular branch of descending genicular A, 10**- Second branch of descending genicular A, a- proximal branch, b- distal branch,
11- Saphenous A.,
12- Saphena media V & Saphenous A.,
13- Genus articular branches.

Fig. 12: A photograph showing the branches of the popliteal artery in the fox (Right stifle).



A- Caudolateral view, B-Caudal view, C- Medial view, D- Cranial view,
E- Opened joint cavity, P- Patella,
FT- Femur trochlea, PL- Patellar ligament,
Ml- Medial collateral ligament,
F- Infrapatellar fat body,
LF- caudal pouch of lateral femorotibial joint sac, MF- caudal pouch of medial femorotibial joint sac, FP- Lateral femoropatellar sac, 1- Popliteal A, 2- Medial proximal branch, 3- Medial distal branch,
4- Lateral proximal branch, 5- Lateral distal branch, 6- Middle genus branch,
7- Rete articulare genus,
8- Rete patellae, 9- Descending genicular A.

DISCUSSION

This study differs from any study on the stifle joint in the nature of animal used in the study, the researchers published in the field of wild animals were rare especially fox, no available works of literature for accurate data applied on the fox, that gave this study an especial importance. So studying the normal anatomy was a very important to many authors were not know any data about fox anatomy, also the present study provided with radiology and MRI, that's a very useful to the surgeon in the field of a wild animal.

In the fox, the bones included within the stifle joint were femur, tibia, fibula and three sesamoid bones, patella, plus medial and lateral sesamoids, no sesamoid bone in the tendon of popliteal muscle, these results similar to that recorded [5] in March deer. While the sesamoid bones were four, patella and medial, lateral and popliteal sesamoids called fabellae [2, 6, 7, 8] in the dog. The sesamoid bones were absent in some breeds of dogs by [9], in horse [10] and in goat [11].

The patella of the fox was an oval in shape, the cranial surface was convex and rough, while the caudal surface was smooth and slightly concave, The lateral and medial sesamoids, located on the supracondyloid facets, The lateral sesamoid was a larger and more superior to the lateral condyle than the medial one, in agreement with [2] in the dog except for the caudal surface of the patella was smooth and convex. The shape of the patella differed between the domestic mammals as it was triangular in goat [11] and Quadrangular in the horse [10].

Three joint sacs communicated together in the fox, large femoropatellar sac and two femorotibial sacs were similar to dog [7], goat [11], sheep [12], buffalo [13] and in the rabbit [14], except that's recorded by [10] in the horse, the femoropatellar joint sac communicated only to the medial femorotibial joint sac.

A single patellar ligament between the apex of the patella and tibial tuberosity present in the fox, as recorded by [2, 7] in dog, [11] in goat, [15] in Bengal tiger, [14] in rabbit, while a three patellar ligaments was found in the stifle, in equines and ruminants [10, 16] in march deer [5], in buffalo [17].

In agreement with [14] in rabbit, a single suprapatellar fibrocartilage in the fox, found proximal to the patella, within the tendon of the quadriceps femoris muscle, absorbed the concussion. While [2, 7] in the dog, observed two parapatellar fibrocartilages bounded the patella laterally and medially, so should not luxate the normal patella of the dog.

The medial and lateral menisci in fox were interposed between the femoral condyles proximally and tibial condyles distally, which was important in improving the congruency in the articular surface of the joint, these results similar in the stifle joint of all animals, these menisci characterized the stifle from any other joint as reported [2, 7] in dog, [18] in sheep, [13] in bufflo, [11] in goat, [10, 19] in domestic animal.

In accordance to [2, 16, 18] in the dog, [10, 19] in the domestic animal, [5] in march deer and [11] in goat, the cruciate, collateral, and meniscal ligaments had a similar arrangements in all animals, while the transverse ligament was attached the medial and lateral meniscus in the fox, as reported in the dog, rabbit, however it was absent in March deer, goat, equine and ruminants.

The researches of arterial supply especially of joint were very rare. The descending genicular and popliteal arteries were the main branches supplied the stifle in fox, as recorded by 10, 16] in horse and ruminant, [8] in dog and [11] in goat .

The descending genicular artery distributed within the medial surface of the stifle supplying the joint capsule, it divided into a proximal branch distributed to the femoropatellar sac and a distal one distributed to the femorotibial sac. The popliteal artery distributed to the caudal surface of the stifle gave off three branches proximal, middle and distal branches such results simulate that observed by [8] in dog and [11] in goat.

In accordance with [20] in canines, radiography was the most common method used in the veterinary medicine; it was considered a rabid method helped in the diagnosis of the joint, if it was normal or abnormal joint, while the MRI was

used less widely in the field of veterinary medicine, the main reasons were the cost and the animal needed a general anesthesia.

In our study, the anatomical structures as ligaments and tendons that entered in the formation of the fox stifle could be easily seen by MRI scanning, collateral ligaments, patellar ligament, tendon of long digital extensor muscle, that's could not be seen by a radiology similar where reported by [20] in canines and [21] in equine. Also, bones and soft tissue structures shared in the joint could be easily identified, the cranial and caudal cruciate ligaments were identified as recorded by [22] in canines.

Conflicts of Interests: **None**

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How to cite this article: Samah. H. El-Bably, Nawal. A. Noor ANATOMICAL, RADIOLOGICAL AND MAGNETIC RESONANCE IMAGING ON THE NORMAL STIFLE JOINT IN RED FOX (VULPES VULPES). Int J Anat Res 2017;5(4.3):4760-4769. **DOI:** 10.16965/ijar.2017.465