

Embolization for Knee Arthritis or Geniculate Artery Embolization

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Case

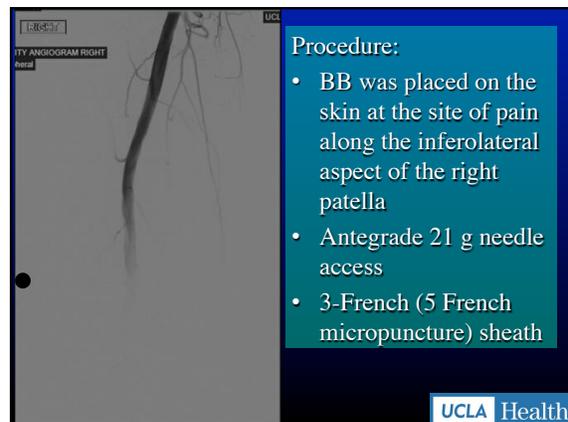
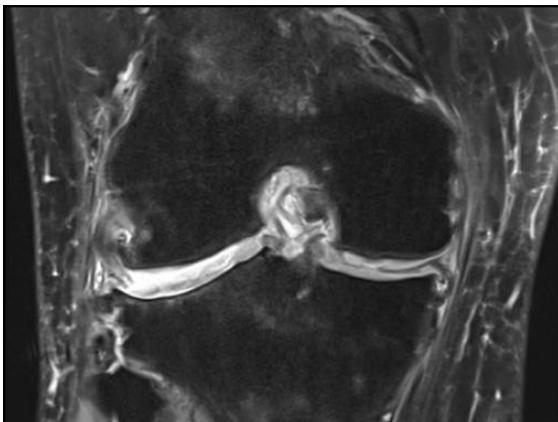
- 60 y.o. male bilateral L3-S1 decompression surgery and chronic right knee pain for over 15 years
 - 5 out of 10
 - worse in the medial portion
 - cannot walk more than 1.5 miles
- Steroid joint injection in past - mild improvement
- Wants to avoid knee replacement

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Case

- **KOOS (raw score)**
 - Symptoms (7 questions): 18
 - Pain (9 questions): 20
 - Function, daily living (17 questions): 35
 - Function, sports and rec (5 questions): 14
 - Quality of life (4 questions): 12
- PMH, SH, Social H: noncontributory
- Physical Exam unremarkable

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-1.7 French Echelon-10
(45 degree tip)
microcatheter and a 0.014
inch fathom wire
-right inferior lateral
genicular arteriogram

- Ice pack was applied to the skin, this is to prevent embolization of skin branches
- 100 um Embozene particles diluted 1:1 contrast:saline ratio

1.5 cc injected. Post-angio

Post-treatment

- Bed rest for 4 hours, in almost all patients only device antegrade in CFA is outer portion of Micropuncture set
- This accommodates the Echelon 10 (45 degree) microcatheter
- Discharge home
- Will follow up in IR clinic in 3 months

Objectives

- Okuno et al
- Relevant Anatomy
- Symptom-related assessment
- Role of imaging

Cardiovasc Intervent Radiol (2015) 38:336–343
DOI 10.1007/s00270-014-0944-8

CLINICAL INVESTIGATION ARTERIAL INTERVENTIONS

Transcatheter Arterial Embolization as a Treatment for Medial Knee Pain in Patients with Mild to Moderate Osteoarthritis

Yuji Okuno · Amine Mohamed Korchi ·
Takuma Shinjo · Shojiro Kato

- 11 pts Cimipenem/cilastatin sodium
- 3 pts 75 um calibrated Embozene microspheres
- Western Ontario and McMaster University Osteoarthritis Index (WOMAC) scores
- Uses Pain, Stiffness, and Physical function, bending, rising from sitting, putting on socks, etc
- Takes approximately 12 minutes to complete, can be taken on paper, on computer, over the phone
- Total scales range from 0-20 for pain, 0-8 for stiffness, and 0-68 for function, combine all 3 get total, range 0-96

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- Results
 - Improved WOMAC pain scores:
 - 12.2 ± 1.9 pre-procedure
 - 3.3 ± 2.1 at 1 month after the procedure
 - 1.7 ± 2.2 at 4 mos
 - WOMAC total scores
 - 47.3 ± 5.8 pre-procedure
 - 11.6 ± 5.4 at 1 month
 - 6.3 ± 6.0 at 4 mos
 - Mean final follow-up: 12 ± 5 months (range 4–19 months).

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Table 1 Baseline characteristics of 14 patients

Characteristics	Value
Age (y), mean ± SD (range)	65.2 ± 8.3 (49–76)
Male gender	6
Right-sided embolization	5
Left-sided embolization	9
Pain duration (mo), mean ± SD (range)	22.1 ± 22.8 (3–77)
Kellgren–Lawrence grade	
0–1	8
2	6
BMI (kg/m ²), mean ± SD	26.3 ± 6.3
VAS score (mm), mean ± SD	70 ± 5
Previous treatment	
Hyaluronic acid injection	12
NSAID	6
Physical therapy	10
Tenderness	
Over anteromedial aspect	11
Over medial joint space	9
Over anterior	5
MRI findings	
Synovial thickening or joint effusion	12
Meniscus tear	4
Abnormal intensity in infrapatellar fat pad	7

BMI body mass index, VAS visual analog scale, NSAID nonsteroidal anti-inflammatory drug, MRI magnetic resonance imaging

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BMI body mass index, VAS visual analog scale, NSAID nonsteroidal anti-inflammatory drug, MRI magnetic resonance imaging

Excluded 34 because they were candidates for knee replacement > grade 3 (moderate) arthritic changes

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Transcatheter Arterial Embolization as a Treatment for Medial Knee Pain in Patients with Mild to Moderate Osteoarthritis

Yuji Okuno · Amine Mohamed Korchi · Takuma Shinjo · Shojiro Kato

- Technique
 - 3 Fr introducer sheath via Ipsi antegrade access
 - 3000 Units IV heparin
 - 3 Fr MPA
 - Looked at descending genicular artery, superior and inferior lateral genicular arteries, superior and inferior medial genicular arteries, and median genicular artery in all patients
 - 2.4F microcatheter (Meister Cass; Medikit Co. Ltd., Tokyo, Japan)
 - Embolic agent was infused until blood flow stagnated.
 - Hemostasis: manual compression for 10 min and bed rest for 2 h after the femoral sheath removal.

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Transcatheter Arterial Embolization as a Treatment for Medial Knee Pain in Patients with Mild to Moderate Osteoarthritis

Yuji Okuno · Amine Mohamed Korchi · Takuma Shinjo · Shojiro Kato

- Embo choice
 - IPM/CS embolic agent
 - selected due to previous report of embolization of refractory painful tendinopathy and enthesopathy and intestinal bleeding
 - 10 to 70 um particles
 - 75 um Embozene microspheres:
 - 0.15 mL of that solution diluted with 2 mL of contrast
 - injected in 0.2 mL increments until blood flow stagnated

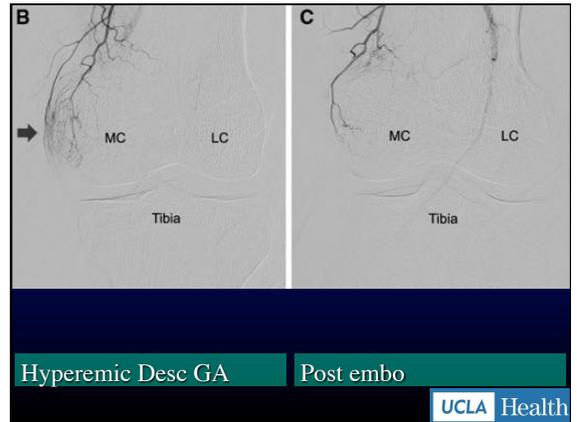
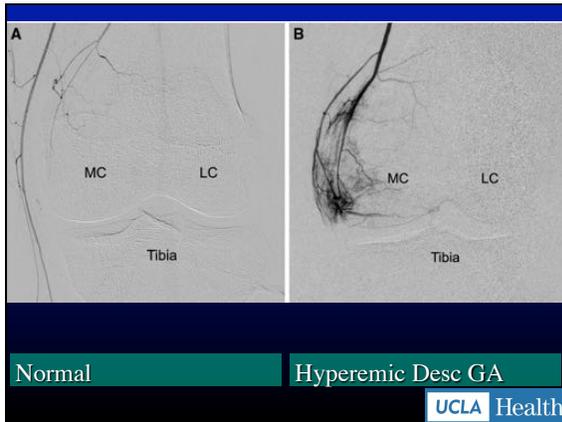
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Transcatheter Arterial Embolization as a Treatment for Medial Knee Pain in Patients with Mild to Moderate Osteoarthritis

Yuji Okuno · Amine Mohamed Korchi · Takuma Shinjo · Shojiro Kato

- Angio findings
- Abnormal neovessels were clearly depicted in all patients, originating from several arteries:
 - descending genicular artery (n = 13)
 - inferior medial genicular artery (n = 8)
 - inferior lateral genicular artery (n = 7)
 - superior lateral genicular artery (n = 2)
 - median genicular artery (n = 2)
 - superior medial genicular artery (n = 1)

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Table 3 Changes in clinical features and WOMAC scores throughout the study

Characteristics	Baseline	1 Month	4 Months	12 Months
IPMCS group (n = 11 [5])				
Pain during walking	8 [4]	2 [2]	1 [1]	1 [1]
Pain using stairs	11 [5]	4 [2]	1 [1]	2 [1]
Pain WOMAC, mean ± SD	12.1 ± 1.8	3.5 ± 2.4	1.8 ± 2.5	1.9 ± 2.7
Total WOMAC, mean ± SD	48.5 ± 9.4	12.5 ± 7.6	7.5 ± 6.4	6.0 ± 8.3
Patients receiving NSAIDs	8	3	1	1
Patients receiving HA inj	5	0	0	1
Embozene group (n = 3 [1])				
Pain during walking	3 [1]	0	0	
Pain using stairs	3 [1]	1 [1]	0	
Pain WOMAC, mean ± SD	12.6 ± 2.5	2.7 ± 1.2	1.3 ± 1.1	
Total WOMAC, mean ± SD	43.3 ± 6.8	9.0 ± 4.6	6.0 ± 5.3	
Patients receiving NSAIDs	2	1	0	
Patients receiving HA injection	1	0	0	

Numbers in square brackets indicate number of patients with Kellgren-Lawrence grade 2 radiographic change
 WOMAC: Western Ontario and McMaster University Osteoarthritis Index, IPMCS: ipempfen/cilastatin sodium, NSAID: nonsteroidal anti-inflammatory drug, HA inj: intra-articular hyaluronic acid injection

- Transcatheter Arterial Embolization as a Treatment for Medial Knee Pain in Patients with Mild to Moderate Osteoarthritis**
 Yuji Okuno · Amine Mohamed Korchi · Takuma Shinjo · Shojiro Kato
- Interesting study findings
 - Best results: Mild or minimal degenerative changes and severe symptoms
 - Periarticular soft tissues (synovium, fat pad, periosteum, and joint capsule) are the likely source of knee joint pain based on prior MR studies
 - Two distinct time points when pain and symptoms improved:
 - Soon after embolization: few minutes after infusion
 - several weeks or months after embolization
 - Hard to demonstrate which particle is more effective as a result of the small patient cohort.

- ## At UCLA
- Clinic visit
 - H&P
 - Prior knee-related treatments
 - Physical exam
 - KOOS score, similar to WOMAC, however, more specific for knee issues, range 0-100, lower score indicates worse problem
 - Imaging
 - X-ray
 - KL score (Kellgren-Lawrence Osteoarthritis score)
 - MRI knee
 - » Occasional CTA LE if suspect extensive PAD

Clinical Assessment

Knee Injury and Osteoarthritis Outcome Score (KOOS)

- Questionnaire designed to assess short and long-term patient-relevant outcomes following knee injury
- Self-administered and assesses five outcomes:
 - Pain
 - Symptoms
 - activities of daily living
 - sport and recreation function
 - knee-related quality of life

Roos EM, Roos HP, Lohmander LS, Ekdahl C, Beynon BD. Knee Injury and Osteoarthritis Outcome Score (KOOS)—development of a self-administered outcome measure. *J Orthop Sports Phys Ther.* 1998 Aug;28(2):88-96.

Pain						
P1	How often is your knee painful?	<input type="checkbox"/> Never	<input type="checkbox"/> Monthly	<input type="checkbox"/> Weekly	<input type="checkbox"/> Daily	<input type="checkbox"/> Always
What degree of pain have you experienced the last week when...?						
P2	Twisting/pivoting on your knee	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
P3	Straightening knee fully	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
P4	Bending knee fully	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
P5	Walking on flat surface	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
P6	Going up or down stairs	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
P7	At night while in bed	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
P8	Sitting or lying	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
P9	Standing upright	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme

Symptoms						
Sy1	How severe is your knee stiffness after first wakening in the morning?	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
Sy2	How severe is your knee stiffness after sitting, lying, or resting later in the day?	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
Sy3	Do you have swelling in your knee?	<input type="checkbox"/> Never	<input type="checkbox"/> Rarely	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Often	<input type="checkbox"/> Always
Sy4	Do you feel grinding, hear clicking or any other type of noise when your knee moves?	<input type="checkbox"/> Never	<input type="checkbox"/> Rarely	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Often	<input type="checkbox"/> Always
Sy5	Does your knee catch or hang up when moving?	<input type="checkbox"/> Never	<input type="checkbox"/> Rarely	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Often	<input type="checkbox"/> Always
Sy6	Can you straighten your knee fully?	<input type="checkbox"/> Always	<input type="checkbox"/> Often	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Rarely	<input type="checkbox"/> Never
Sy7	Can you bend your knee fully?	<input type="checkbox"/> Always	<input type="checkbox"/> Often	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Rarely	<input type="checkbox"/> Never

Activities of daily living						
What difficulty have you experienced the last week...?						
A1	Descending stairs	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
A2	Ascending stairs	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
A3	Rising from sitting	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
A4	Standing	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
A5	Bending to floor/picking up an object	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
A6	Walking on flat surface	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
A7	Getting in/out of car	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
A8	Going shopping	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
A9	Putting on socks/stockings	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
A10	Rising from bed	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
A11	Taking off socks/stockings	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
A12	Lying in bed (turning over, maintaining knee position)	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
A13	Getting in/out of bath	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
A14	Sitting	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
A15	Getting on/off toilet	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
A16	Heavy domestic duties (shovelling, scrubbing floors, etc)	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
A17	Light domestic duties (cooking, dusting, etc)	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme

Sport and recreation function						
What difficulty have you experienced the last week...?						
Sp1	Squatting	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
Sp2	Running	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
Sp3	Jumping	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
Sp4	Turning/twisting on your injured knee	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
Sp5	Kneeling	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme

Knee-related quality of life						
Q1	How often are you aware of your knee problems?	<input type="checkbox"/> Never	<input type="checkbox"/> Monthly	<input type="checkbox"/> Weekly	<input type="checkbox"/> Daily	<input type="checkbox"/> Always
Q2	Have you modified your lifestyle to avoid potentially damaging activities to your knee?	<input type="checkbox"/> Not at all	<input type="checkbox"/> Mildly	<input type="checkbox"/> Moderately	<input type="checkbox"/> Severely	<input type="checkbox"/> Totally
Q3	How troubled are you with lack of confidence in your knee?	<input type="checkbox"/> Not at all	<input type="checkbox"/> Mildly	<input type="checkbox"/> Moderately	<input type="checkbox"/> Severely	<input type="checkbox"/> Totally
Q4	In general, how much difficulty do you have with your knee?	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme

WOMAC

- Western Ontario and McMaster Universities Osteoarthritis Index
- The test questions are scored on a scale of 0-4:
 - None (0)
 - Mild (1)
 - Moderate (2)
 - Severe (3)
 - Extreme (4)
- Score range of 0-20 for Pain, 0-8 for Stiffness, and 0-68 for Physical Function.
- A sum of the scores for all three subscales gives a total WOMAC score
 - Higher scores indicate worse pain, stiffness, and functional limitations.



WOMAC

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Symptoms - These questions should be answered thinking of your knee symptoms during the **last week**.

S1. Do you have swelling in your knee?
 Never Rarely

S2. Do you feel grinding, hear clicking or any other type of noise when your knee moves?
 Never Rarely

S3. Does your knee catch or hang up when moving?
 Never Rarely

S4. Can you straighten your knee fully?
 Never Rarely

S5. Can you bend your knee fully?
 Never Rarely

Stiffness - The following questions concern the amount of joint stiffness you have experienced during the **last week**.

S6. How severe is your knee joint stiffness after first wakening in the morning?
 None Mild

S7. How severe is your knee stiffness after sitting, lying or resting **later in the day**?
 None Mild

WOMAC UCLA Health

Pain

P1. How often do you experience knee pain?
 Never Monthly Weekly

What amount of knee pain have you experienced the **last week** during the following activities?

P2. Twisting/turning on your knee
 None Mild Moderate

P3. Straightening knee fully
 None Mild Moderate

P4. Bending knee fully
 None Mild Moderate

P5. Walking on flat surface
 None Mild Moderate

P6. Going up or down stairs
 None Mild Moderate

P7. At night while in bed
 None Mild Moderate

P8. Sitting or lying
 None Mild Moderate

P9. Standing upright
 None Mild Moderate

WOMAC UCLA Health

Function, daily living - The following questions concern your physical function. By this we mean your ability to move around and to look after yourself. For each of the following activities please indicate the degree of difficulty you have experienced in the **last week** due to your knee.

A1. Descending stairs
 None Mild Moderate Severe

A2. Ascending stairs
 None Mild Moderate Severe

A3. Rising from sitting
 None Mild Moderate Severe

A4. Standing
 None Mild Moderate Severe

A5. Bending to floor/pick up an object
 None Mild Moderate Severe

A6. Walking on flat surface
 None Mild Moderate Severe

A7. Getting in/out of car
 None Mild Moderate Severe

A8. Going shopping
 None Mild Moderate Severe

A9. Putting on socks/stockings
 None Mild Moderate Severe

A10. Rising from bed
 None Mild Moderate Severe

WOMAC UCLA Health

A10. Rising from bed
 None Mild Moderate

A11. Taking off socks/stockings
 None Mild Moderate

A12. Lying in bed (turning over, maintaining knee position)
 None Mild Moderate

A13. Getting in/out of bath
 None Mild Moderate

A14. Sitting
 None Mild Moderate

A15. Getting on/off toilet
 None Mild Moderate

For each of the following activities please indicate the degree of difficulty you have experienced in the **last week** due to your knee

A16. Heavy domestic duties (moving heavy boxes, scrubbing floors, etc)
 Never Rarely Sometimes

A17. Light domestic duties (cooking, dusting, etc)
 Never Rarely Sometimes

WOMAC UCLA Health

WOMAC

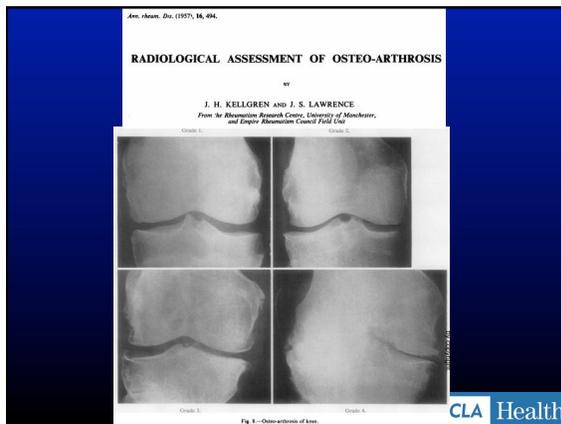
- ACR: The test-retest reliability of the WOMAC varies for the different subscales.
 - Pain subscale has not been consistent across studies, but it generally meets the minimum standard.
 - Physical function subscale is more consistent and has a stronger test-retest reliability.
 - Stiffness subscale has shown low test-retest reliability

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Radiographic assessment

Kellgren and Lawrence

- System for classification of osteoarthritis
- Proposed 1957, accepted by WHO in 1961
- 5 grades
- For knee: must use AP
 - **grade 0 (none)**: definite absence of x-ray changes of osteoarthritis
 - **grade 1 (doubtful)**: doubtful joint space narrowing and possible osteophytic lipping
 - **grade 2 (minimal)**: definite osteophytes and possible joint space narrowing
 - **grade 3 (moderate)**: moderate multiple osteophytes, definite narrowing of joint space and some sclerosis and possible deformity of bone ends
 - **grade 4 (severe)**: large osteophytes, marked narrowing of joint space, severe sclerosis and definite deformity of bone ends



Am. Rheum. Dis. (1957), 16, 494.

RADIOLOGICAL ASSESSMENT OF OSTEO-ARTHRITIS

J. H. KELLGREN AND J. S. LAWRENCE

From the Rheumatism Research Centre, University of Manchester, and Empire Rheumatism Council Field Unit

TABLE III
CORRELATION OF FOUR OBSERVER DIAGNOSIS OF OSTEO-ARTHRITIS (GRADES 2-4)

Observer	D.I.P.s.		M. Ps.		C. M. Cs.		Wrists		Cervical Spine		Dorso-Lumbar Spine		Hips		Knees		All Joints											
	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2		Mean										
A	B1	55	54	0.73	27	14	0.66	36	19	0.78	4	5	0.10	36	12	0.57	20	14	0.52	13	3	0.40	47	32	0.83	288	153	221
B1	B1	54	57	0.77	14	15	0.73	19	25	0.77	5	3	0.82	12	9	0.66	14	16	0.42	3	4	0.75	32	40	0.83	153	169	161
A	B	55	48	0.85	27	17	0.75	36	30	0.88	4	1	0.74	36	20	0.67	20	20	0.47	13	6	0.66	47	37	0.87	288	179	234
B1	A+B	54	48	0.81	14	17	0.64	19	30	0.80	5	1	0.18	12	20	0.57	14	20	0.42	3	6	0.47	32	37	0.86	153	179	166

510 Xrays from 85 persons graded by two independent observers.

Am. Rheum. Dis. (1957), 16, 494.

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	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2		Mean										
A	B1	55	54	0.73	27	14	0.66	36	19	0.78	4	5	0.10	36	12	0.57	20	14	0.52	13	3	0.40	47	32	0.83	288	153	221
B1	B1	54	57	0.77	14	15	0.73	19	25	0.77	5	3	0.82	12	9	0.66	14	16	0.42	3	4	0.75	32	40	0.83	153	169	161
A	B	55	48	0.85	27	17	0.75	36	30	0.88	4	1	0.74	36	20	0.67	20	20	0.47	13	6	0.66	47	37	0.87	288	179	234
B1	A+B	54	48	0.81	14	17	0.64	19	30	0.80	5	1	0.18	12	20	0.57	14	20	0.42	3	6	0.47	32	37	0.86	153	179	166

510 Xrays from 85 persons graded by two independent observers.

Significant correlation for knees (and all else except wrist)

Kellgren and Lawrence

- Felton et al 1987
- 424 elderly patients (ages 63-94 years old, mean = 73 years)
- interrater intraclass correlation coefficient of 0.85 ("very good")
- Limitation: mostly white, few minority knees

Kellgren and Lawrence

Scott et al 1993

50 standing AP knee radiographs

25 men and five women (ages 42-84 years old, mean age of men = 67 years, mean age of women = 71 years)

2 skeletal radiologists and 2 rheumatologists

interreader intraclass correlation coefficient of 0.68 ("good")

intra-reader intraclass correlation coefficient of 0.87 ("very good")

No data on demographics

Kellgren and Lawrence

Groves et al 2008

93 radiographs selected from 1759 radiographs from five databases of trials or cohort studies

two trained rheumatologists

interreader intraclass correlation coefficient of 0.72 (95% CI, 0.38-0.86) ("good")

intra-reader intraclass correlation coefficient of 0.72 (95% CI, 0.55-0.83) ("good")

No data on demographics

Kellgren and Lawrence

Wright 2014

Assessed KL + 5 other radiographic classification schemes

632 patients enrolled in the Multicenter ACL Revision Study (MARS) consortium

*consisted of cohorts of patients from 83 surgeons from 52 sites

three independent and blinded observers (specific qualifications and training not explicitly stated by authors)

weighting AP and/or Rosenberg radiographs (depending on availability)

Other OA Grading Scales

Grading scales for the radiographic osteoarthritis classification systems [44]

Scale	Grade and characteristics
Kellgren-Lawrence [126, 127]	0: No JSN or reactive changes 1: Doubtful JSN, possible osteophyte lipping 2: Definite osteophytes, possible JSN 3: Moderate osteophytes, definite JSN, some sclerosis, possible bone-end deformity 4: Large osteophytes, marked JSN, severe sclerosis, definite bone-end deformity
IKDC [16, 17]	A: No JSN* B: > 4-mm joint space; small osteophytes, slight sclerosis, or femoral condyle flattening C: 2- to 4-mm joint space D: < 2-mm joint space
Fairbank [3, 22]	0: Normal 1: Squaring of tibial margin 2: Flattening of femoral condyle; squaring and sclerosis of tibial margin 3: JSN, hypertrophic changes, or both 4: > 75% JSN with secondary feature
Brandt et al. [4]	0: < 25% JSN without secondary features (subchondral sclerosis, pitting, and osteophytes) 1: < 25% JSN with secondary features of 25%-50% JSN without secondary features 2: 25%-50% JSN with secondary features or 50%-75% JSN without secondary features 3: 50%-75% JSN with secondary features or > 75% JSN without secondary features 4: > 75% JSN with secondary features
Ahlbäck [11]	0: Normal 1: JSN [†] (with or without subchondral sclerosis) 2: Obliteration of joint space 3: Bone defect less < 5 mm 4: Bone defect and/or loss > 5 mm
Jäger-Wirth [26, 127]	0: No arthrosis 1: Initial arthrosis, small osteophytes, minimal JSN 2: Moderate arthrosis, approximately 50% JSN 3: Medium-grade arthrosis 4: Heavy arthrosis

Wright RW. Osteoarthritis classification scales: interobserver reliability and arthroscopic correlation. *J Bone Joint Surg Am.* 2014;96:1145-1151. * JSN = joint space narrowing; IKDC = International Knee Documentation Committee; † joint space narrowing is < 3 mm of the joint space or < 50% of the other compartment.

Kellgren and Lawrence

Wright 2014

632 patients enrolled in the Multicenter ACL Revision Study (MARS) consortium

*consisted of cohorts of patients from 83 surgeons from 52 sites

KL system was the most studied among the different classification systems

an interobserver reliability intraclass correlation coefficient of 0.51 (in 0.89 considered "excellent" to "very good")

Wright et al

Interobserver Reliability of the Various Radiographic Classification Systems for Osteoarthritis: Correlation with Arthroscopic Findings¹

Osteoarthritis Classification System	Radiograph	Intraclass Correlation Coefficient	
		Estimate	95% Confidence Interval
Kellgren-Lawrence	AP	0.38	0.33-0.43
	R	0.54	0.48-0.59
IKDC	AP	0.59	0.55-0.63
	R	0.66	0.62-0.71
Fairbank	AP	0.36	0.31-0.41
	R	0.44	0.38-0.50
Brandt et al.	AP	0.47	0.42-0.52
	R	0.57	0.51-0.61
Ahlbäck	AP	0.43	0.38-0.48
	R	0.67	0.62-0.71
Jäger-Wirth	AP	0.53	0.49-0.58
	R	0.51	0.46-0.57
Unilateral radiographs	AP (n = 164)	0.55	0.51-0.58
	R (n = 100)	0.54	0.49-0.58
Bilateral radiographs	AP (n = 478)	0.55	0.52-0.57
	R (n = 315)	0.65	0.63-0.67
Total radiographs	AP (n = 592)	0.55	0.53-0.56
	R (n = 415)	0.63	0.61-0.65

Wright et al

Interobserver Reliability of the Various Radiographic Classification Systems for Osteoarthritis: Correlation with Arthroscopic Findings²

Osteoarthritis Classification System	Radiograph	Intraclass Correlation Coefficient		
		Estimate	95% Confidence Interval	
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	R	0.51	0.46	0.57
Unilateral radiographs	AP (n = 164)	0.55	0.51	0.58
	R (n = 100)	0.54	0.49	0.58
Bilateral radiographs	AP (n = 428)	0.55	0.52	0.57
	R (n = 315)	0.65	0.63	0.67
Total radiographs	AP (n = 592)	0.55	0.53	0.56
	R (n = 415)	0.63	0.61	0.65

Wright et al

Interobserver Reliability of the Various Radiographic Classification Systems for Osteoarthritis: Correlation with Arthroscopic Findings²

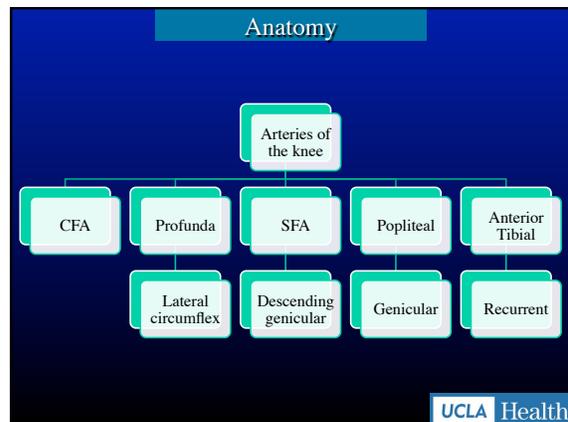
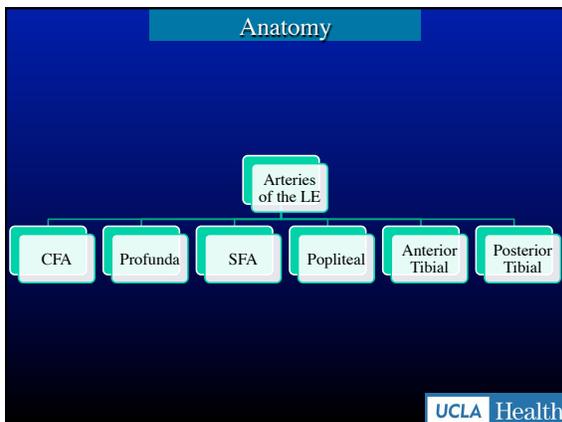
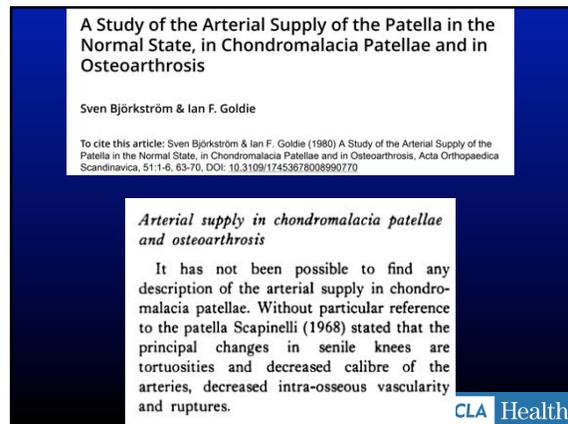
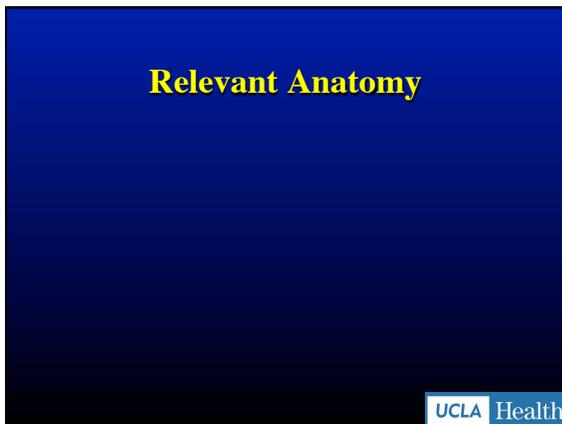
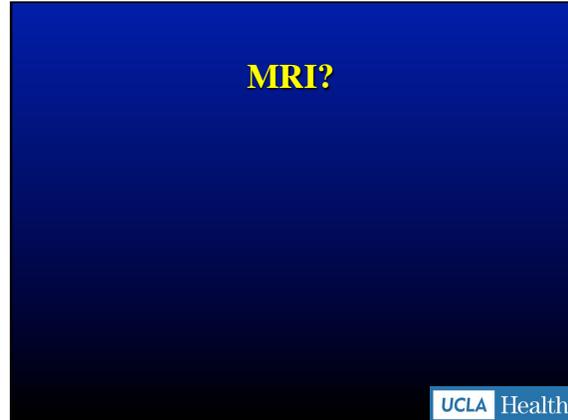
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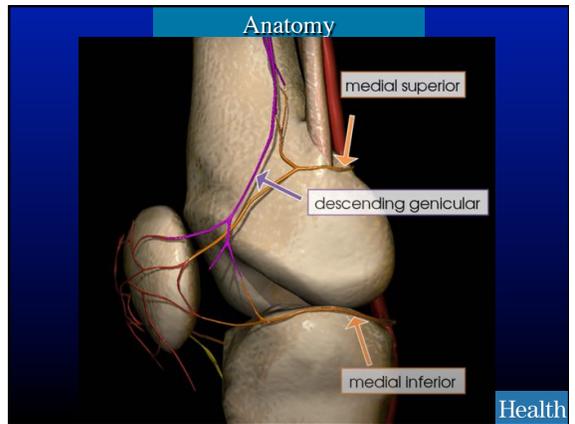
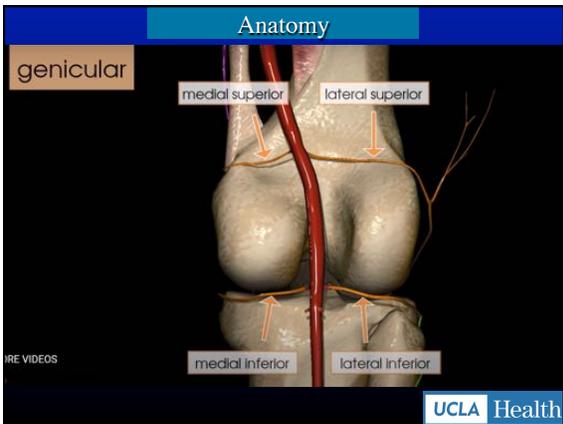
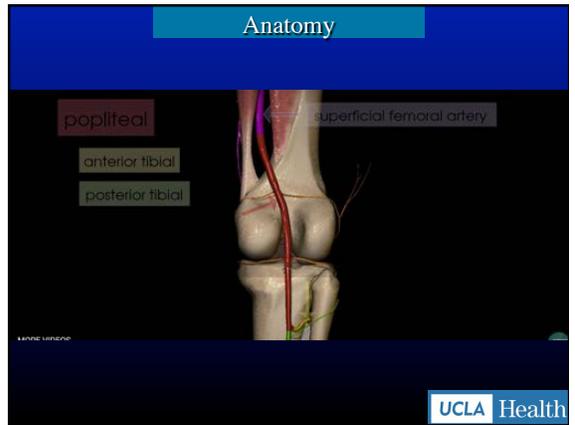
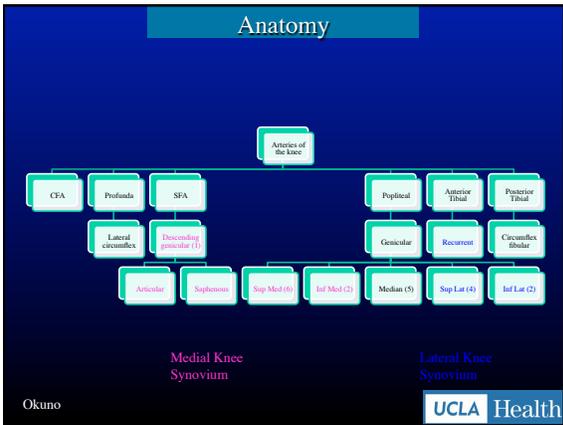
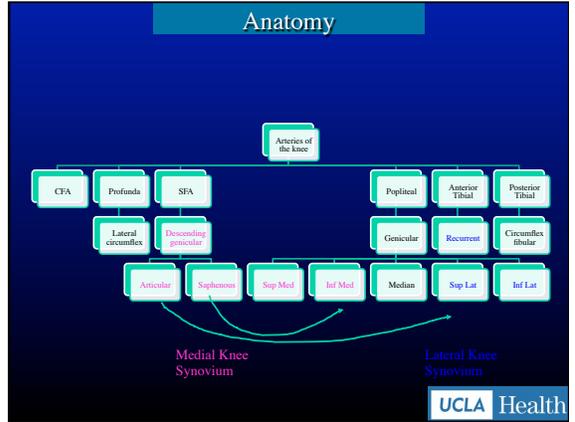
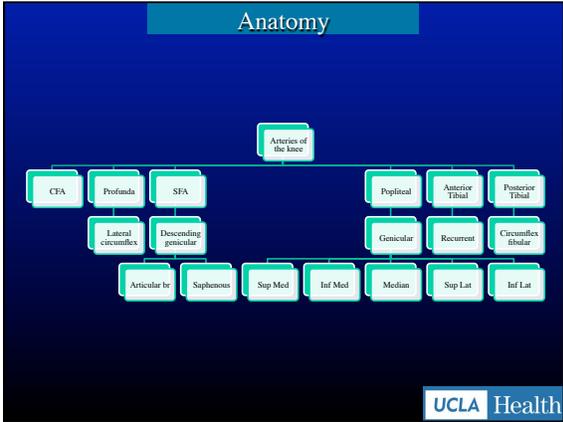


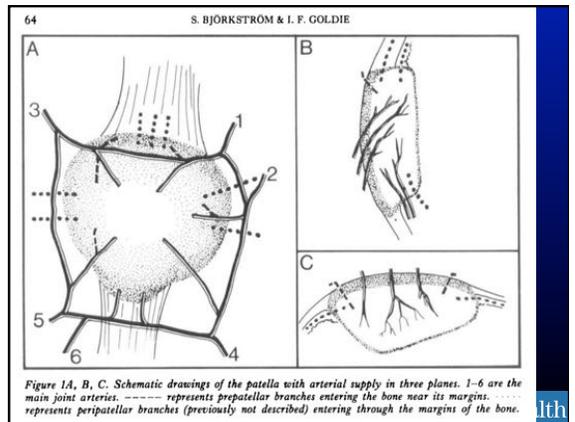
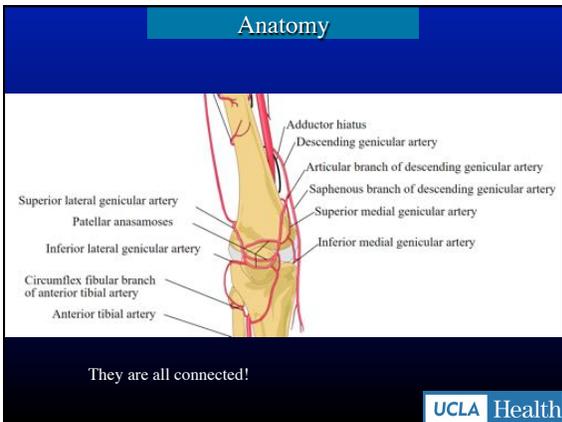
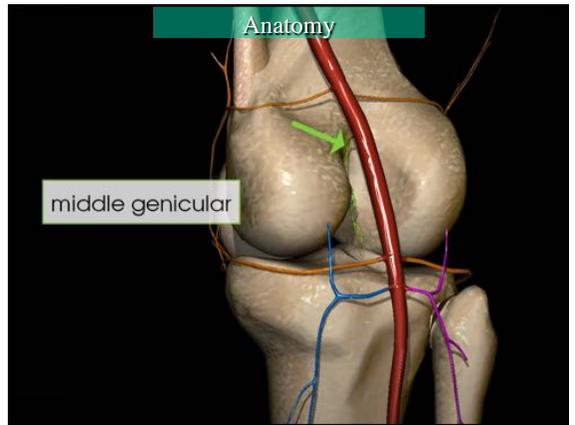
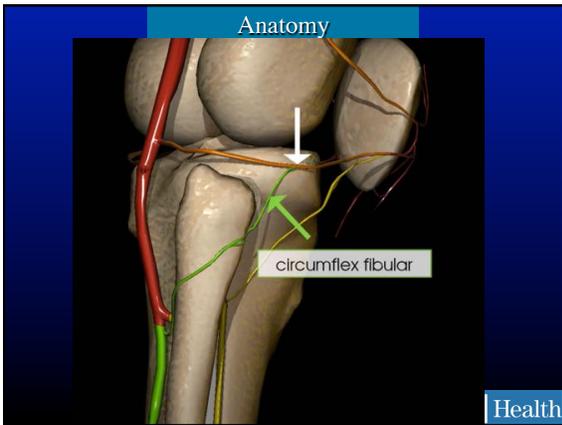
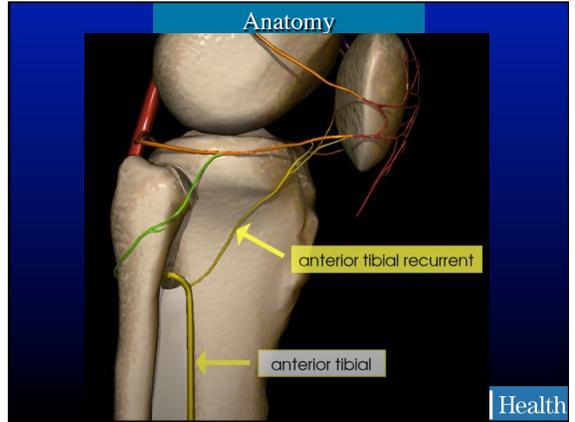
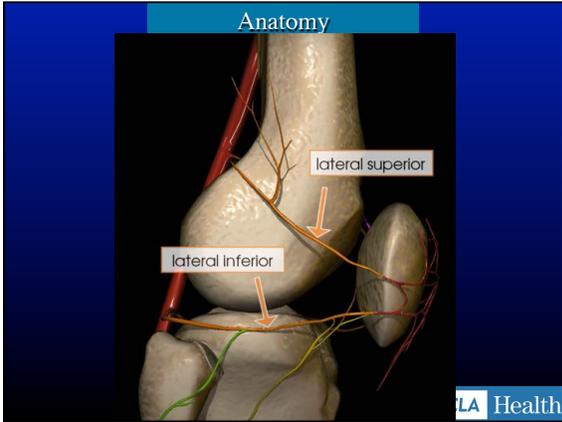
- PA
- central ray angled 10-20 degrees caudad at the level of the knee joint
- typically 1.5 cm distal to the apex of the patella

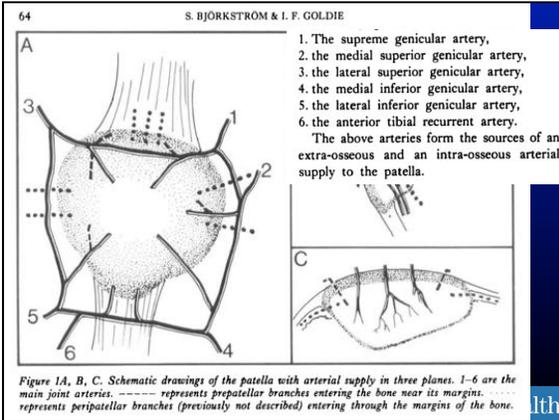
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- typically 1.5 cm distal to the apex of the patella









Summary

- Pain is subjective and not well understood
- Vascularity of knee synovium, fat pad, periosteum, and joint capsule may play a role in knee pain
- Clinical / Radiologic assessment
- Anatomy