78. Meniscal Tears II

While horizontal tears, described in the previous chapter, tend to occur in the late stages of meniscal degeneration, vertical tears are more frequently traumatic in origin. These tears are oriented perpendicular to the long axis of the meniscus on coronal images. An example of such a tear within the lateral meniscus is seen in the coronal FS T2WI of Figure 78.1 A. This hyperintense tear (white arrow) extends to both the superior and inferior articular surfaces. In this image, there is also hyperintensity within the lateral femoral condyle and to a lesser extent within the lateral tibial plateau, reflecting edema, although the possibility of inhomogeneous fat suppression should always be kept in mind. T1WI demonstrated abnormal hypointensity in the above regions, confirming a bone contusion. Note the relative graininess of the FS T2WI in Figure 78.1 A compared to the FS PDWI in Figure 78.1 B, owing to the FS T2WI being obtained at a lower field strength (1.5 T versus 3 T) and the intrinsically lower SNR of this sequence compared to PDWI.

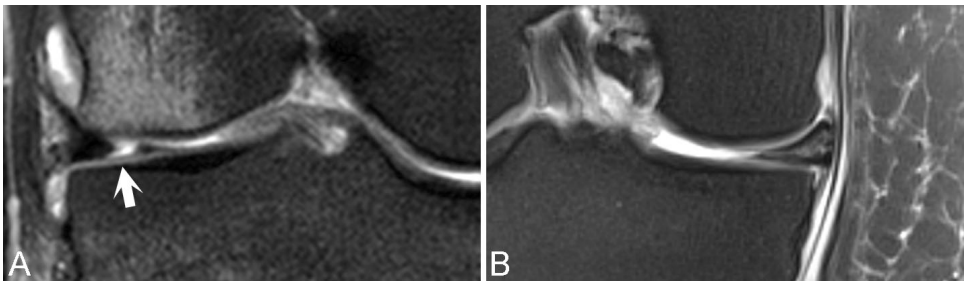

Fig. 78.1

In addition to classifications based on a tear's appearance on cross-sectional MR, tears may be grouped based on surface pattern into radial, longitudinal, and flap types. These tears all extend to the superior or inferior articular surface, whereas horizontally-oriented (cleave) tears may extend through the inner free edge (see Figure 77.1C,D). Non-pure horizontal (see Figure 77.1A,B) tears may extend to the surface as flap or longitudinal tears, but only vertical (as viewed in the coronal plane) tears extend as radial tears. In the axial plane, longitudinal tears follow the meniscal long-axis. A combination of longitudinal and radial hyperintensity defines a flap tear. In coronal images, the orientation of a flap tear is often, although not uniformly, oblique. Radial tears are oriented perpendicular to the meniscal long axis and occur more frequently in the lateral meniscus. These tears may be associated with additional horizontal and flap tears commonly located in the lateral and medial menisci, respectively. A radial meniscal root tear may be associated with the ghost meniscus sign in which the posterior horn of the structure appears absent sagittally near the intercondylar notch. Root tears are more common in the posterior horn of the medial

meniscus and are associated with concurrent anterior cruciate ligament tears. Complex tears exhibit a combination of the above types of lesion. Such a lesion is illustrated in Figure 78.1B—a large, complex tear involving the body and posterior horn of the medial meniscus.

As in the brain (see Chapter 14), simultaneous multislice (SMS) imaging is an important imaging advance to implement clinically, allowing for knee imaging a marked reduction in scan time. Figure 78.2 presents a proton density weighted sagittal image of the knee obtained with a SMS factor of 2, allowing a reduction in scan time from 6:36 for the conventional scan to 3:27 min:sec. This makes possible use of a high-resolution image protocol within an acceptable scan time, in this instance with an in-plane spatial resolution of 0.5 x 0.4 mm^2 and a slice thickness of 2.5 mm. Figure 78.2 illustrates, with excellent image quality, a horizontal tear (arrow) of the posterior horn of the medial meniscus.

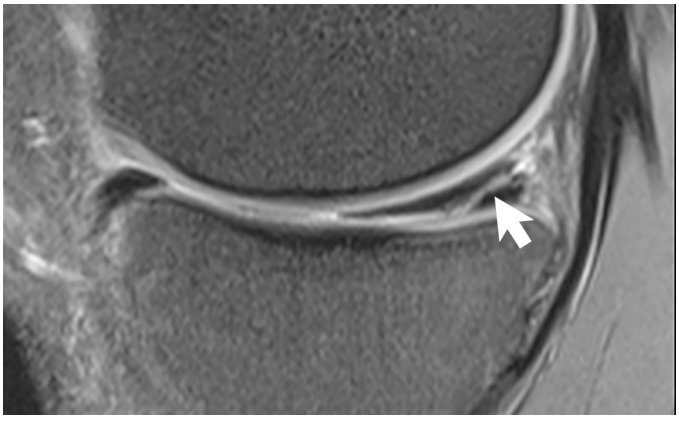

Fig. 78.2

(Adapted with permission from Invest Radiol 2017;52:1)

A displaced vertical longitudinal tear of the meniscus is termed a bucket-handle tear. These most commonly involve the medial meniscus, beginning posteriorly and extending anteriorly. These lesions typically consist of a displaced, adjacent peripheral meniscal fragment. This appearance is demonstrated in Figure 78.3A on coronal FS PDWI where the displaced fragment of the medial meniscus is seen within the intracondylar notch (arrow). If the displaced fragment appears adjacent to the origin of the posterior cruciate ligament (PCL), this appearance is termed the double PCL sign. A similar appearance is seen in the coronal FS PDWI in Figure 78.3B, in a different patient, with the inner head of the medial meniscus (arrow) being displaced into the intracondylar notch. In this case, the remainder of the visualized meniscus also demonstrates a shortened, truncated appearance.

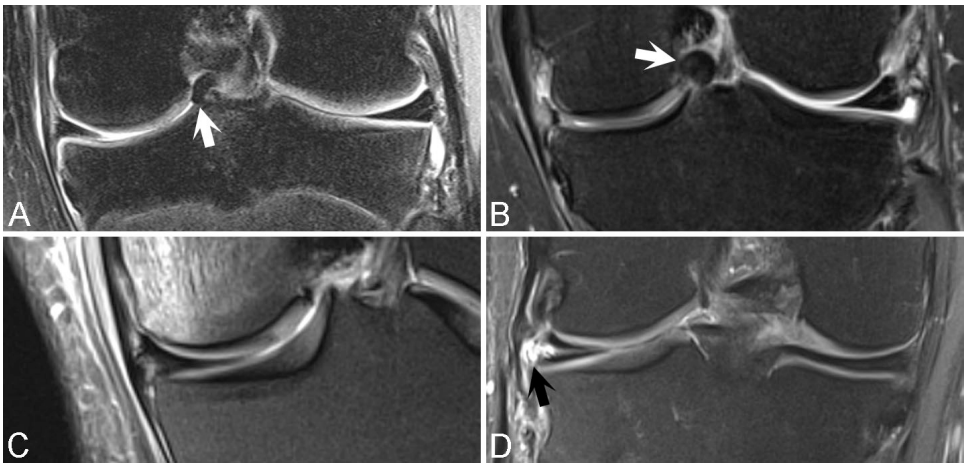

Fig. 78.3

Assessment of fragment degeneration and identification of the involved zone of the meniscus are important in assessing post-operative prognosis. A degenerative displaced fragment is less likely to heal, as are tears through the relatively avascular, central "white zone" as opposed to those within the peripheral, vascularized "red zone." Bucket handle tears most often occur in the setting of acute trauma—an etiology additionally suggested by the presence of joint effusion or osseous contusion. Figure 78.3C demonstrates an example of the latter involving the femoral condyle on coronal FS PDWI. Without fat suppression, this lesion would not be clearly visible on PDWI. A complex tear involving the posterior horn of the medial meniscus is also present. In chronic meniscal tears, synovial cysts may form. These typically appear as well-defined areas of fluid-like SI adjacent to a meniscal tear on MR. The typical appearance of such a cyst is demonstrated in the FS PDWI of Figure 78.3D. In this case there is also a clearly visible horizontal tear of the lateral meniscus. The lateral hyperintense extra-meniscal fluid collection (black arrow) represents a small meniscal cyst.

High intrameniscal signal intensity may represent intrasubstance myxoid degeneration, which does not predispose to tear. Normal pediatric vasculature may give the appearance of linear hyperintensity. High SI truncation artifacts, which occur at the border of tissues with very high and low SI, may mimic meniscal tears but typically parallel the meniscal surface and are encountered only in a single plane. Higher resolution imaging decreases this artifact. Partial volume averaging with nearby fat may also mimic meniscal abnormalities, which can be clarified by evaluating additional planes. Due to restrictions in water motion within tendon collagenous structures, the so-called magic-angle phenomenon may occur in the upsloping portion of the posterior horn of the lateral meniscus when it is angled at 55 degrees to the main magnetic field, resulting in tendinous hyperintensity. Finally, the posterior portion of the meniscofemoral ligament—the ligament of Wrisberg (or Humphrey

if anterior to the PCL)—may, in an externally rotated knee, at its insertion to the posterior horn mimic the appearance of a hyperintense vertical meniscal tear. Other potential pitfalls include determining whether abnormal SI extends to the articular surface in a given case, with examination of the lesion in all three planes helpful. Following reparative surgery, hyperintensity may persist within normally healing menisci, and as such MR arthrography may aid in the diagnosis of postoperative tears.