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Pictorial Essay

Normal Variations in MR Imaging of the Knee: Appearance and Frequency

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MR imaging is advancing rapidly as an important imaging technique for the evaluation of internal derangements of the knee. The utility of MR imaging in the preoperative assessment of knee disorders has been documented [1, 2]. A number of normal anatomic structures within the knee may simulate diseases, such as meniscal and ligamentous tears and osteochondral and meniscal fragments. Careful attention to normal signal intensity of the knee ligaments and contiguous structures is crucial in the accurate assessment of potential disease.

Materials and Methods

MR images of the knee were obtained with a 0.35-T superconducting MR imaging unit (Diasonics, Milpitas, CA) with a quadrature extremity coil. With the knee resting naturally in 15° of external rotation, sagittal and coronal slices were obtained contiguously with slice thickness of 5 mm by using spin-echo (SE) technique. Repetition times (TR) of 1000 msec (coronal imaging) and 1500 msec (sagittal imaging) were used. The echo-delay time (TE) was 40 msec for all images. Four excitations were used in each sequence with a matrix size of 256 × 256, corresponding to a spatial resolution of 0.95 mm.

Normal Anatomic Structures Studied

Transverse Geniculate Ligament

This structure courses anterior to the knee joint capsule and posterior to the Hoffa fat pad, connecting the anterior convex margin of the lateral meniscus to the anterior aspect of the medial meniscus [3] (Fig. 1A). The ligament varies in thickness and may be absent. The region of confluence of this ligament with the anterior horn of the lateral meniscus and its central tendinous attachments has the appearance of a high-signal cleft within the meniscus on sagittal images. This may be mistaken for an oblique tear within the anterior horn of the lateral meniscus (Figs. 2A and 2B). Pseudotears of the anterior horn of the lateral meniscus due to the course of the transverse geniculate ligament are seen in 22–38% of MR examinations of the knee [4–6].

Meniscofemoral Ligament

This is a strong fasciculus arising from the lateral meniscus, close to its posterior attachment, which passes cephalad and medially to insert onto the medial condyle of the femur (Fig. 1B). The ligament may consist of one or two branches [7]. The more constant branch is known as the ligament of Wrisberg, situated posteriorly to the posterior cruciate ligament. The ligament of Wrisberg is visible on 33% of sagittal images as a separate, small, ovoid low-signal focus immediately posterior to the posterior cruciate ligament [4] (Figs. 3A and 3B). The anterior branch of the meniscofemoral ligament, known as the ligament of Humphry, is present in 34% of autopsy dissections [7]. The Humphry ligament originates from the posterior aspect of the lateral meniscus and extends obliquely, medially, and cephalad, anterior to the posterior

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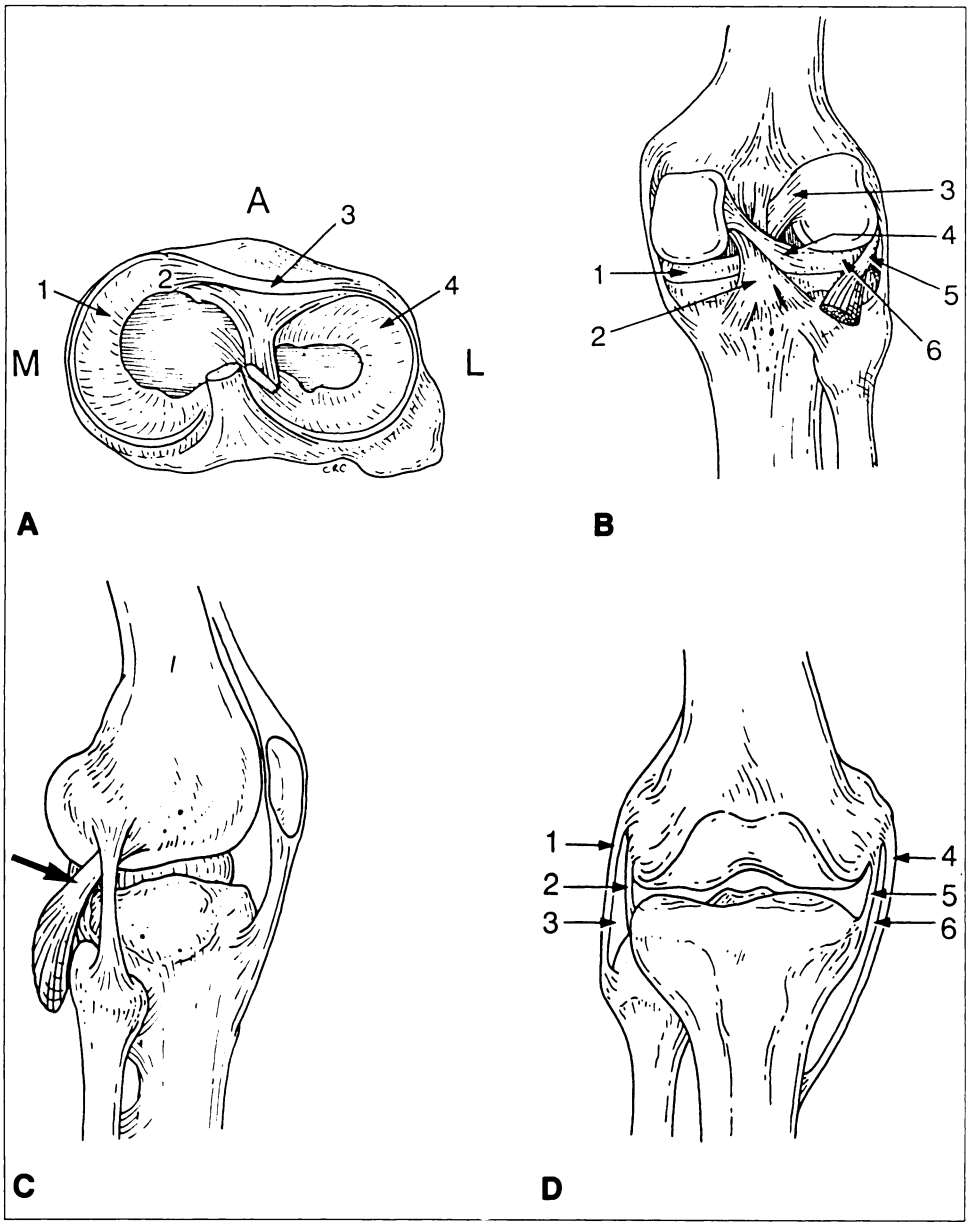


Fig. 1.—*A*, Superior view of menisci of right knee. 1=medial meniscus, 2=central attachments of anterior horn of medial meniscus, 3=transverse geniculate ligament, 4=lateral meniscus.

***B*, Posterior view of right knee. 1=medial meniscus, 2=posterior cruciate ligament, 3=anterior cruciate ligament, 4=Wrisberg ligament, 5=popliteus tendon, 6=lateral meniscus.**

***C*, Lateral view of right knee. Popliteus tendon (*arrow*) crossing periphery of lateral meniscus.**

***D*, Anterior view of collateral ligament system of right knee. 1=fibular collateral ligament, 2=lateral capsular ligament, 3=interligamentous region, 4=superficial layer of medial collateral ligament, 5=deep (capsular) layer of medial collateral ligament, 6=interligamentous potential space.**

(Reprinted, with permission, from Watanabe et al. [4].)

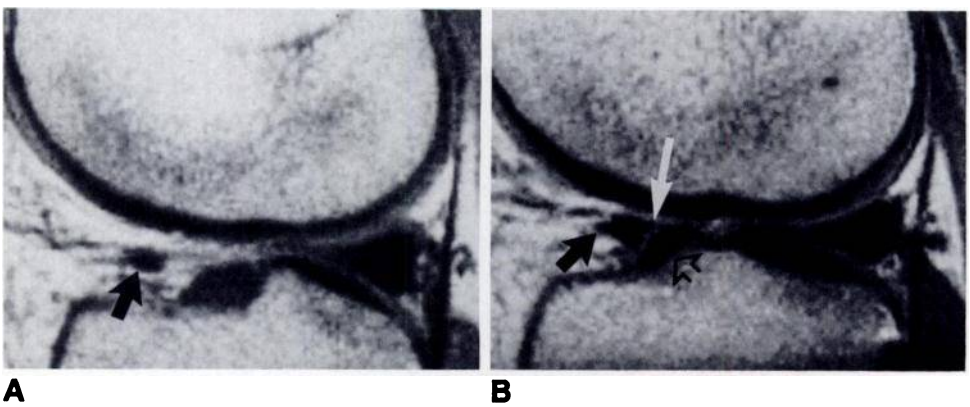


Fig. 2.—Sagittal MR image of knee (SE 1500/40).

***A*, Low-signal transverse geniculate ligament (*arrow*).**

***B*, Transverse geniculate ligament (*black arrow*) coalescing with anterior horn of lateral meniscus (*open arrow*), simulating a meniscal tear (*white arrow*).**

(Reprinted, with permission, from Watanabe et al. [4].)

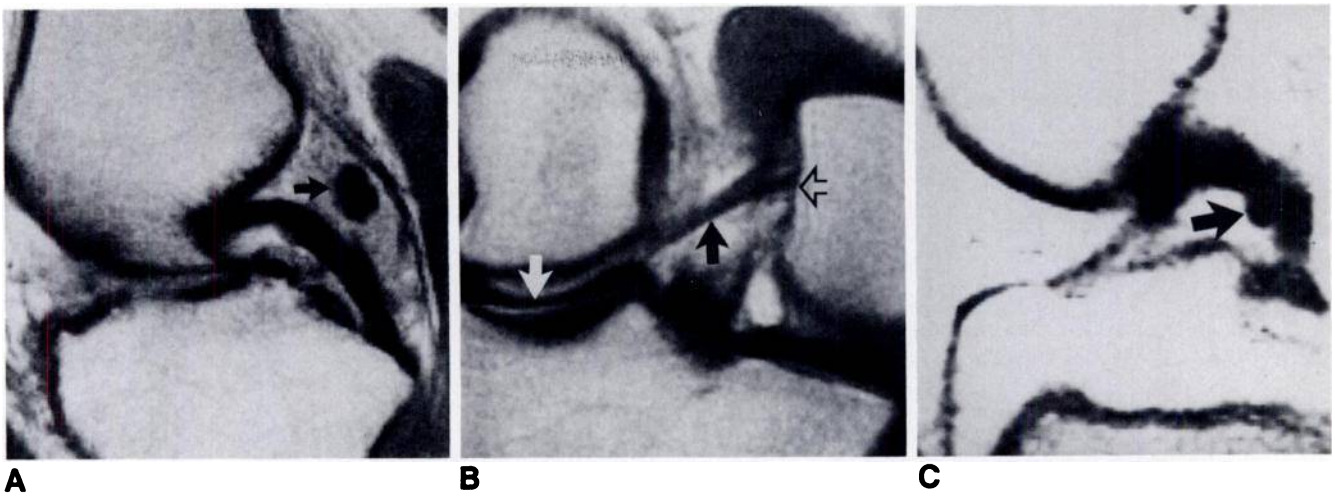


Fig. 3.—*A*, Sagittal MR image of knee (1500/40). Ligament of Wrisberg posterior to posterior cruciate ligament (*arrow*). This ligament may simulate an intraarticular loose body.

***B*, Coronal MR image of knee (1000/40). Ligament of Wrisberg (*black arrow*) coursing from lateral meniscus (*white arrow*) to attachments on lateral surface of medial femoral condyle (*open arrow*).**

***C*, Sagittal MR image of knee (1500/40). Ligament of Humphry (*arrow*) anterior to and separate from posterior cruciate ligament. Humphry ligament could be mistaken for an osteochondral or meniscal fragment.**

cruciate ligament, to insert onto the medial femoral condyle. The ligament of Humphry is visualized on 33% of sagittal MR images either as a discrete low-signal bulge along the concave surface of the posterior cruciate ligament (Fig. 3C) or as a small ovoid low-signal focus just anterior to the posterior cruciate ligament [4]. When visible on sagittal images, the oblique course of both ligamentous branches is usually shown on coronal MR images as a thin low-signal band. Both branches of the meniscofemoral ligament can be identified concomitantly in only 3% of examinations, which correlates well with autopsy data [4, 7]. Either the ligament of Wrisberg or the ligament of Humphry could be mistaken for intraarticular fragments.

Bursa of the Popliteus Tendon

The tendinous portion of the popliteus muscle crosses the periphery of the lateral meniscus, bounded anteromedially by a synovial sheath that communicates with the knee joint space (Figs. 1B and 1C). The superior and inferior meniscal attachments, or struts, of the lateral meniscus form the roof and floor, respectively, of the popliteus bursa. The bursa appears as a vertical or slightly diagonal linear high-signal-intensity focus seemingly within the posterior horn of the lateral meniscus, simulating a meniscal tear in 28% of cases [4] (Fig. 4). There is normally low signal intensity within the meniscus and popliteus tendon.

Fig. 4.—Sagittal MR image of knee (1500/40). Bursa of popliteus tendon (*arrow*) simulating a tear in posterior horn of lateral meniscus.

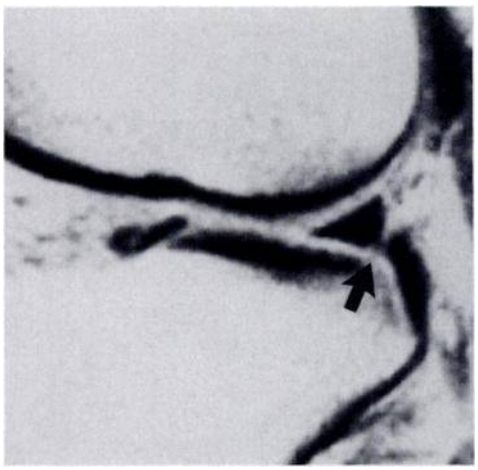
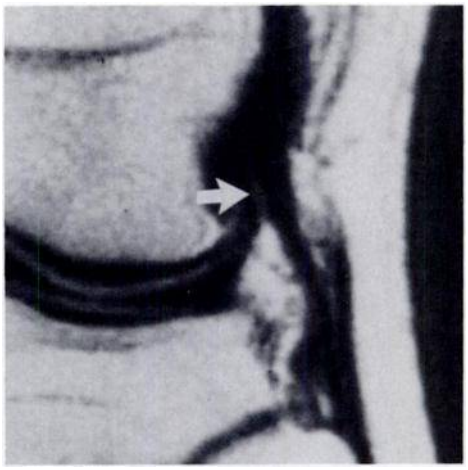


Fig. 5.—Coronal MR image of knee (1000/40). Linear high signal (*arrow*) due to fat medial to the lateral capsular ligament should not be mistaken for hemorrhage.



Collateral Ligaments

The lateral collateral system is a complex group of structures (Fig. 1D) including the fibular collateral ligament, lateral capsular ligament, arcuate ligament, popliteus tendon, and iliotibial band, with the posterolateral joint capsule reinforced by the lateral head of the gastrocnemius muscle [8]. The fibular collateral ligament, which lies free of the joint capsule and has no attachment to the lateral meniscus, is separated from the lateral capsular ligament by a variable amount of soft tissue that is predominantly fatty in nature. This fatty tissue was always visualized as an elongated linear structure of increased signal intensity on coronal images (Fig. 5).

The medial collateral ligament system consists of superficial and deep capsular layers (Fig. 1D). The deep layer is contiguous with the joint capsule. The medial collateral ligament is associated with a bursa and a variable amount of fatty tissue [3]. Increased signal intensity, ranging in configuration from a thin linear stripe to an elongated triangular collection (approximately 4 mm in its greatest dimension), is often present adjacent to the medial collateral ligament. This linear structure may represent either the tissues associated with this bursa or a small amount of joint fluid and should not be mistaken for ligamentous injury.

Conclusions

Normal anatomic variations within the knee are a common and predictable source of potential false-positive diagnoses of internal derangements. Careful attention to normal signal intensity of the knee ligaments and contiguous structures is crucial in the accurate assessment of potential disease.

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