

KNEE MRI

MENISCI (PD w/ FATSAT): 2 bowtie for body of meniscus on sag view (4-5mm slices)

- MEDIAL MENISCUS** (post horn > ant horn)
- LATERAL MENISCUS** (discoid ≥ 3 bowties on sag and extends into IC notch on coronal)—ant horn merge with ACL and may be striated in this region; posterior horn medially may have magic-angle artifact
- Tear types** (on at least 2 images and 2 planes):
 - INTRASUBS DEGENERATION** (ddx: radial, CPPD, magic angle, meniscal cyst): grade I=globular signal, grade II=linear signal (does not extend to any surface), grade III=tear extends to surface
 - HORIZONTAL** (extend to sup/inf art surface, apex, or periphery)
 - note: peripheral tears may be assoc w/ menisco-capsular separation—don't confuse with interstitial bursa btwn post horn of medial meniscus and capsule OR gap btwn post horn of lateral meniscus and popliteus tendon; more common w/ ACL tears)
 - VERTICAL** tears (occur at periphery; may be oriented obliquely)
 - longitudinal (no displaced fragment; equidistant from periphery on all sag images; may extend to articular surface)
 - bucket handle (attached on both ends but displaced; only one bowtie on sag; double PCL or ant flipped meniscus)
 - flap (displaced flap attached only on one end; undersurface tear may displace into medial gutter; seen on coronal)
 - RADIAL/FREE EDGE** (only one bowtie on sag)=partial/complete
 - radial (blunted free edge; perpendicular to edge of meniscus; seen in post horn/body)
 - parrot beak (like radial tear, oriented obliquely “comma”)
 - root tear (near IC notch)
 - COMPLEX** tear (branching); **MASCERATED**
 - Peripheral extrusion (aka subluxation)—extending into superior/inferior gutter
- Parameniscal cyst (may result in surface bone erosion)
- Transverse lig 40% (seen ant, from AHMM to AHLM, surrounded by fat)
- Menisiofemoral lig—oblique from PHLM to med fem condyle; ant (more-common “Humphry”) or post (“Wrisberg”) to PCL
- Meniscal ossicle (usually PHMM)
- Meniscal flounce (normal variant undulation/wavy periphery of meniscus)
- Meniscal cyst
- Partial meniscectomy (truncated) if prior repair

LIGAMENT (ACL/PCL on PD and MCL/LCL on T2)

- ACL** (parallel to or steeper than roof of IC notch on sag; interspersed hi signal fat near tibial attach; peripheral PHLM tears common)
 - Anteromedial and posterolateral bands; tibial attachment is stronger than femoral attachment
 - ACL sprain or partial tear—increased signal+laxity (correlate for ACL insuff); Tears mid>prox>distal; Mucoïd degen (drumstick)
 - O'donahue triad (ACL tear, MCL injury, medial meniscus) + patellar dislocation (medial retinaculum)
 - Assoc w/ posterolat tibia & anterlat femoral condyle kissing contusion, OC fx OR tibial eminence avulsion fx (r/o transverse lig not displaced underneath the avulsion fx) OR second fx (posterolat capsular avulsion fx)—assoc with posterolateral corner injury

ACL graft

- some signal (less than fluid) 1st 2yrs
- tibial tunnel parallel to roof of IC notch “straight and back”
- tibial tunnel oriented parallel to BS line and intraart opening post to where BS line meets tibia on sag
- if tibial tunnel too ant → roof impingement on IC notch; if too post → graft instability
- femoral tunnel where posterior cortex meets physcal scar (11 or 11'oclock position on coronal view of right or left knee)
- inf femoral tunnel located at intersection of line along post fem cortex and line along interchondylar notch (blumensaat line) on sag
- Arthrofibrosis=focal (Cyclops) vs diffuse
- cystic degen (ganglion along tunnel)—as long as graft intact, this is not a big issue
- loose bodies

- PCL** (thickening+intermed signal is abnl; usually tears off tibial attachment); not question mark (PCL buckling sec to ACL injury)
- MCL** (superficial band + fat/bursa + deep band firmly attached to meniscus; also POL=post oblique lig; look for meniscocapsular separation; sprain=signal superficial to MCL, partial tear=thickening or signal within MCL but overall intact; complete disruption)
- LCL** (IT band anteriorly onto tibial Gerdy's tubercle; FCL+Biceps femoris form “conjoined tendon” and inserts on fibular head)
- MED/LAT RETINACULUM** (axial; med ret injury w/ patellar disloc/reloc injury)

TENDON/MUSCLE: (T2)

- TENDON**

-QUAD TENDON

-PATELLAR TENDON (on sag; pre-patellar/deep infra-patellar bursitis; Jumper's)

-IT BAND (axial and coronal—fluid on both sides at level of fem condyle)

-POPITEAL TENDON (sag; from lat fem condyle inferiorly to btwn PFLM and jt capsule; bursitis vs tear)

-PES ANSERINE (sartorius, gracilis, semitendinosus; bursa btwn MCL and pes anserine below joint line) ← coronal (inserts quite anteriorly below joint line upon medial tibial metaphysis)

-Posterolateral corner syndrome → suspect if tear of two or more (FCL/biceps femoris conjoined tendon “V”+ arcuate lig + pop tendon=arcuate complex; and popliteofibular lig) plus PCL > ACL tear; may or may not have edema in fibular head; emergency call ortho!! Need to operate <1wk

-MUSCLE (plantaris tendon tear aka “tennis leg”)

BONE/CARTILAGE: (cartilage on PD both with fatsat)

-BONE

-anatomy: intercondylar notch/fossa; intercondylar tibial eminence (medial/lateral tibial spines); trochlear groove of femur and patellar apex; anterior tibial tuberosity

-bone bruise vs osteochondral fx

-femoral trochlear dysplasia (shallow <3mm)

-SONK (insuff fx medial fem condyle)

-avulsion fx may not be assoc with sig marrow edema unlike contusion or impacted fx

-patellar dislocation/relocation injury (look for chondral defect, loose bodies, shallow trochlear groove, medial retinaculum and medial patellofemoral lig tear; risk of patellofemoral instability=femoral trochlear hypoplasia, increased trochlear tubercle distance, lateral patellar shift)

-OCD: stable vs unstable (fluid signal undercutting lesion and/or multiple T2 cyst surrounding lesion; BM edema not useful)

-Anatomic axis: Normal tibiofemoral angle 0-10deg; varus <0deg; valgus >10deg

-Patellar tendon lateral femoral condyle friction syndrome (patellar tracking abnormality): superolateral Hoffa fat pad impingement btwn inf patella and lat femoral condyle;

DYNAMIC CT=image knee in full extension (0deg) and varying deg of flexion (15/30/60/90deg); lateral patellar tilt=negative “lateral patellar angle” with early flexion <30deg (normal is positive angle) → with further flexion subluxation may improve or worsen; lateral patellar subluxation/shift (AC/AB) reported in percentage; basically significant tilt or subluxation by 20deg of flexion is mal-alignment; patella normally may sit lateral to trochlea at full extension but with flexion it engages the trochlea and should be centered without tilt;

-CARTILAGE (PD or GRE)

-if >1.5cm → grade; chondral degeneration vs defect; post-op: chondral thinning w/ subchondral microfx

-PF JOINT (patellar eminence or median ridge, and trochlear groove)

-FT JOINT (ant/post WB surface; intercondylar notch of femur; medial/lateral tibial eminence or spine)

-I=normal (softening), II=fraying/abnl signal, III=fissure/ulceration/fragmentation, IV=full thick defect

-3D SPGR w/ fatsat (TR60, TE5, flip angle 40) 6min

-Microfractures (lenticular defects)—prior cartilage repair

MISCELLANEOUS:

-EFFUSION

-LOOSE BODIES

-SYNOVITIS

-SYNOVIAL PLICAE (thickened medial vs supra/infrapatellar vs lateral plica; look for any synovitis, PF chondral defect, or hoffitis)

-BAKER'S CYST (“M&M” medial head gastroc and semimembranous tendon; can be septated or complicated or partially ruptured or leaking)

-BURSITIS (post horseshoe “semimembranous-TCL” located medial knee; Pes anserine bursa located more distally anteriorly and superficially to SMTCL bursa; popliteal bursa; prepatellar vs superficial/deep infrapatellar bursa; FCL-biceps femoris bursa located laterally)

-HOFFA FAT (hoffitis)

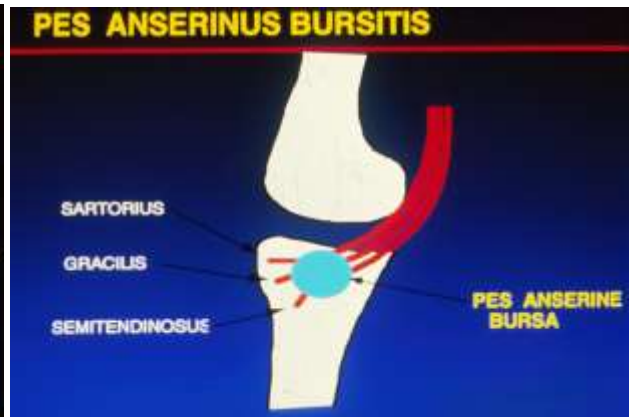
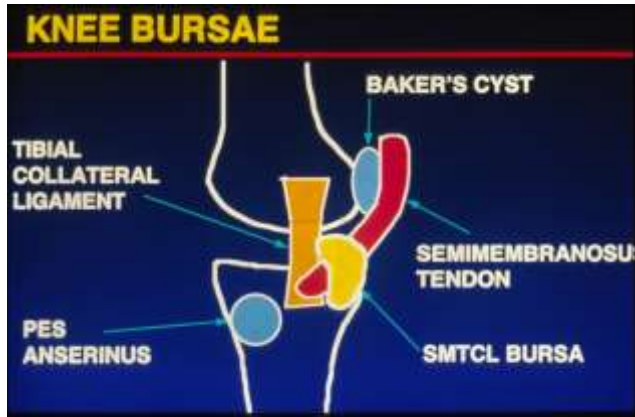
-HOFFA FAT MASS (lipoma, hemangioma, synovial chondromatosis, focal villonodular synovitis, ganglion cyst, osteochondroma, and chondrosarcoma)

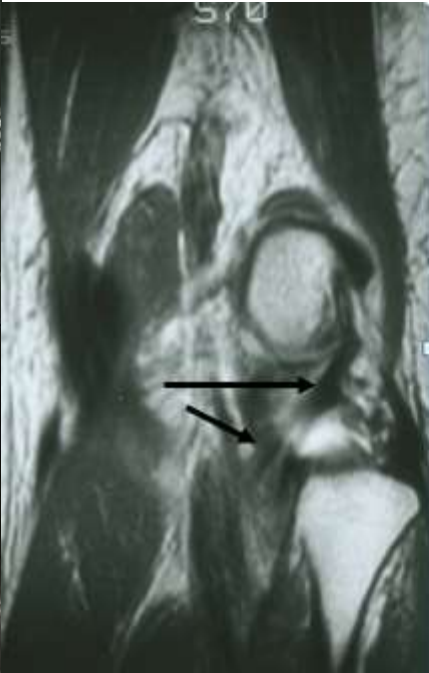
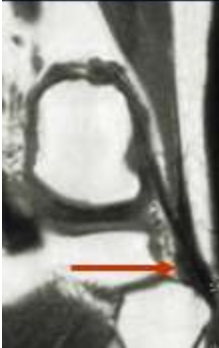
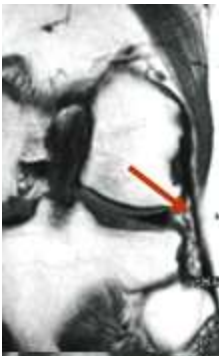
VASCULAR:

-popliteal aneurysm

-venous thrombosis (loss of pulsation artifact)

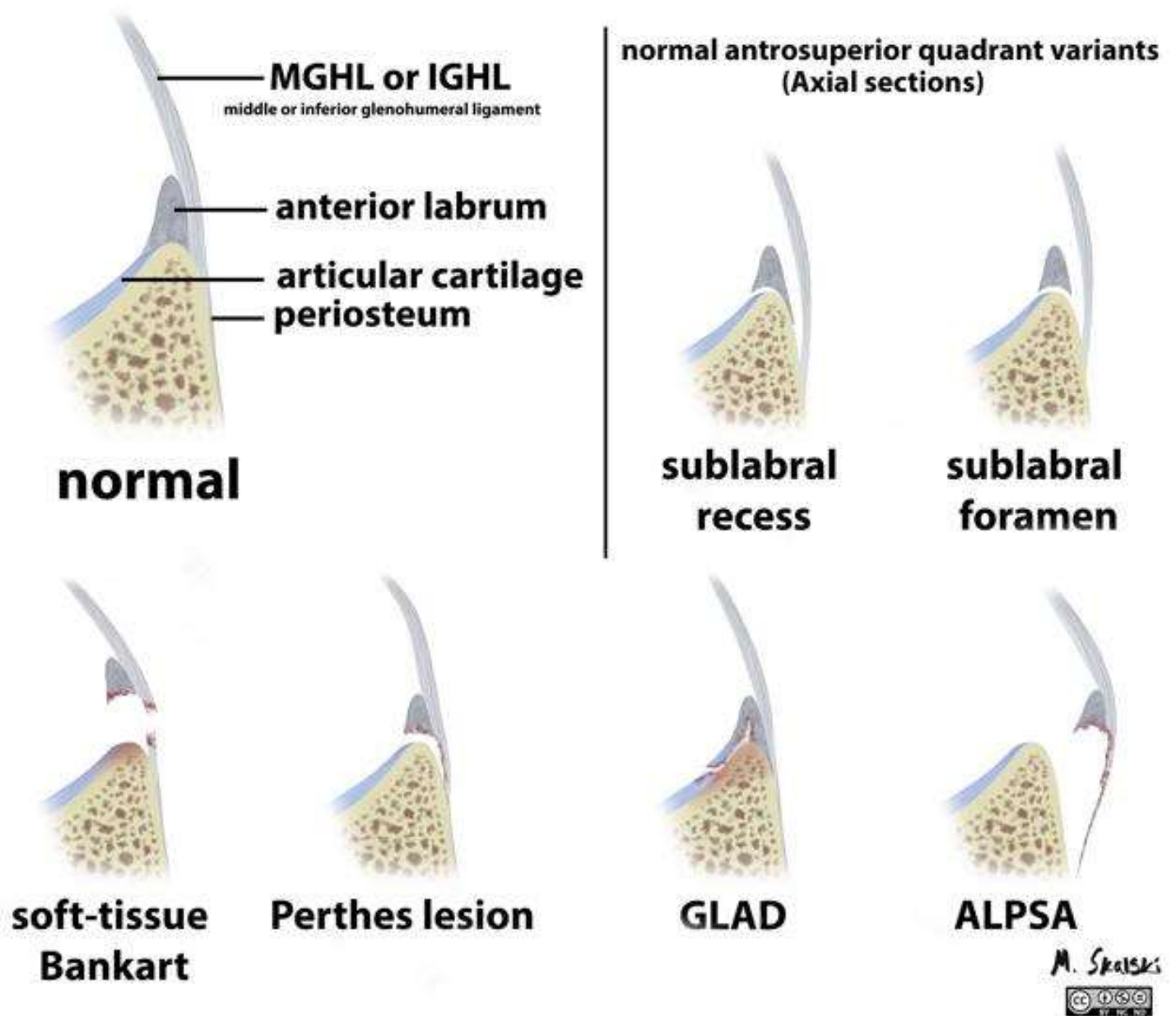
-Cystic adventitial disease (T2 bright cystic changes of popliteal artery wall with stenosis)
-LAD





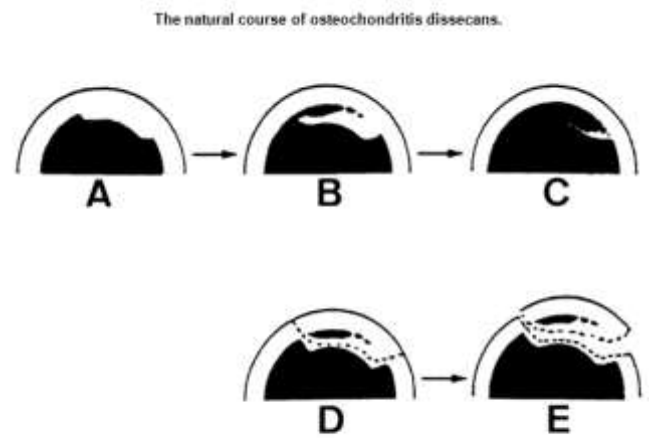
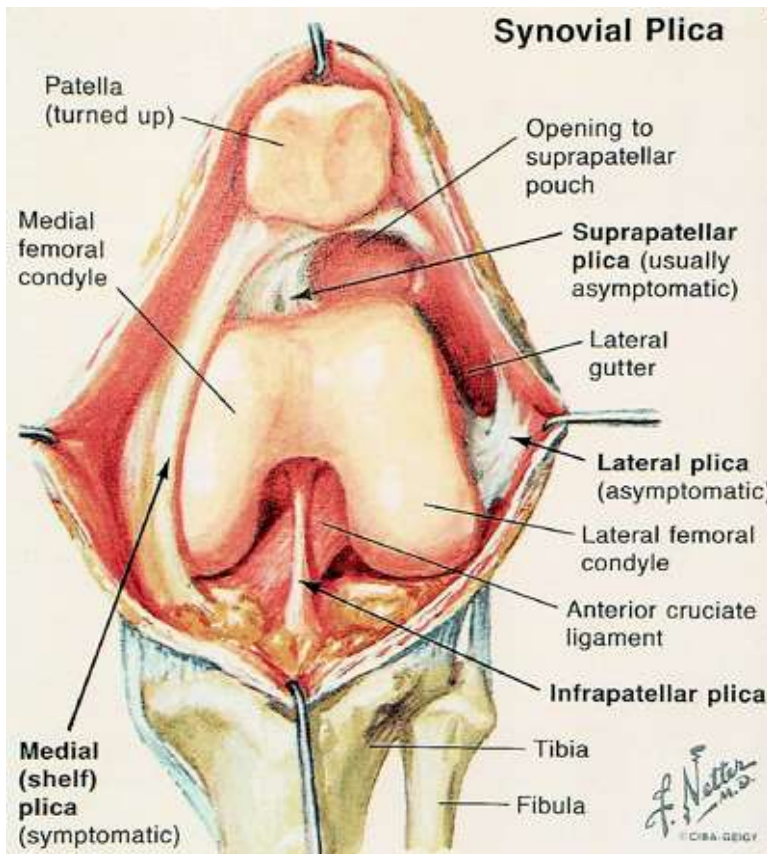
Description
Softening of the cartilage
superficial freying
thining of cartilage
complete loss of cartilage to bone

Glenoid labrum tears



OSTEOCHONDRAL INJURY STAGING

Stage	Description
1	Injury limited to articular cartilage
2	Cartilage injury with associated subchondral fracture
3	High signal around osteochondral fracture (rim sign) but not displaced
4	Osteochondral fragment displaced
5	Subchondral cyst formation



Takahara Met al. Radiology 2000;216:207-212

Radiology

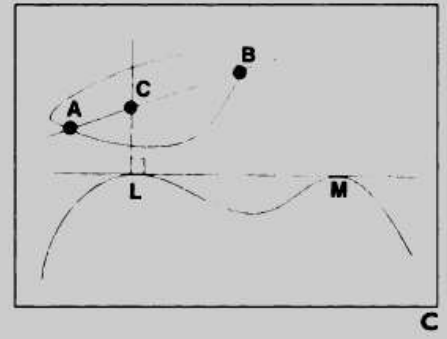
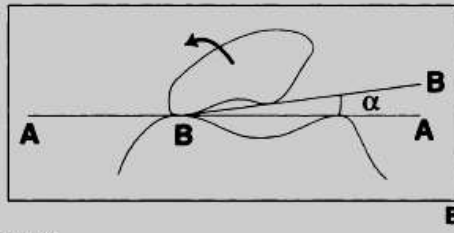
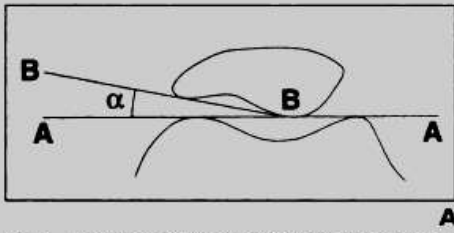


Fig. 4.—Drawings of lateral patellofemoral angle and lateral shift.

A, Drawing shows lateral patellofemoral angle (α) between lines A-A and B-B. Normally, angle is open laterally and expressed as positive number.

B, In patients with lateral patellar tilting, lateral patellofemoral angle is measured medially and expressed as negative number.

C, Drawing shows lateral shift, which is defined as percentage of patellar width (AC/CB) lateral to line perpendicular to center of lateral condyle (L). M = medial condyle.

MALALIGNMENT PATTERNS

45 PATIENTS

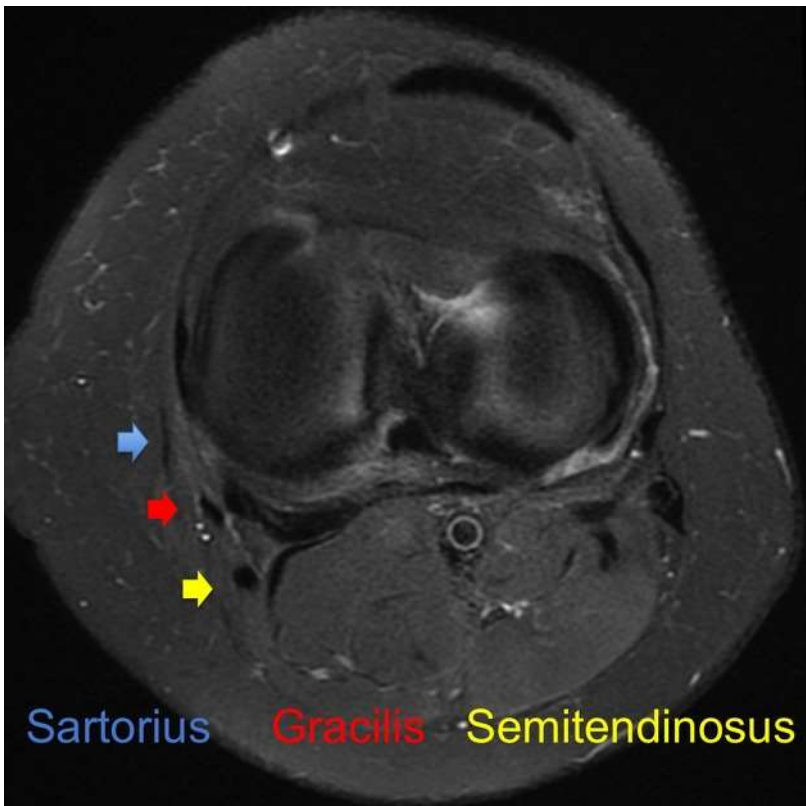
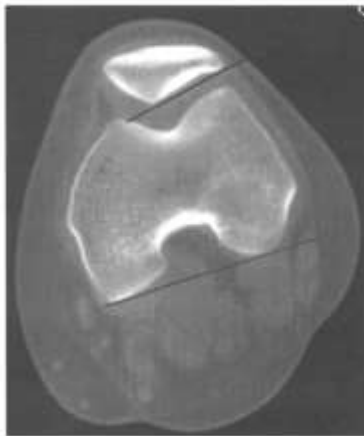
Type 1 - Sublux without tilt
18 Patients, 21 Knees



Type 2 - Sublux with tilt
14 Patients, 19 Knees

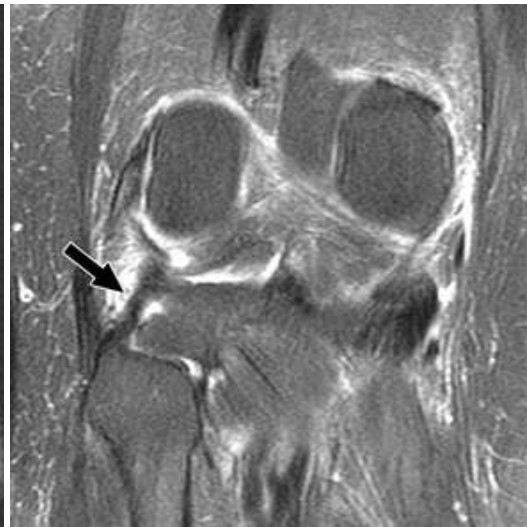
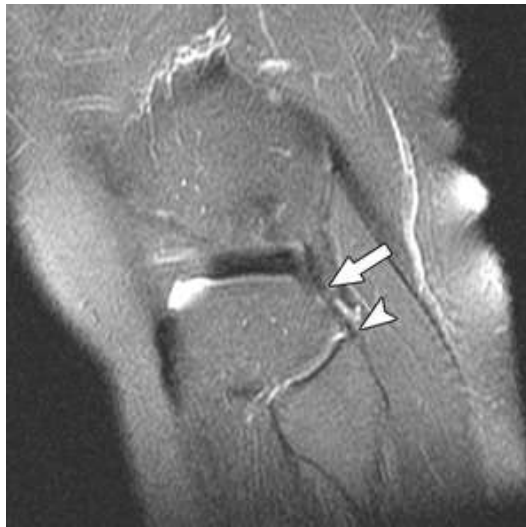
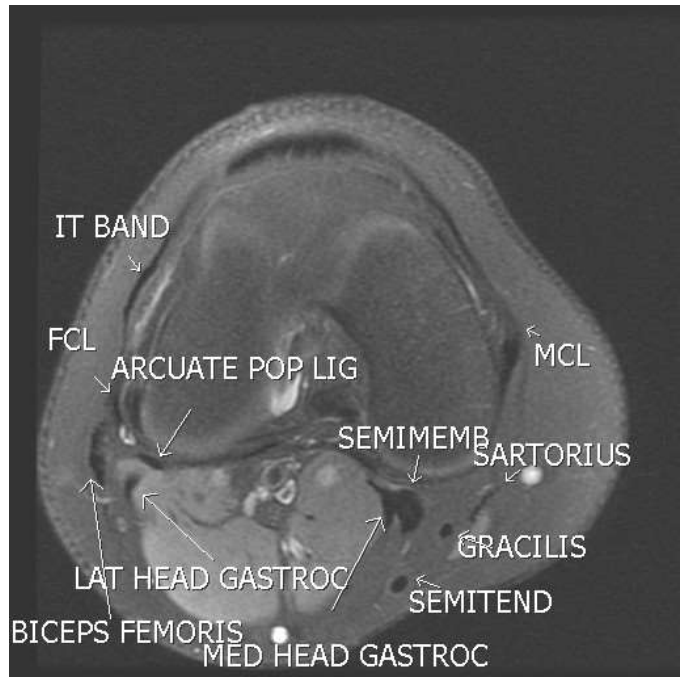
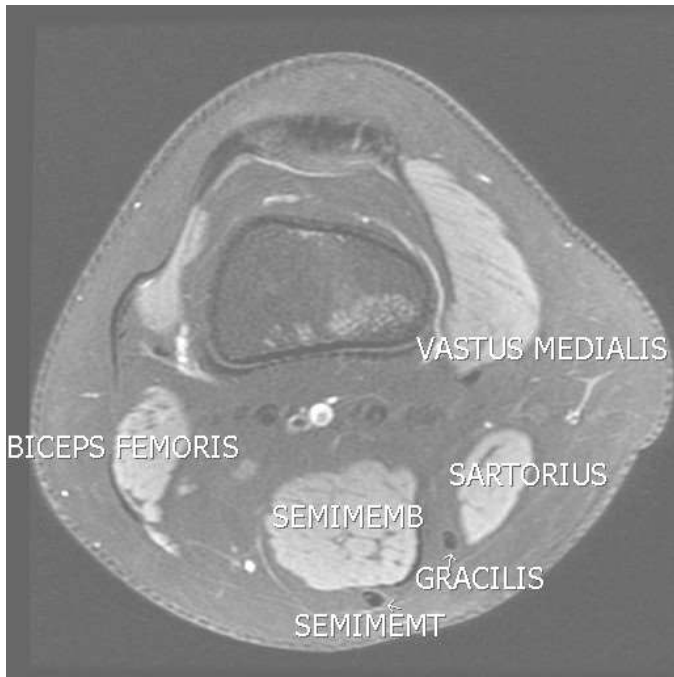


Type 3 - Tilt without sublux
19 Patients, 25 Knees

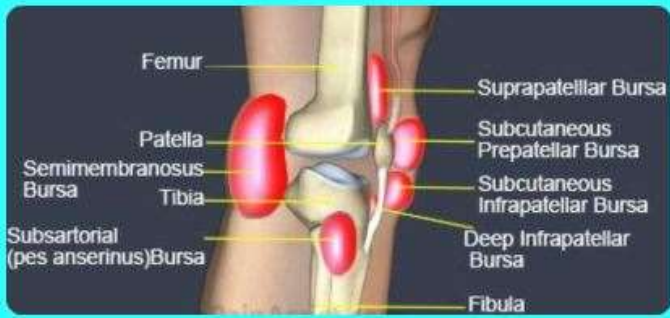
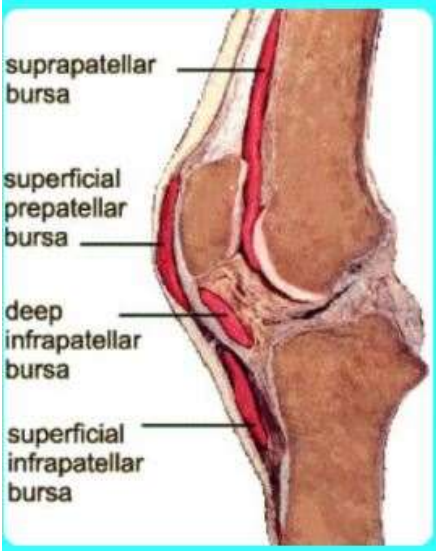
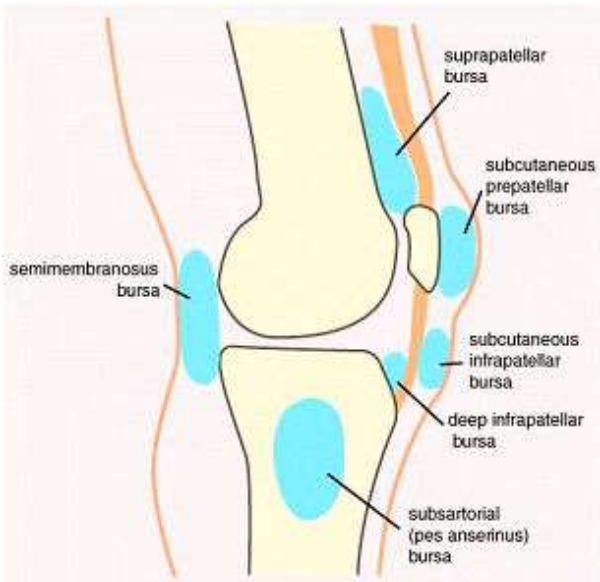


Sartorius Gracilis Semitendinosus

SAY GRACE BEFORE TEA



POPLITEOFIB LIG



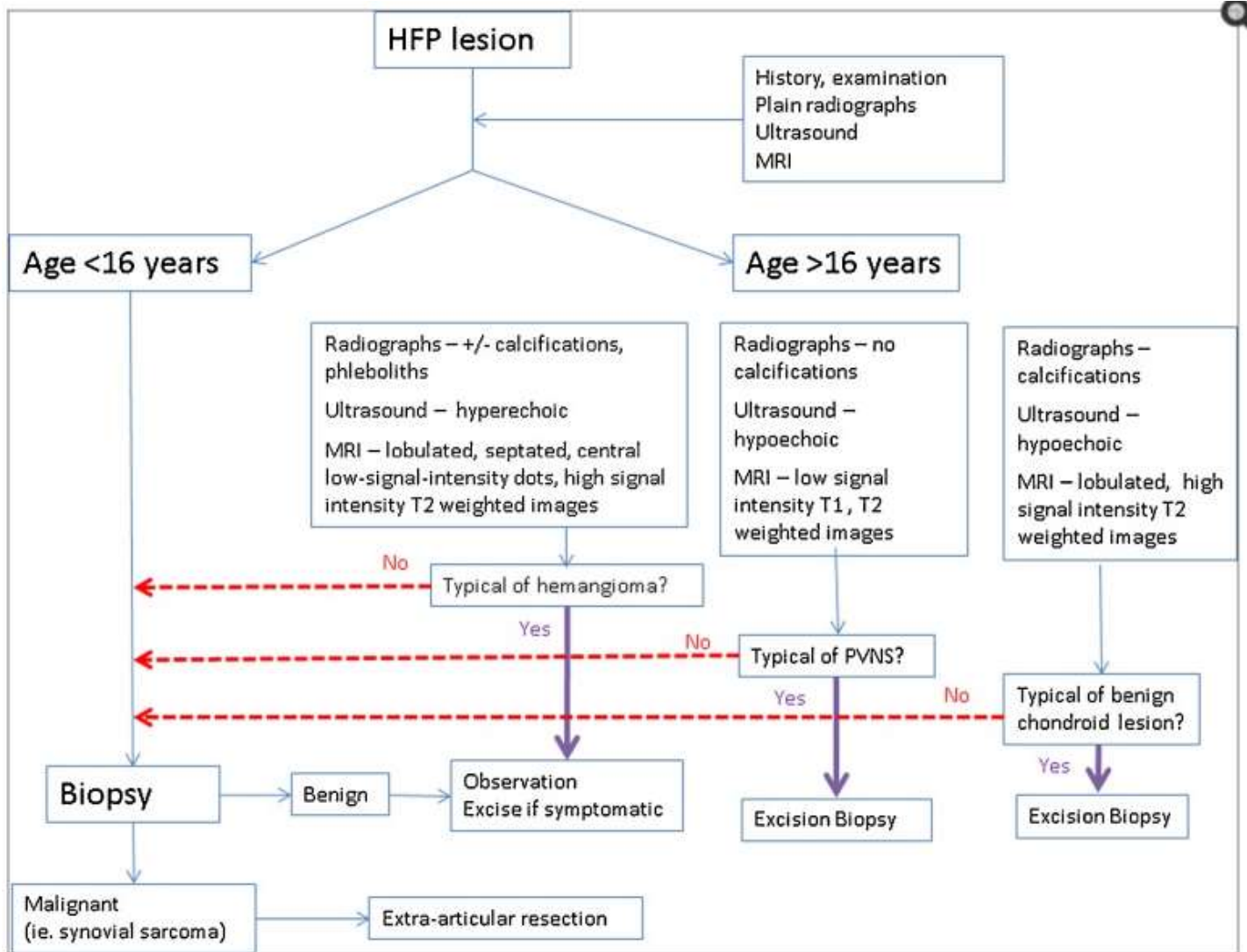
MR signal intensity (SI) characteristics of the lesion or part of the lesion	Synovial disorder	Relative incidence	Other MR characteristics
High SI on T_1W & T_2W	Subacute haemorrhage	Common	Fluid–fluid levels, no enhancement
	Ossified nodules of SOC	Uncommon	Usually multiple nodules, no enhancement
	Lipoma arborescens	Rare	Fron-d-like appearances, no enhancement
	Synovial haemangioma	Very rare	Serpiginous vessels, signal voids, fatty components do not enhance
Low/intermediate SI on T_1W & T_2W	Inactive fibrous pannus	Common	Slight or no enhancement
	Giant cell tumour of tendon sheath	Common	Extraarticular, solitary, nodular, enhances
	Pigmented villonodular synovitis	Uncommon	Intraarticular, diffuse, enhances
	Amyloid	Uncommon ^a	Sub-chondral cysts, no enhancement
	Calcified nodules of SOC	Uncommon	Usually multiple nodules, no enhancement
	Gouty tophi (especially if high concentration of calcium)	Uncommon	Paraarticular erosions, enhances
	Benign fibrous histiocytoma (deep)	Rare	Extraarticular, ill defined, enhances
	Recurrent intraarticular bleeding	Uncommon	Sub-chondral cysts,
Bleeding diatheses, <i>e.g.</i> haemophilia	Very rare	Serpiginous vessels, signal voids, low/intermediate SI components enhance	
Homogeneous low SI on T_1W & very high SI on T_2W	Ganglion cyst	Common	Well defined, uni/multilocular, peripheral enhancement
	Synovial cyst	Common	Well defined, rounded, peripheral enhancement
Low/intermediate SI on T_1W & high SI on T_2W	Active rheumatoid arthritis	Common	Erosions, loss of cartilage, enhances
	Infective arthritis		
	Tuberculous arthritis	Uncommon ^b	Similar to rheumatoid, enhances
	Pyogenic arthritis	Uncommon	Bony destruction, enhances
	Unmineralized nodules of SOC	Uncommon	Usually multiple nodules, enhances
	Synovial sarcoma	Uncommon	Juxtaarticular, enhances
	Metastasis: local spread	Uncommon	Contiguous bony lesion, enhances
	Metastasis: haematogenous	Very rare	Enhances
Synovial chondrosarcoma	Very rare	Mineralization due to pre-existing SOC or malignant cartilage, enhances	

For the relative MR signal intensities of tissues and pathological lesions, skeletal muscle is graded as intermediate SI and cortical bone as very low SI on both T_1W and T_2W SE images. Fat is graded as very high SI on T_1W and water very high SI on T_2W SE images.

^a Common in patients on chronic peritoneal dialysis.

^b Common in endemic regions.

SOC, Synovial osteochondromatosis.



Proposed management of Hoffa's fat pad (HFP) tumours. PVNS pigmented villonodular synovitis