

Stifle Joint Injury

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Stifle Joint Injury

Cranial Cruciate Ligament Injury

- **isolated injury**

adult complete, partial stable, partial unstable

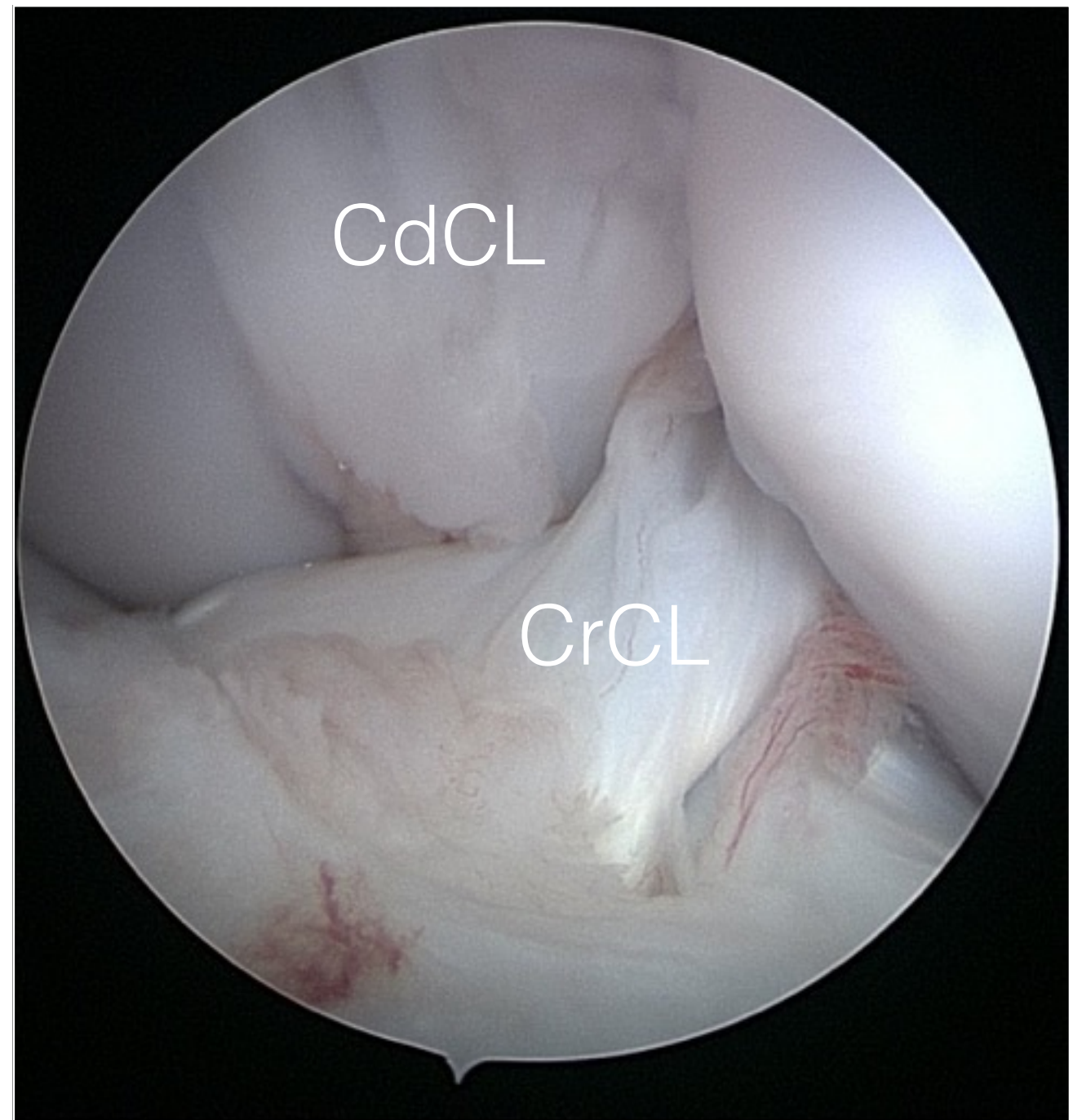
juvenile complete, avulsion

Multiple Ligament Injury

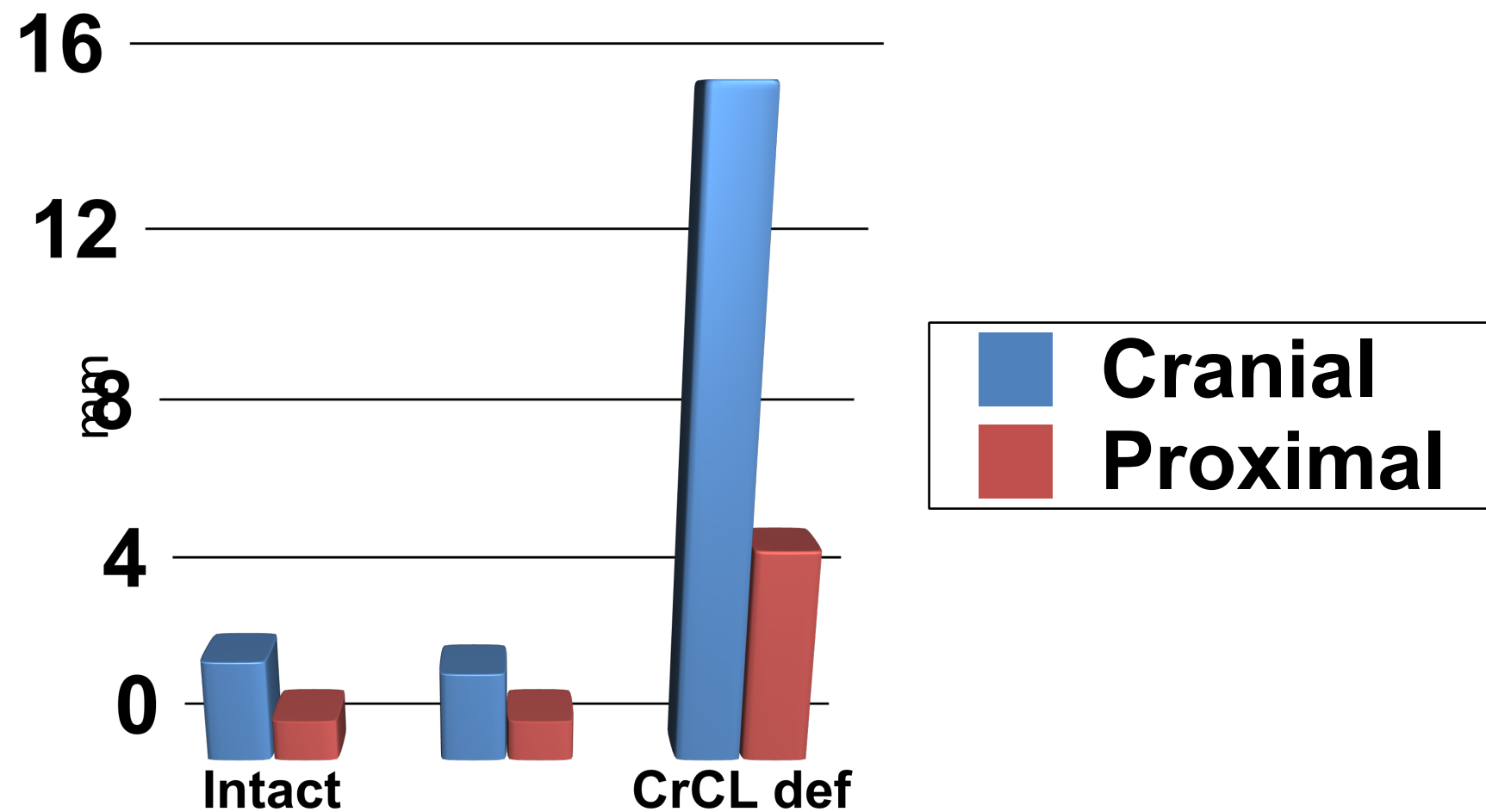
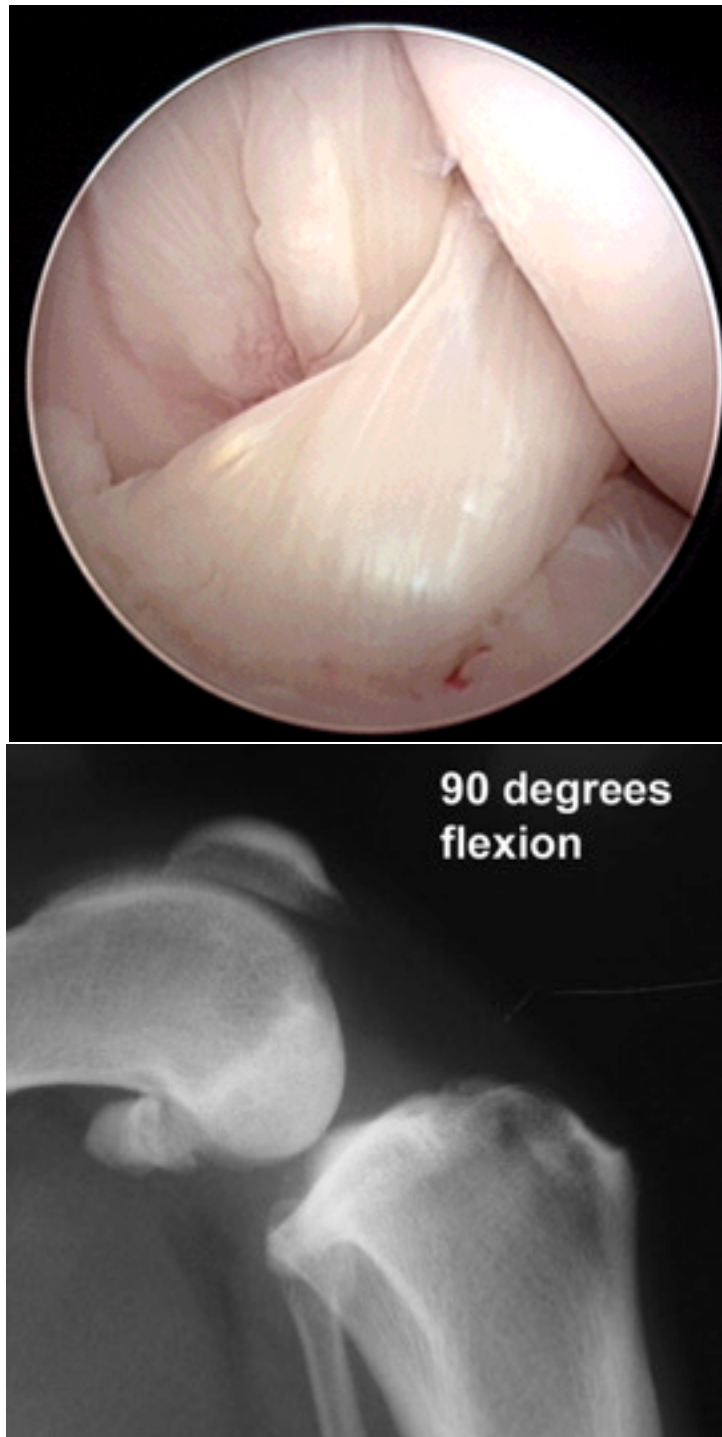
CrCL, CaCL, MCL, LCL

Cruciate Ligaments

- **Intra-articular but extra-synovial**
- **Core contains**
 - **Mechanoreceptors**
 - **Proprioceptors**
- **Innervation**
 - **Axons penetrate from synovial layer**



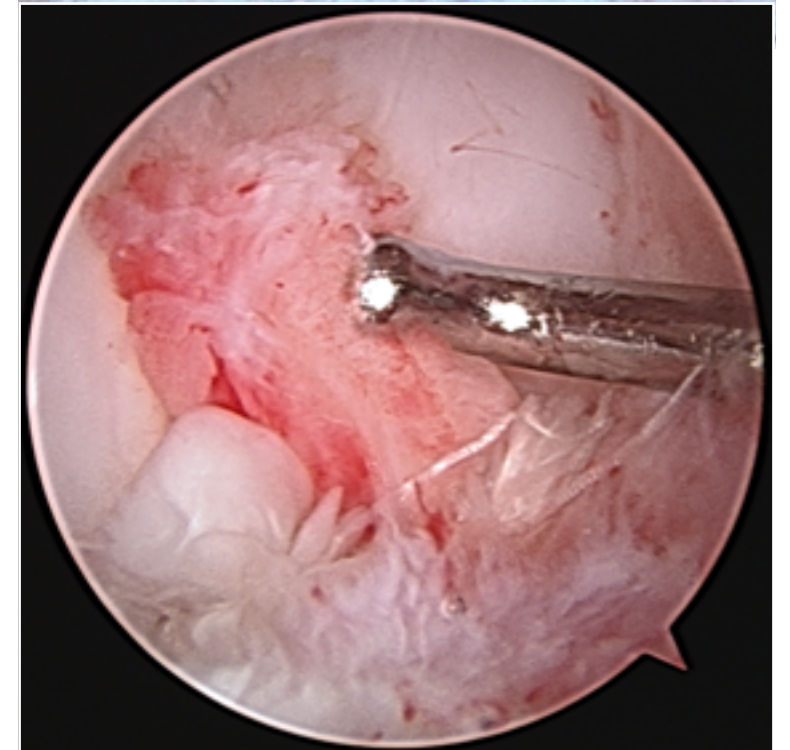
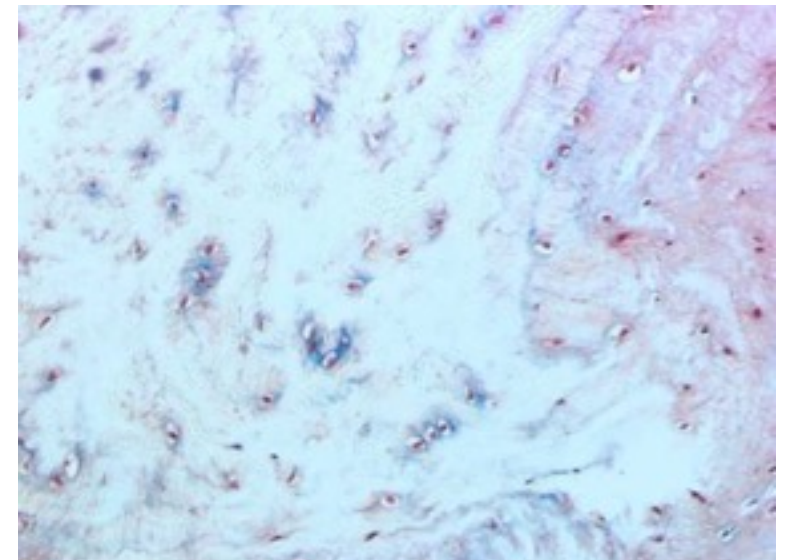
CrCL Function



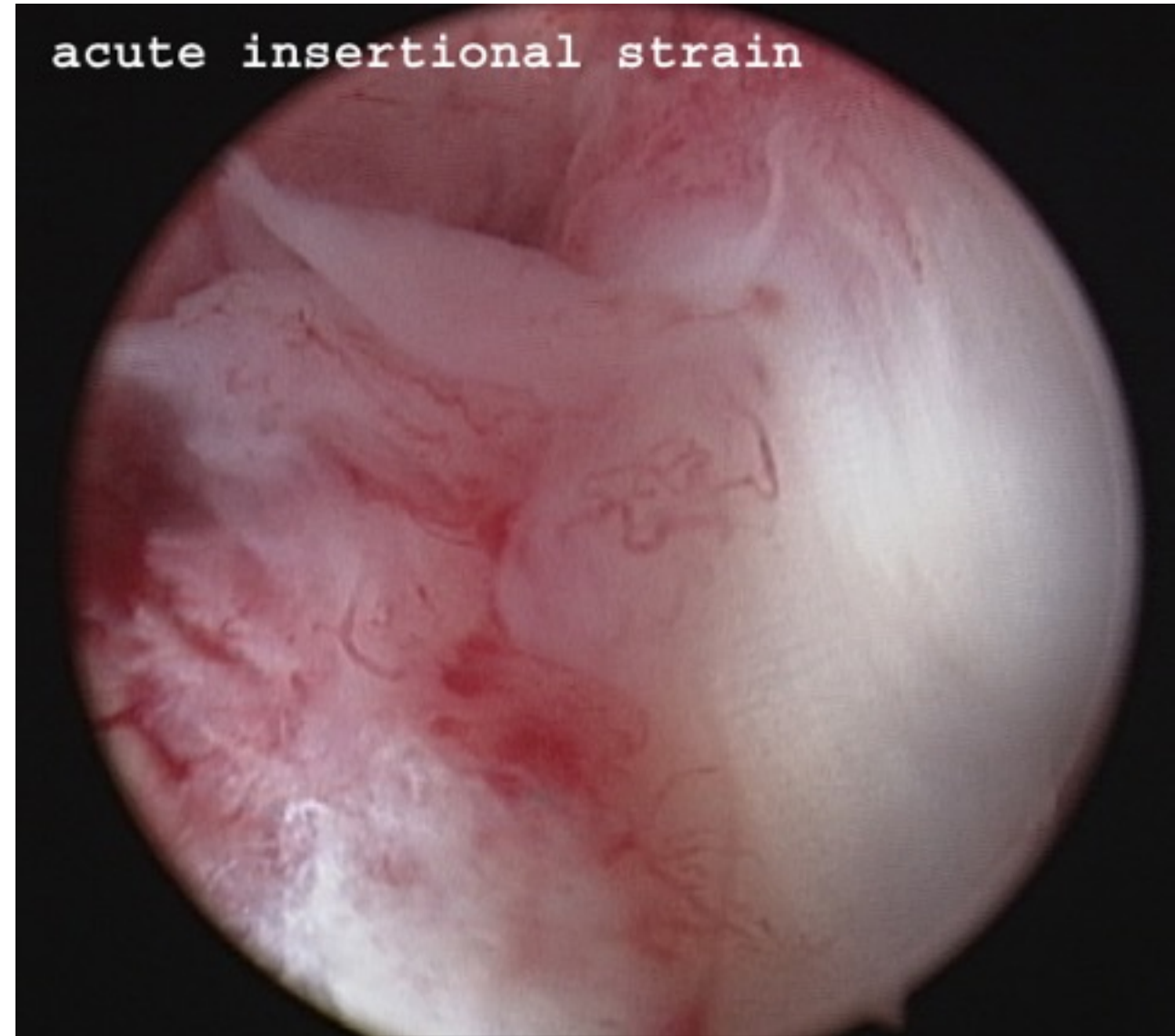
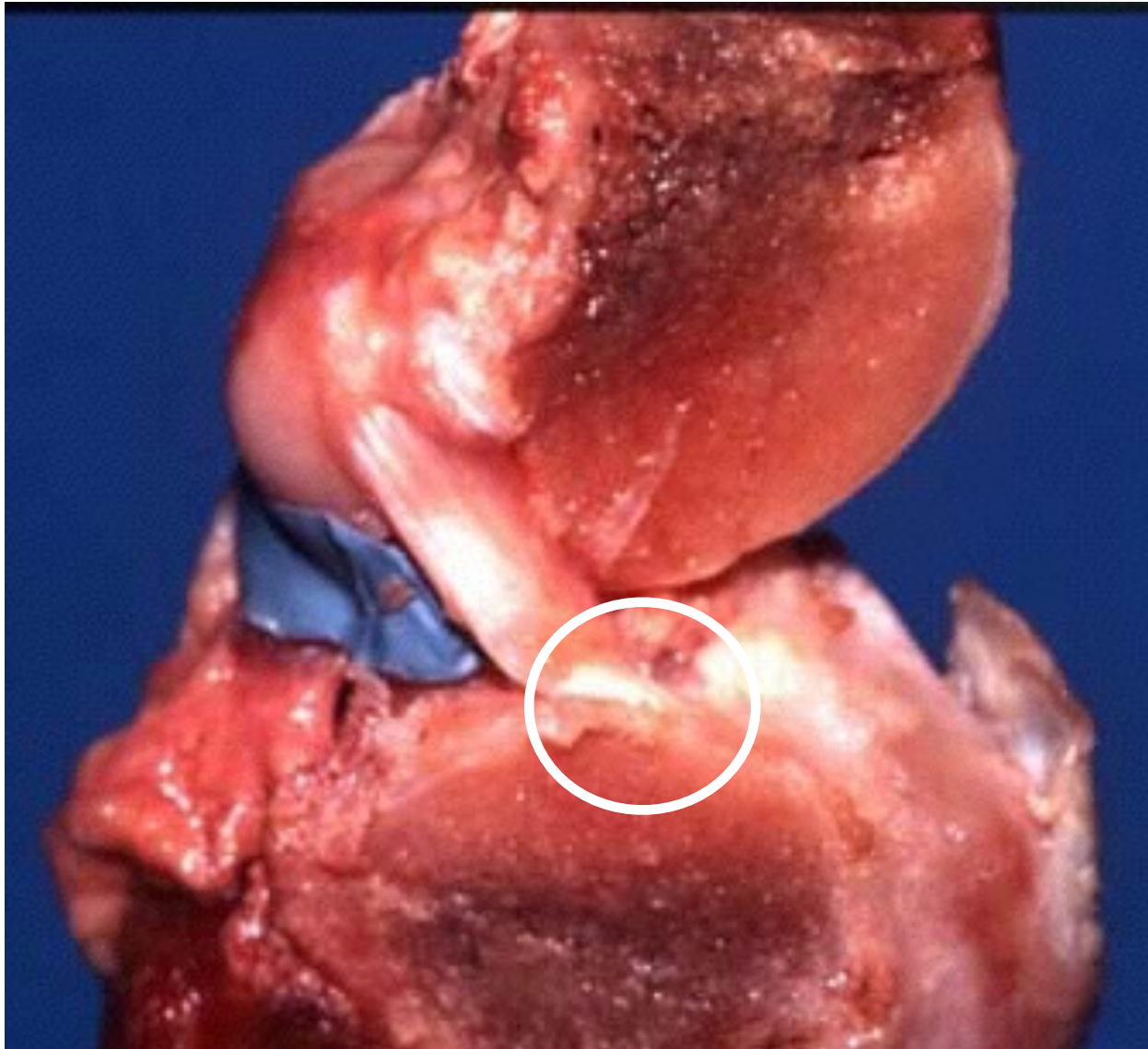
CrCL Resists Proximal and Cranial Tibial Thrust

Etiopathogenesis of Degenerative CrCL Injury

- Comerford- fiber size and distribution
- Innes- metabolic changes
- Muir- extracellular matrix changes
- Vasseur- structural changes
- Pozzi- biomechanics
- Hayashi- cellular changes
- Wilke- genetics
- And many others



Repeated overuse injury



Excessive Tibial Plateau Angle

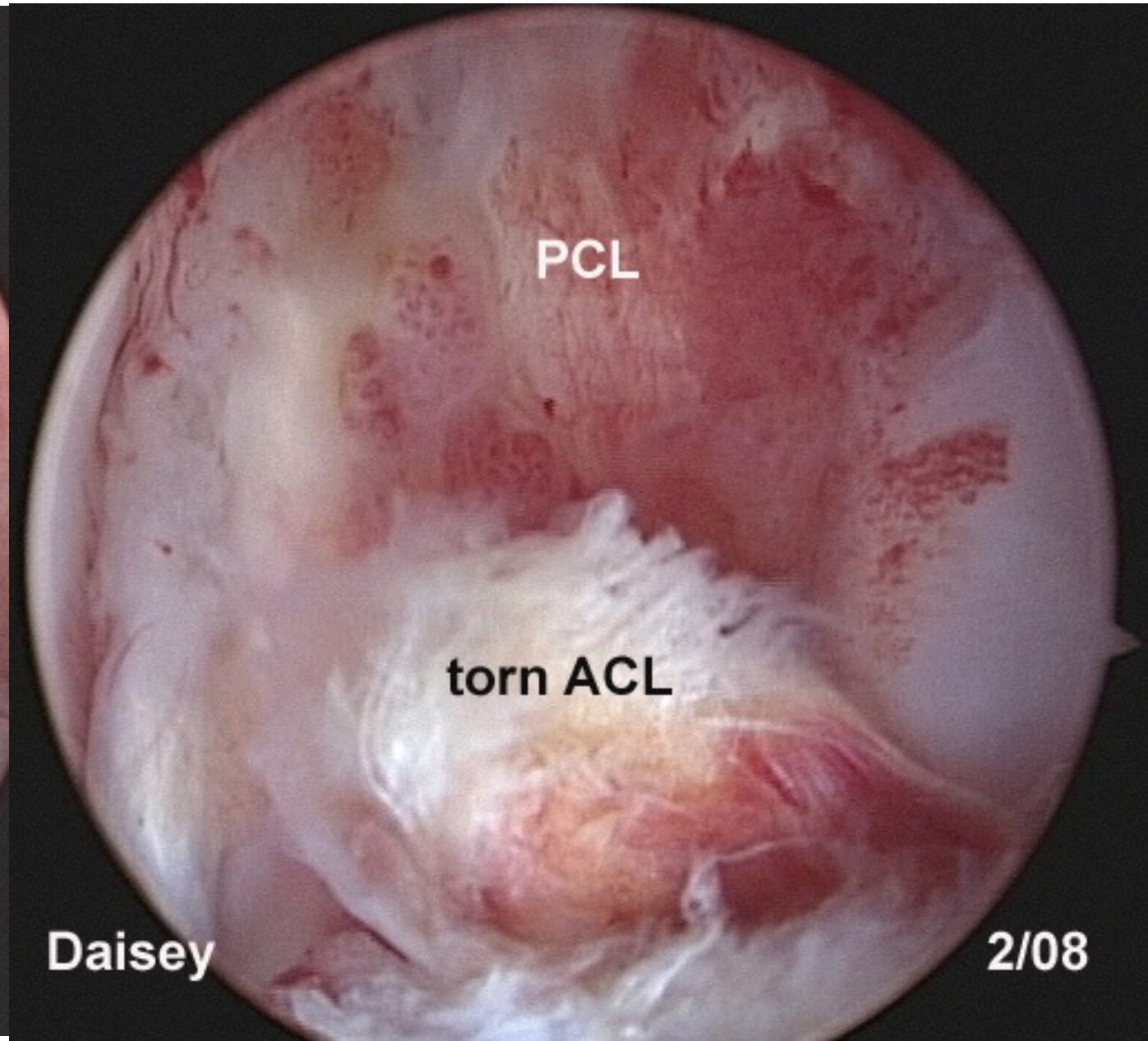
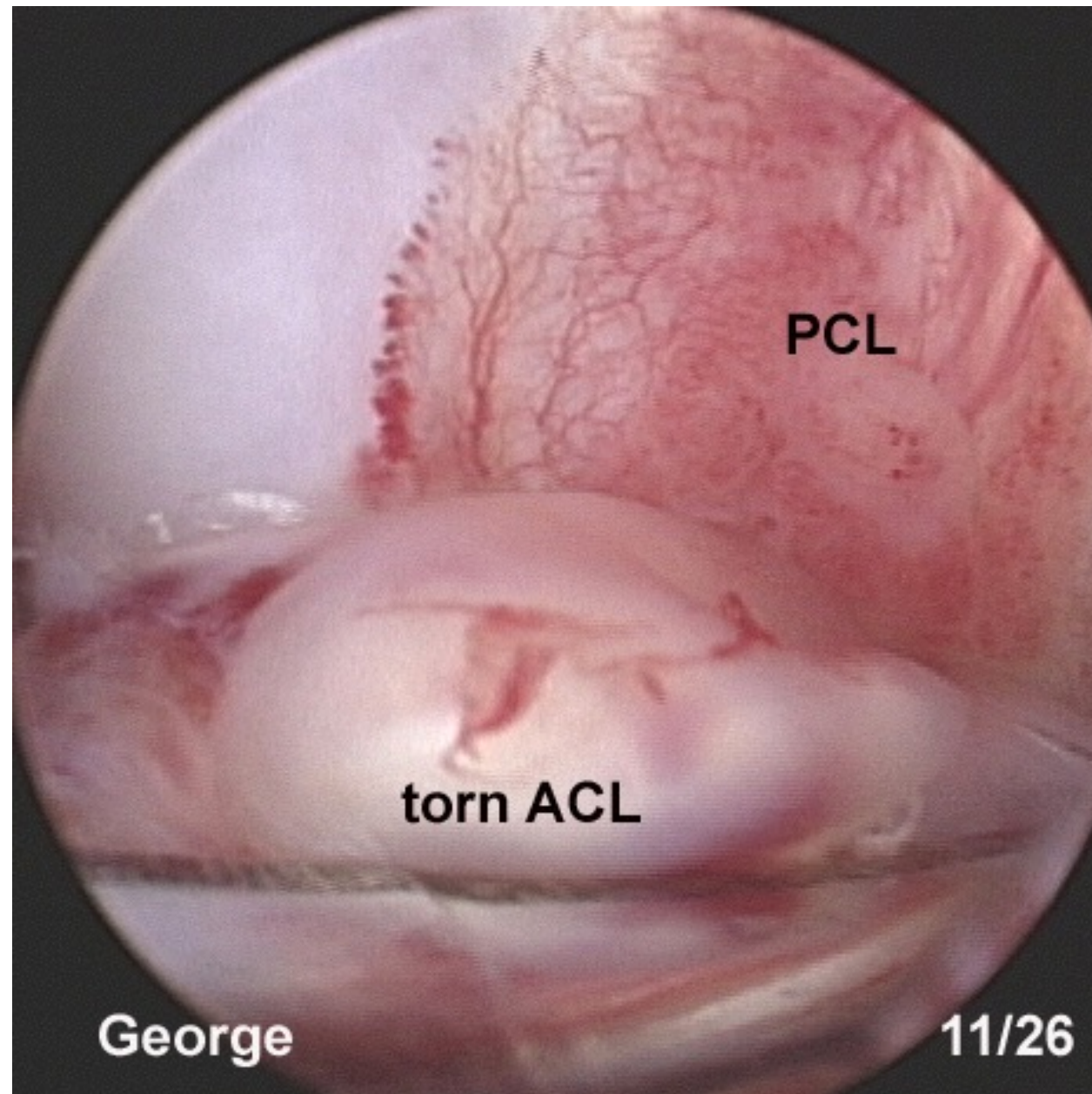


Breeds At Risk

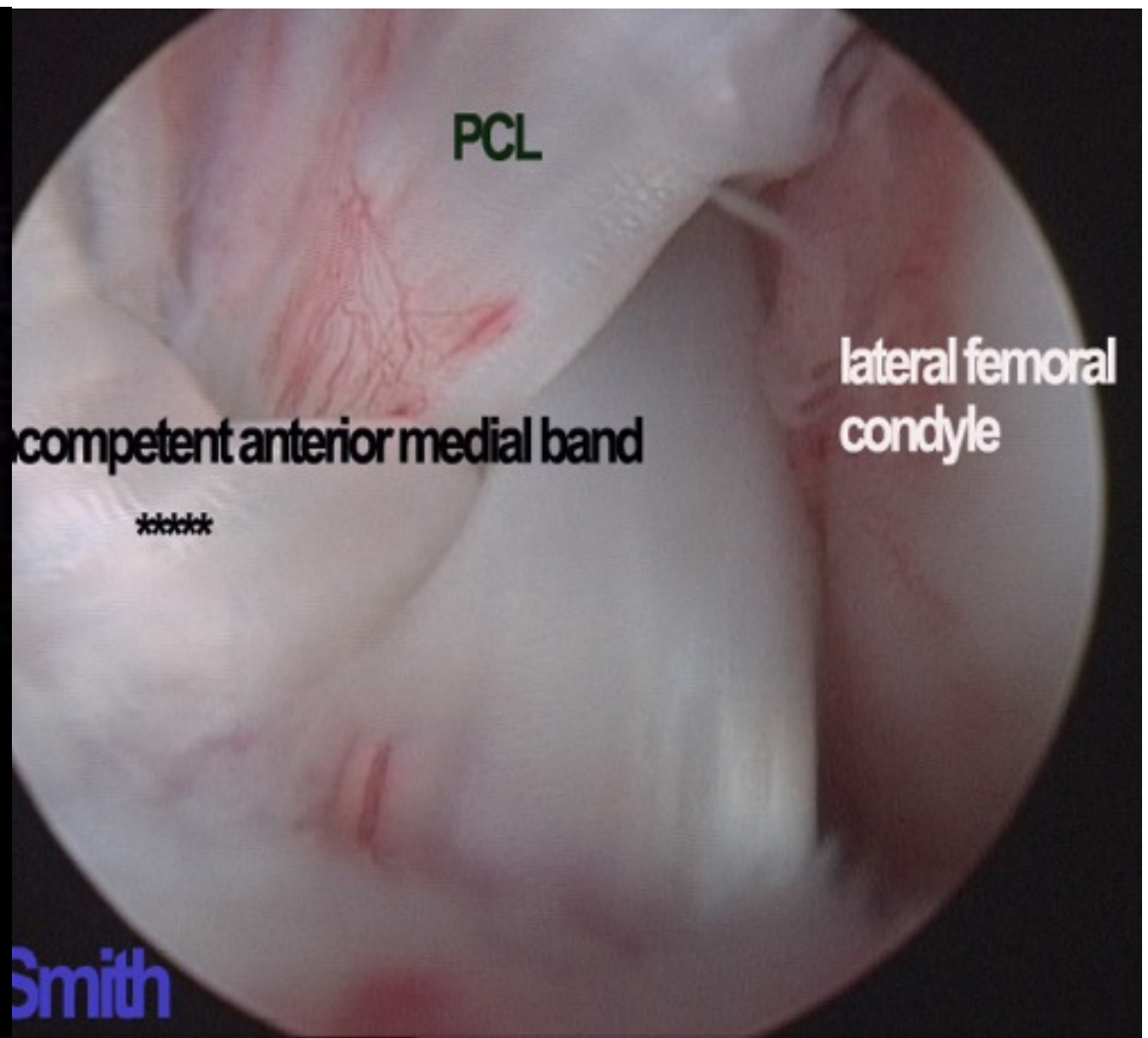
- **Newfoundlands**
- **Rottweilers**
- **Labs**
- **Mastiff**
- **Breeds at low risk**
 - **Dachshund**
 - **Greyhound**
- **Small dogs tear later**



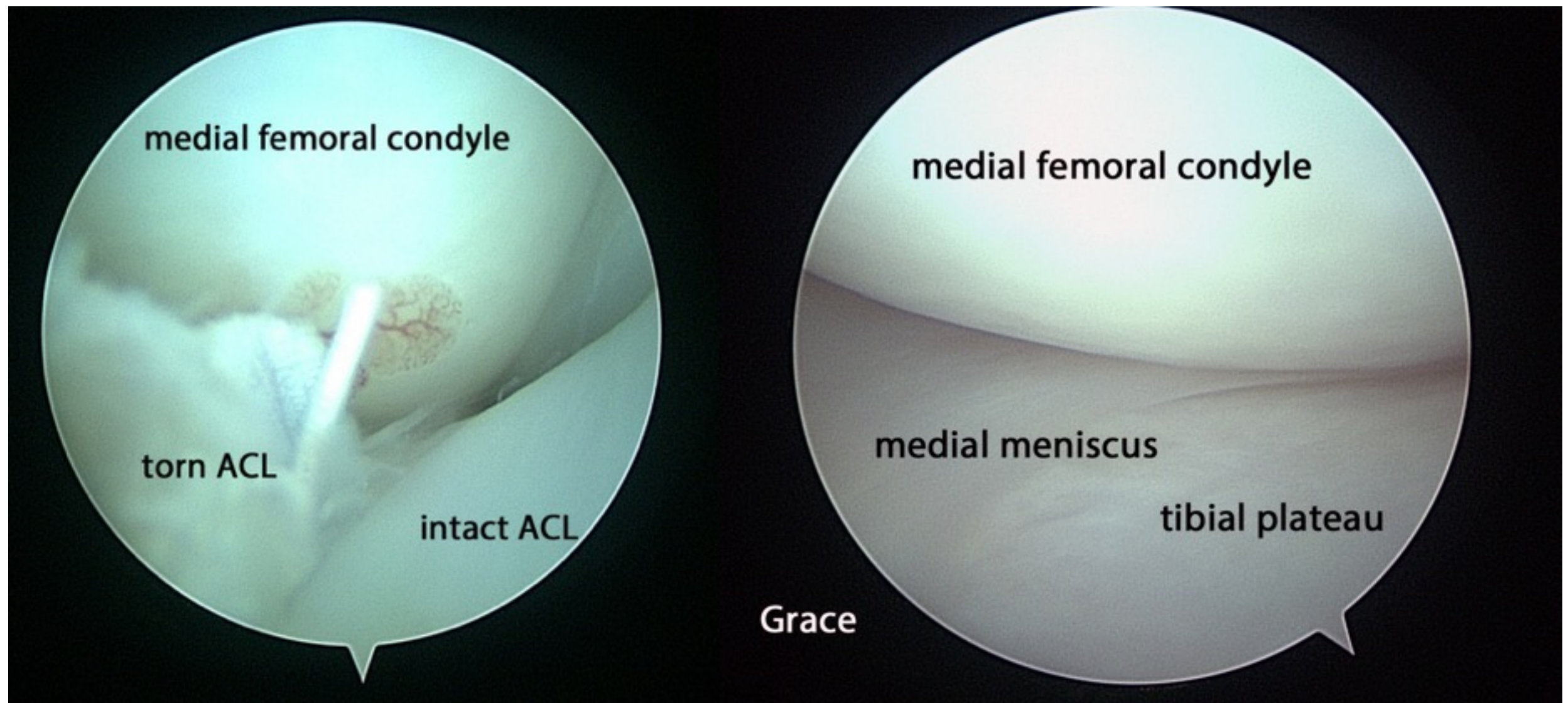
Lesions of the Knee.... CrCL, complete tear



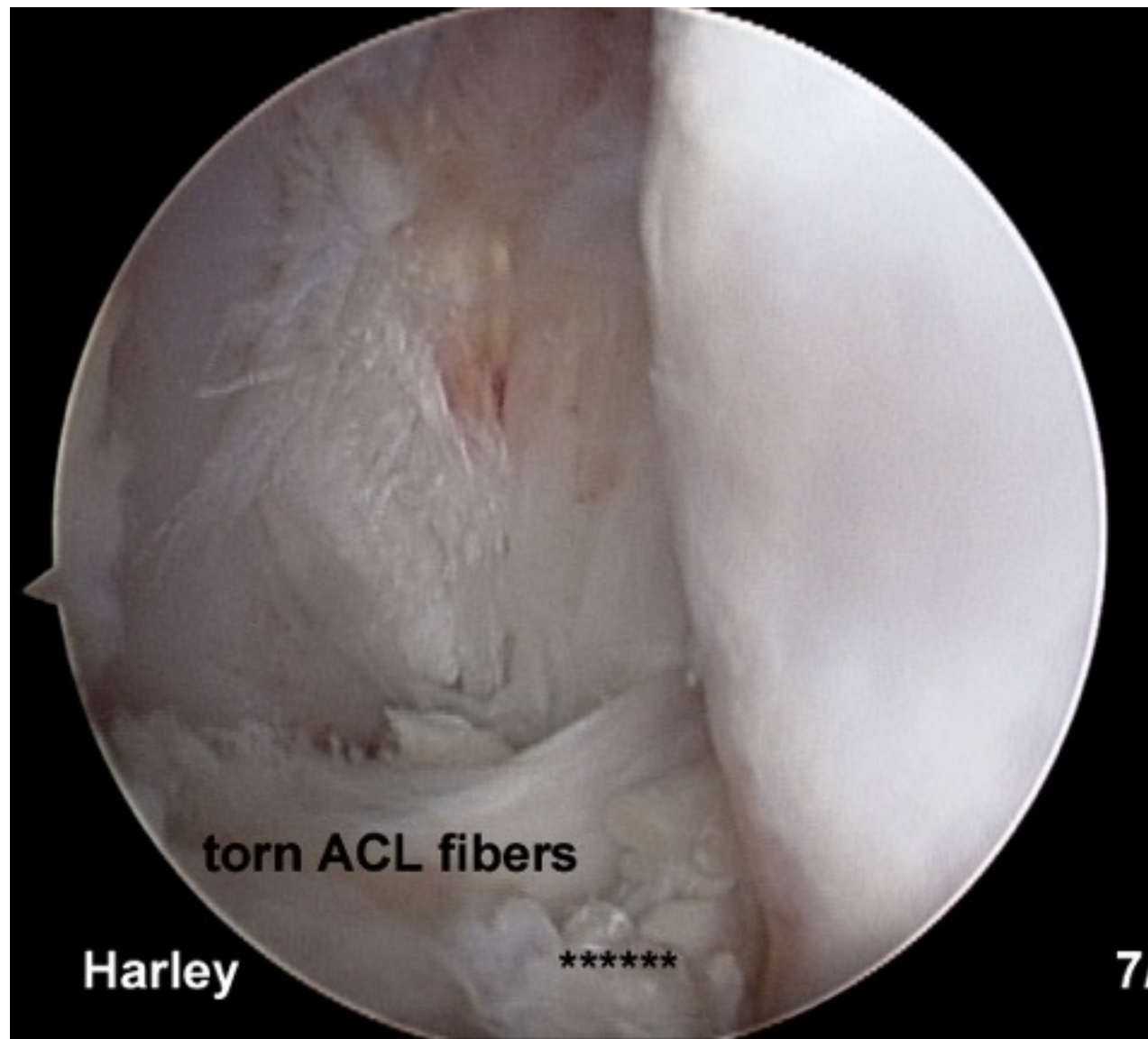
Lesions of the Knee CrCL.... partial stable



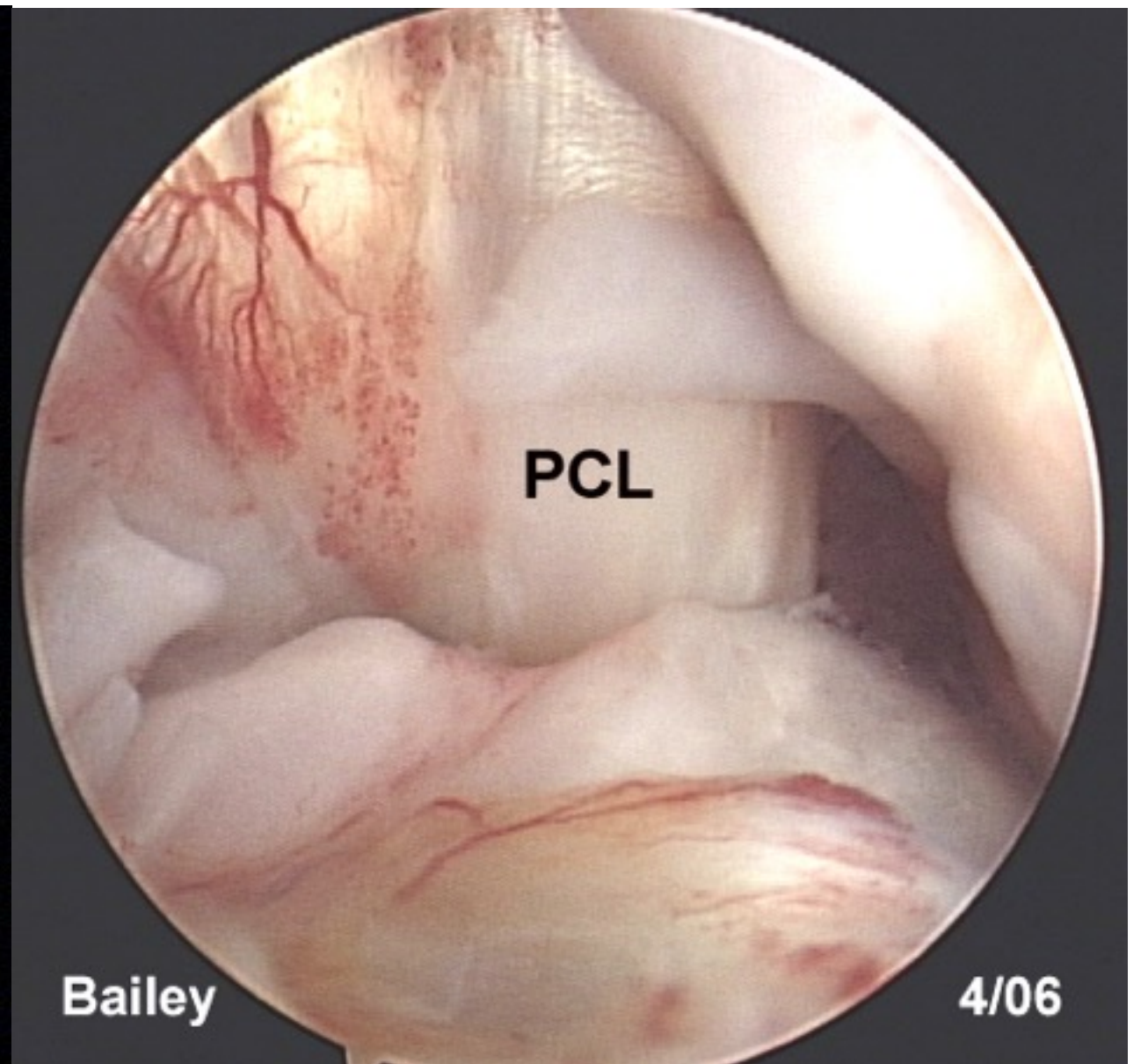
- 2 yr, Fe/S, Corgi
- Insertional tear anteromedial band



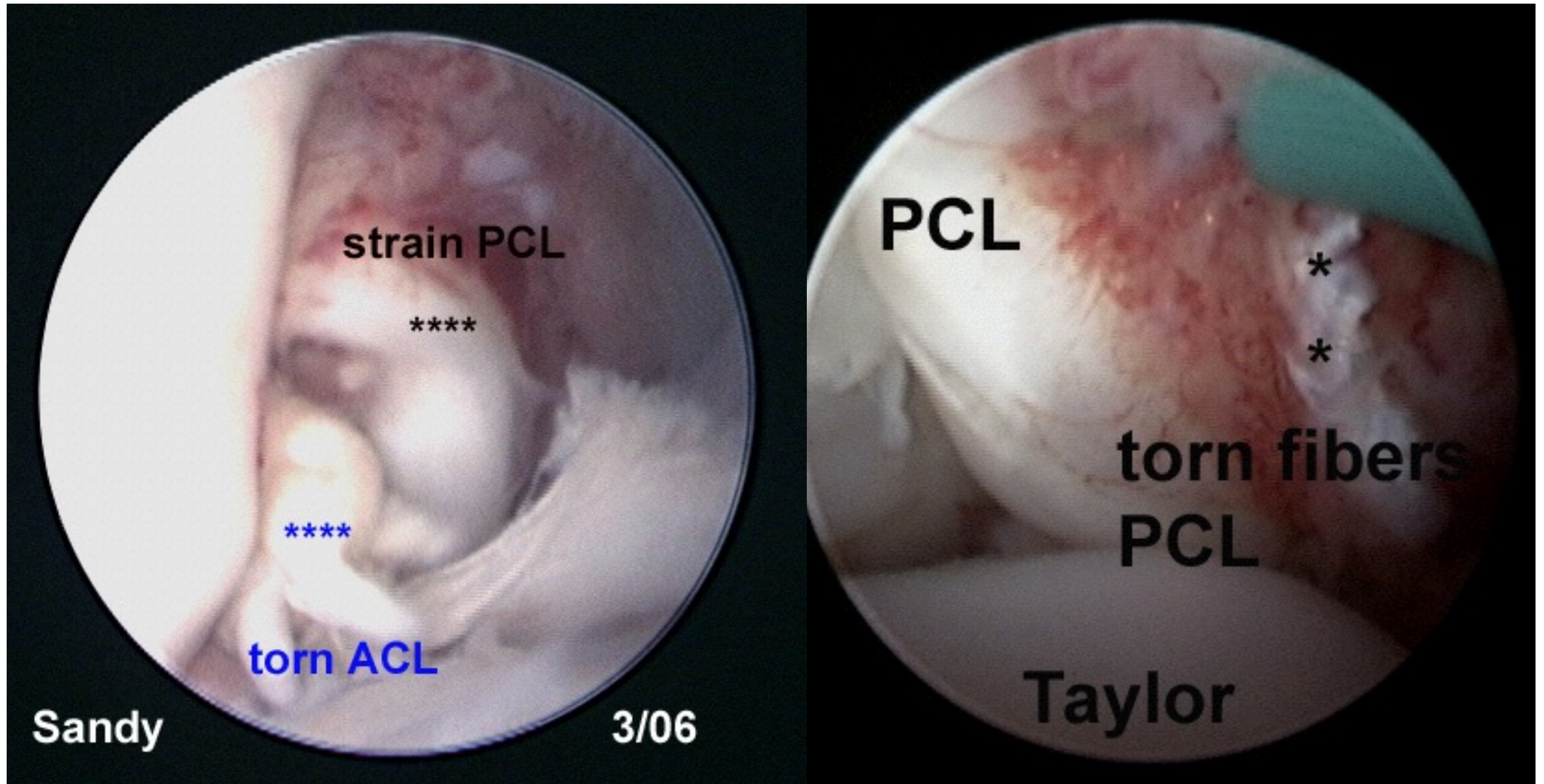
Lesions of the Knee.... CrCl partial unstable



Lesions of the Knee.... CrCl



Lesions of the Knee.... CaCL



Diagnosis CCL injury

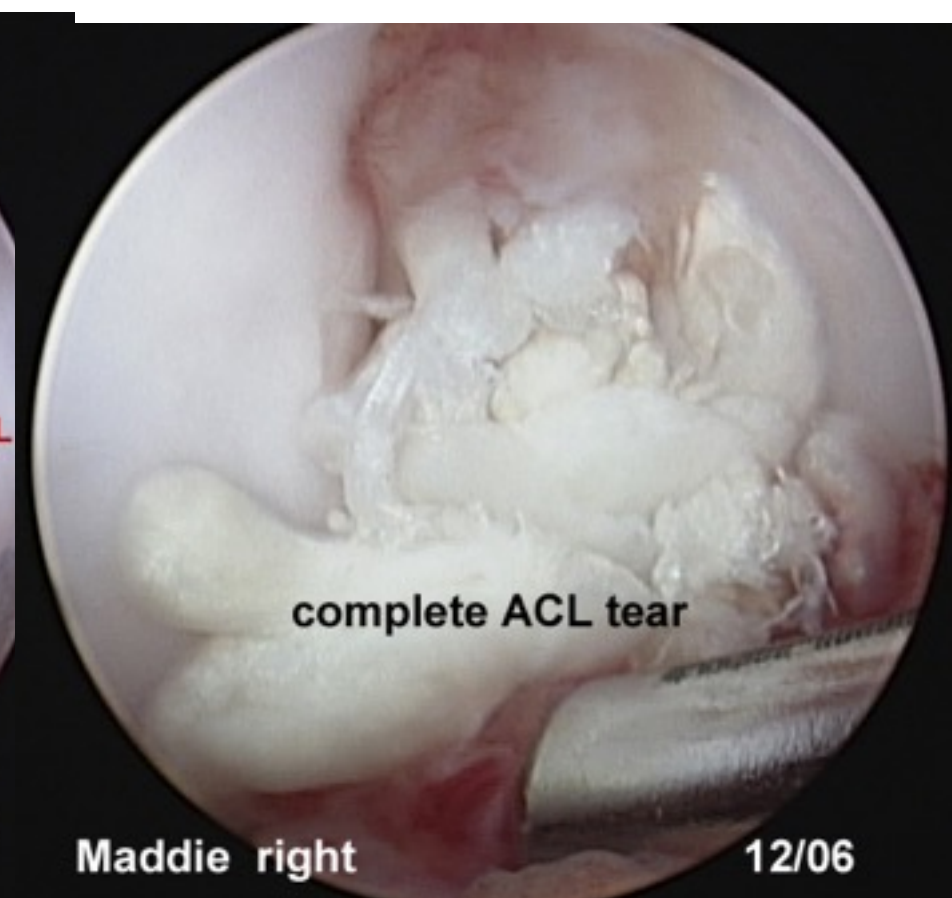
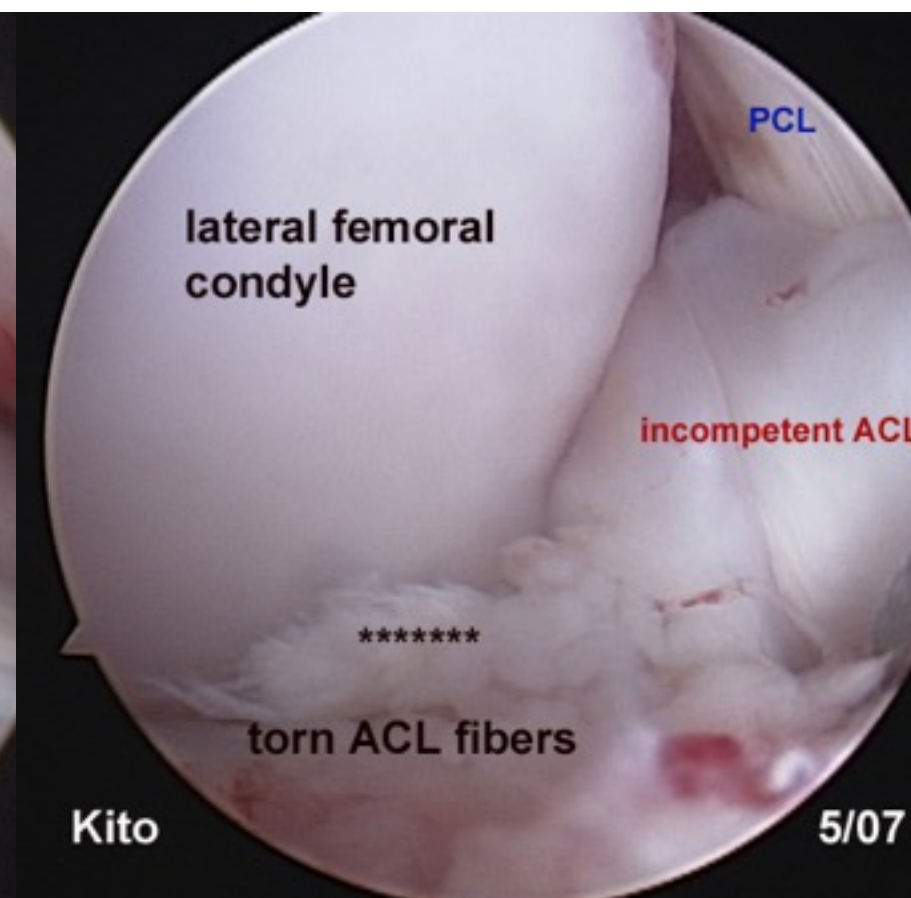
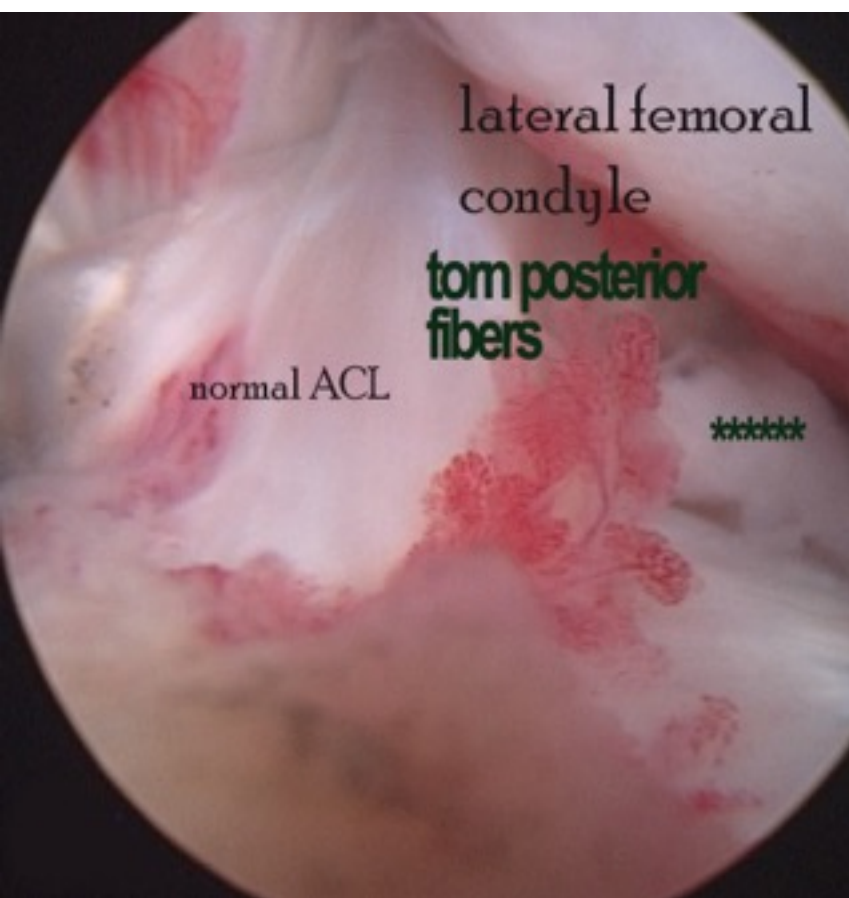
Methods:

- **signalment & history**
- **gait & sit test**
- **physical exam**
- **imaging**



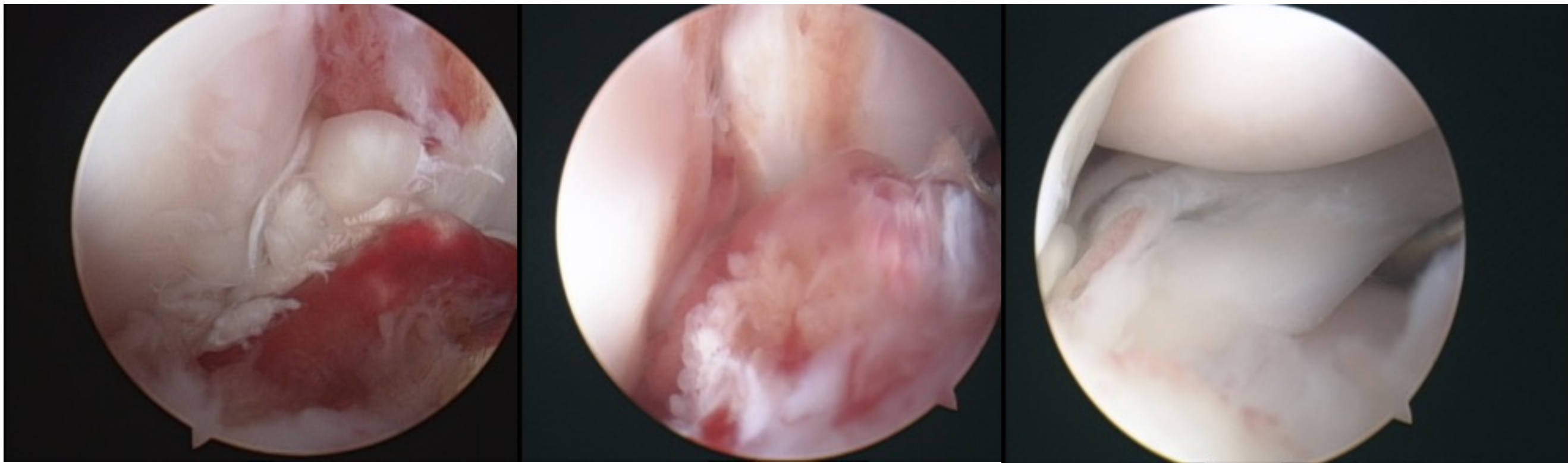
Signalment & history:

- Labrador, Rottweiler, Boxer(large breeds)
- 3 - 7 years
- exercise induced weight bearing lameness (PACL)
- “Acute” onset....substantial fiber tear, meniscal tear



Signalment & history:

- **Poodle, Terrier, Beagle (small breeds)**
- **acute non-weight bearing lameness (CACL)**



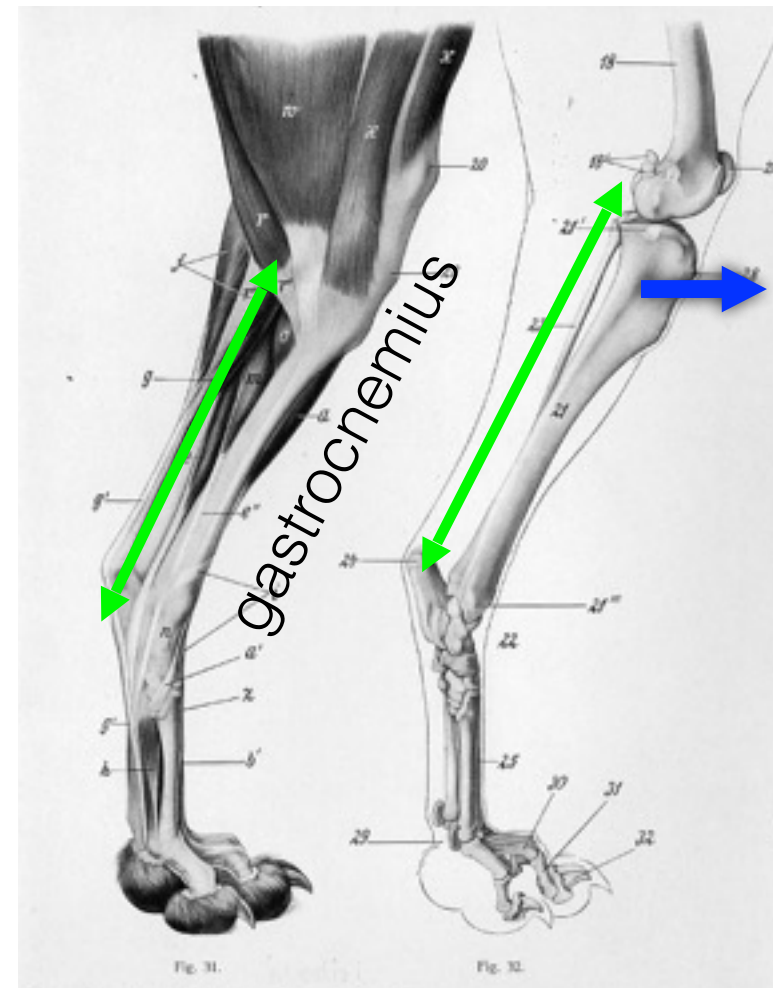
Cranial Drawer Test

- **May be negative with chronic CrCL rupture**
 - **Periarticular fibrosis**
- **Hamstring contraction counters instability**
 - **Perform under sedation**
- **Partial CrCL tear**
 - **May be positive or negative**

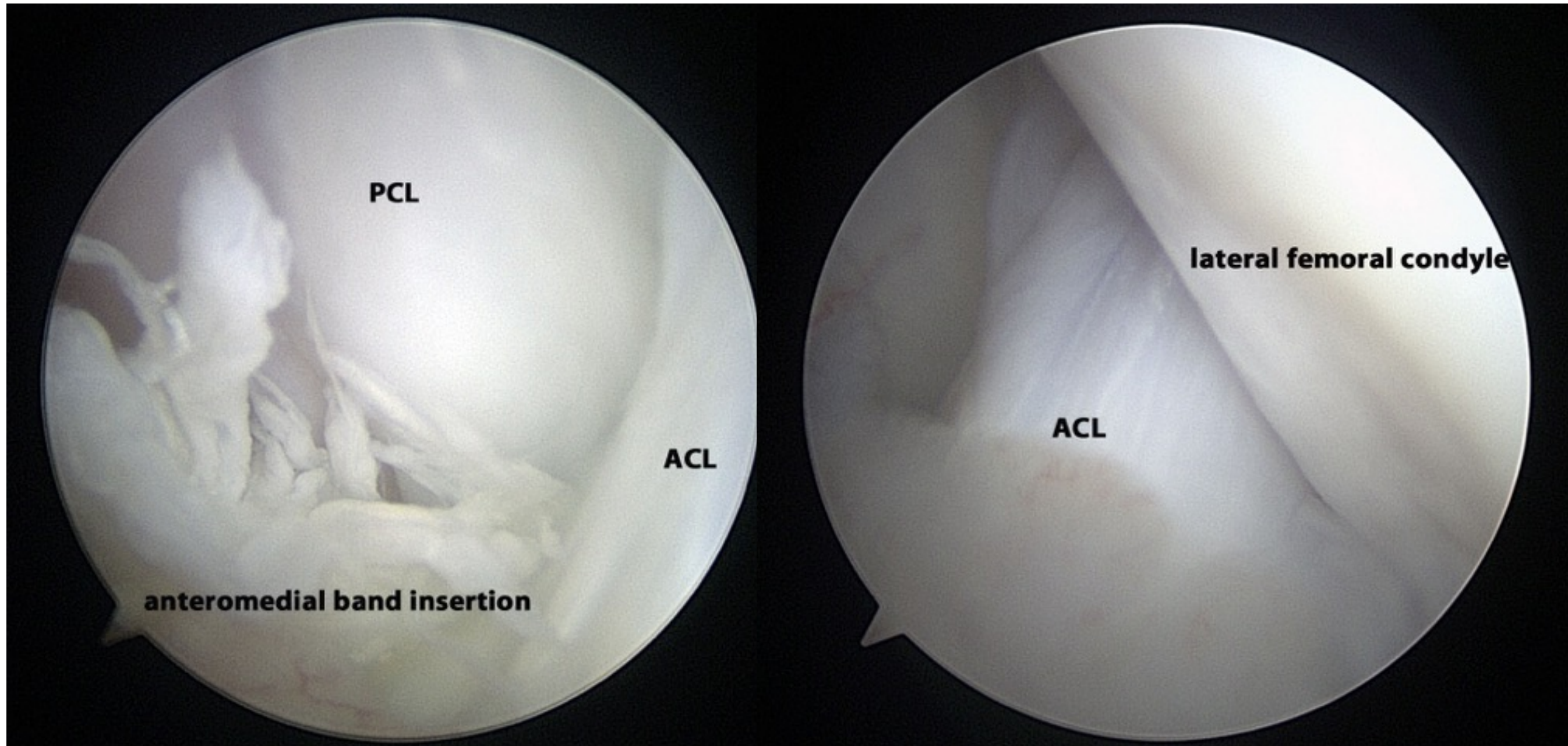


Tibial Compression Test

- **Stifle joint compression**
 - Produces cranial tibial thrust force
- **Positive indicates cranial tibial subluxation**



Robin



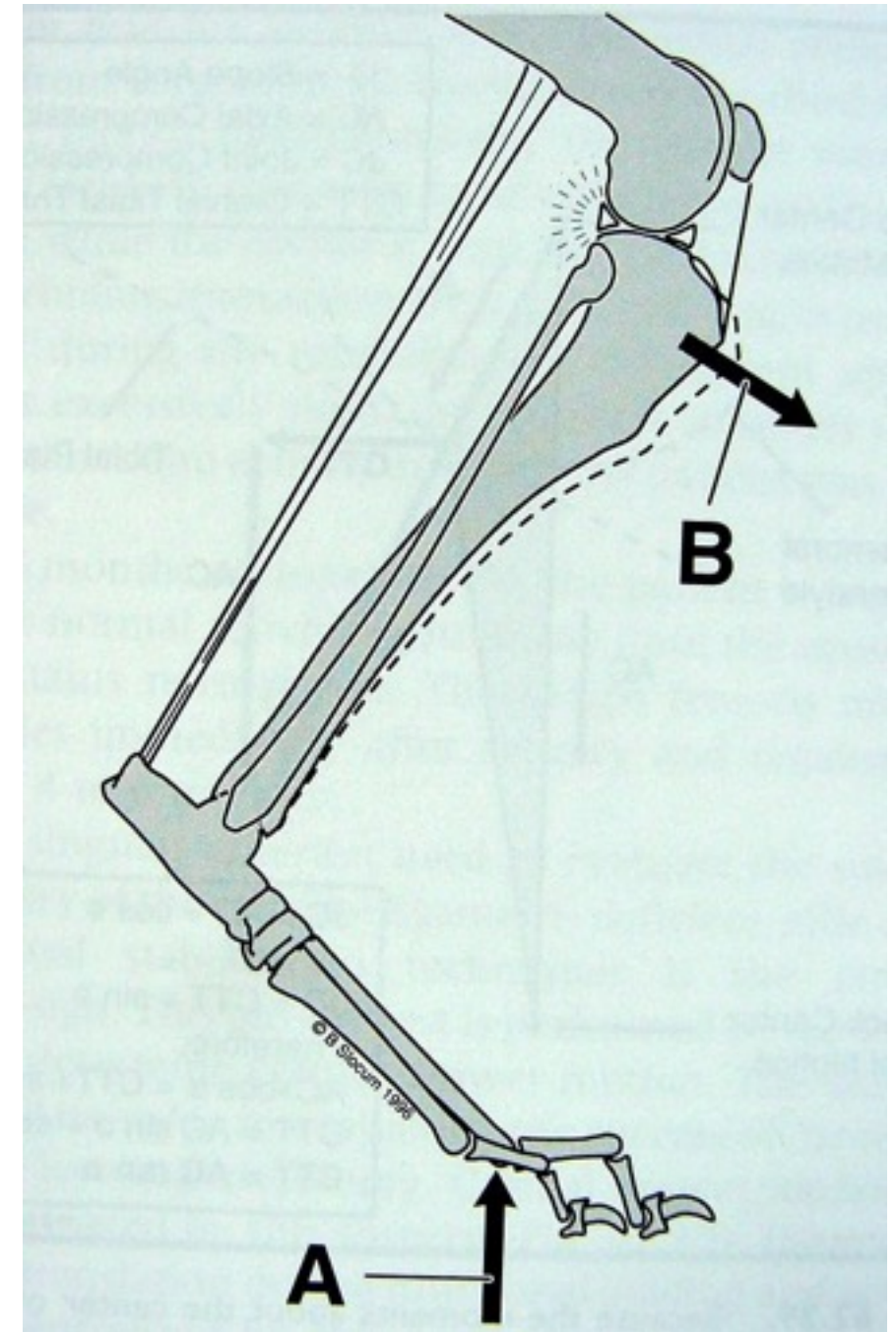
- 1 yr female, Gordon Setter
- Grade 1 /4 lameness when first rising
- Abnormal sit test

Normal Sit Test:

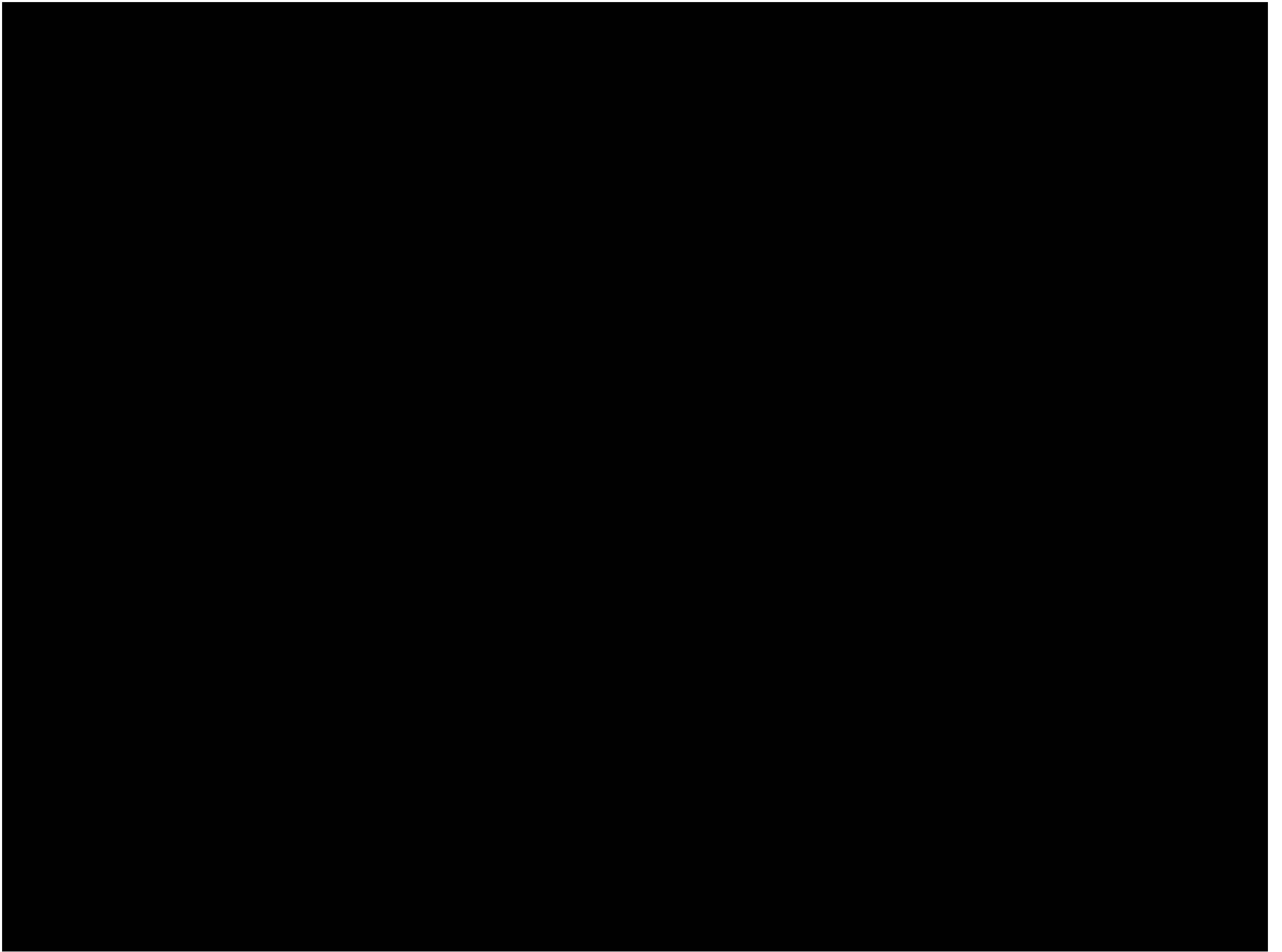


stifle and tarsus should fold in direct axial line

Abnormal sit test



tarsus does not flex to 30 degrees



Methods:

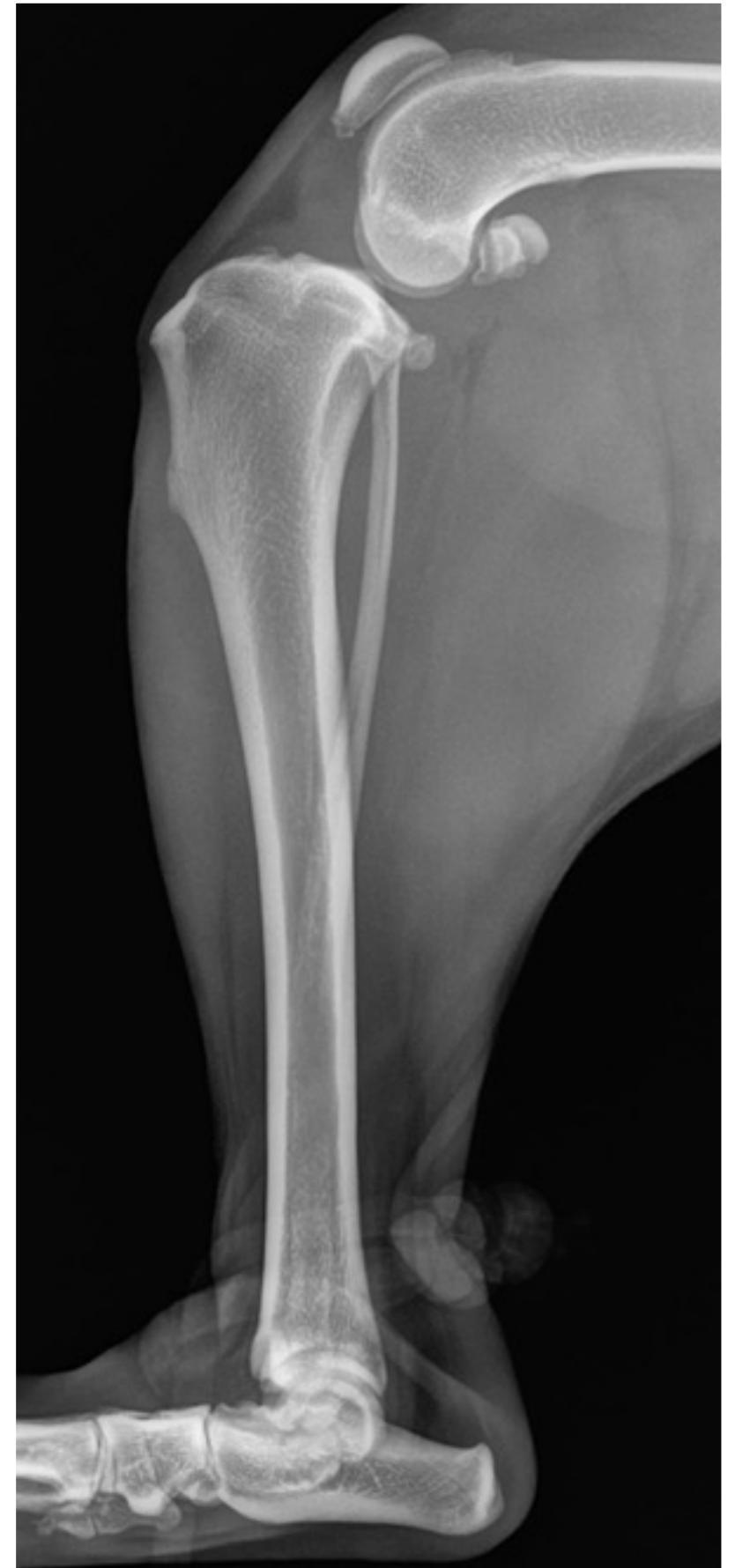
imaging

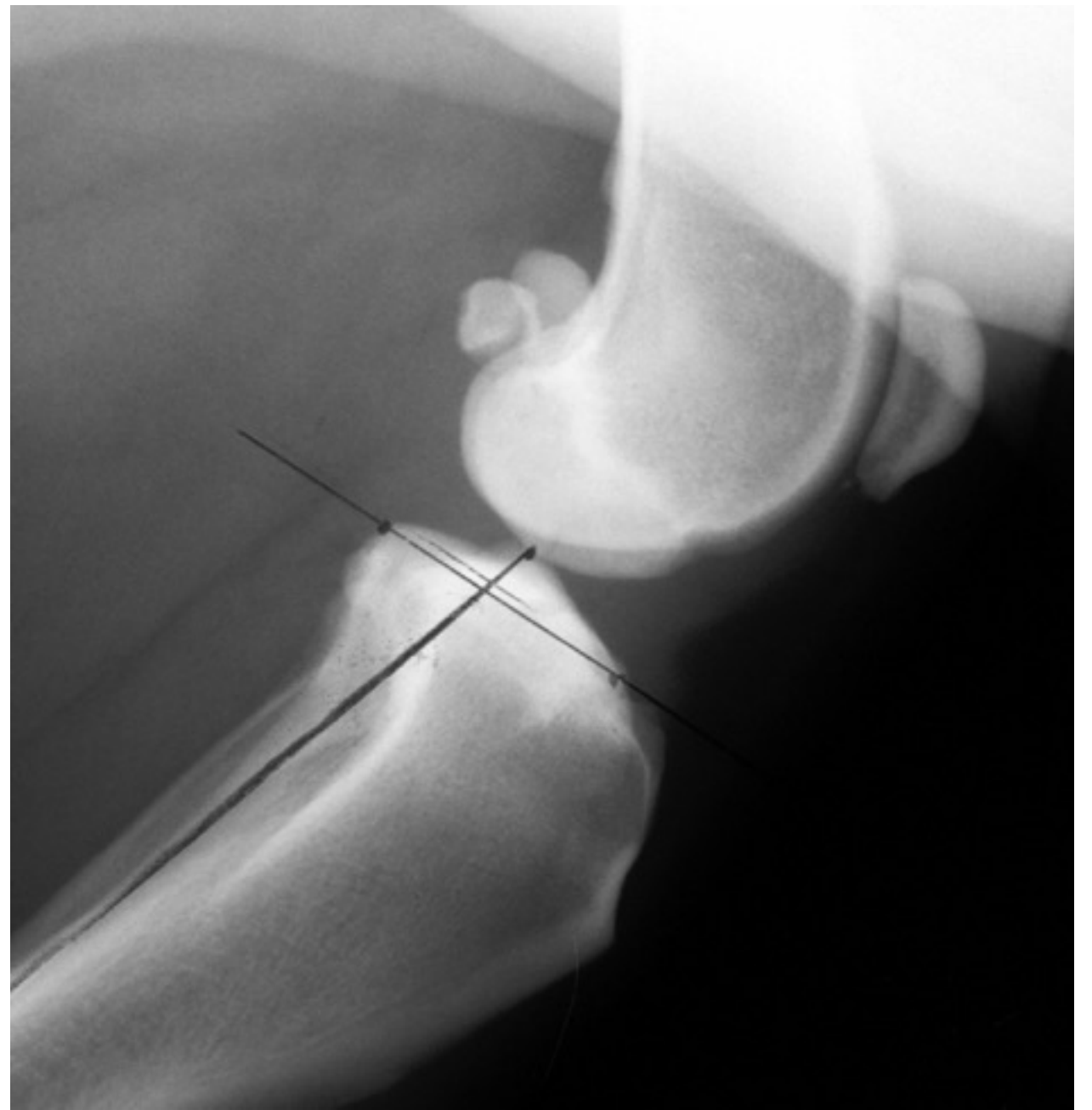


Stifle

Radiographs

- **Two view stifle**
 - **Mediolateral “TPLO” view**
 - **Stifle & hock visible**
 - **90° flexion**
 - **Craniocaudal view**
- **Typical findings**
 - **Joint effusion**
 - **subluxation**
 - **Degenerative changes**

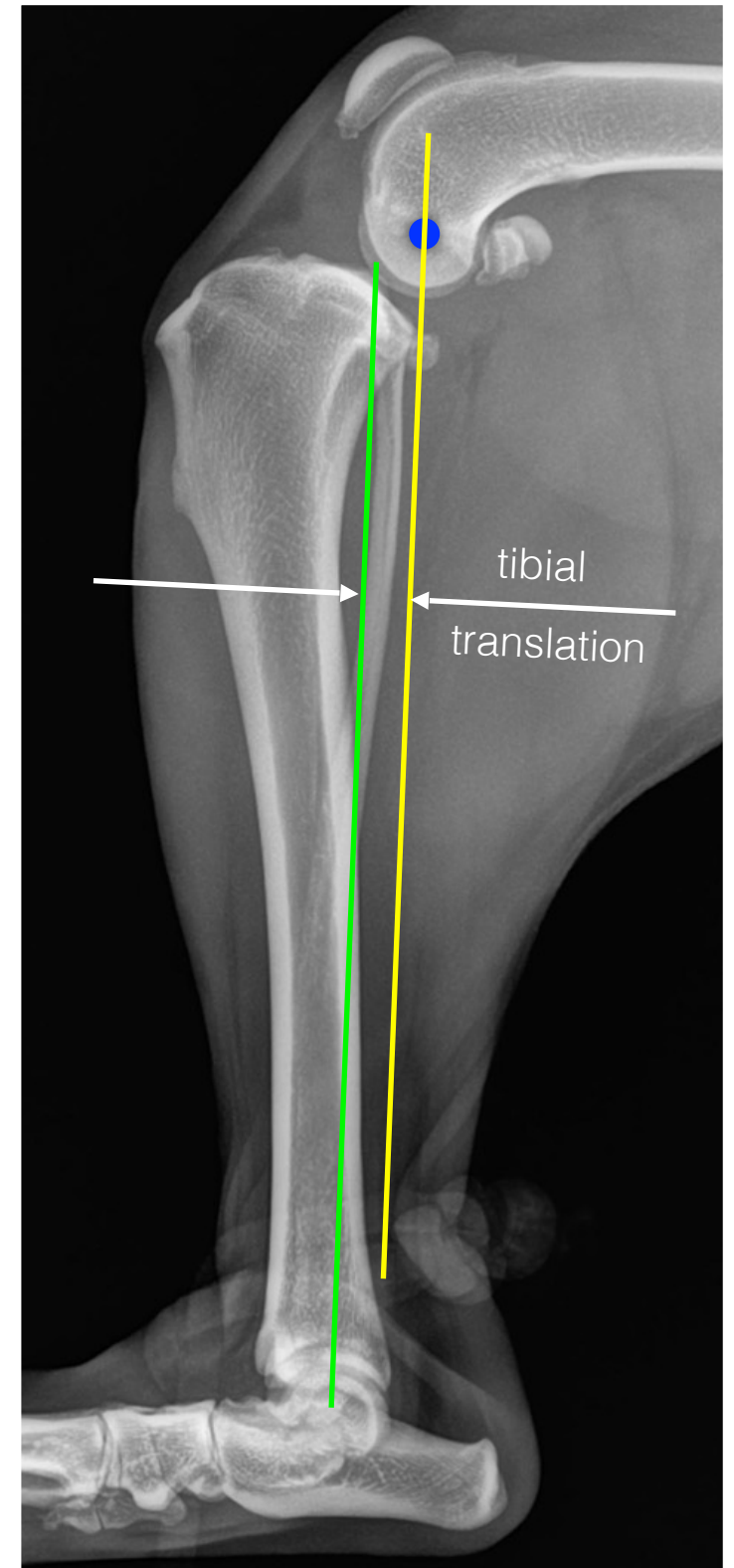
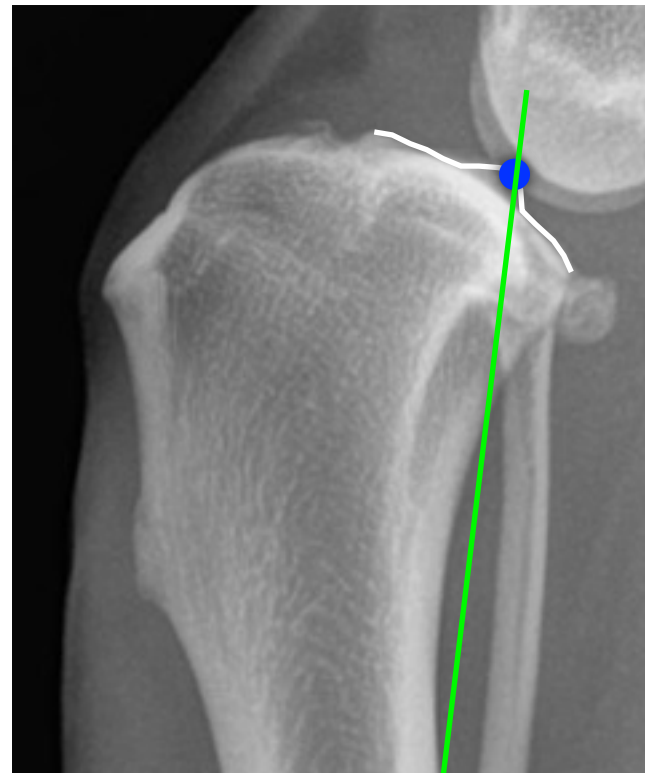




Radiographic effusion

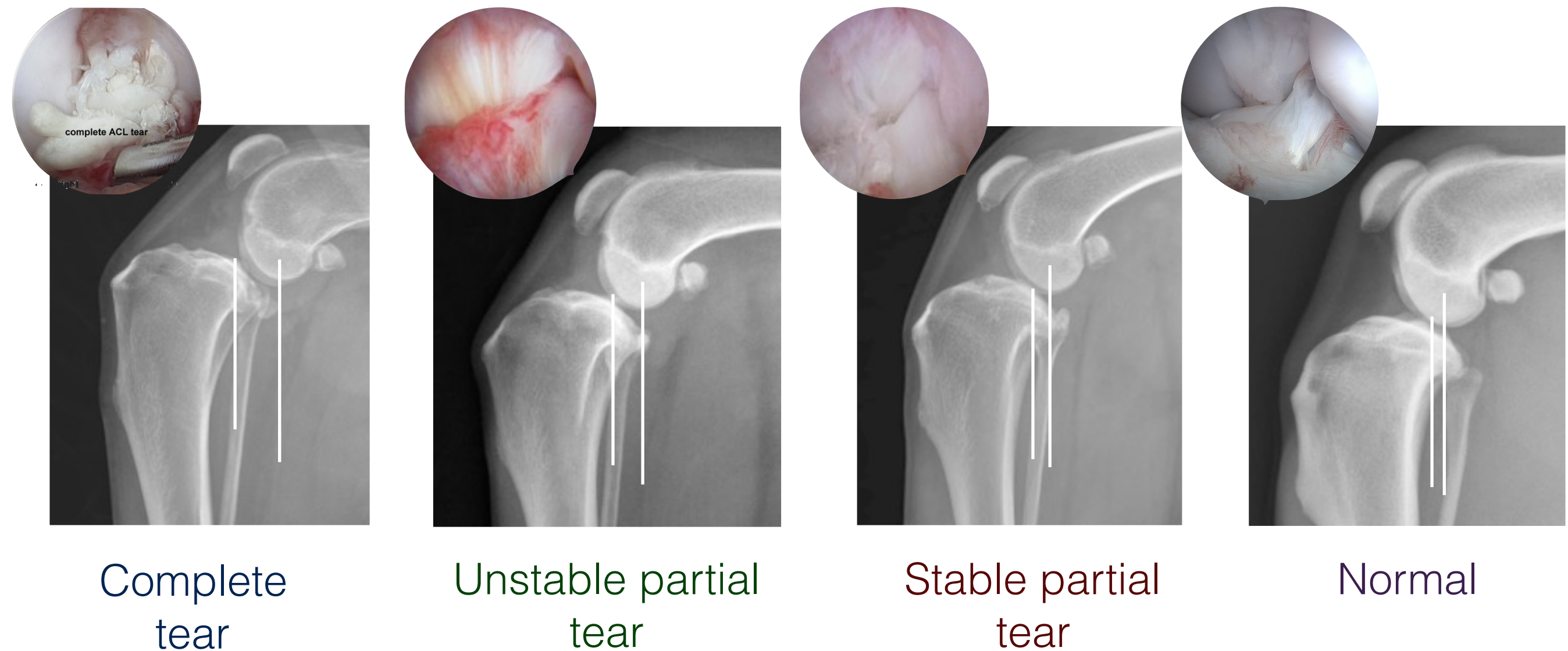
Measuring Tibial Translation

- **Sagittal “TPLO” view**
- **Tibial mechanical axis**
- **Center of femoral condyle**
- **Parallel line**



CrCL Tears

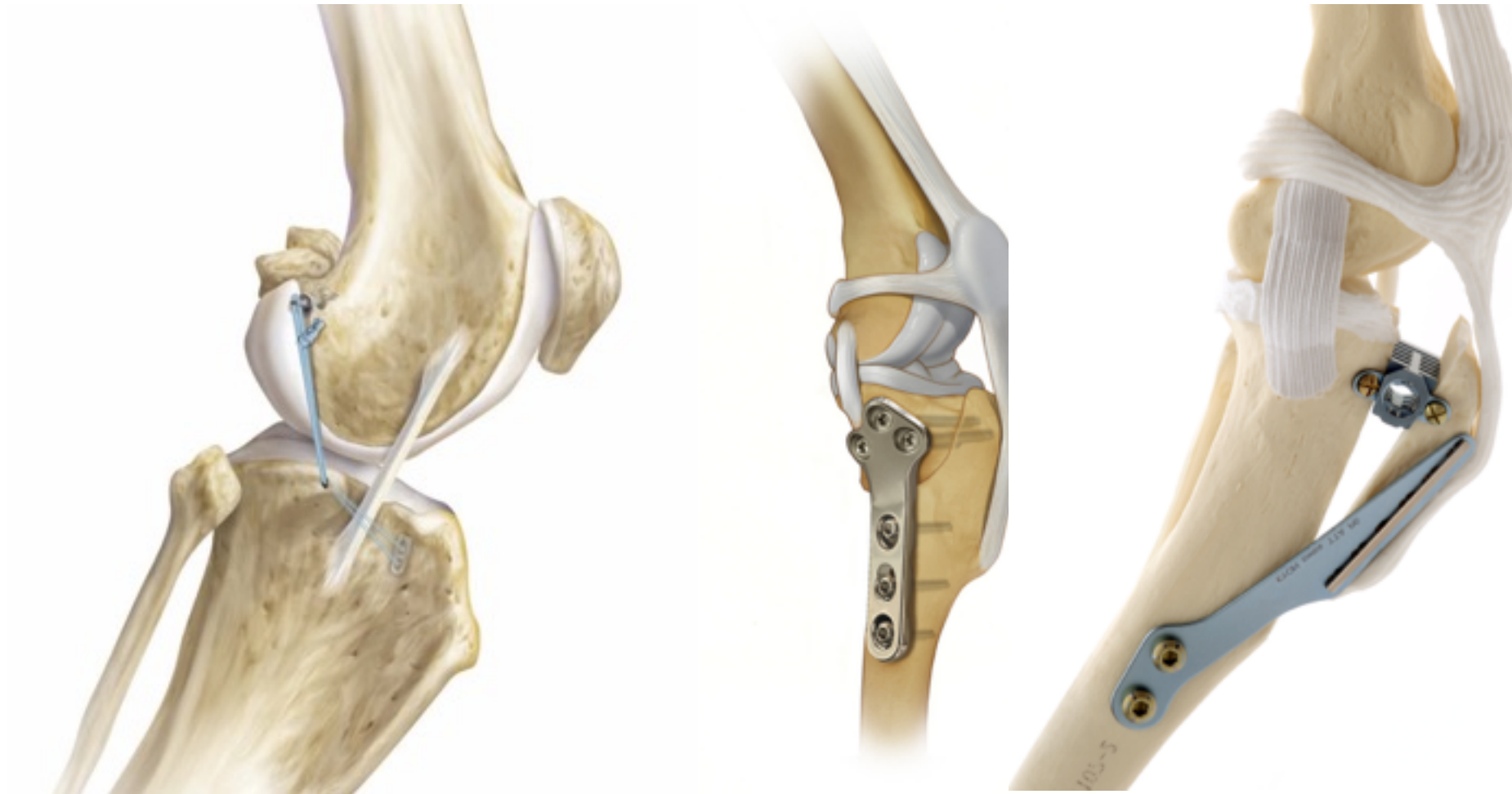
cranial tibial translation



Degenerative Changes



Technique of Choice ?????

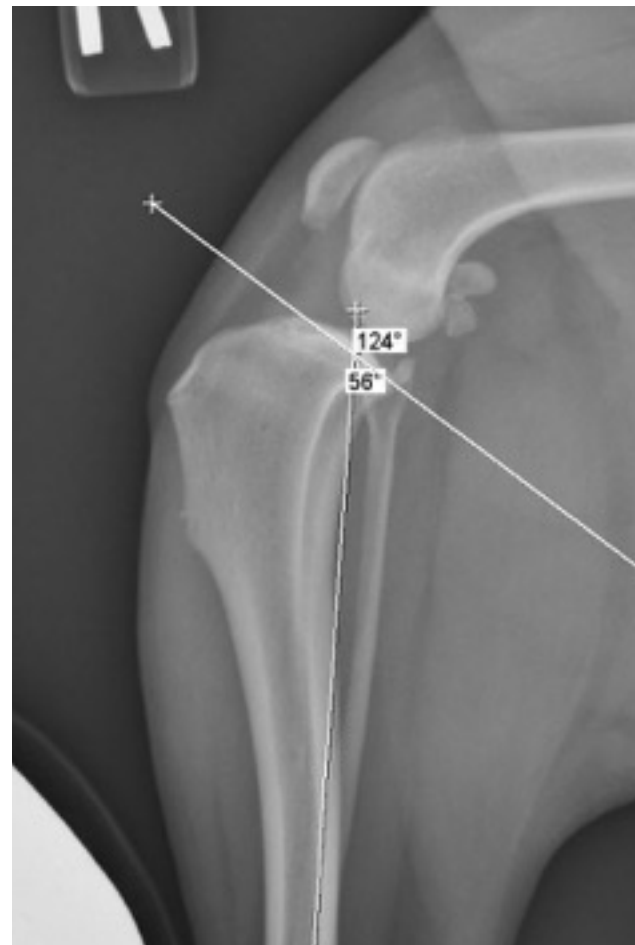


Dogs with excessive tibial plateau slope (> 34 deg)

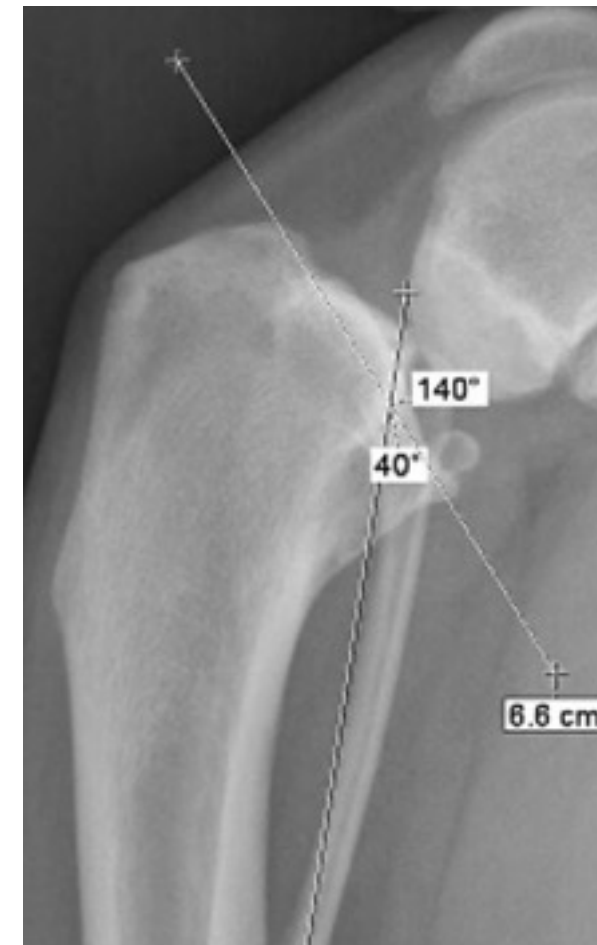
- leveling osteotomy is preferred



Bassett hound 35deg

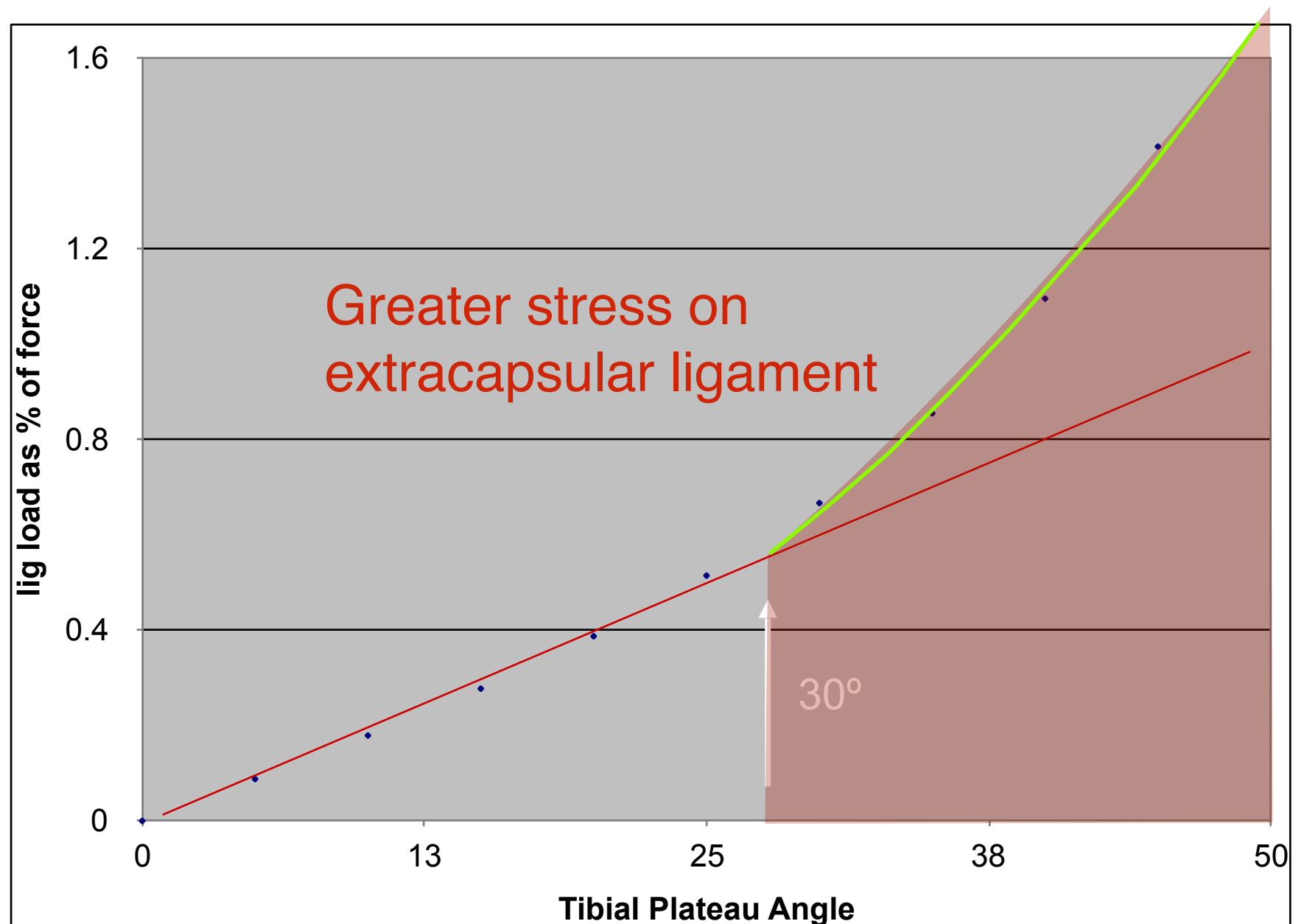


Beagle 34 deg

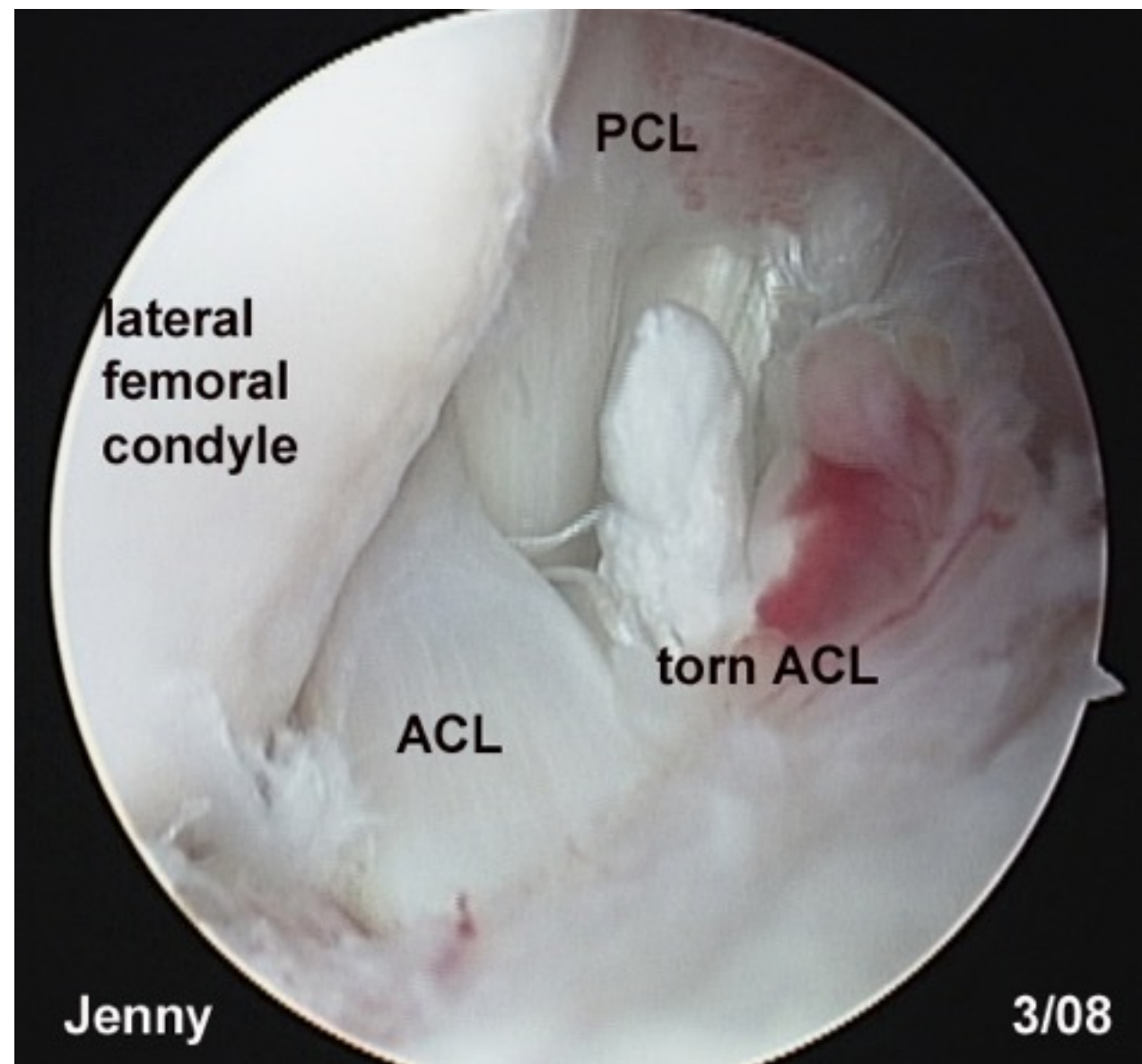


Westie 50 deg slope

Effect of TPA on the load



Partial Tear with substantial functional CCL

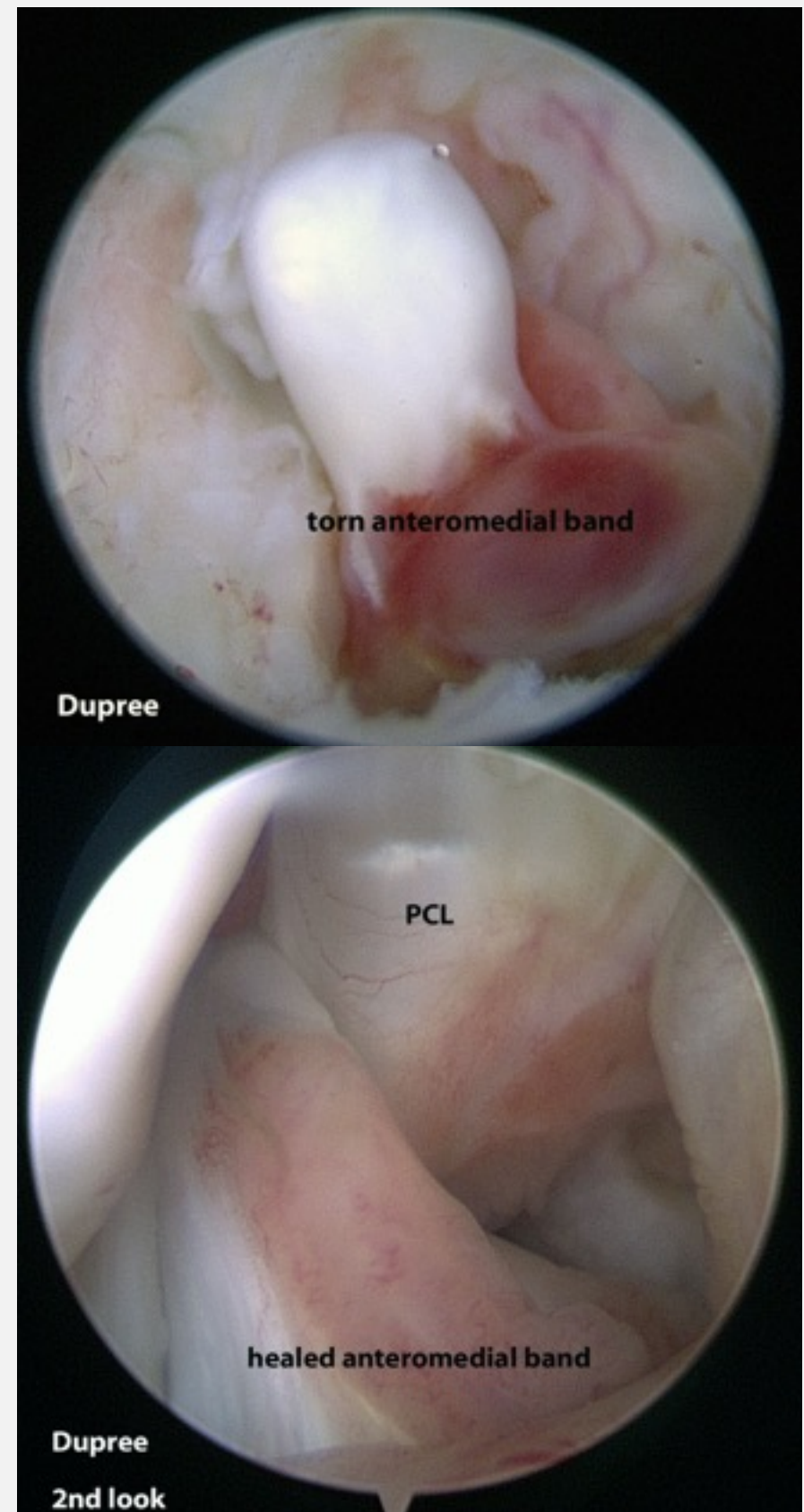


Leveling osteotomy preferred
isometric stabilization with anchor system

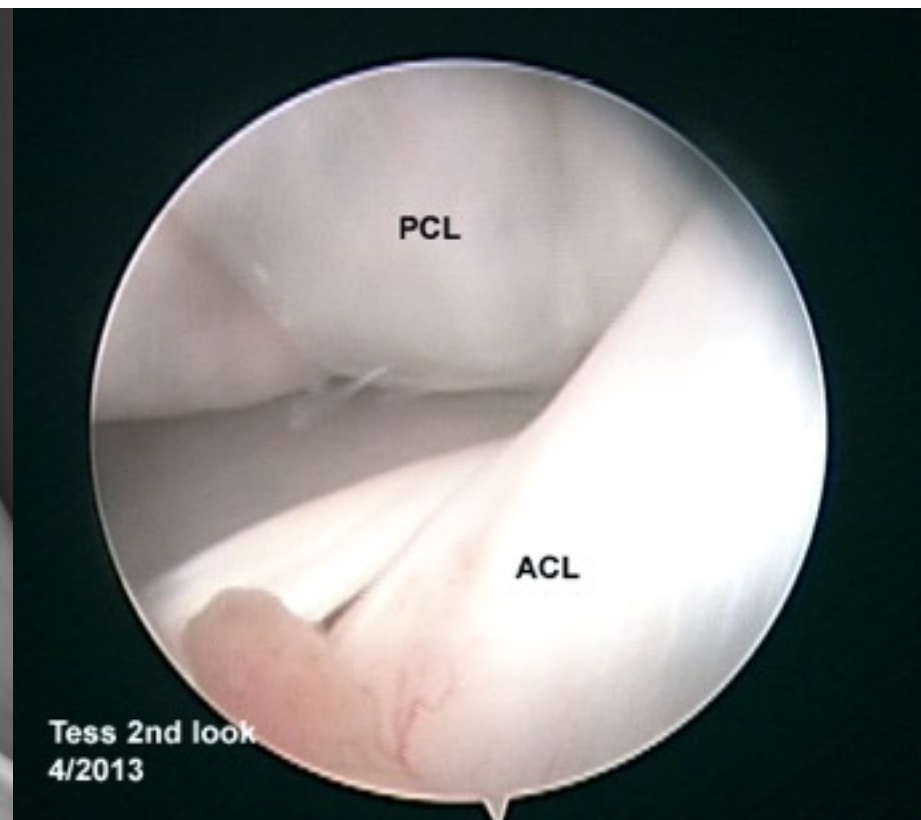
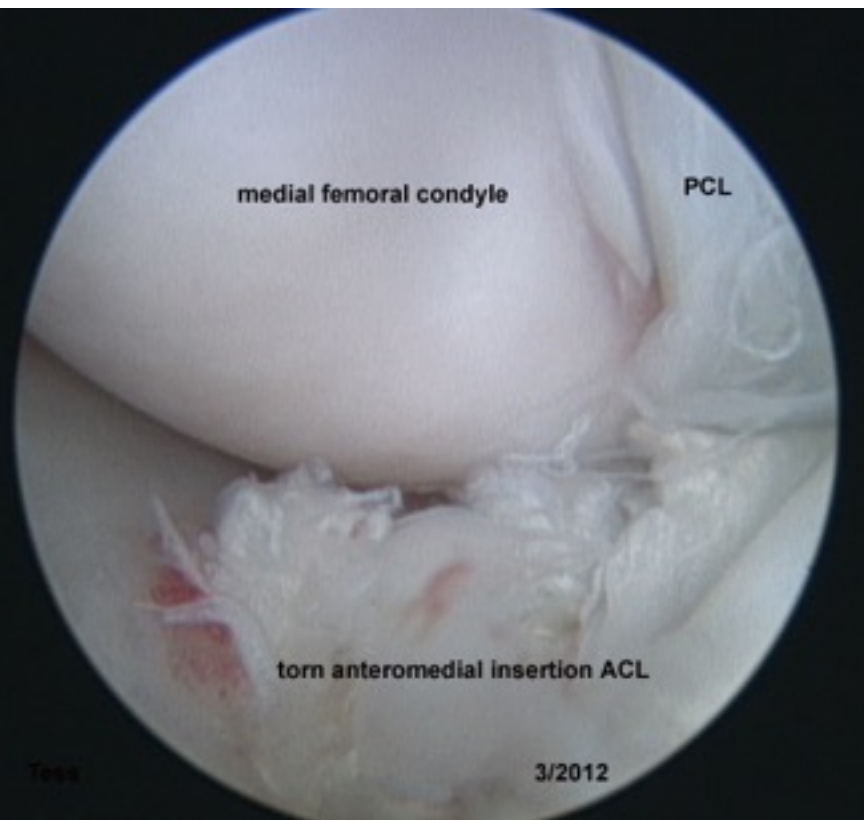
Facilitates Healing of Early ACL Tears



standing lateral 8 weeks PO



Facilitates Healing of Early ACL Tears

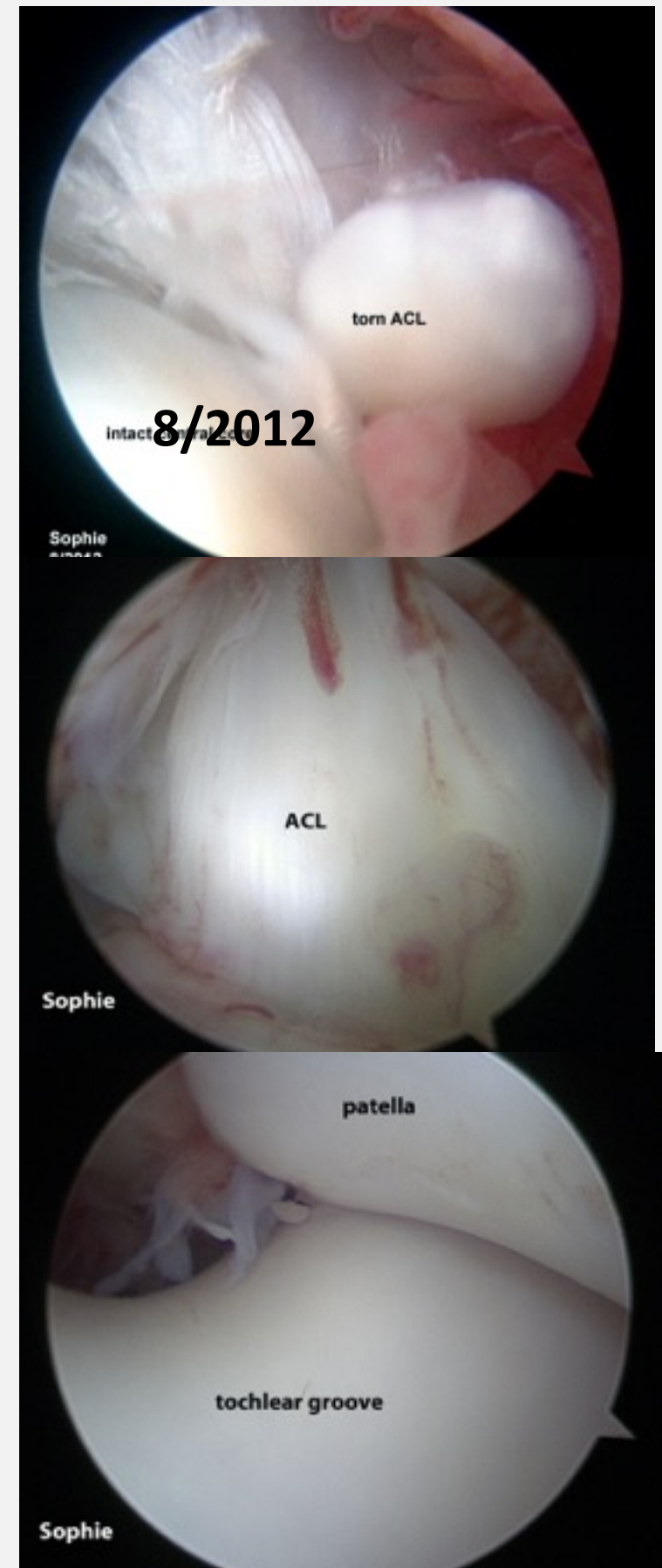


1 yr PO

Facilitates Healing of Early ACL Tears

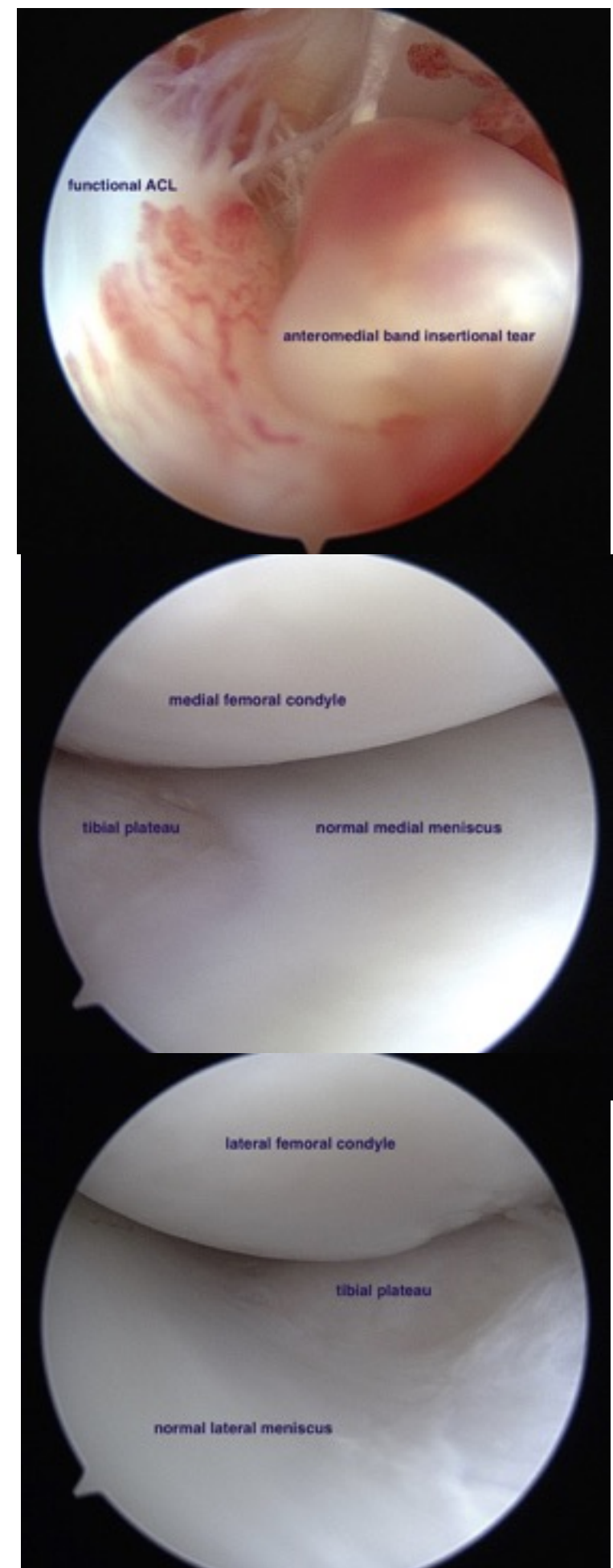
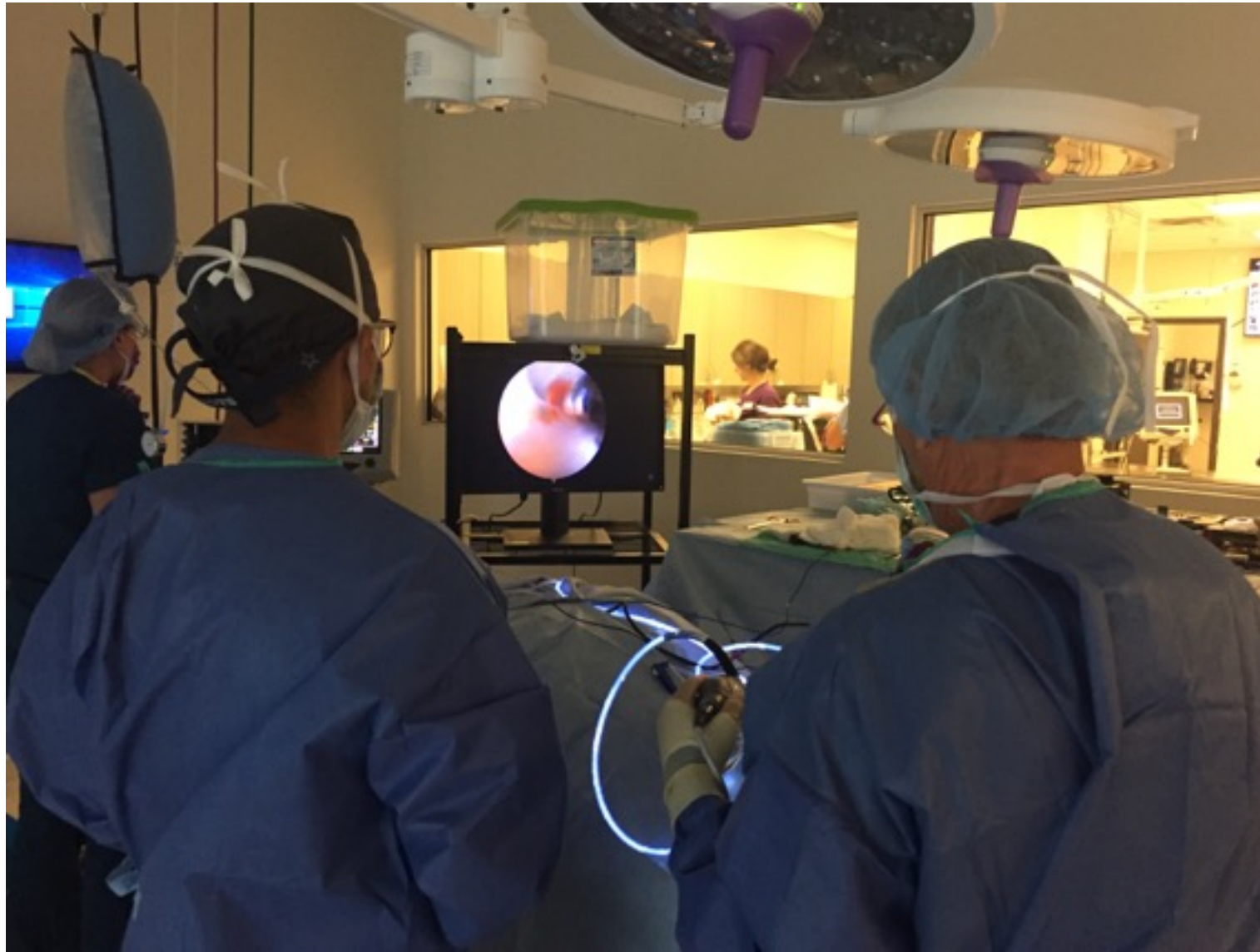


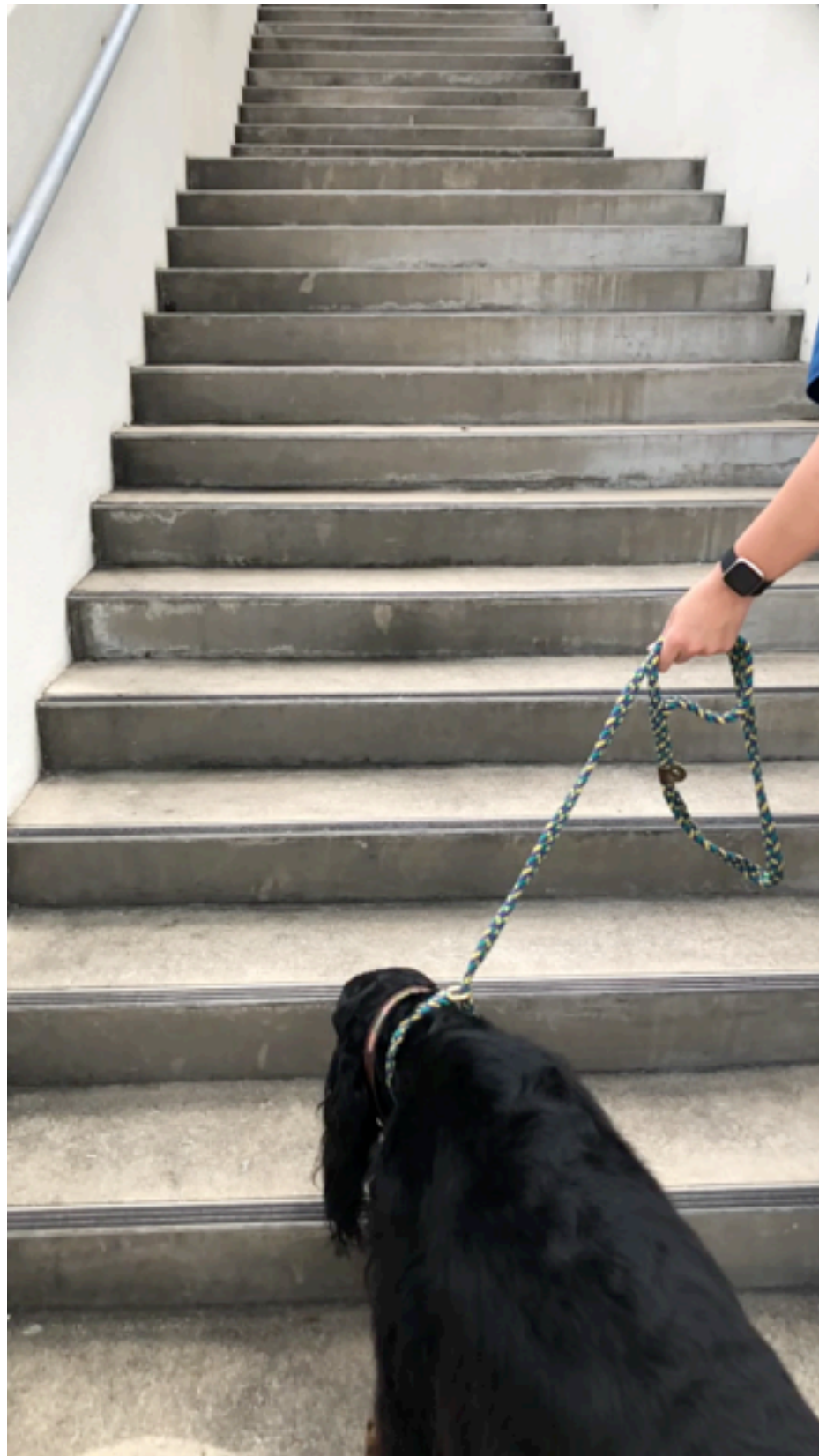
Sophie/AVES



31 months PO

Facilitates Healing of Early ACL Tears





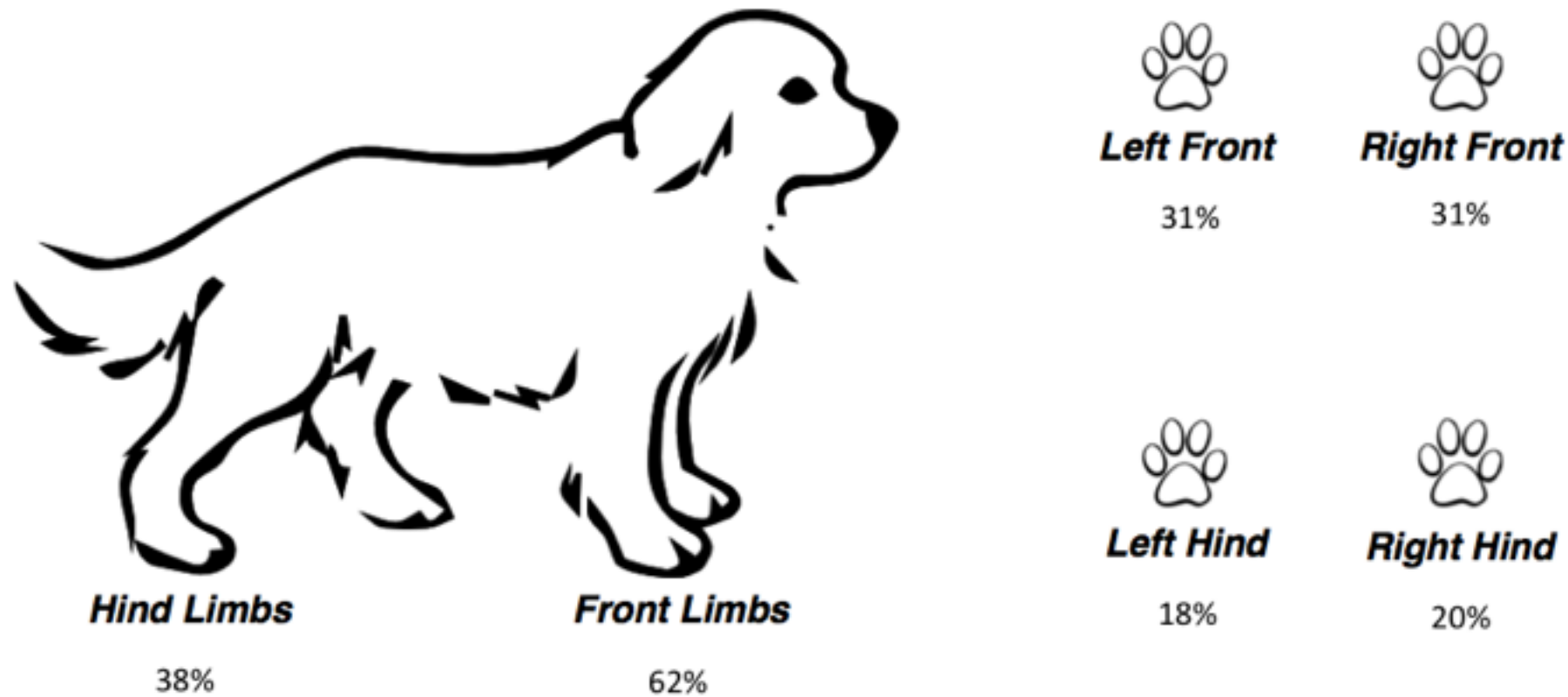
3 weeks PO



3 weeks PO

6 weeks PO

Weight Distribution



Limb	Side	Weight Distribution (%WD)	Vertical Force		Braking Force		Propulsion Force	
			Peak Force (%BW)	Impulse (%BW*s)	Peak Force (%BW)	Impulse (%BW*s)	Peak Force (%BW)	Impulse (%BW*s)
Hind	Right	20%	77.8	9.3	-6.5	-0.2	9.3	0.8
	Left	18%	70.7	8.7	-7.9	-0.2	8.4	0.7
	% Difference (Right vs. Left)	10%	10%	6%	18%	15%	10%	13%

Giant & Large Breeds



leveling osteotomy is preferred
isometric stabilization with anchor system

What if we do nothing

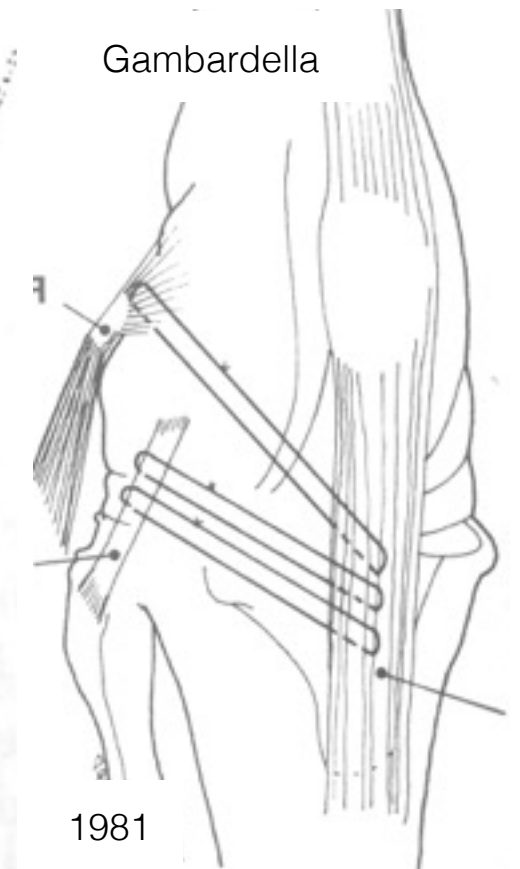
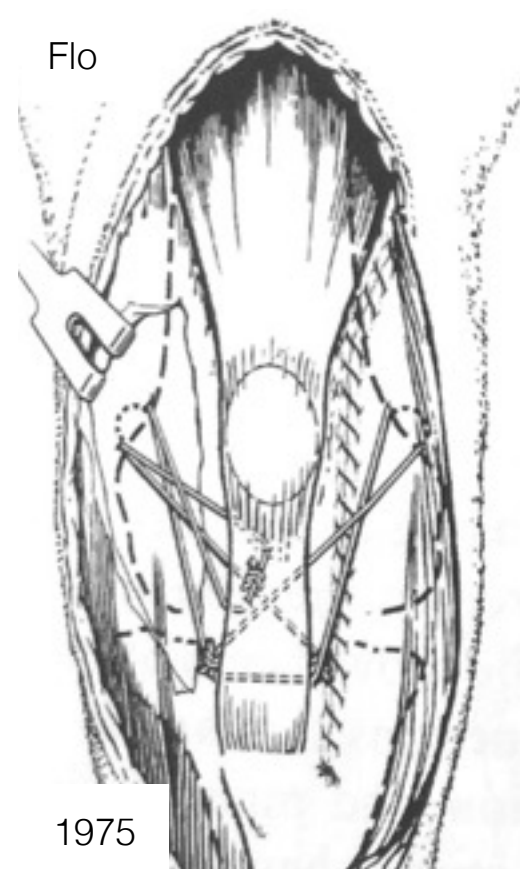
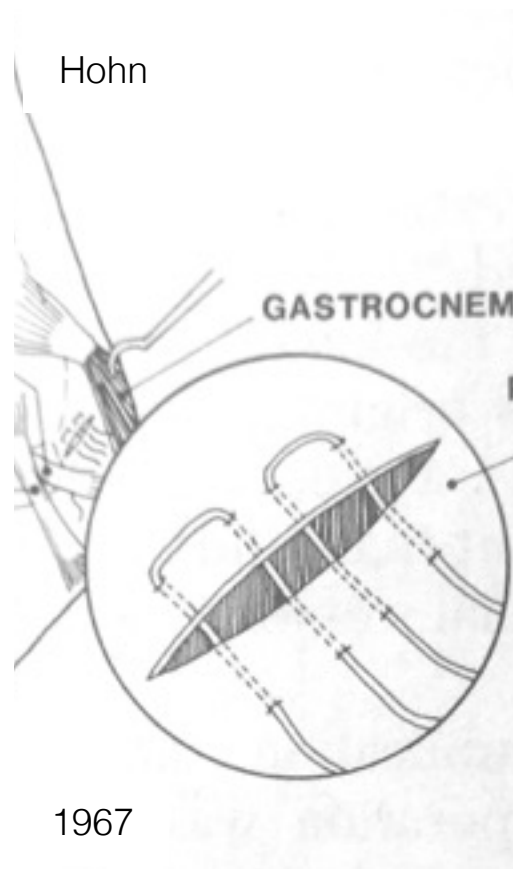


Isometric Extra-articular ACL Repair

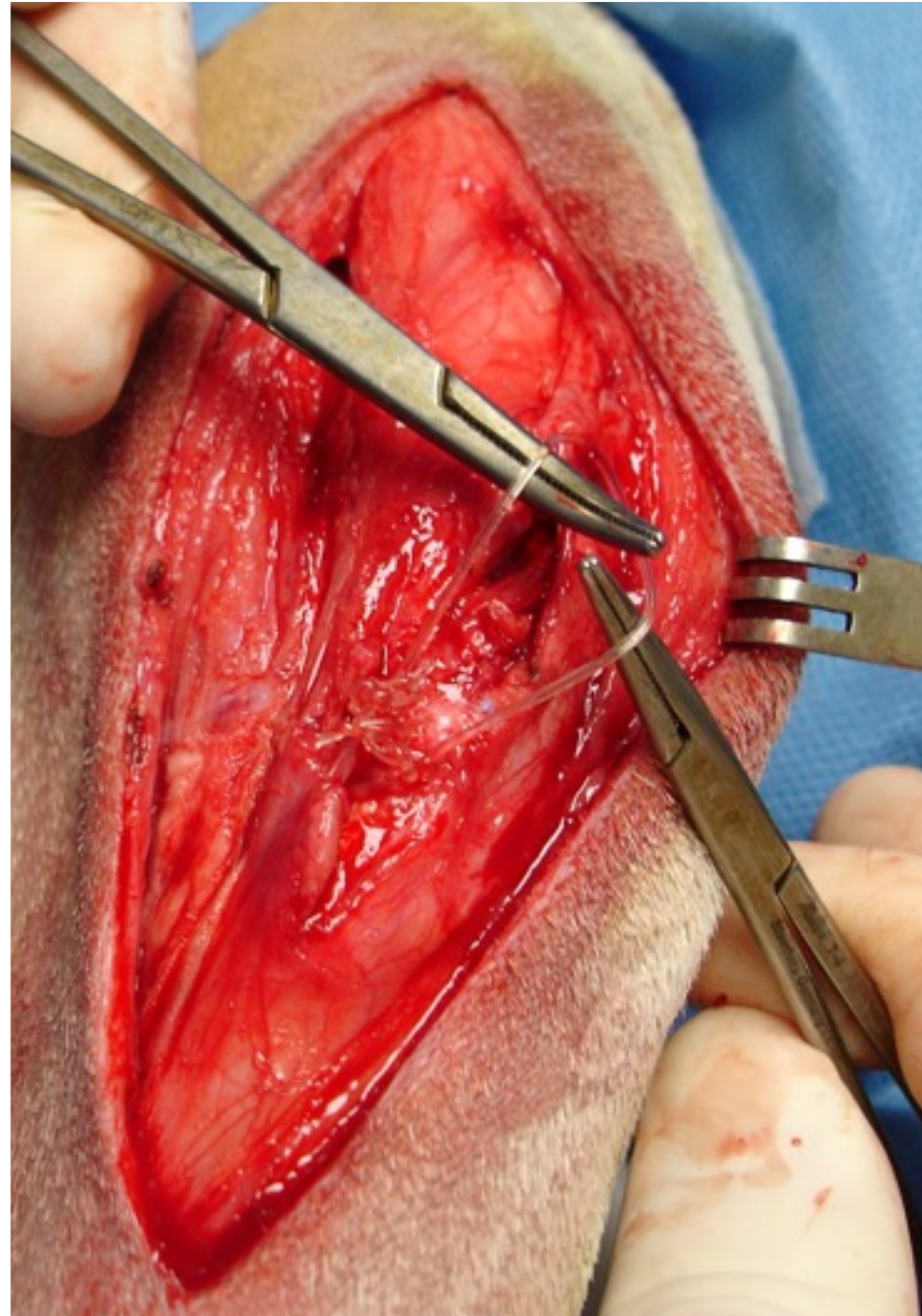


Don Hulse DVM, ACVS, ECVS

CrCL Repair - the early years

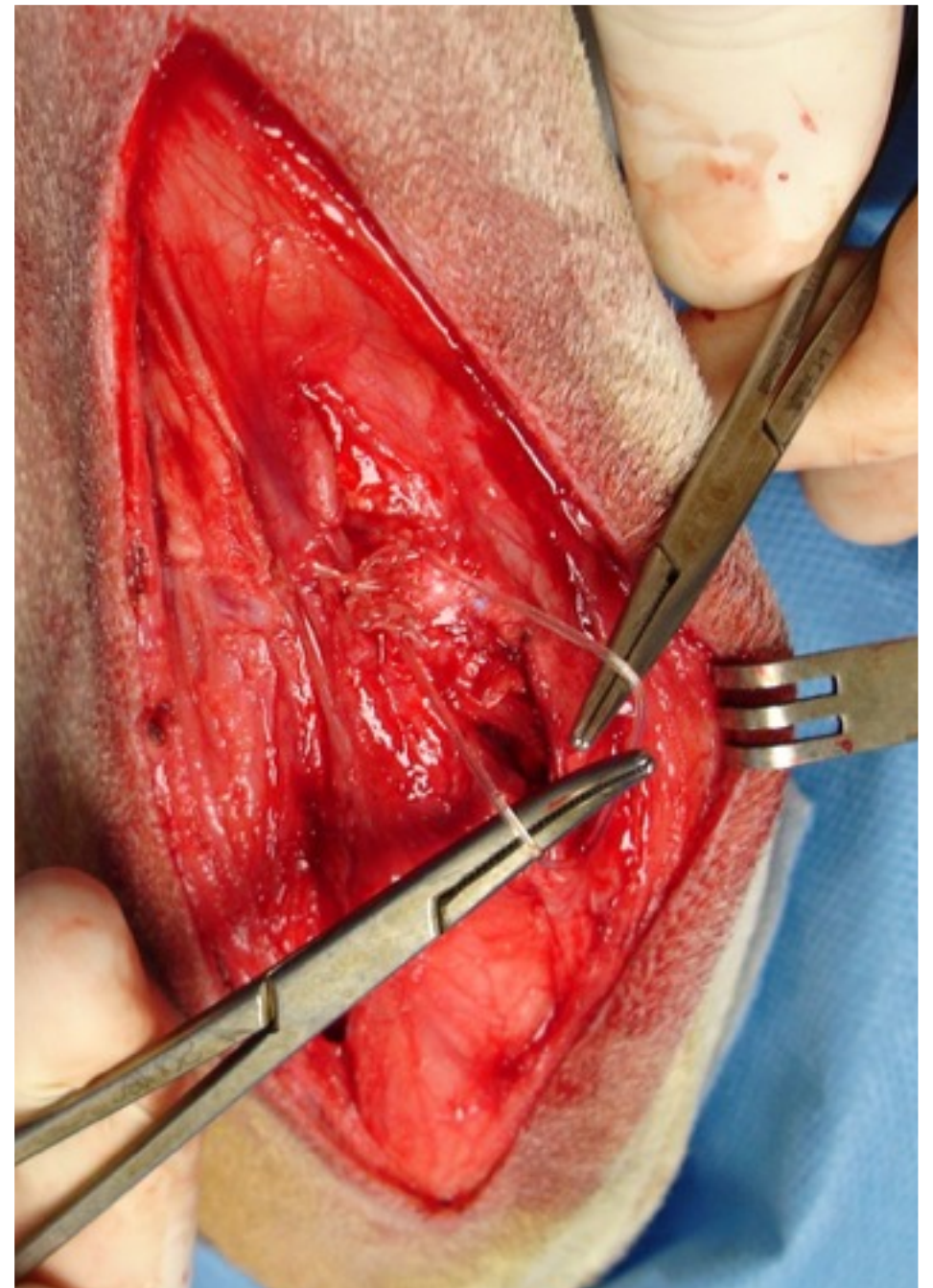


Why did this fail?



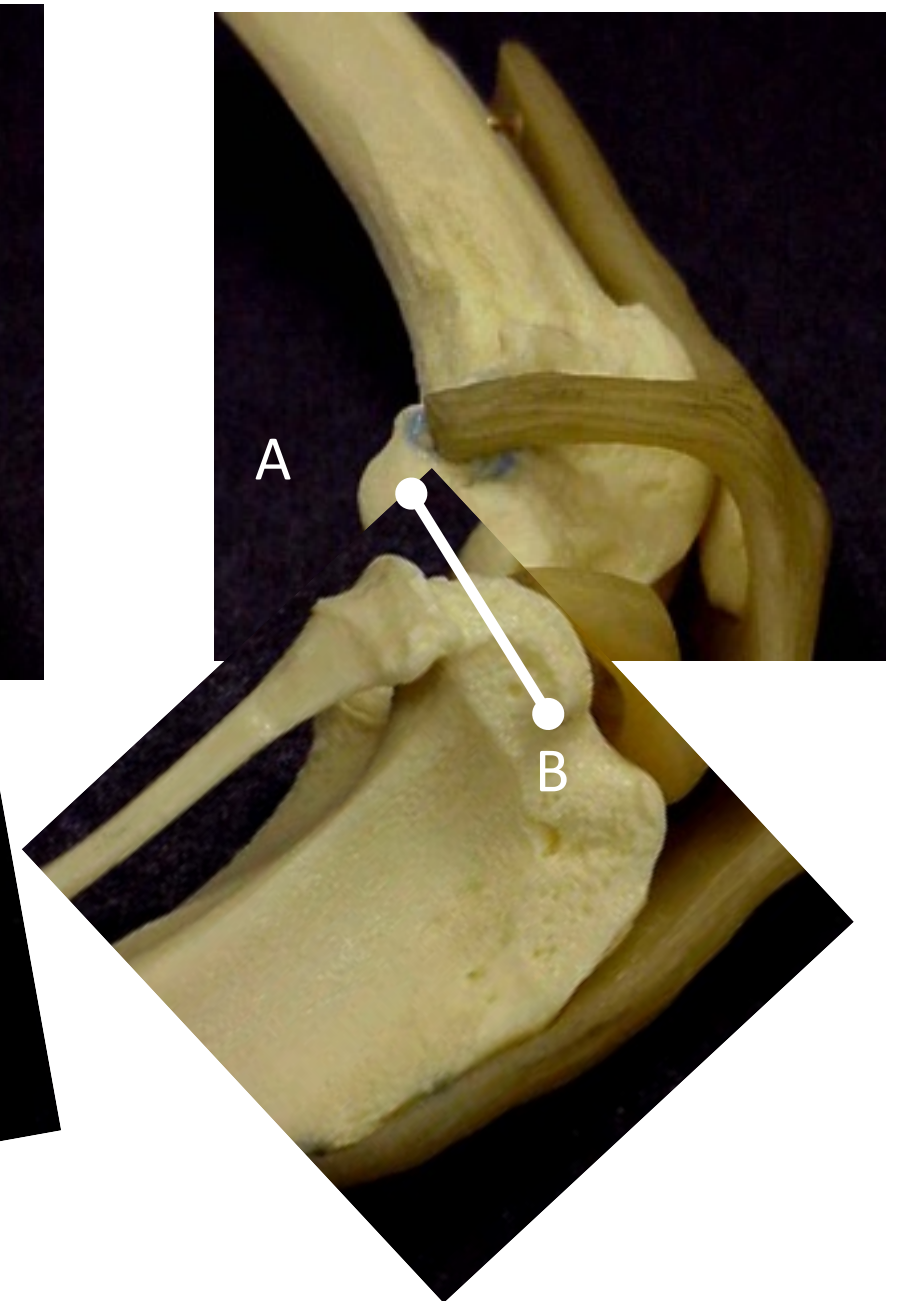
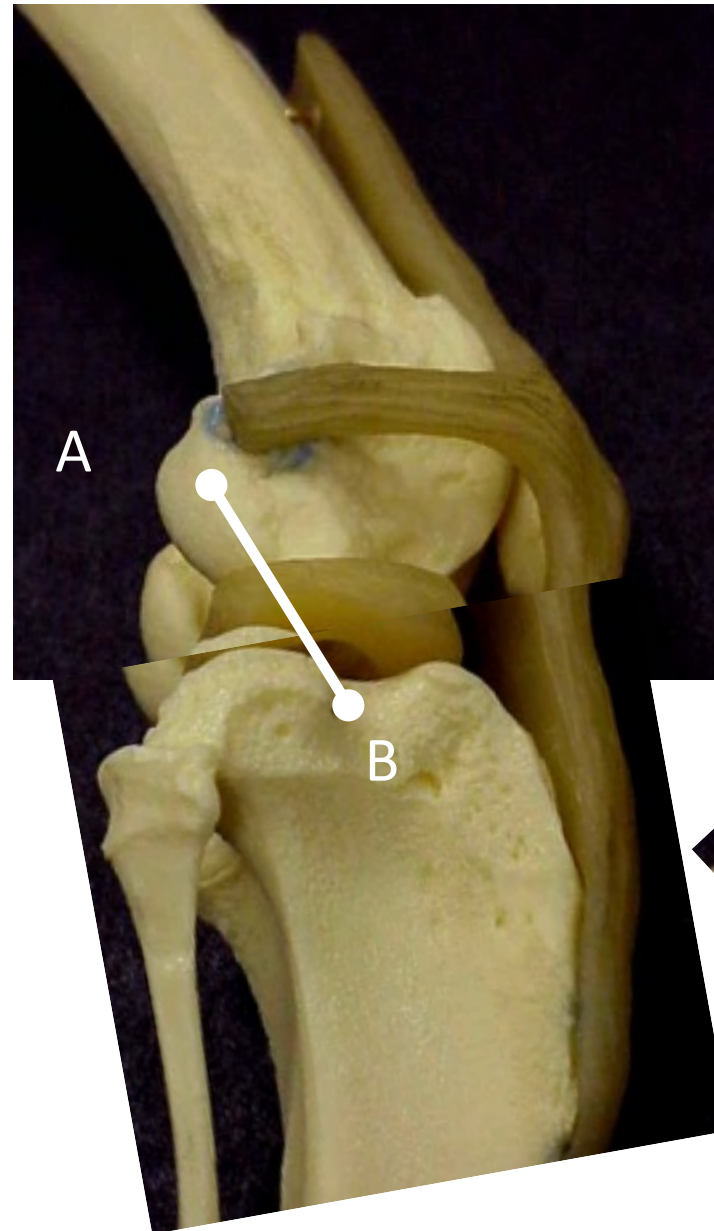
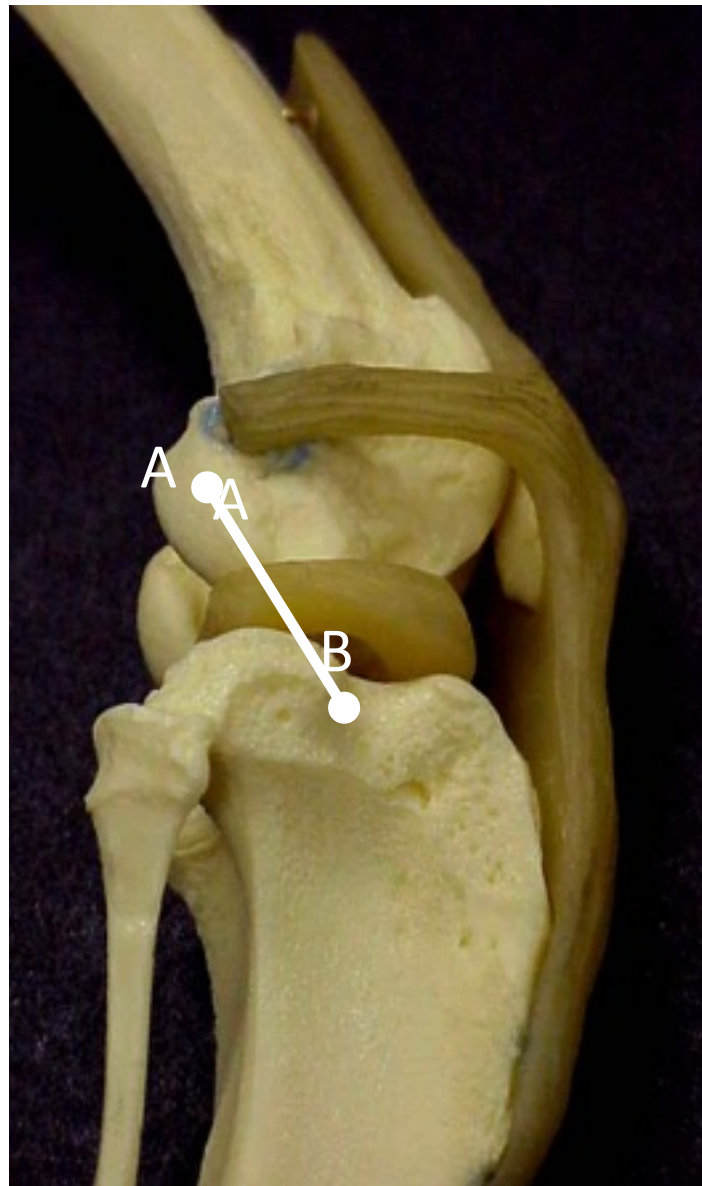
Perhaps

- suture isometry/joint motion
- structural & material property
- anchorage
- excessive TPA

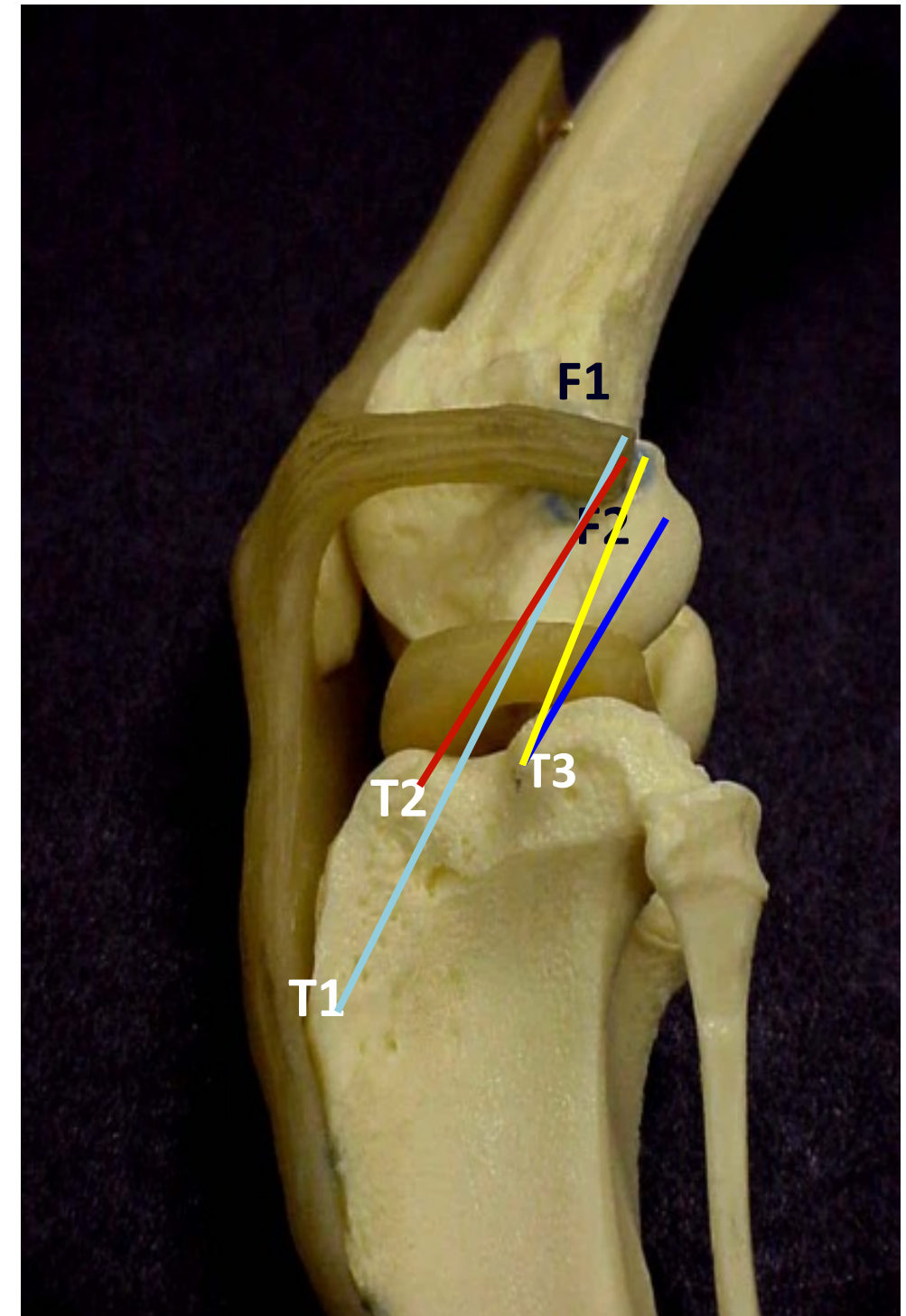
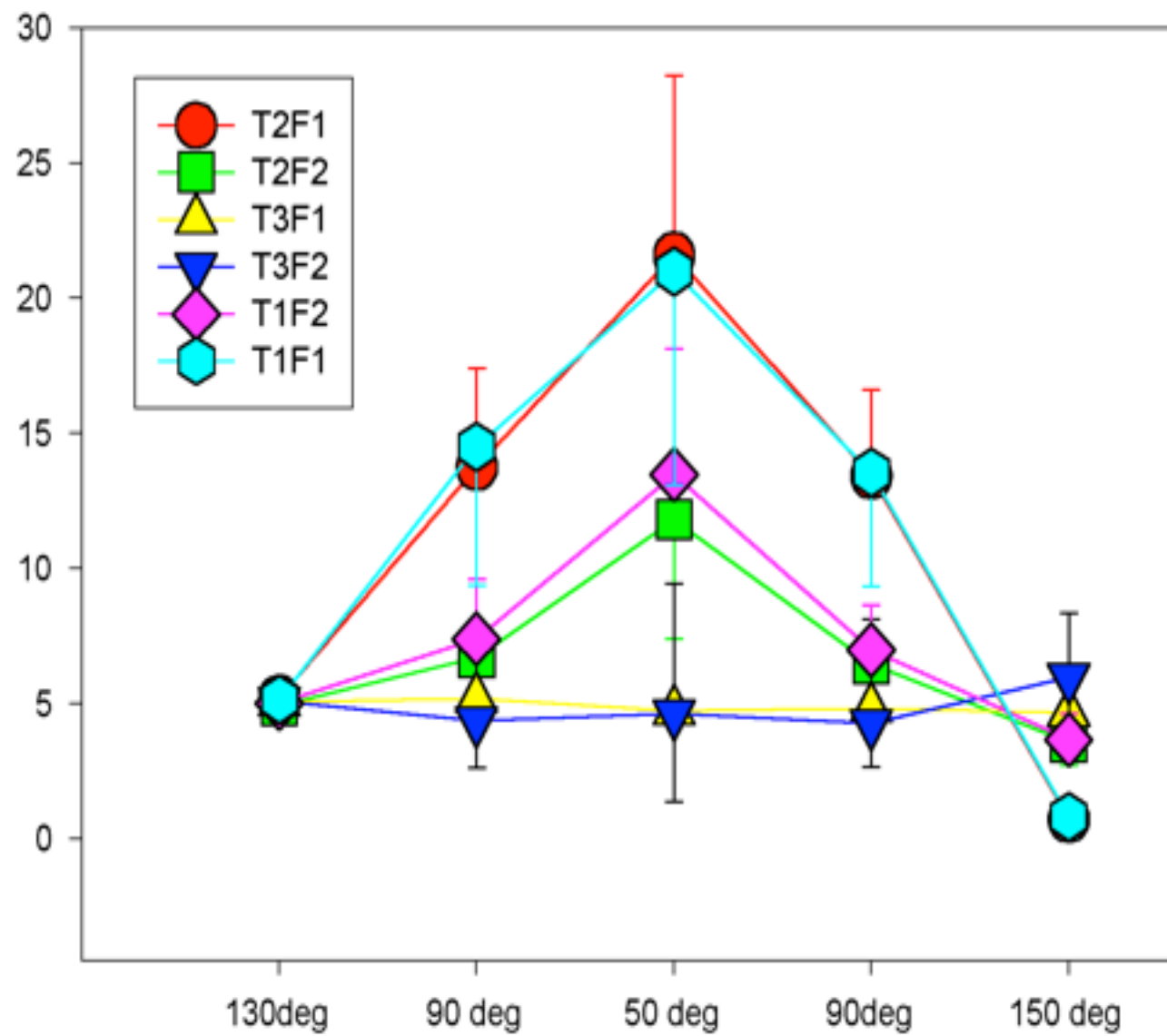


What is isometry?

The distance between two given points remains constant during range of motion

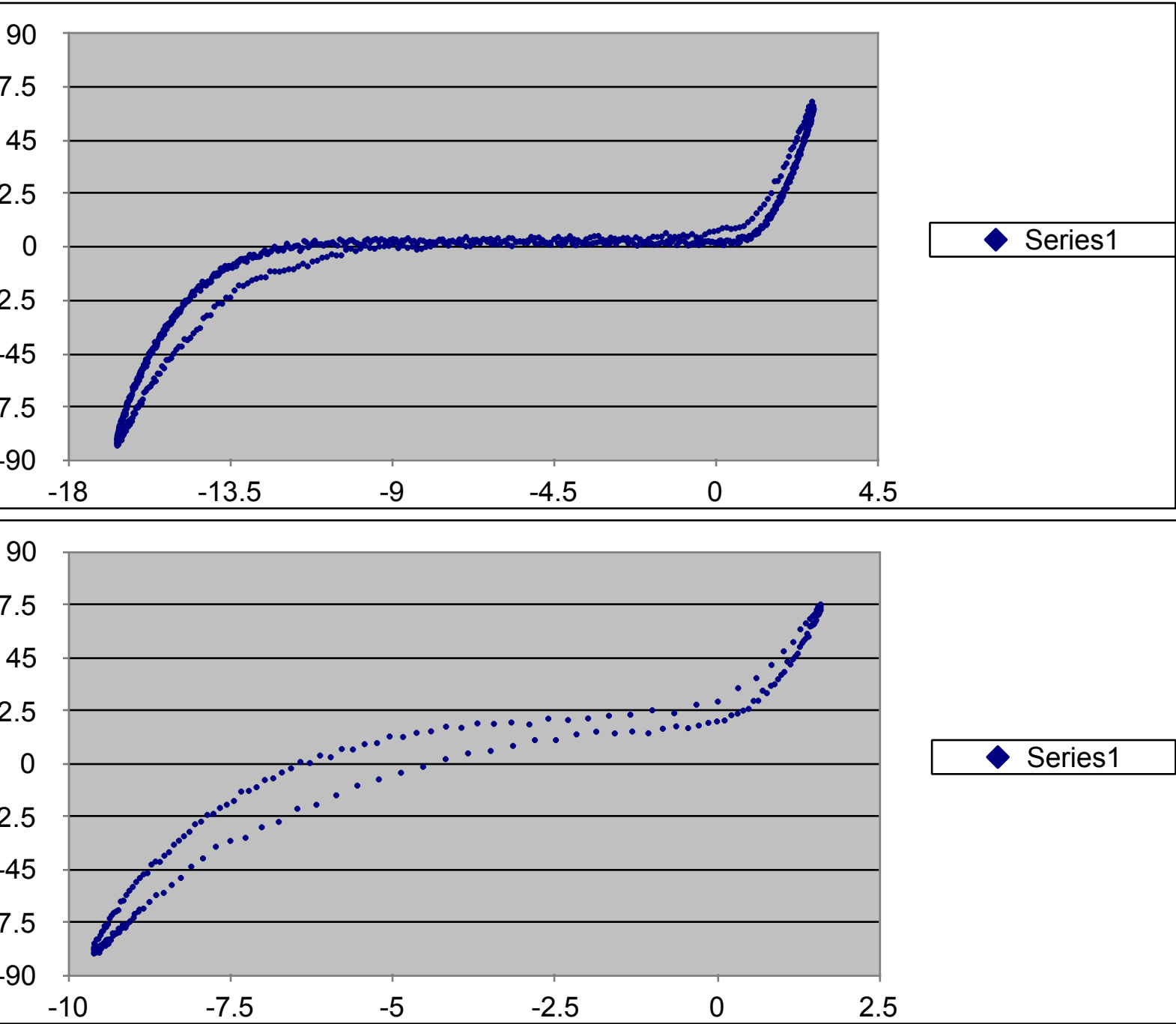


Isometric Sites

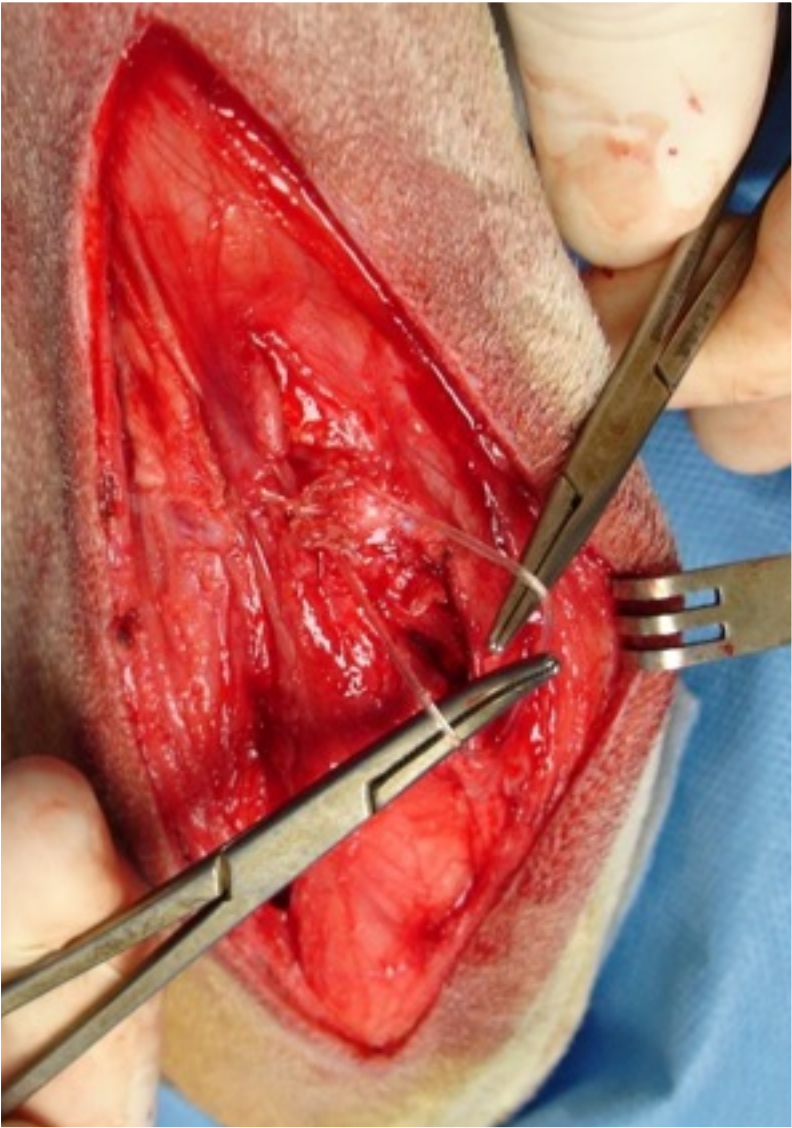


non-isometric site

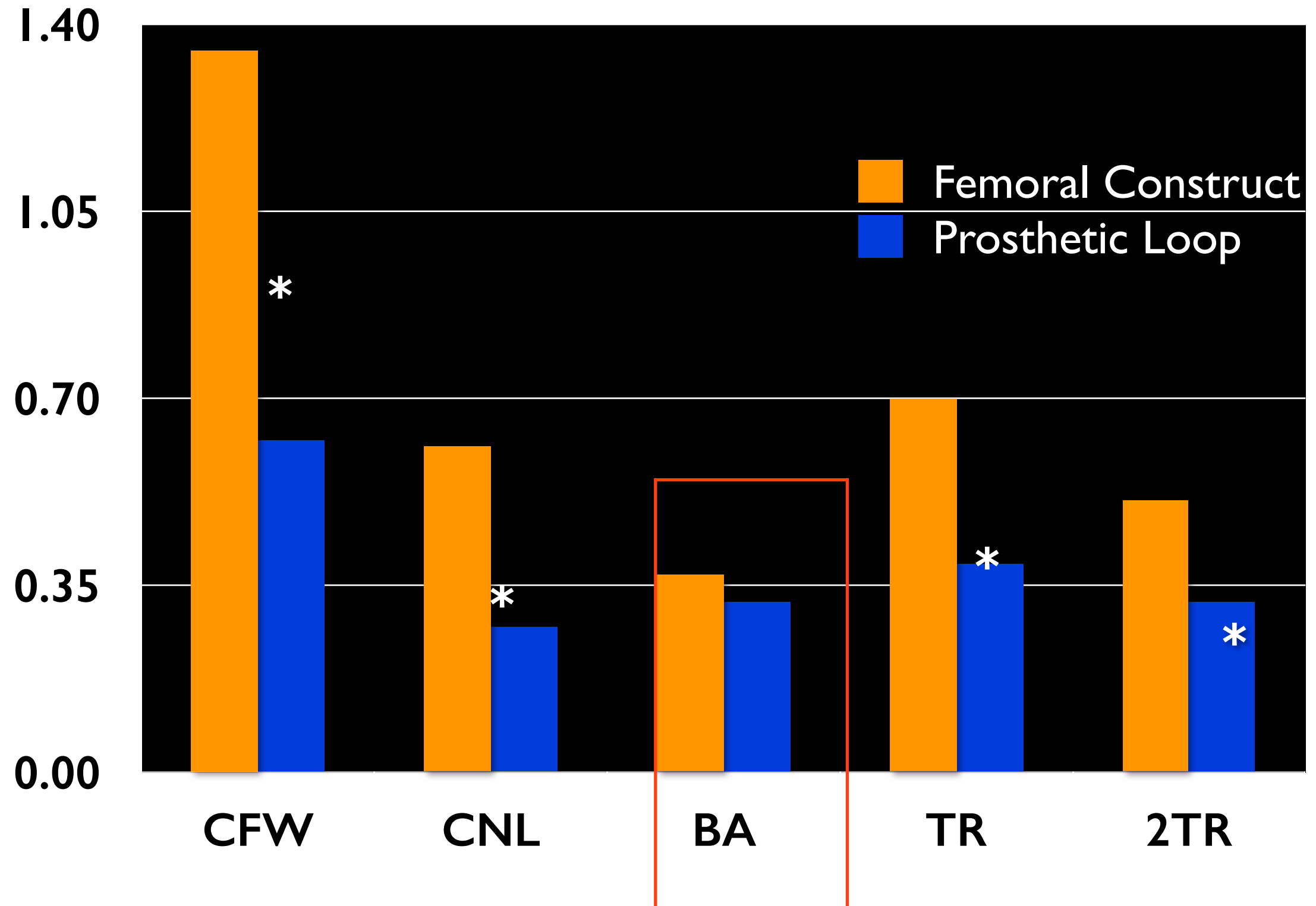
Transected L/D Curve



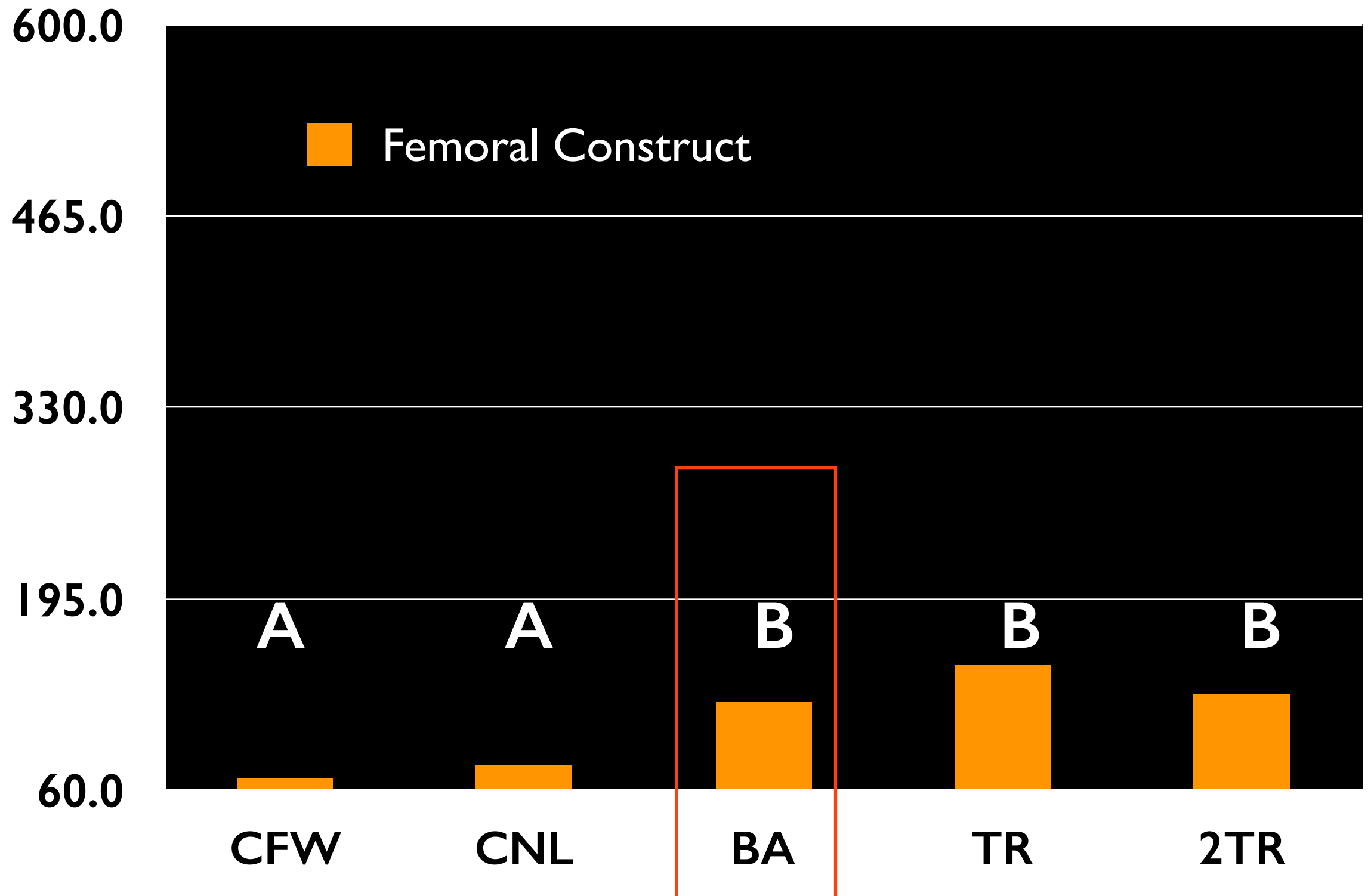
Nylon LFTS after 6 hrs cycling to 80 N in direction of cranial drawer

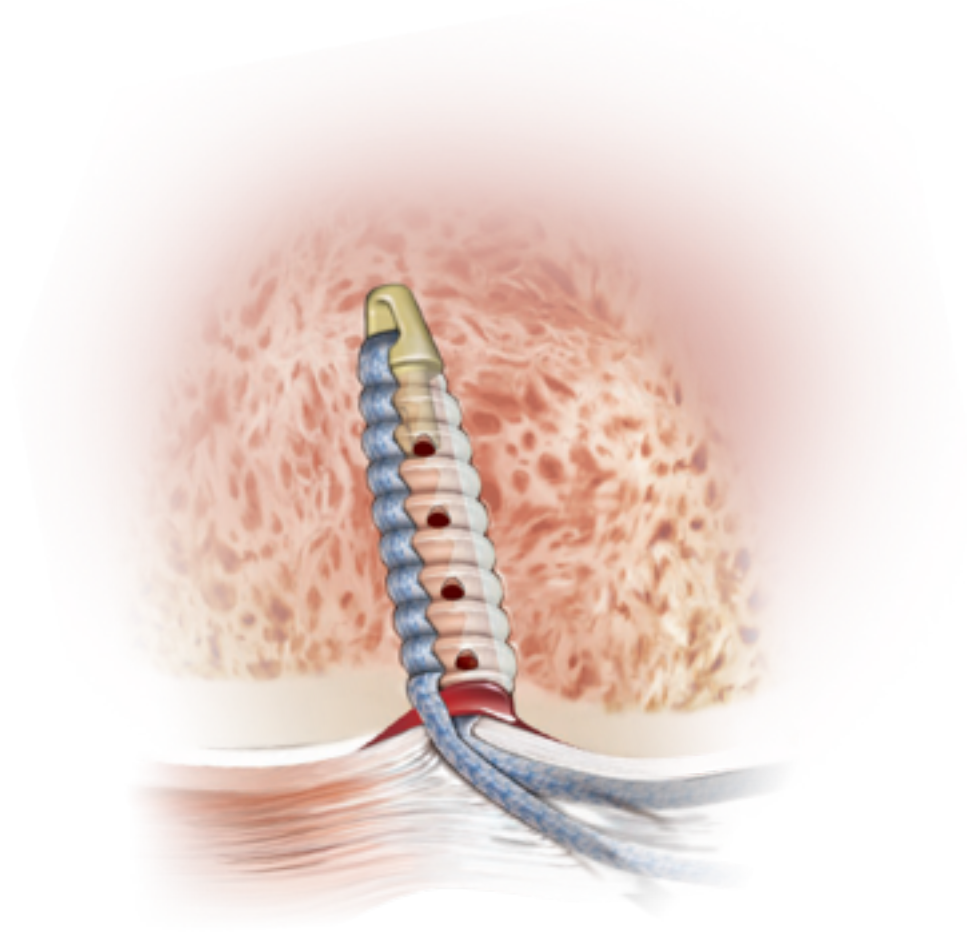


Lowest Creep Depends on Lack of Knot



Bone Attachment Techniques are Stiffer

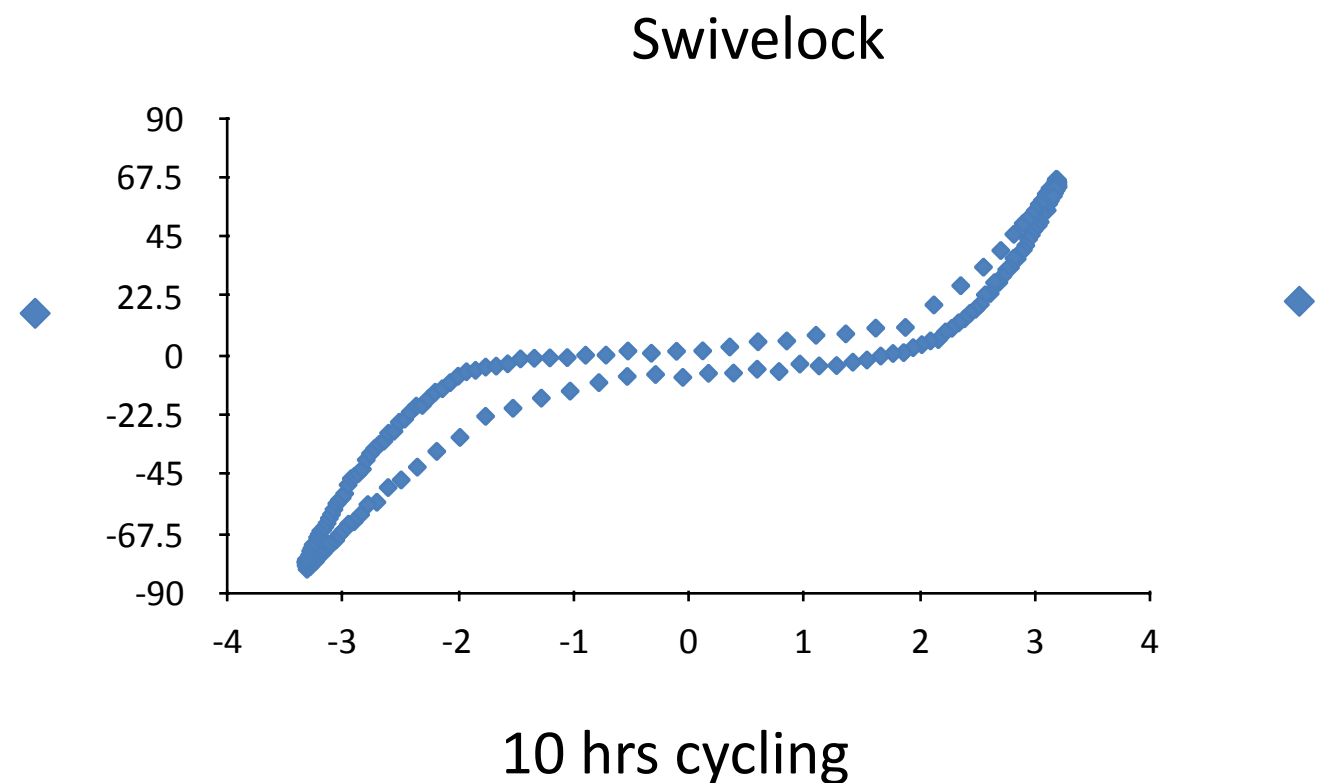
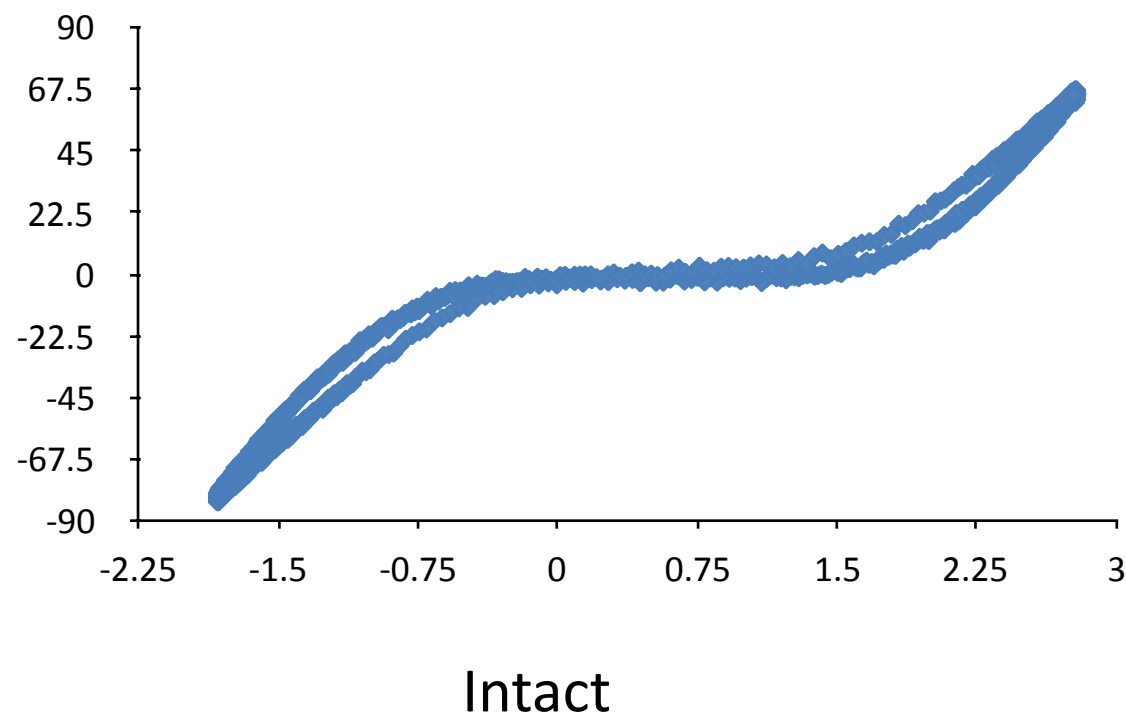


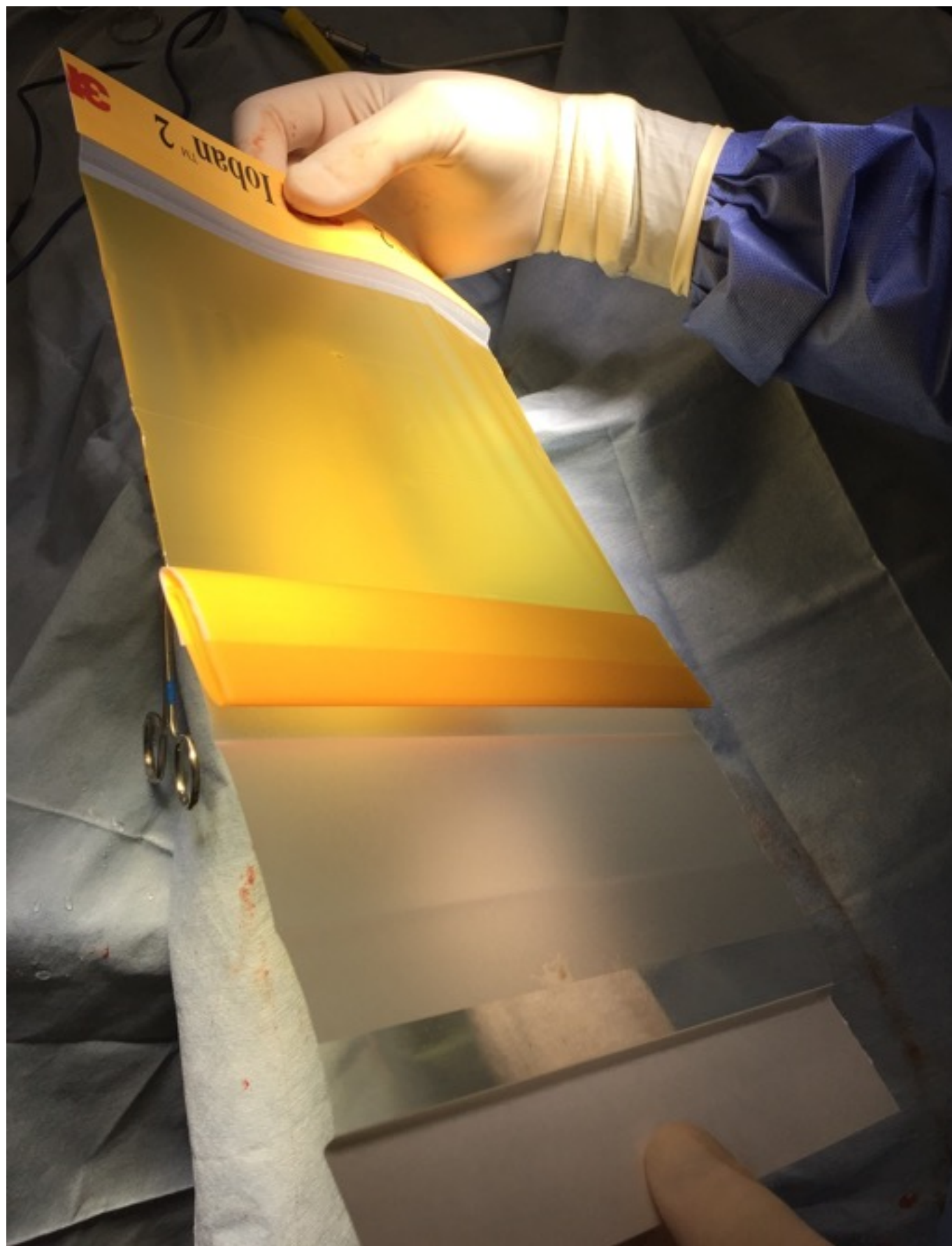


Mechanical Comparison of Lateral Circumfabellar Suture, Tightrope CCL, and SwiveLock Bone Anchor for Extracapsular Stabilization of the Cranial Cruciate Ligament-Deficient Stifle in Dogs

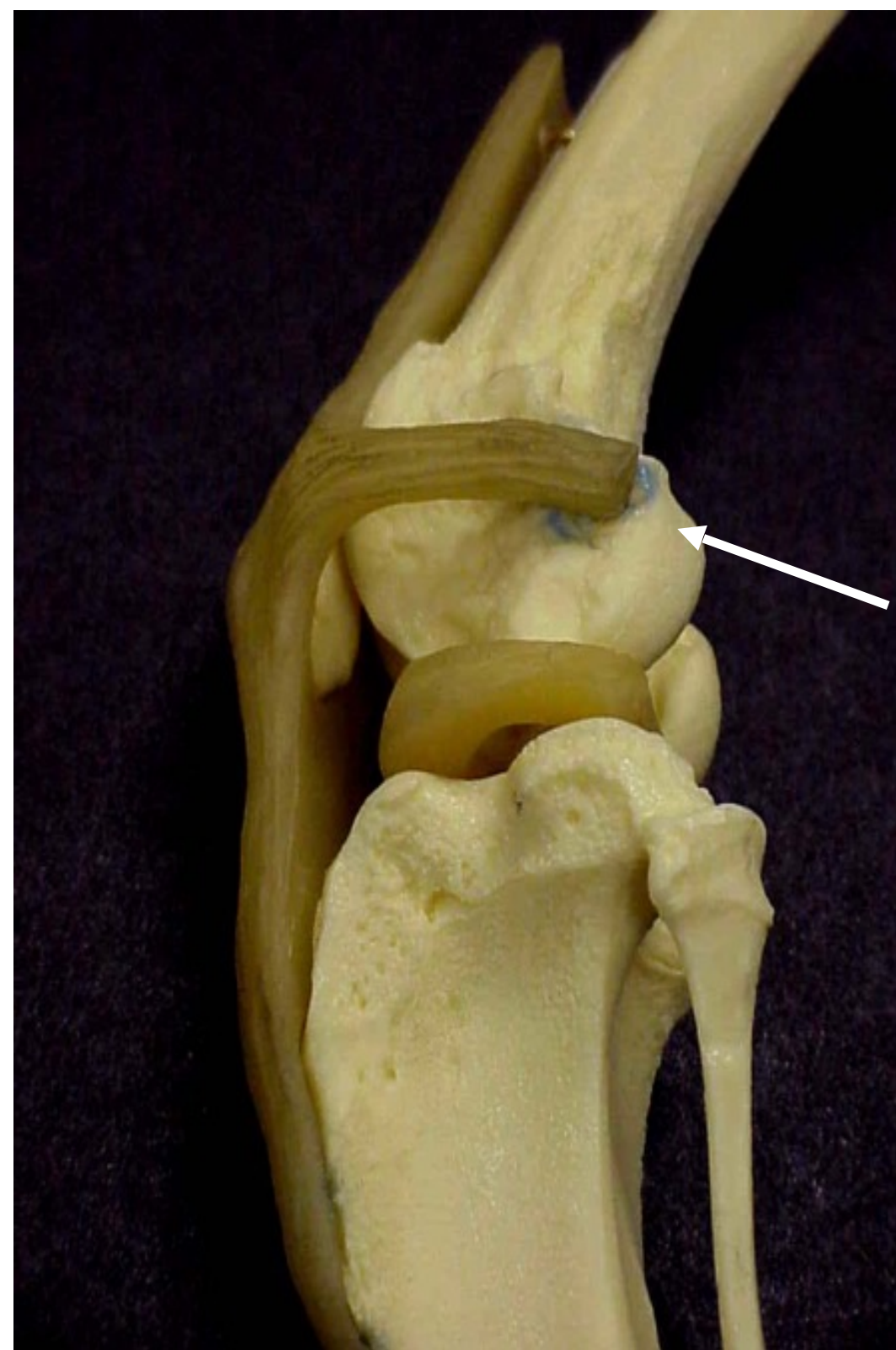
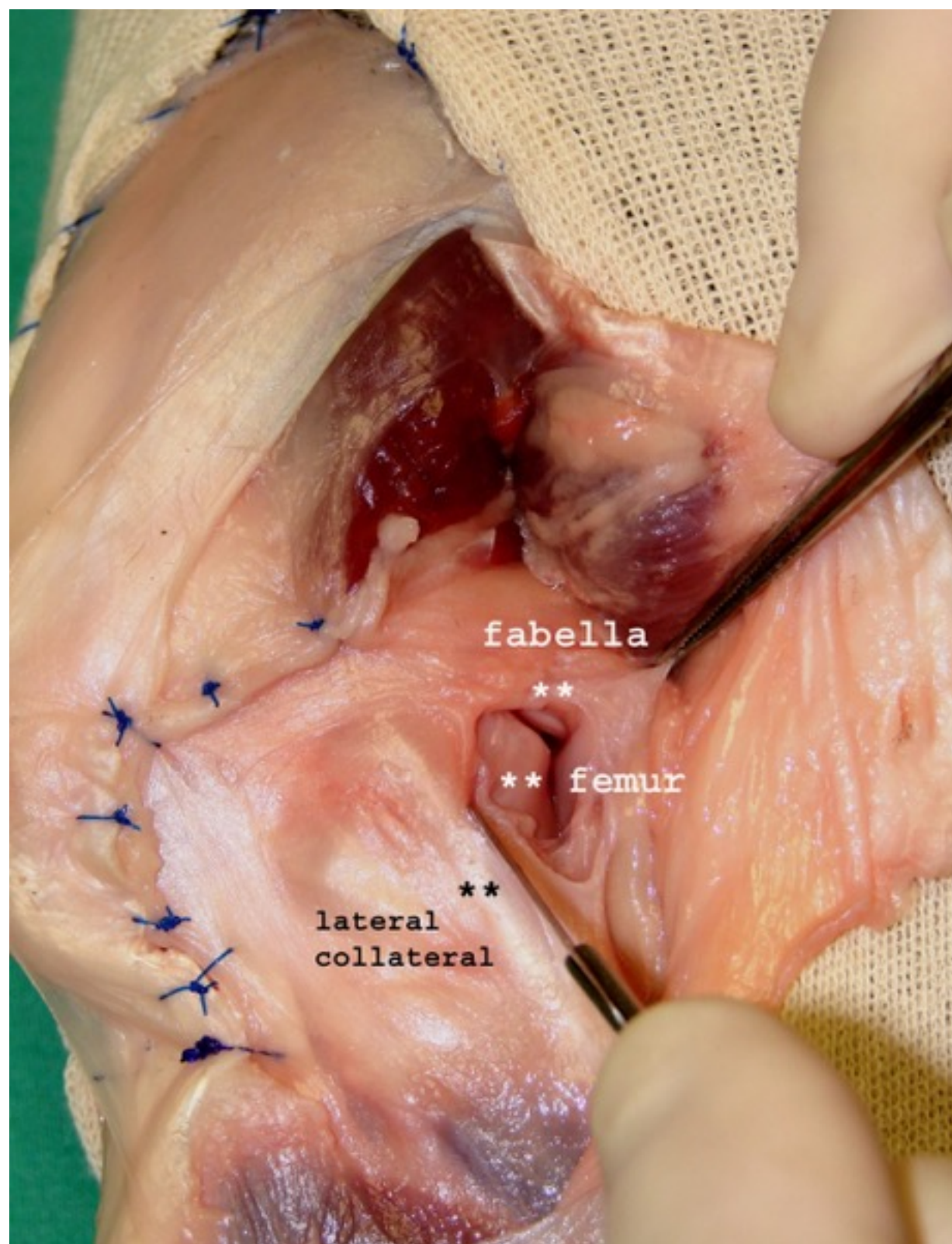
Christina J. Choate, DVM, Antonio Pozzi, DVM, MS, et.
al

- SwiveLock had least elongation, stress relaxation, and CREEP
- 2 strands (4 arms) = 769 N
- SwiveLock constructs had the least peak to peak elongation

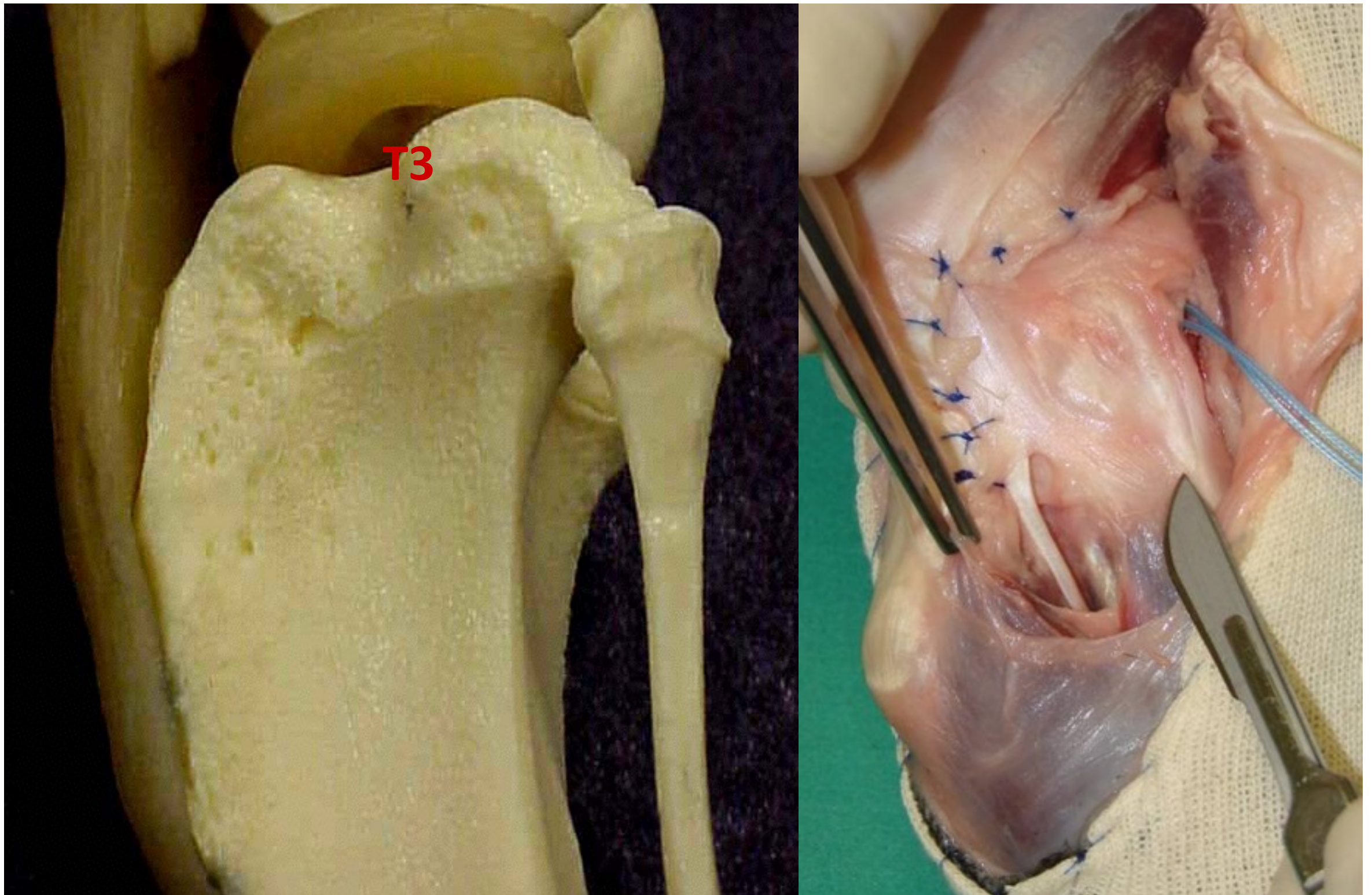


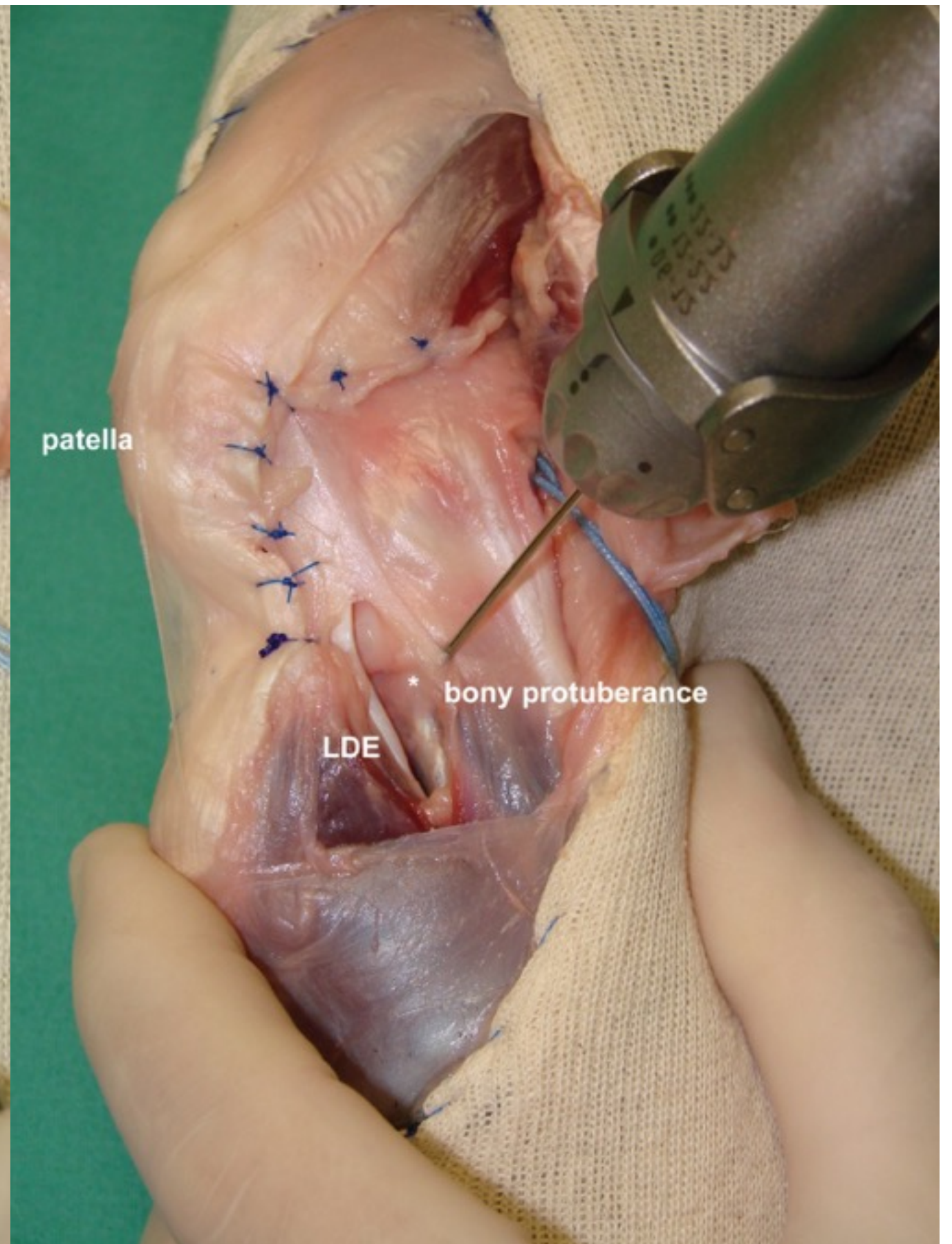
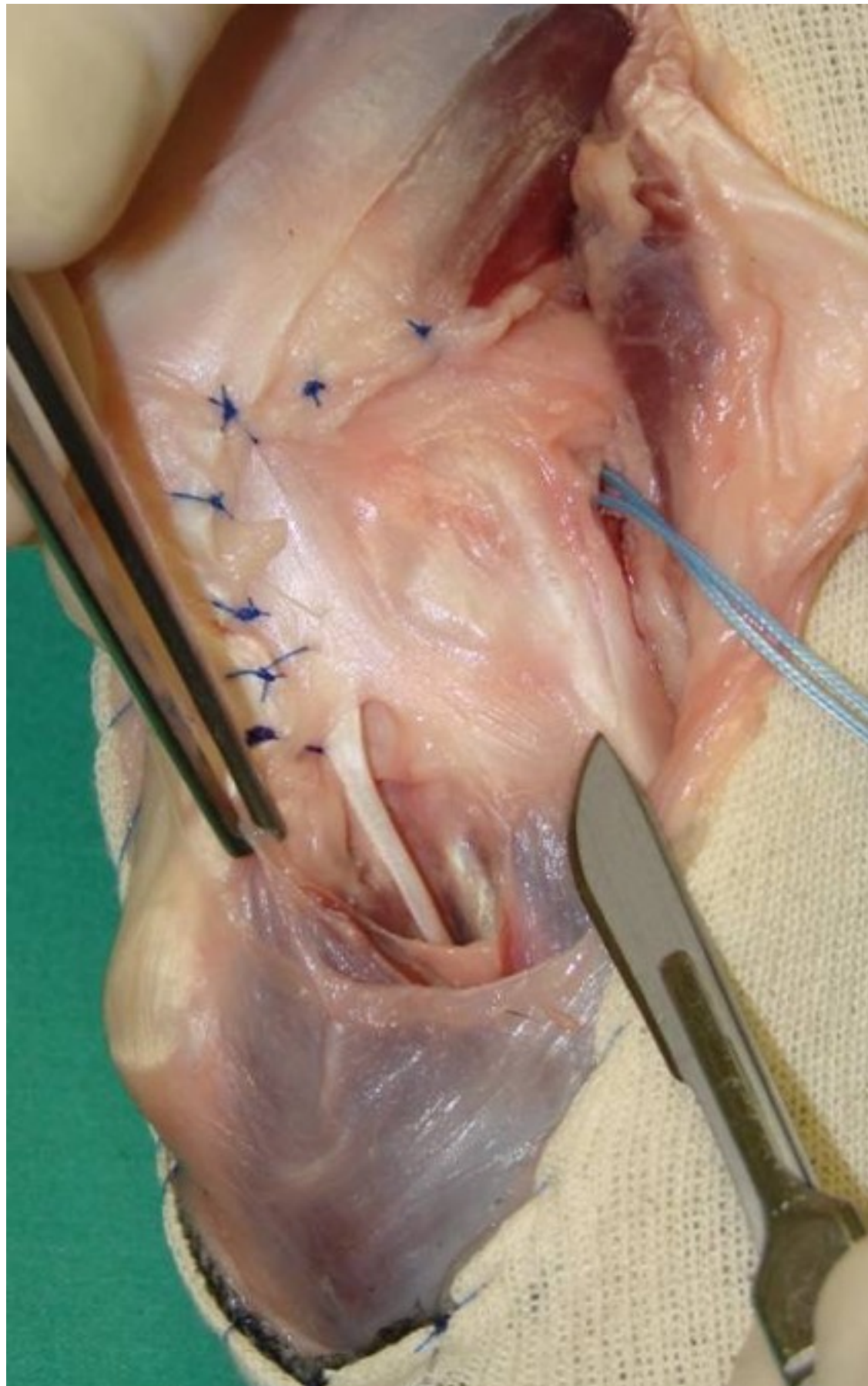


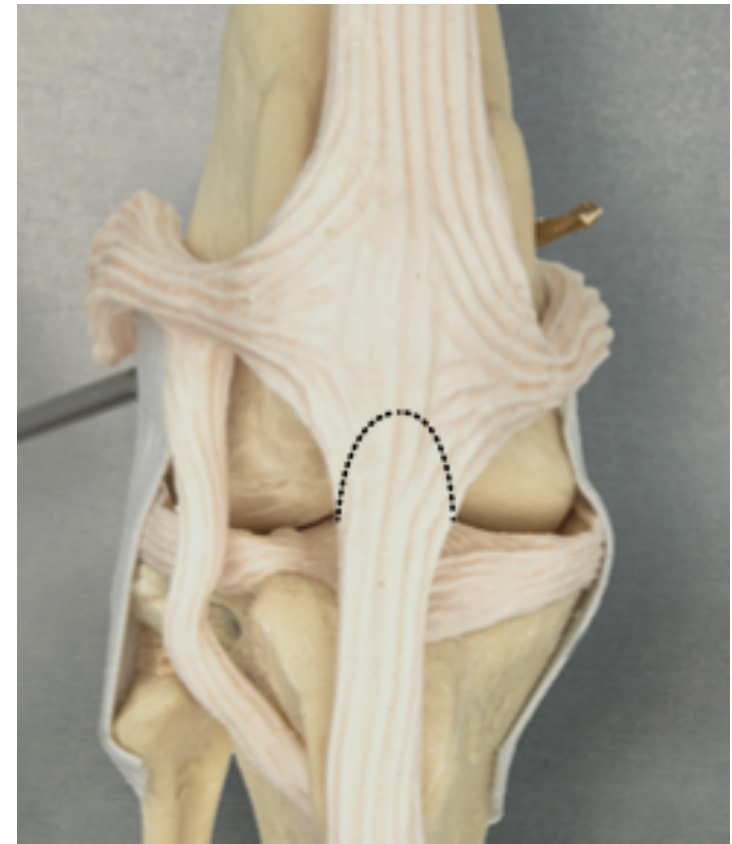


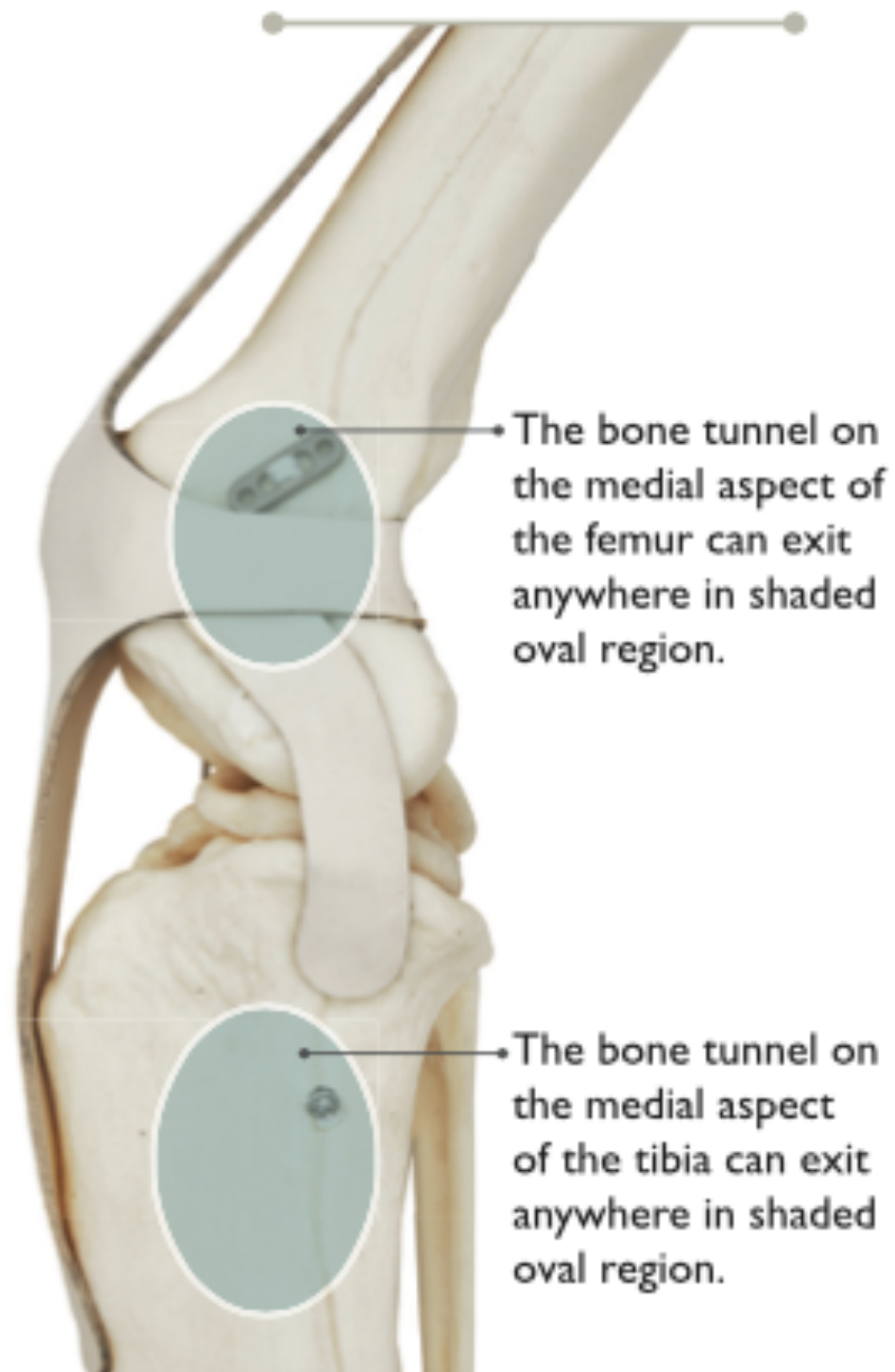


Tibial Site





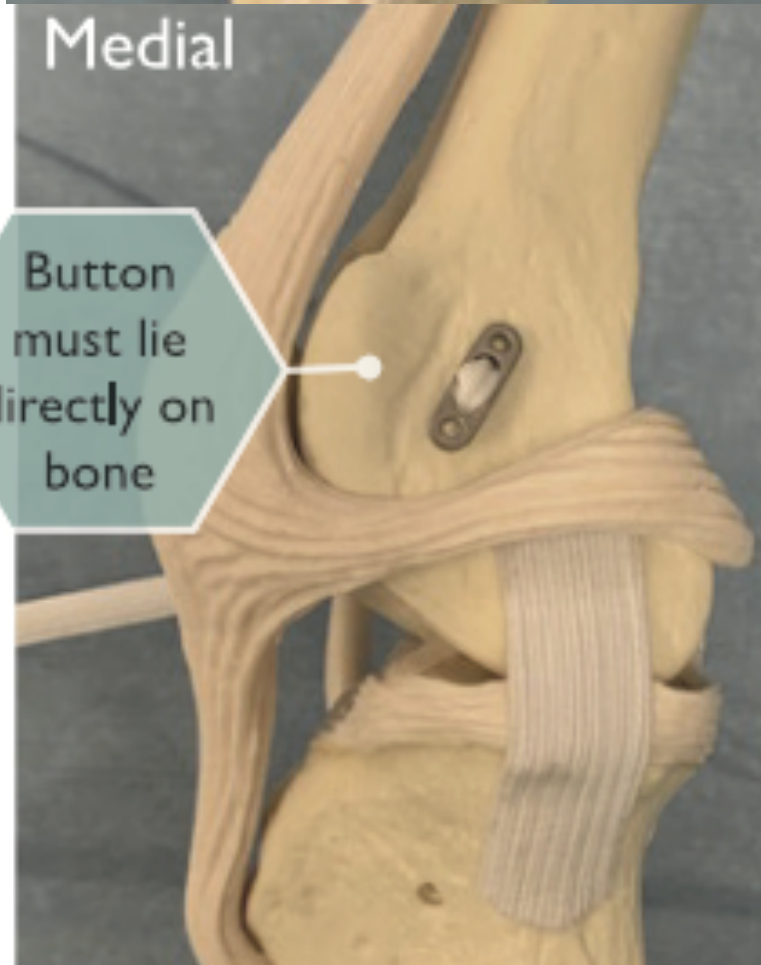


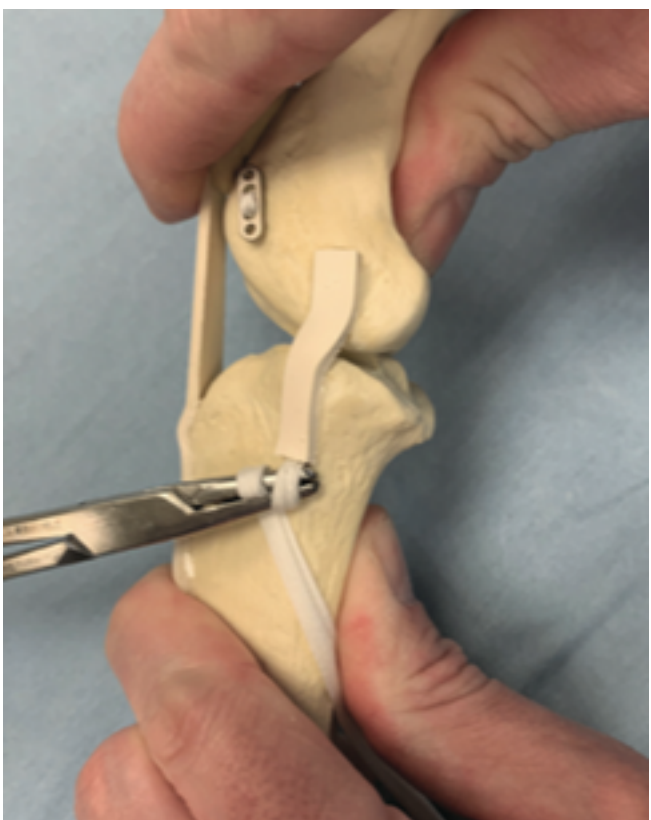




Medial

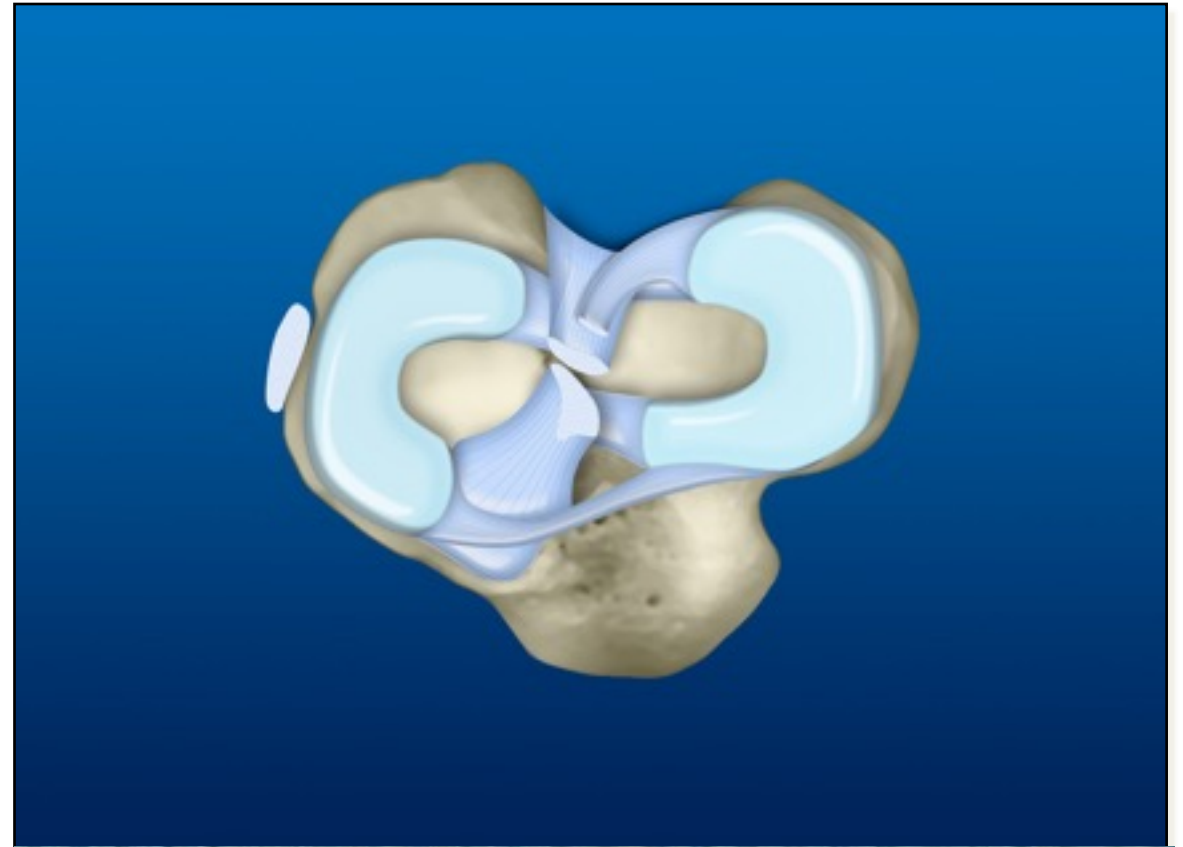
Button
must lie
directly on
bone



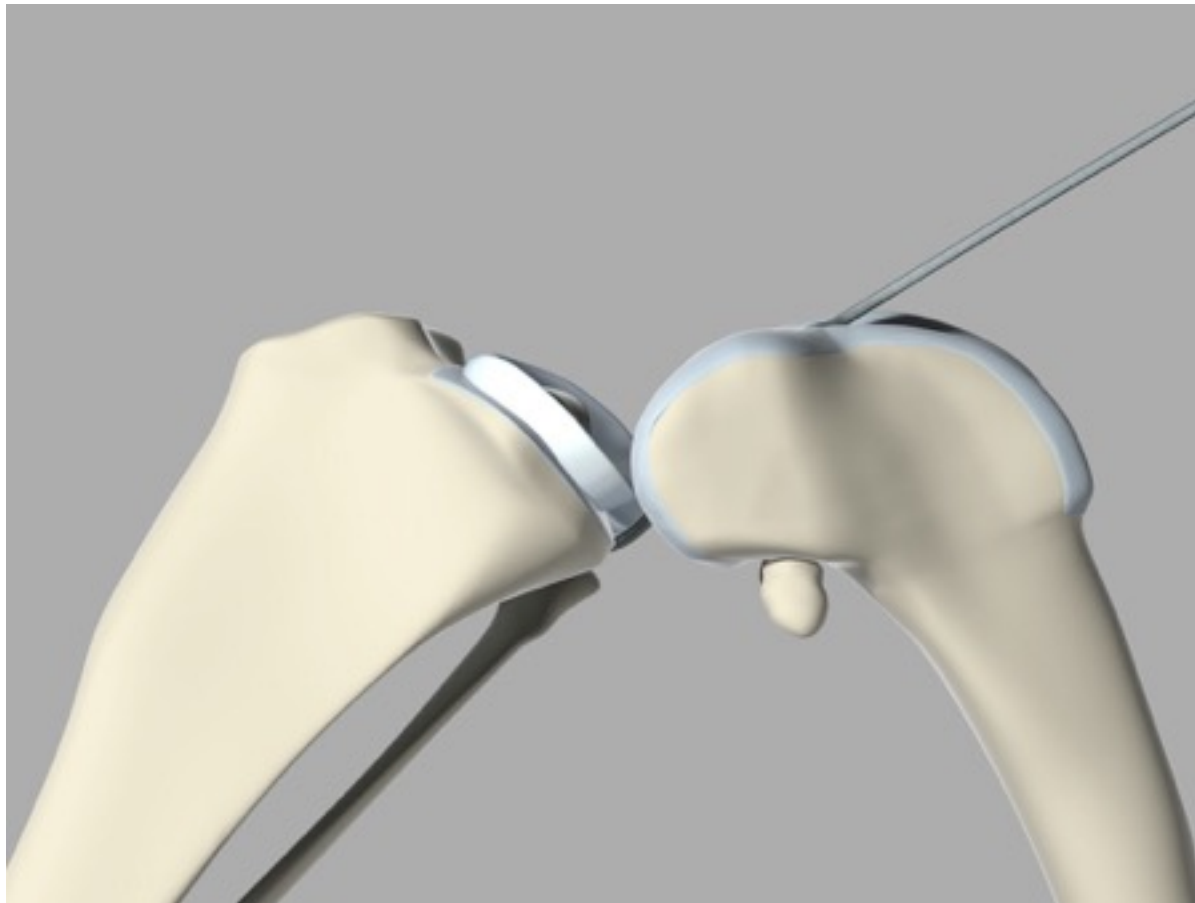


Meniscal Anatomy

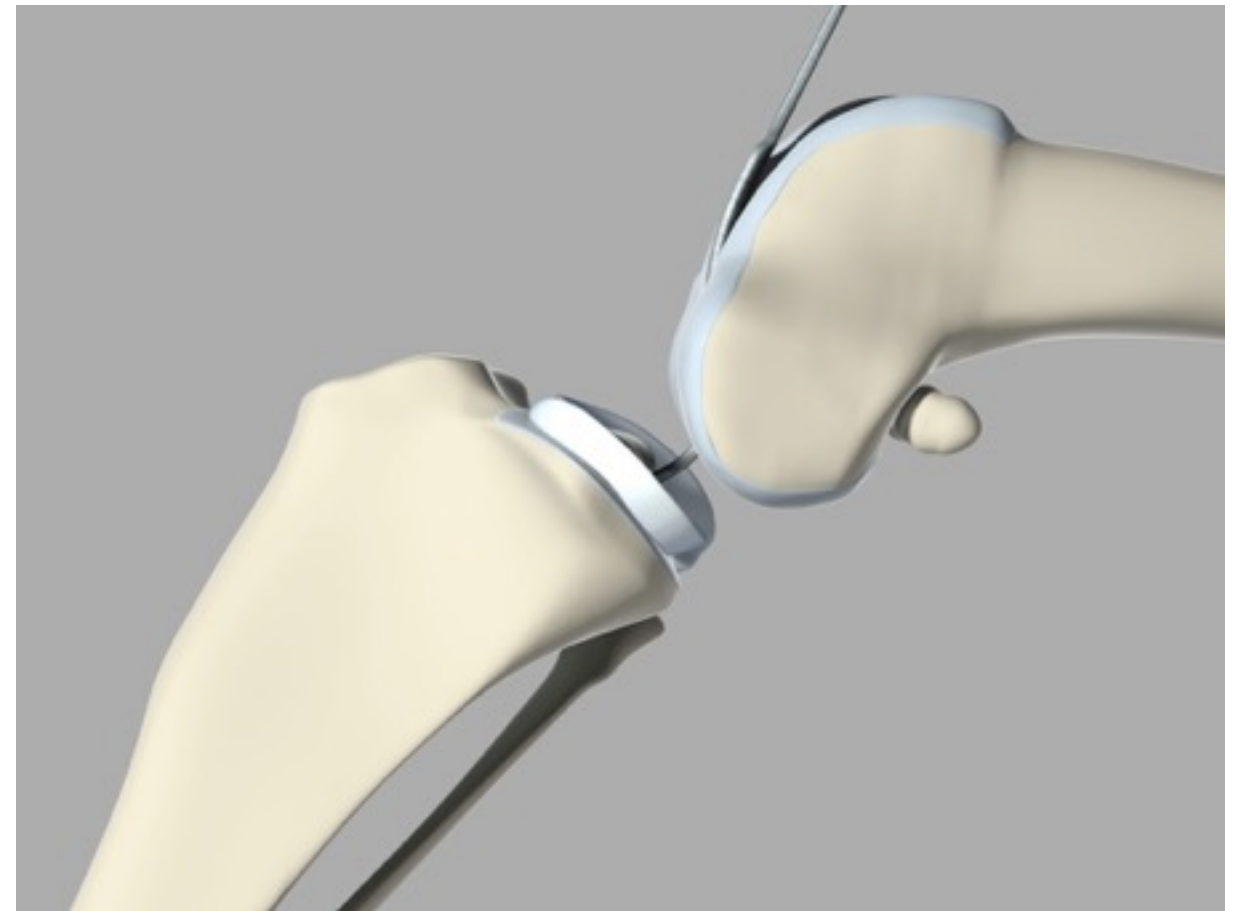
- CnCL
- CdCL
- Medial meniscus
- Lateral meniscus



Tibial Subluxation



Tibial Distraction

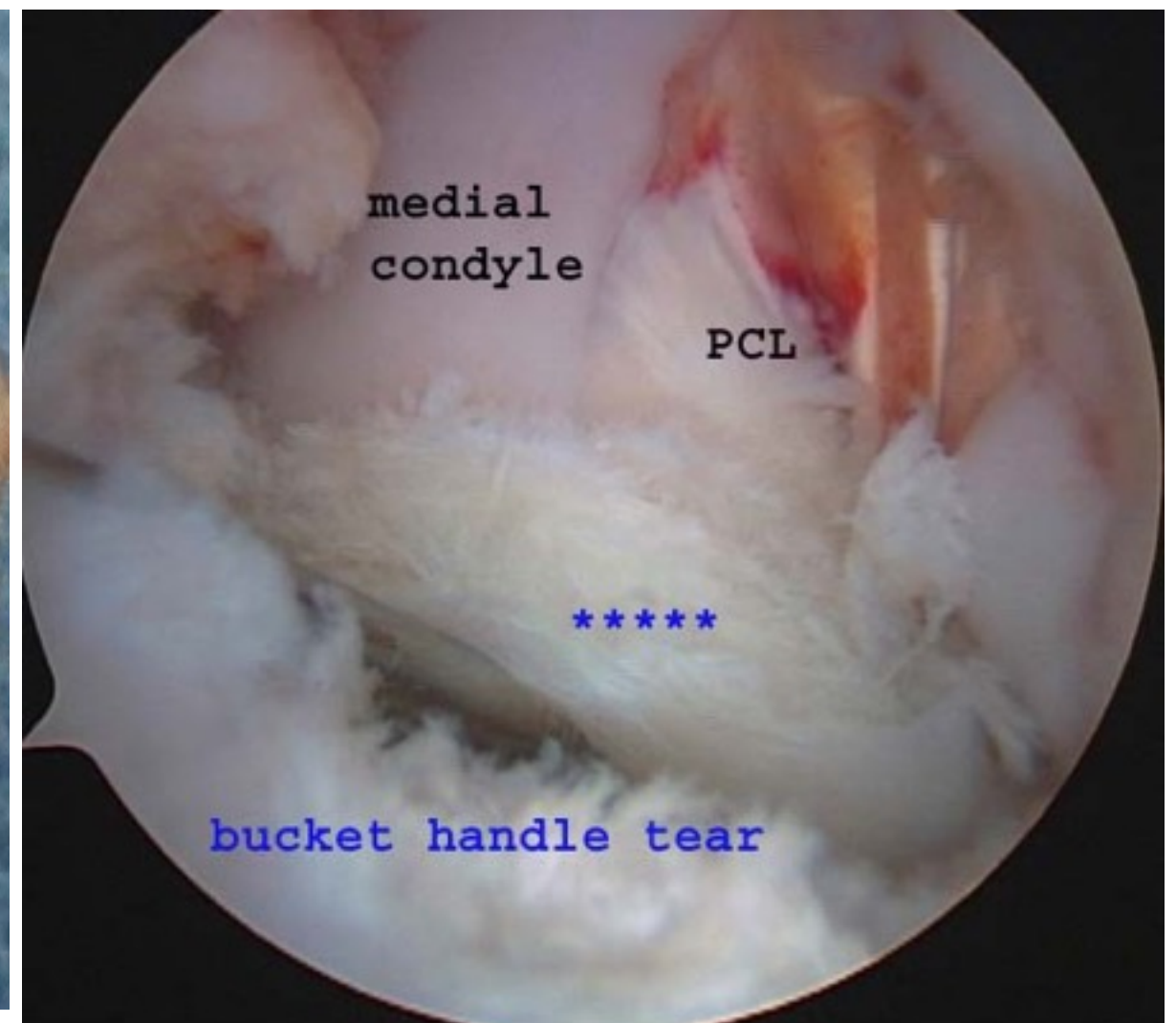
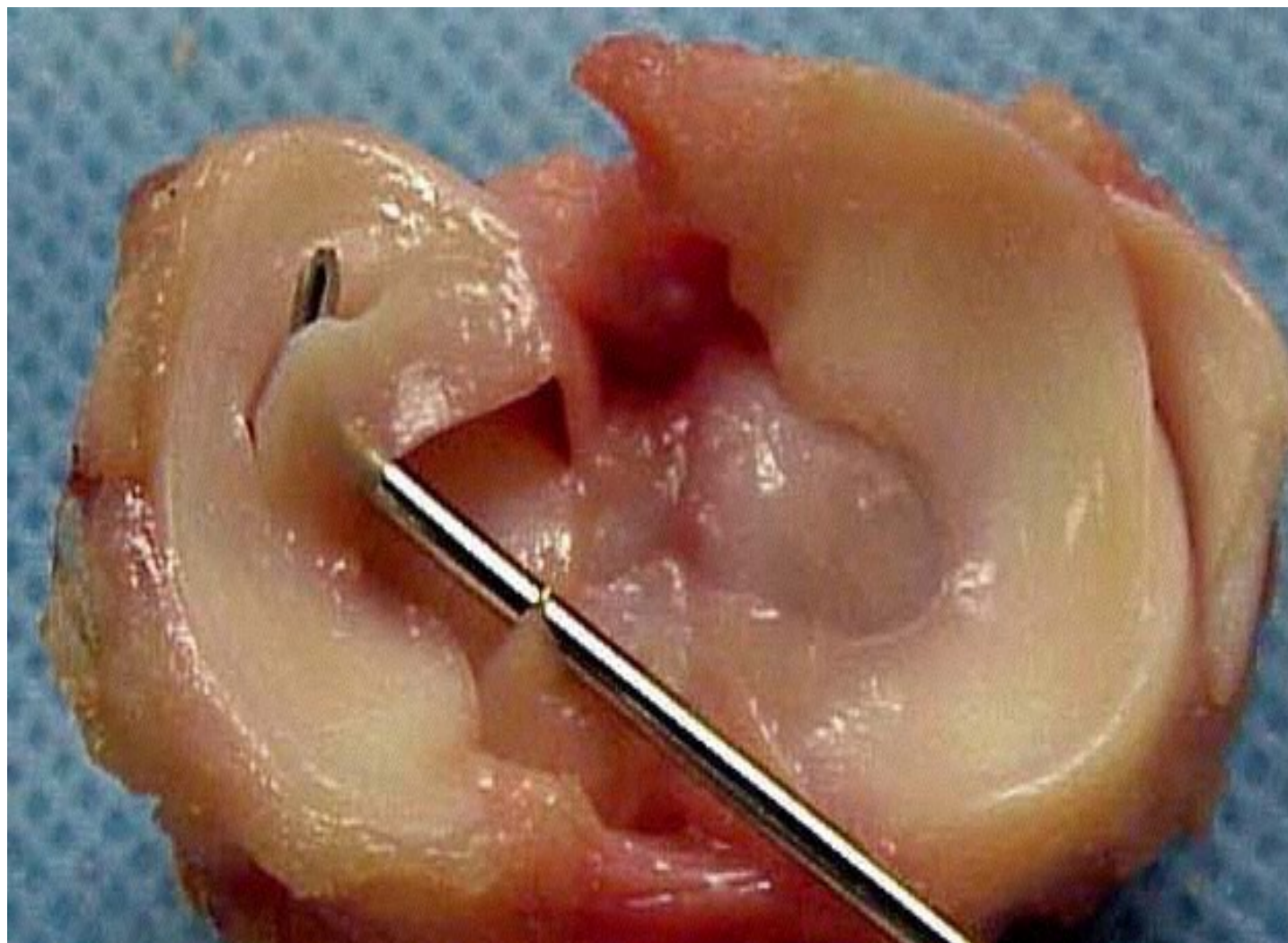


Storz Stifle Distractor

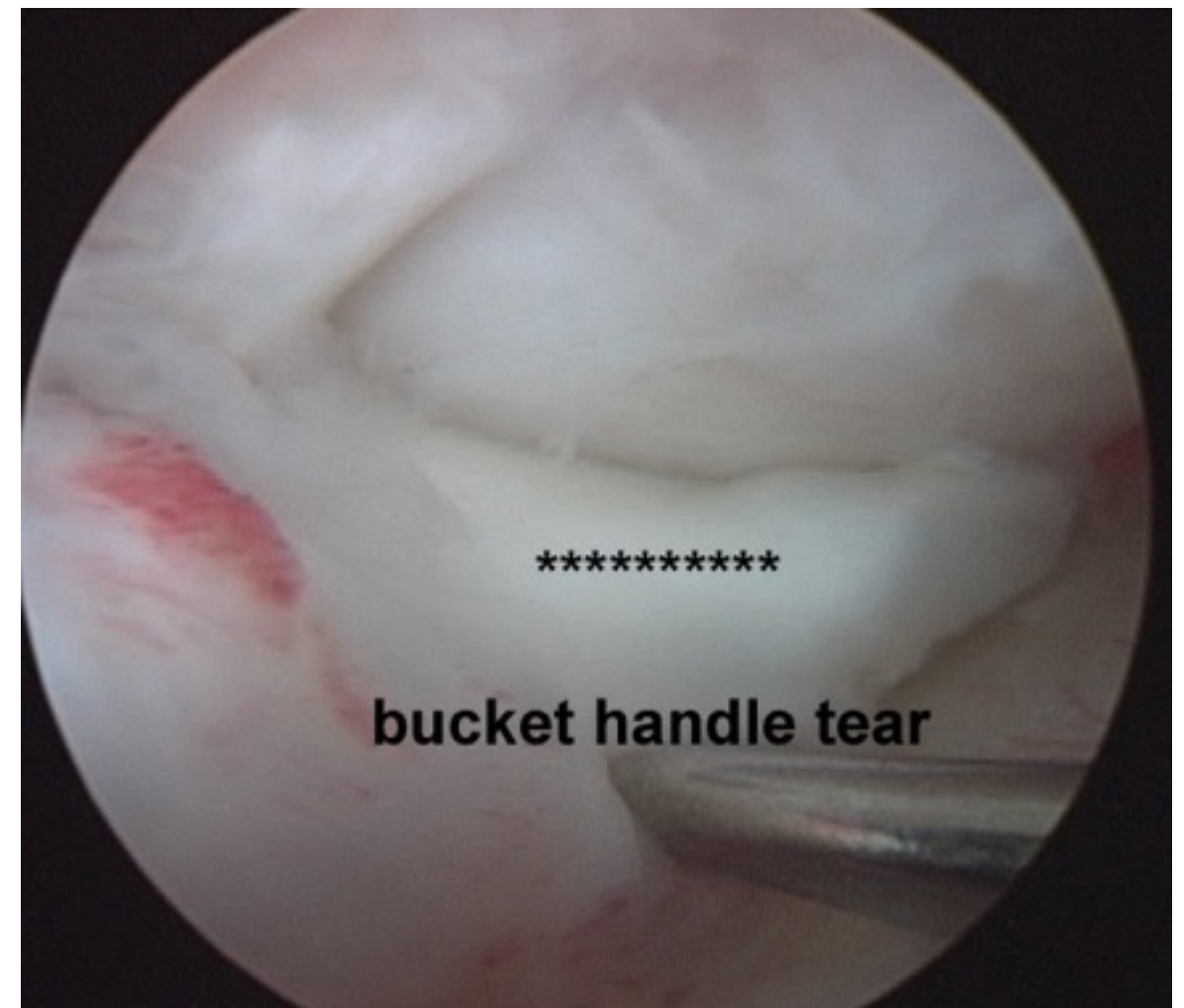
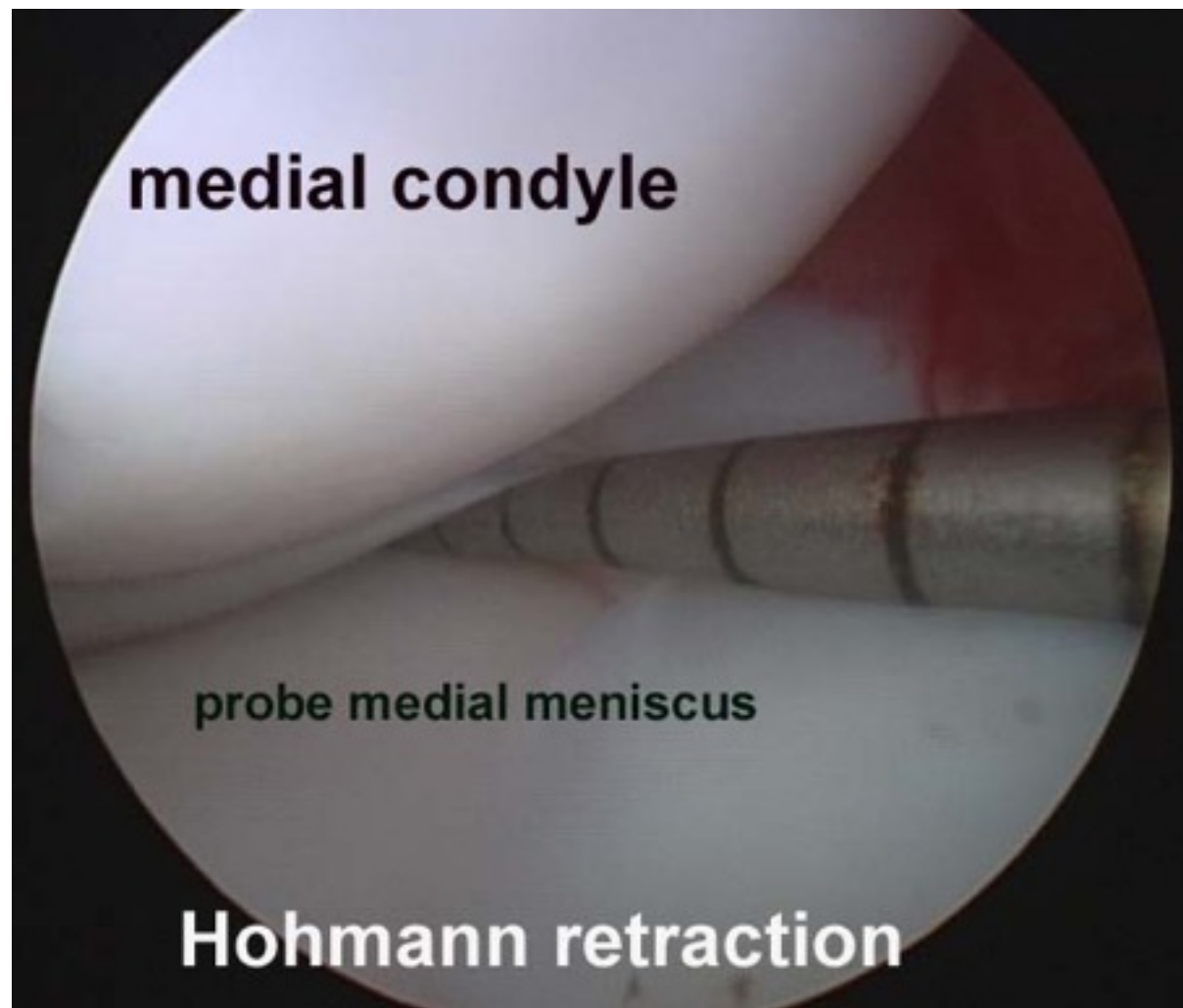


Bucket-handle Tear

- Full thickness tear within the body of the posterior horn

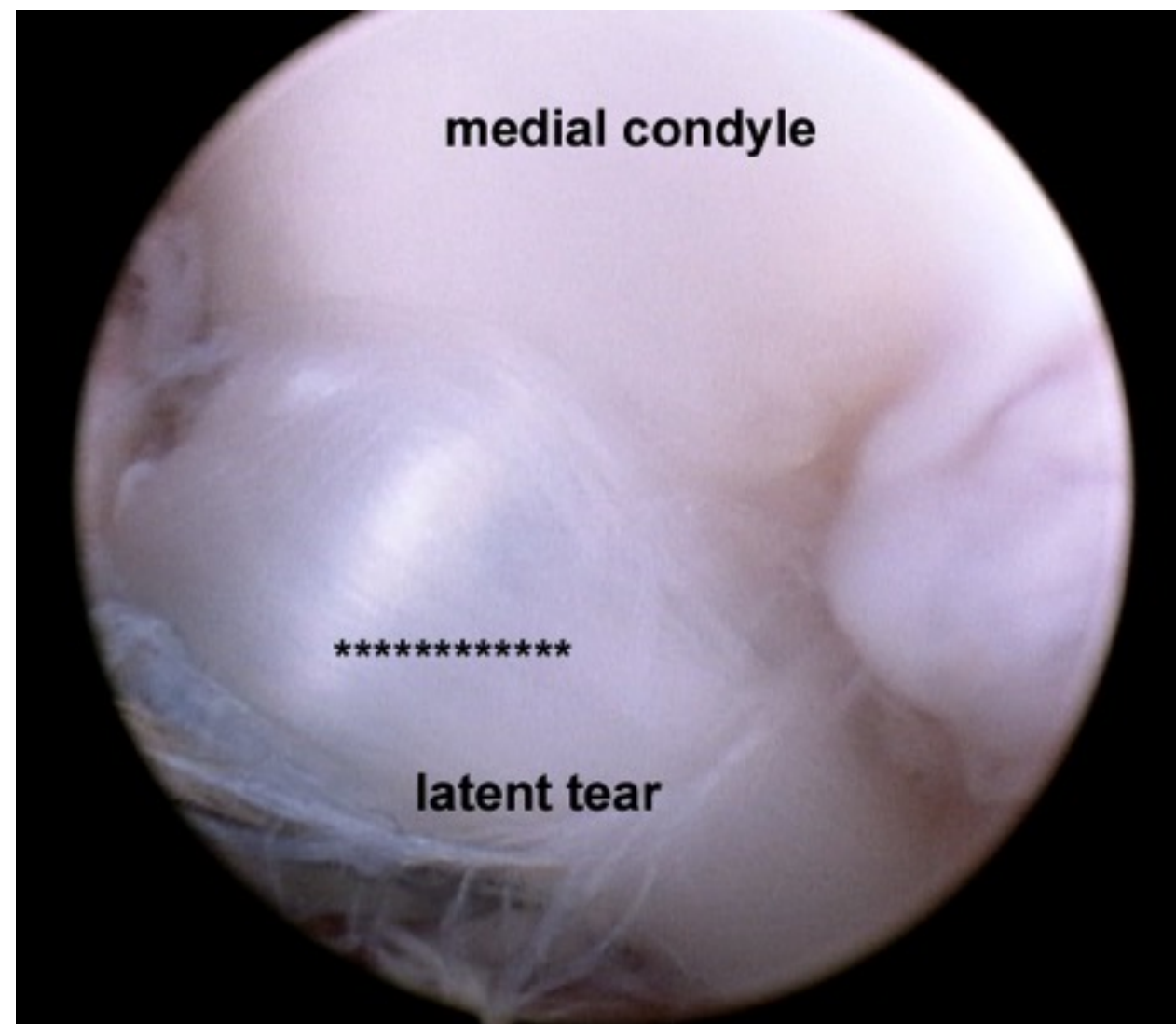
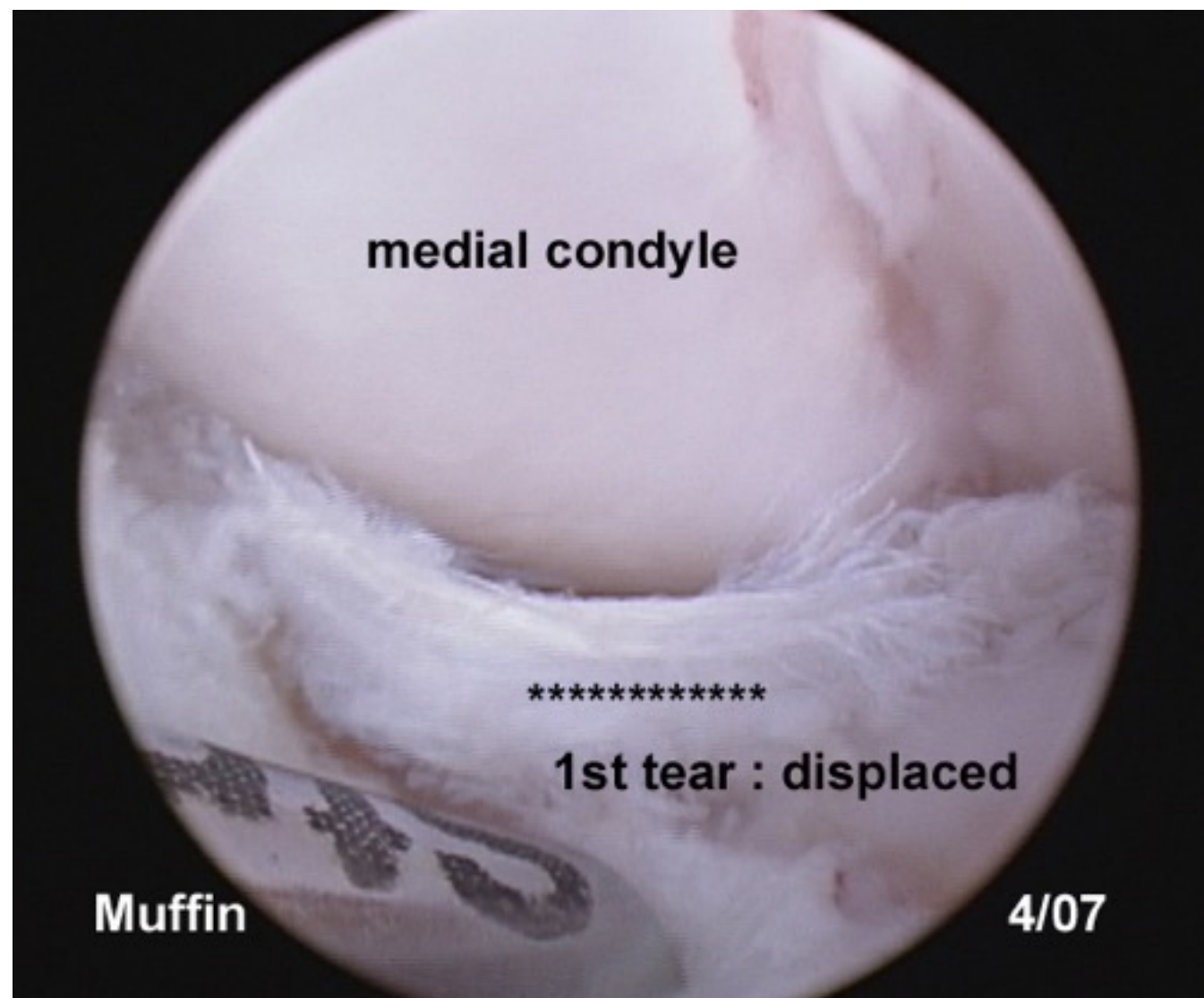


Latent Meniscal Tear



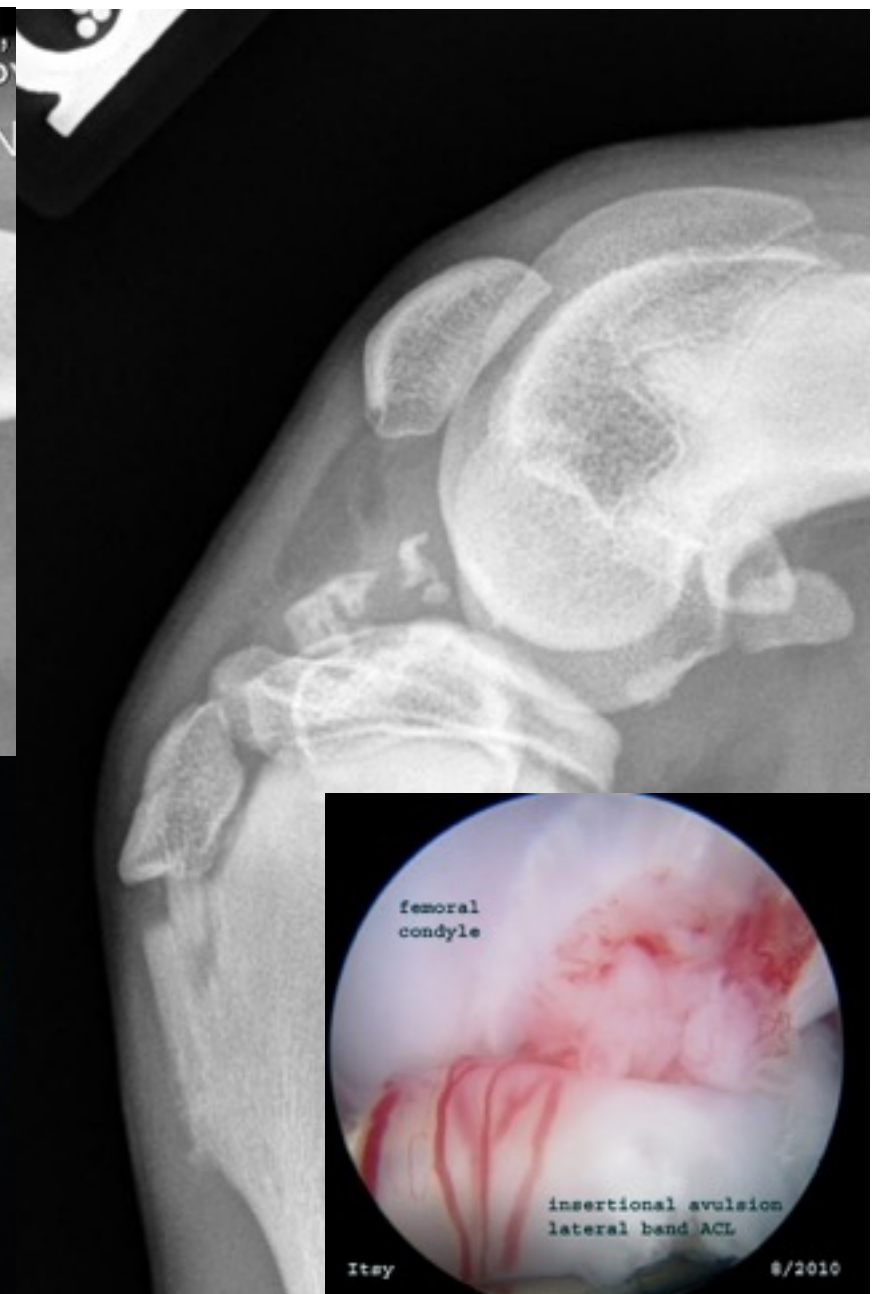
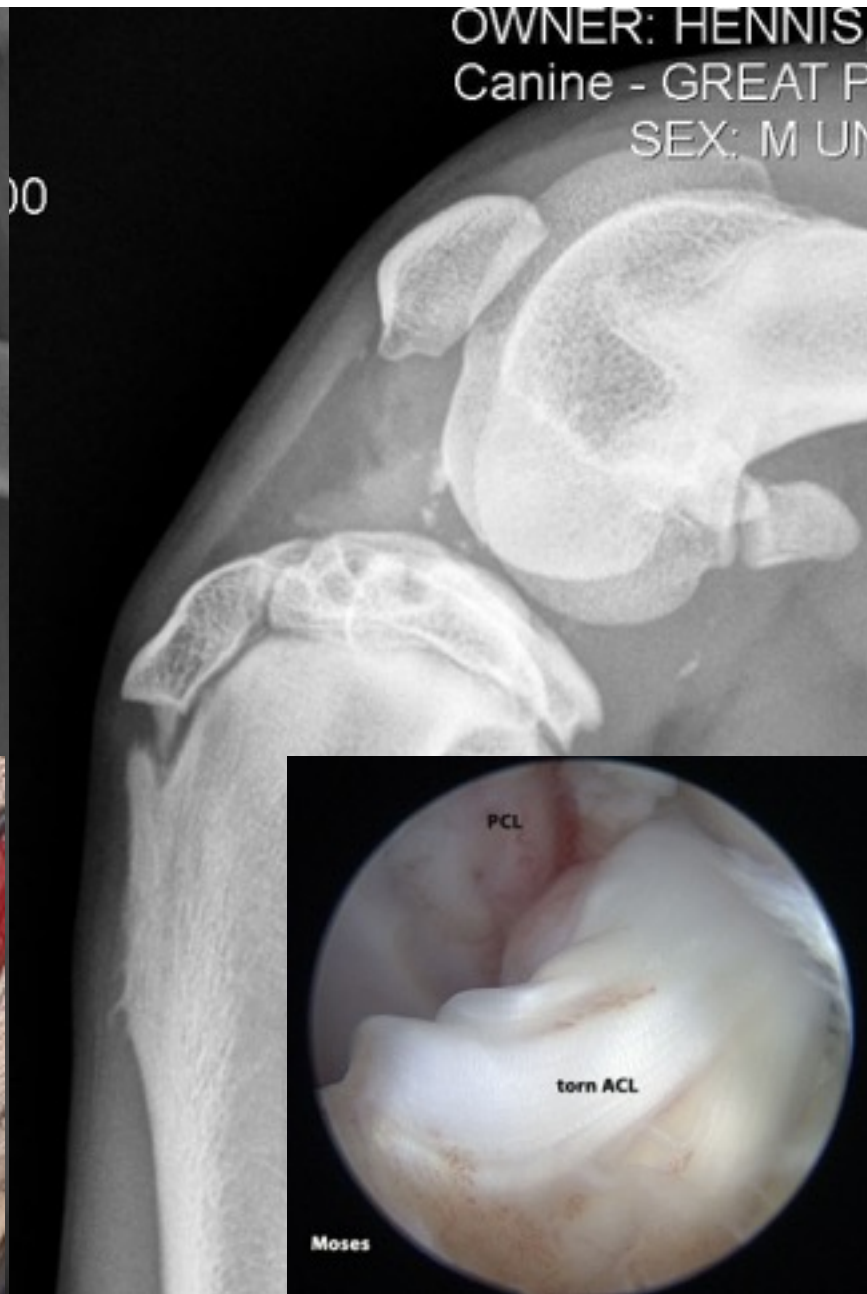
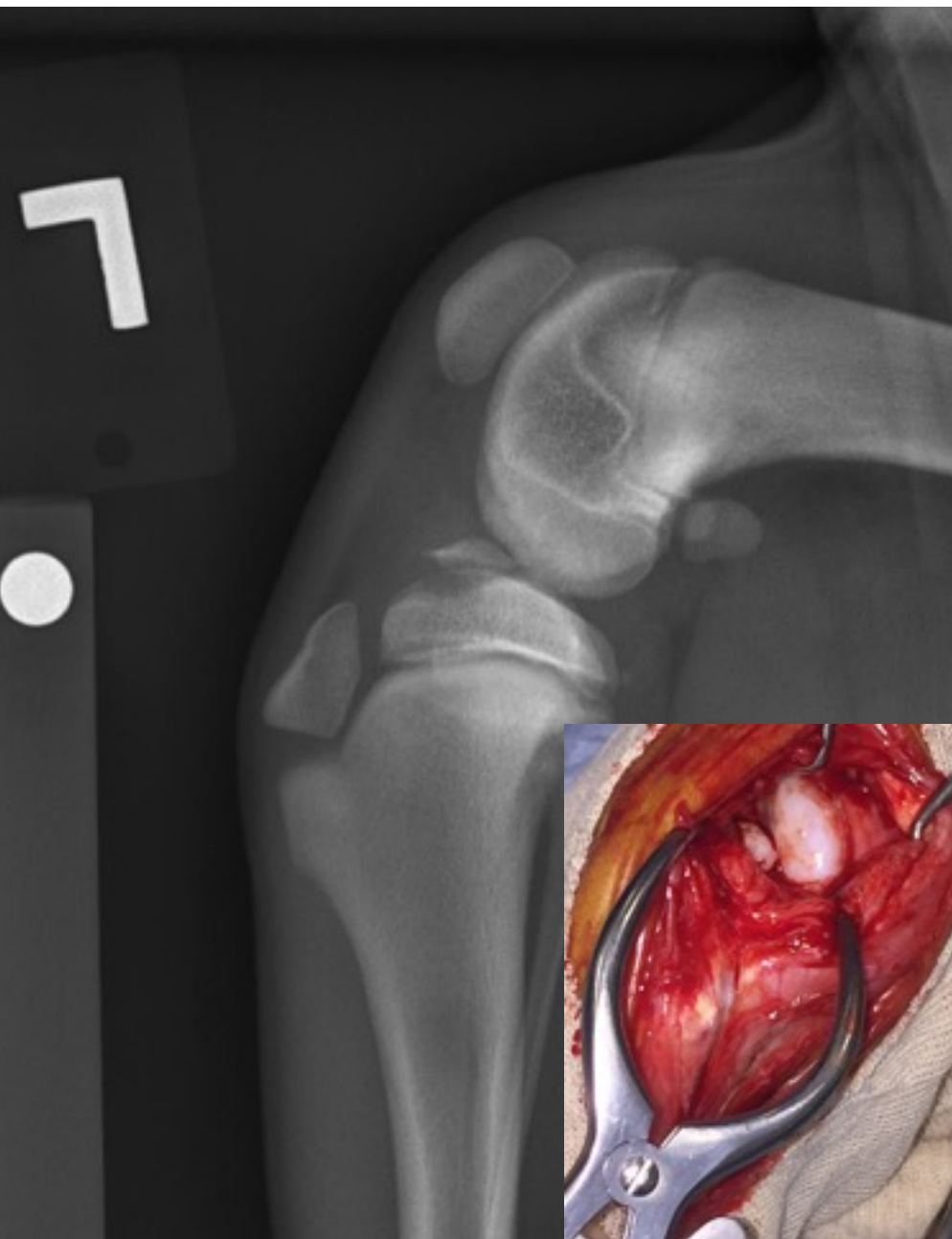
thorough probing

Latent Meniscal Tear



thorough probing

Juvenile ACL Injury

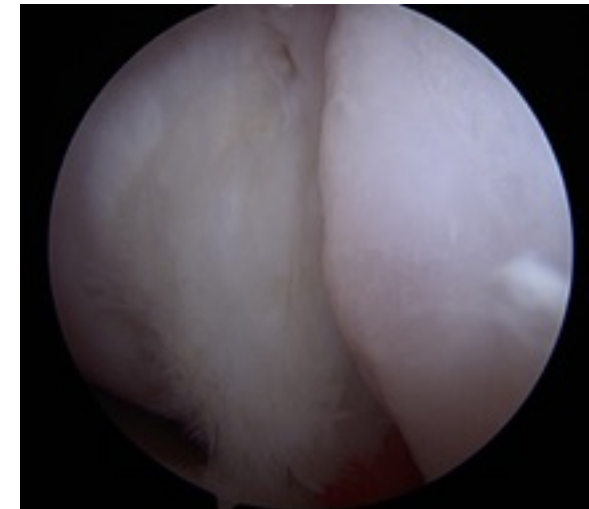
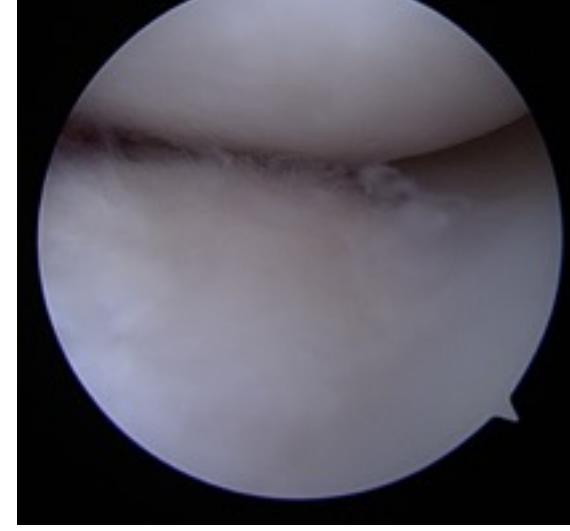
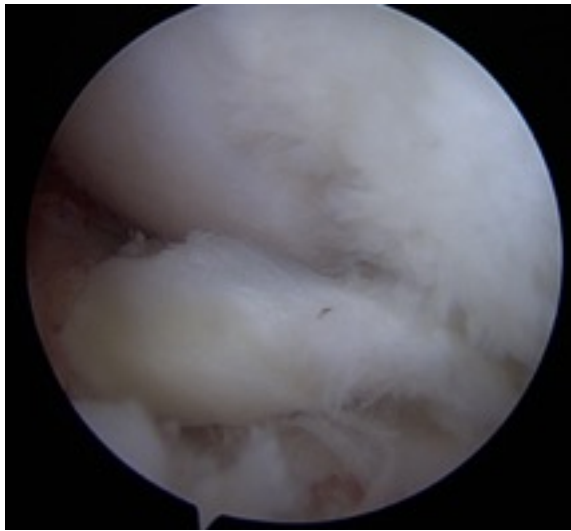


Sequential measurements of the tibial plateau angle in large-breed, growing dogs

Jacob W. Odders, DVM; Carl R. Jessen, DVM, PhD; Alan J. Lipowitz, DVM, MS

AJVR, Vol 65, No. 4, April 2004

Tibial plateau leveling osteotomy is not recommended before 8 to 9 months of age because of potential injury to the proximal tibial physis



11 month old Doberman; injured ACL at 5 months of age

**8 month old Newfoundland
injured ACL at 4 months of age**

**TPA at 4 months, 25 degrees
TPA at 8 months, 34 degrees**

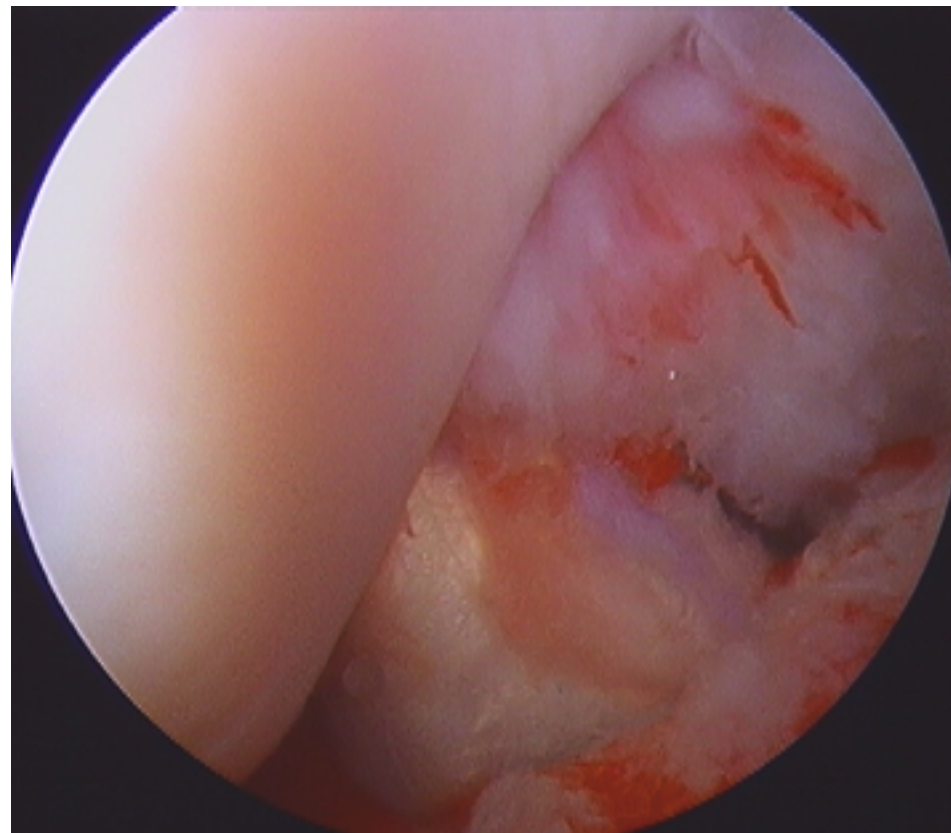
Heuter-Volkman Law



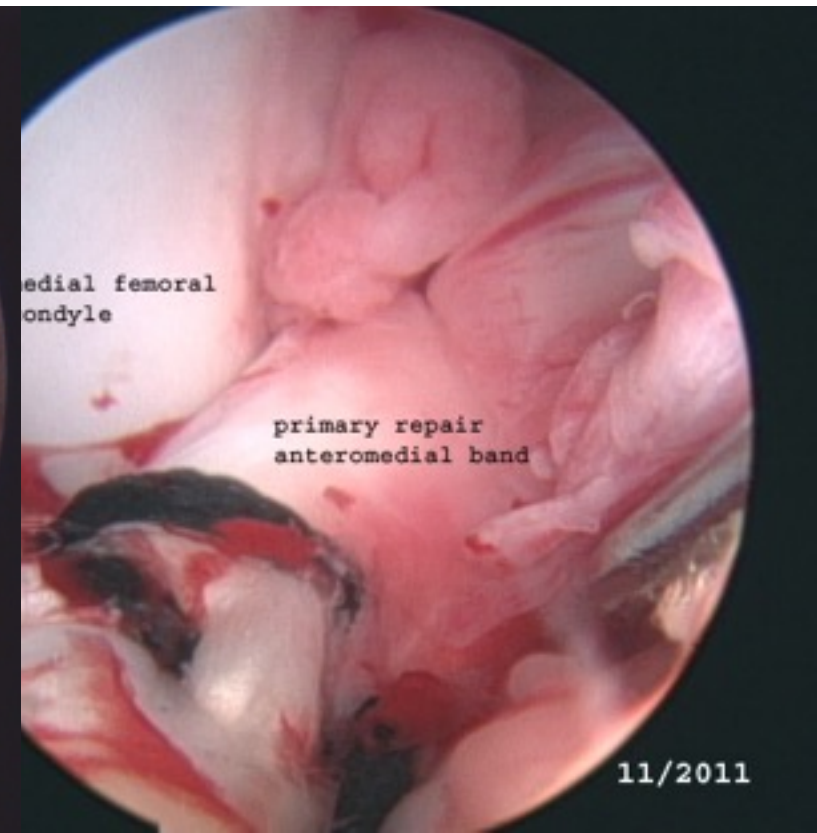
Treatment Modalities



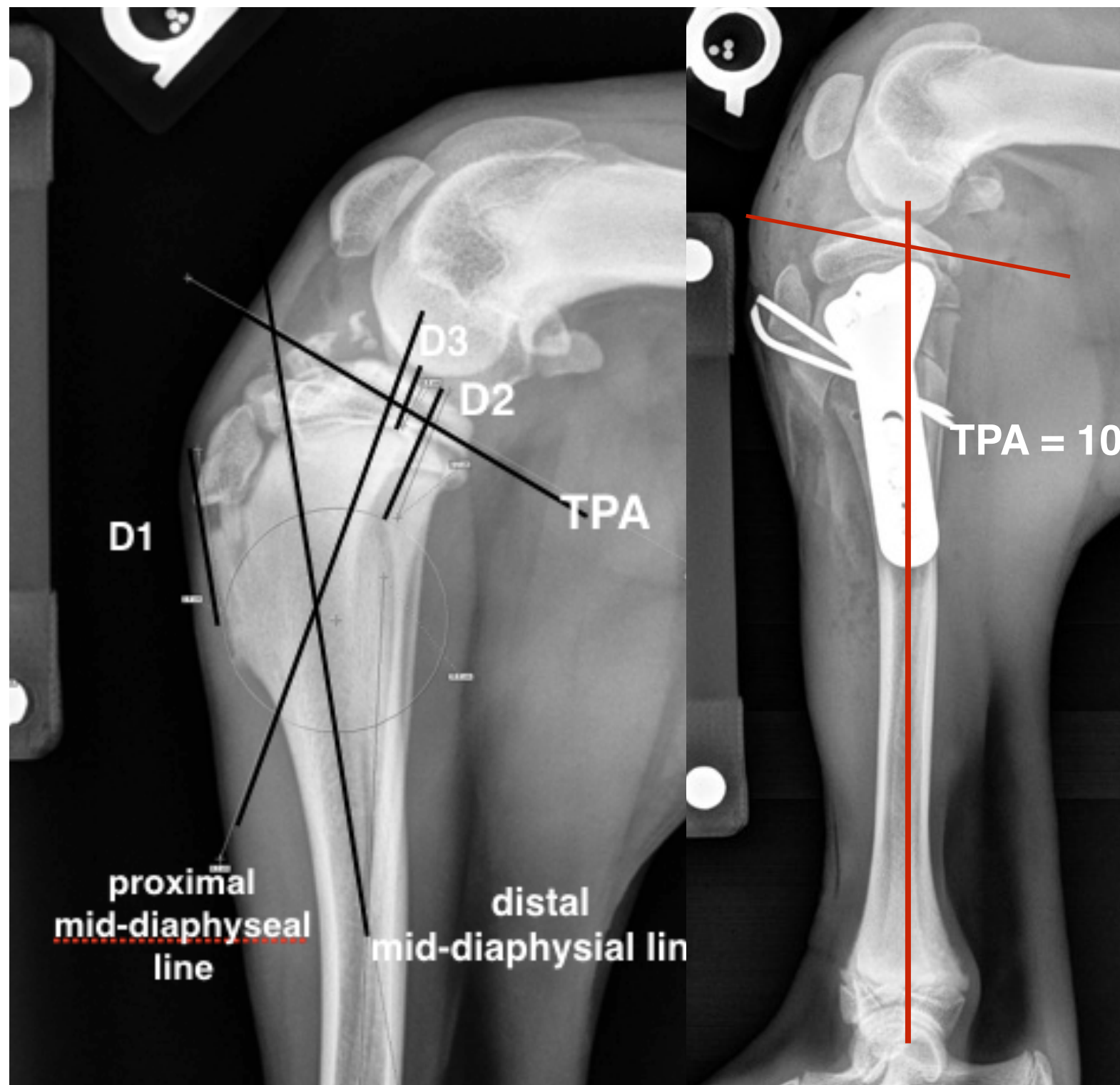
**primary fixation
3 weeks PO**



**Fascia lata/patella tendon
autograft**



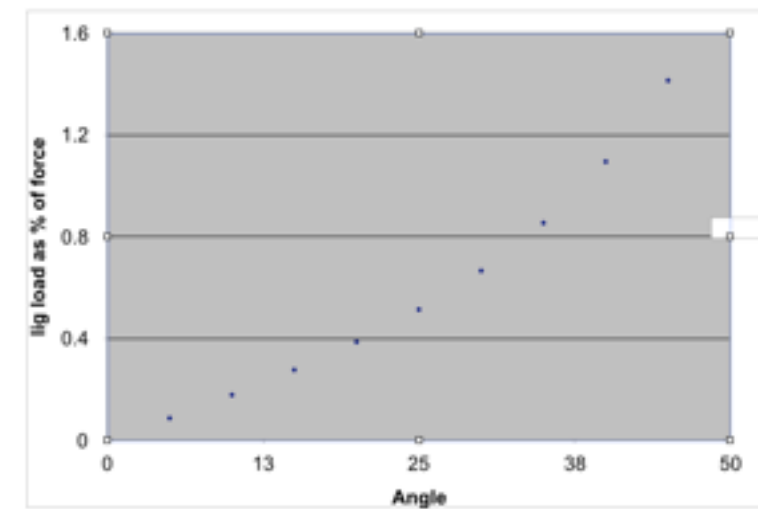
primary suture repair



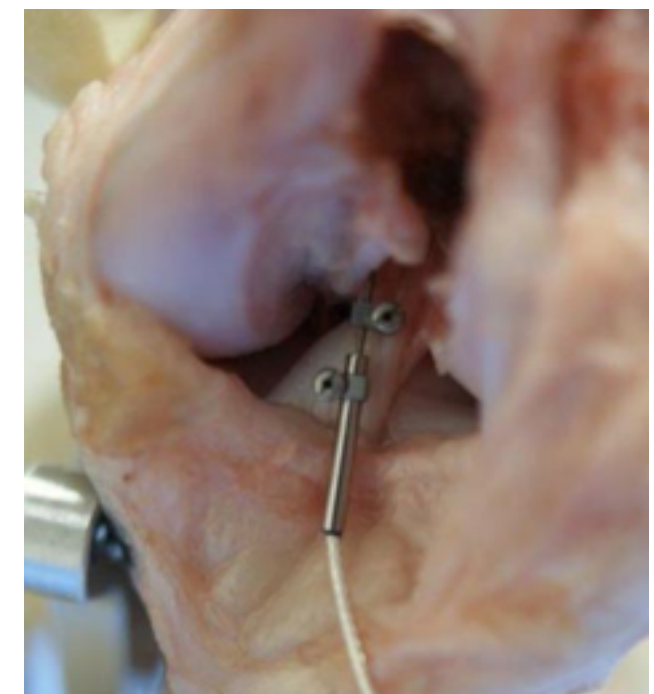
$$FL\ H/F = (\sin(\theta))/\cos(\theta)$$

45
40
35
30
25
20
15
10
5
0

1
0.8391
0.798208
0.57735
0.466308
0.36397
0.267949
0.176327
0.087489
0

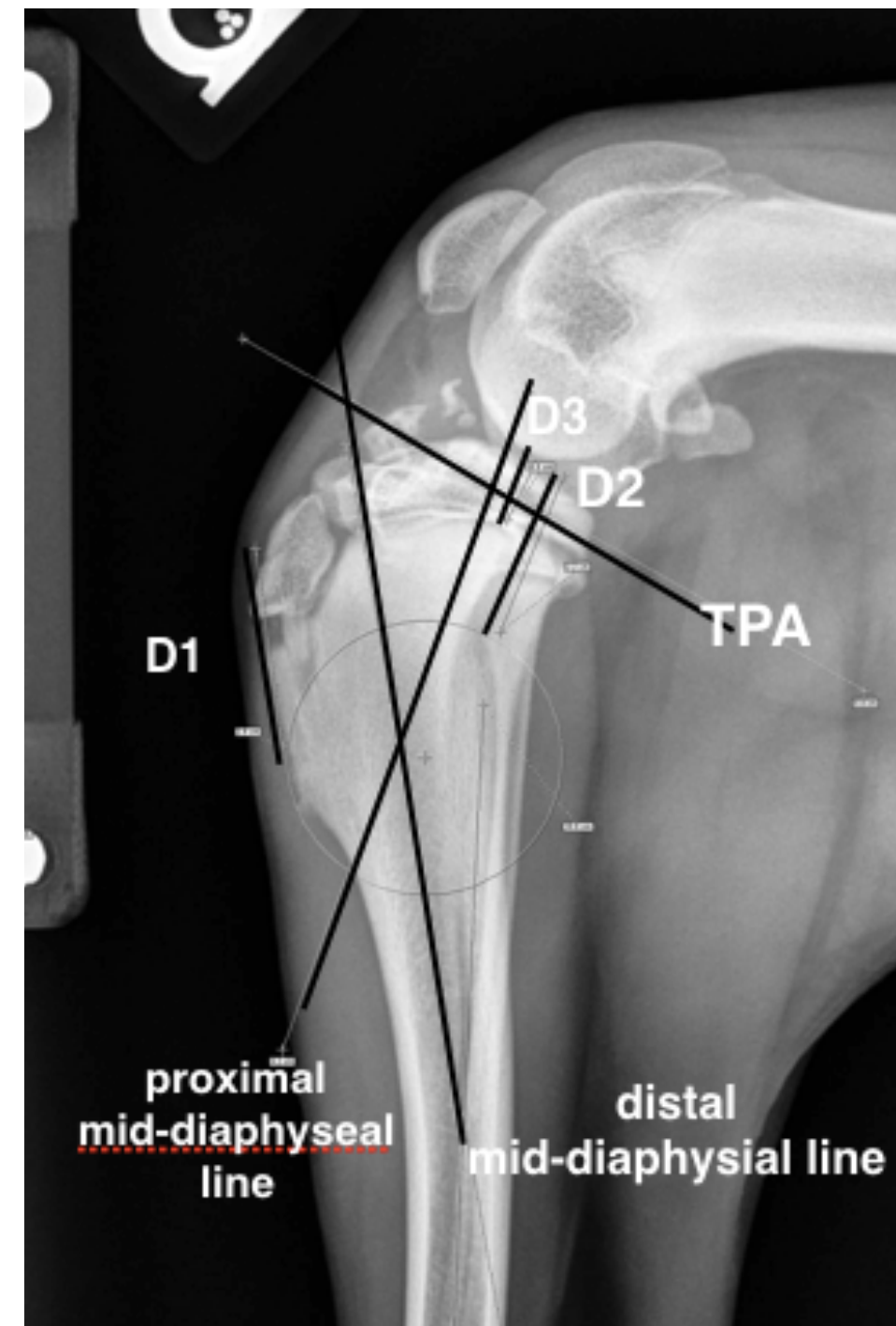
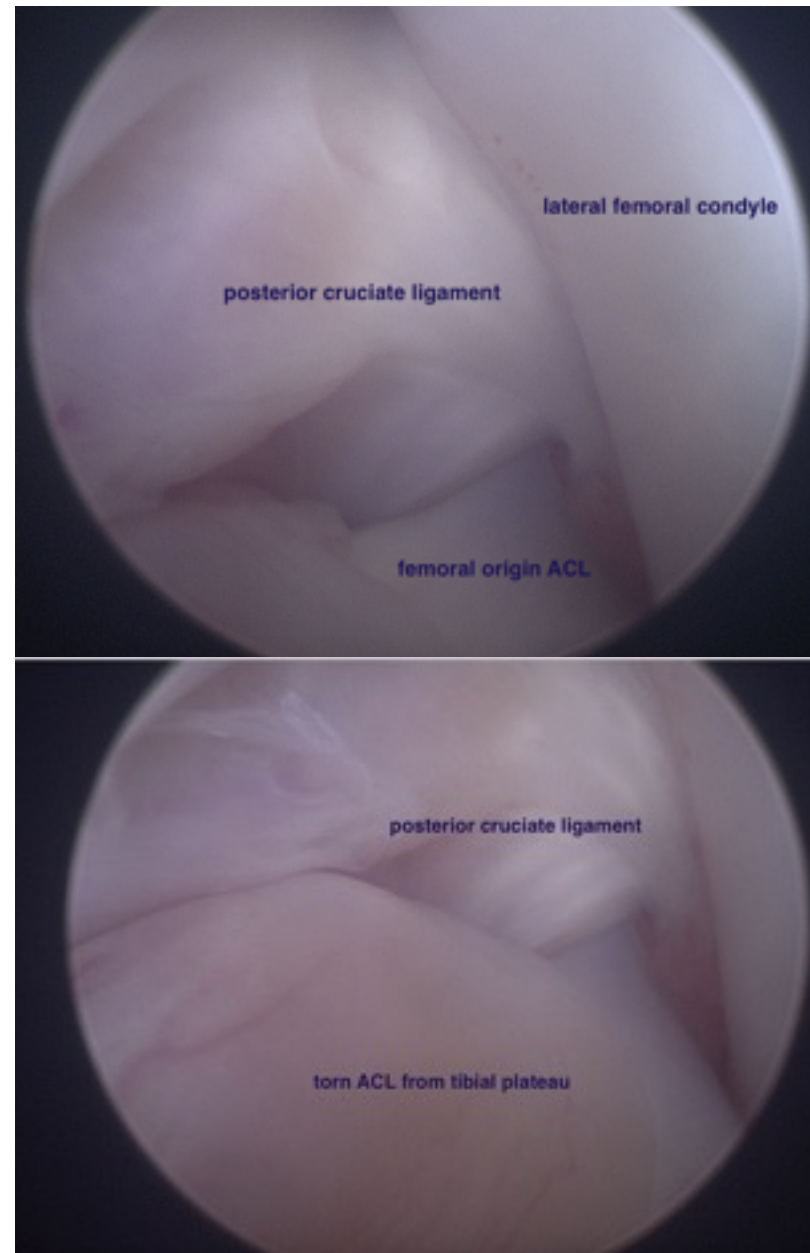
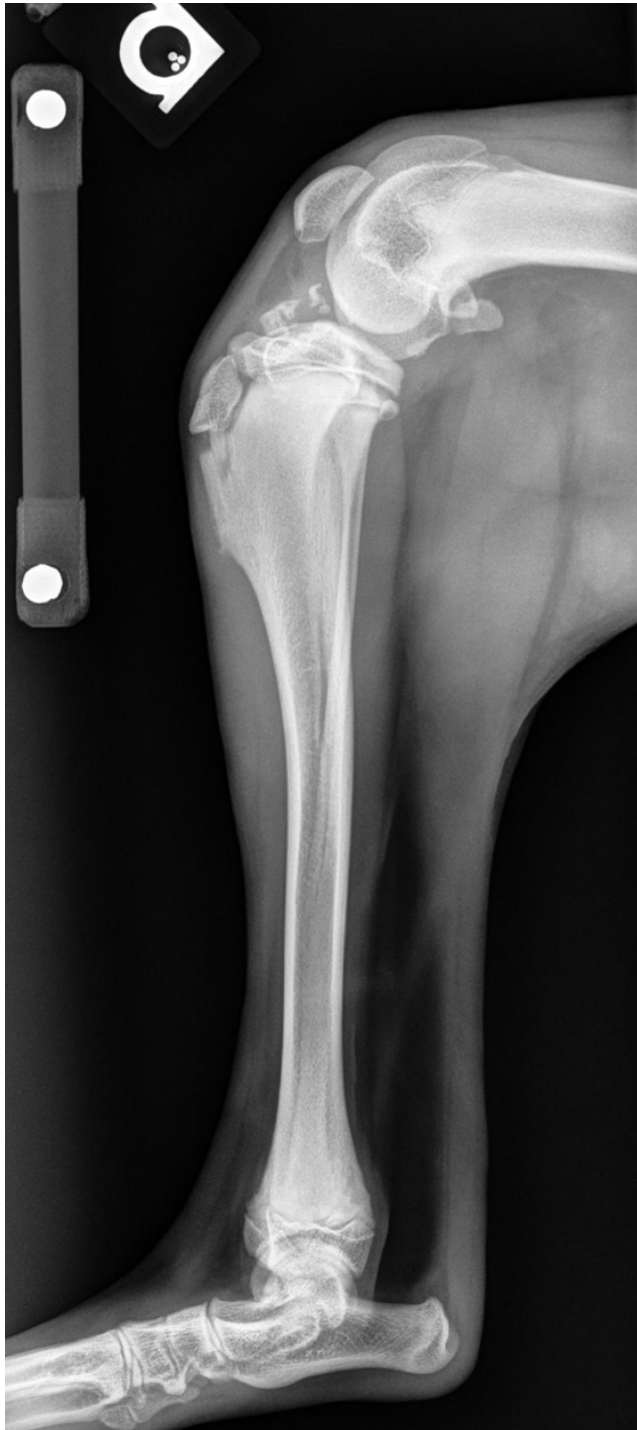


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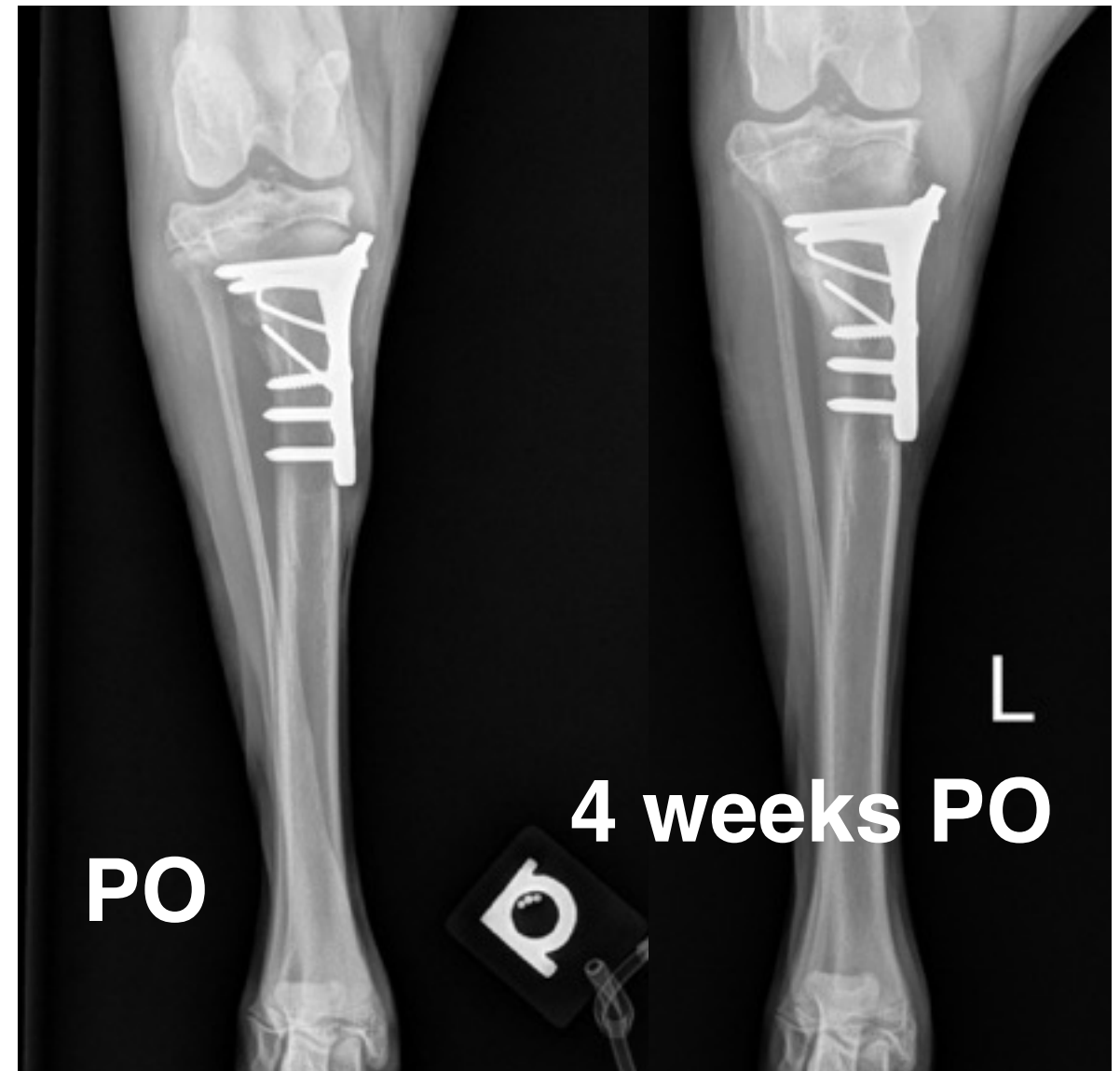
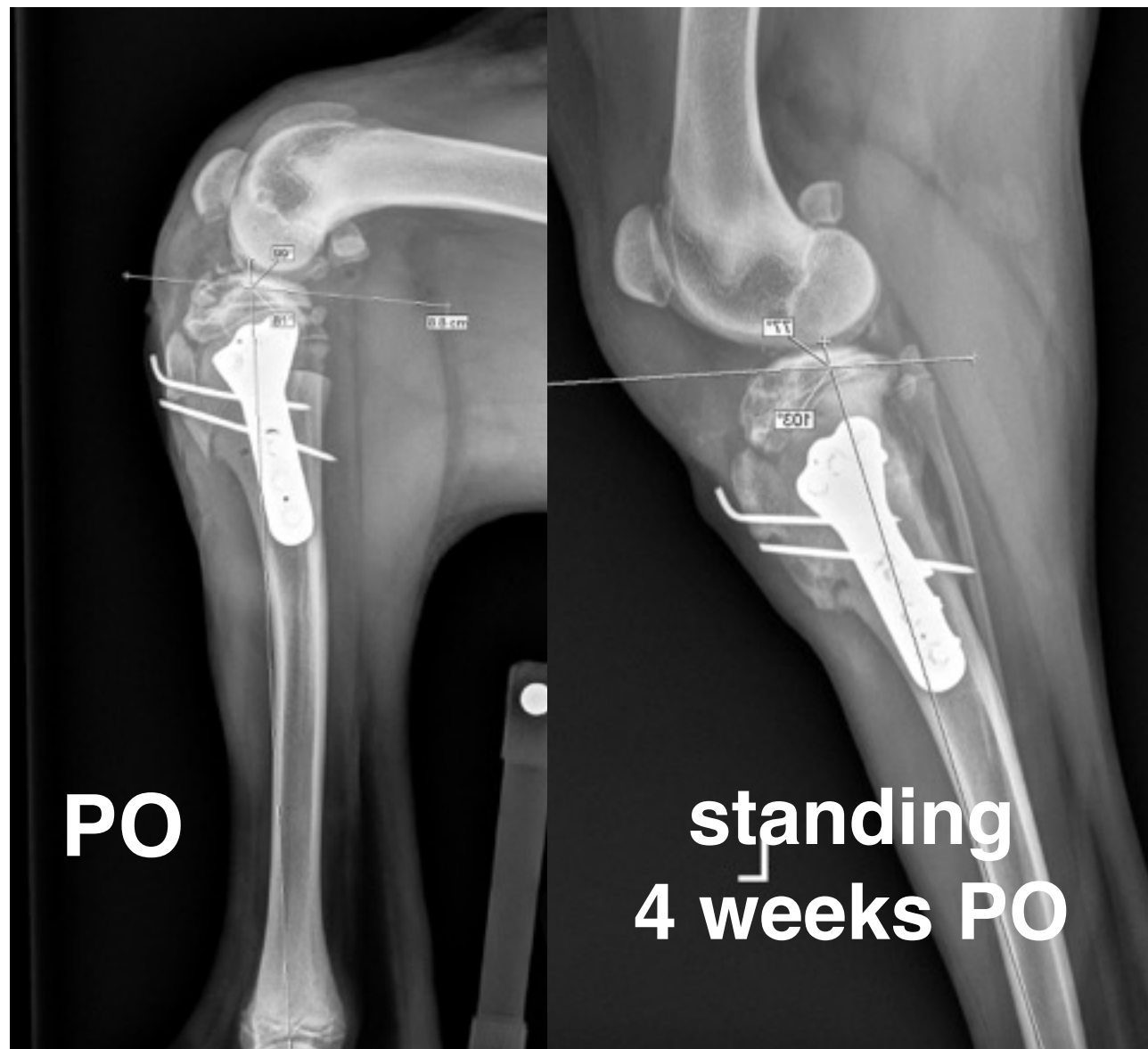


Haynes & Conzemius et. al

all repairs are coupled with a CBLO to reduce load



Huck AVES
5.5 month
Labrador MB



Primary repair 1.3mm Arthrex SutureTape

CBLO 9 degrees; tension band #1 PDS



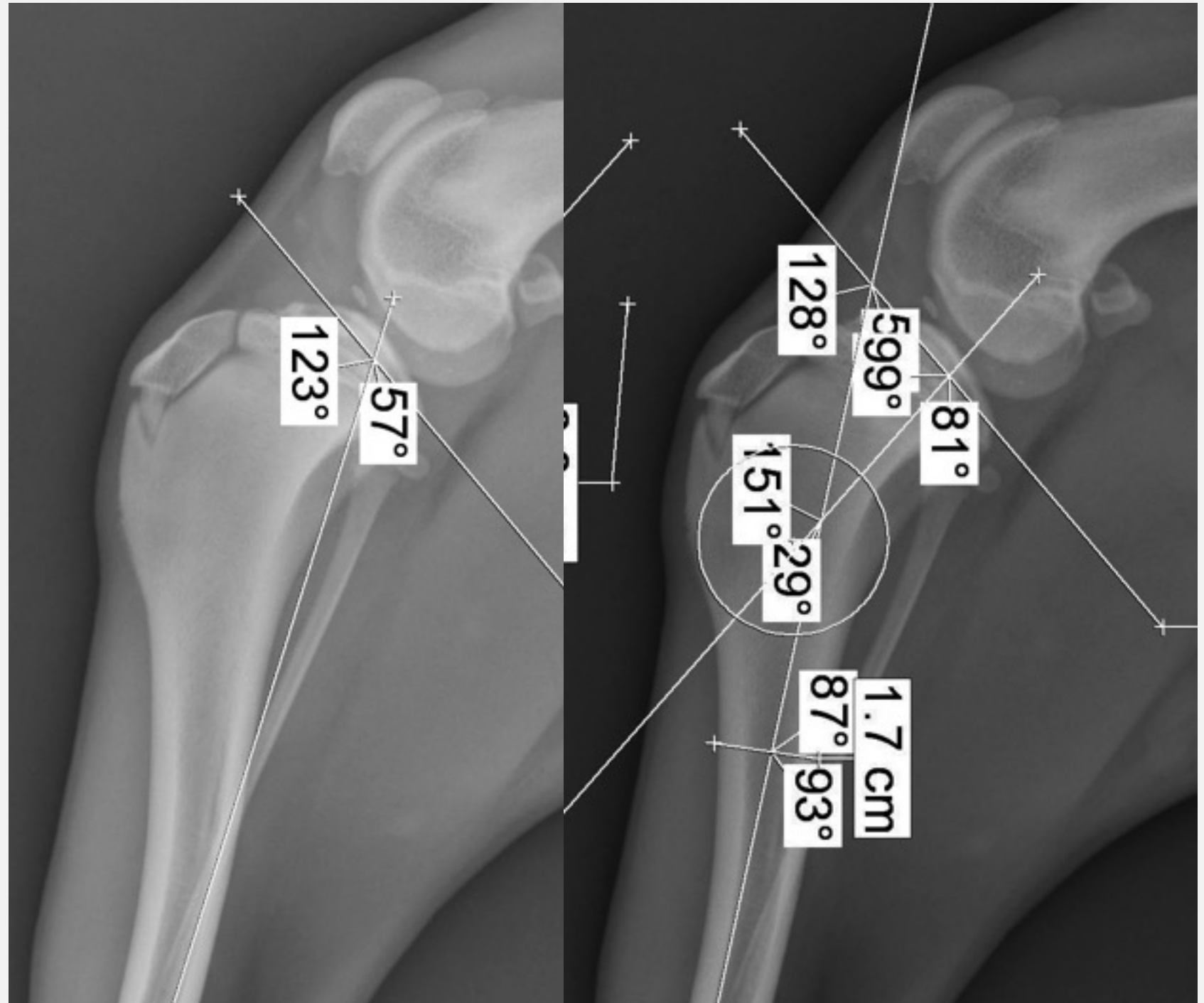
5 months, stable, full function

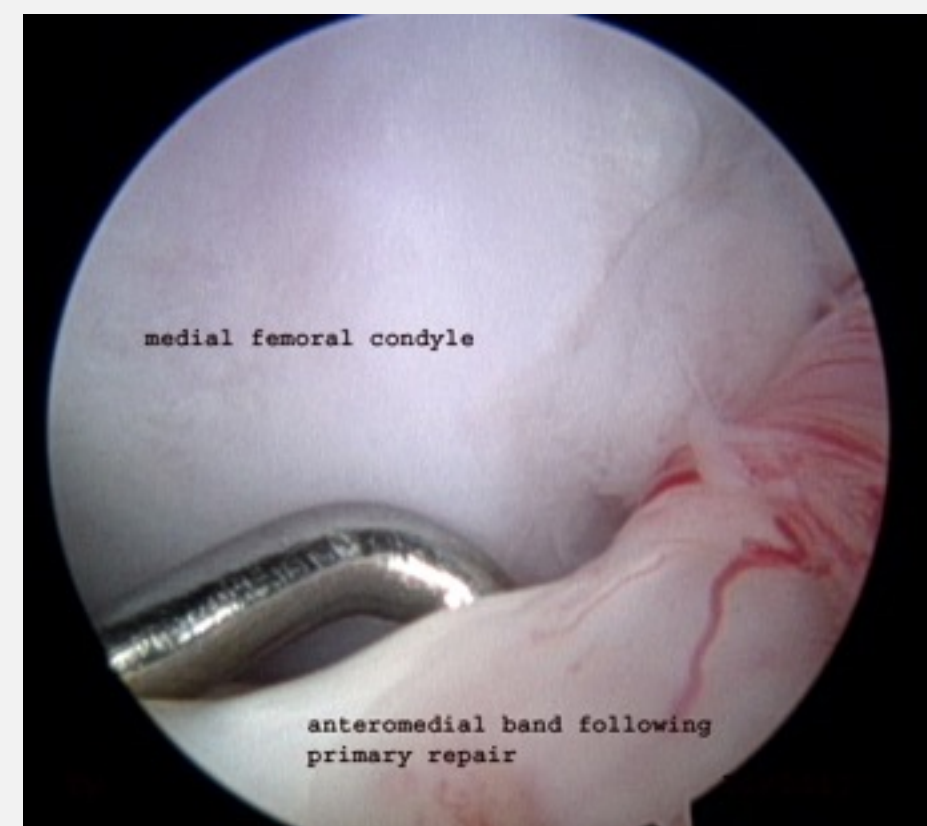
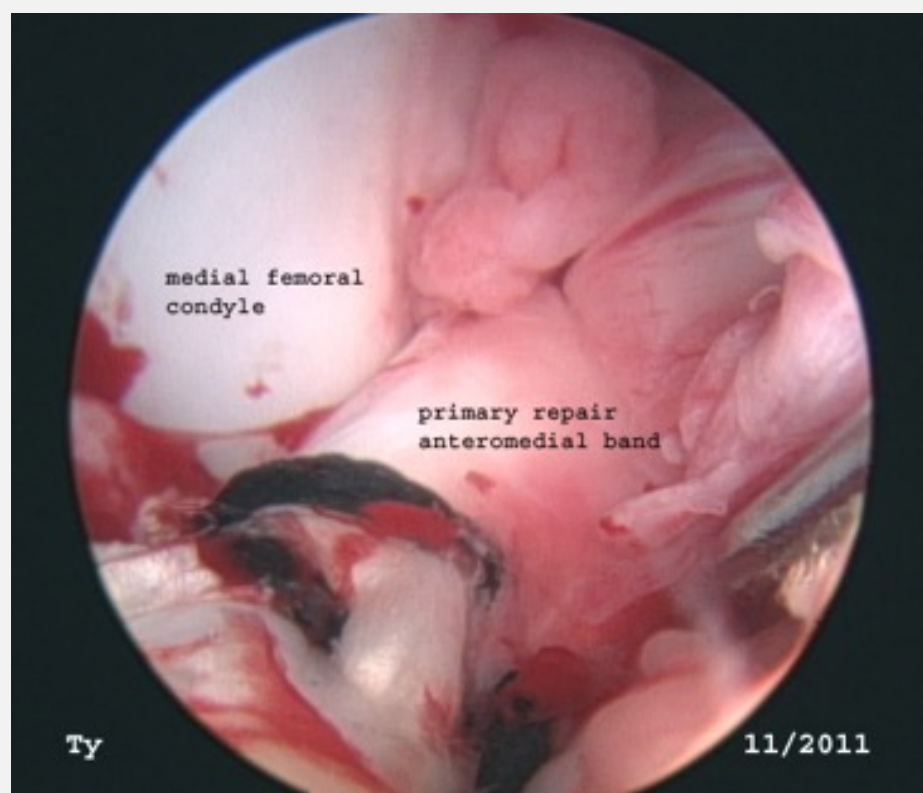
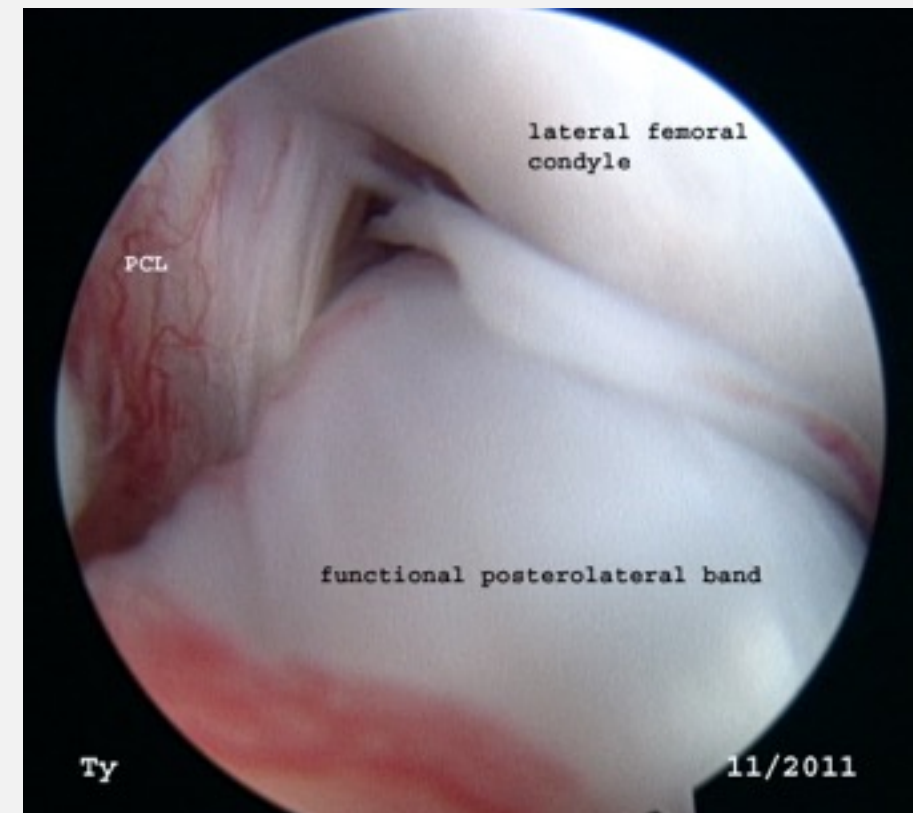
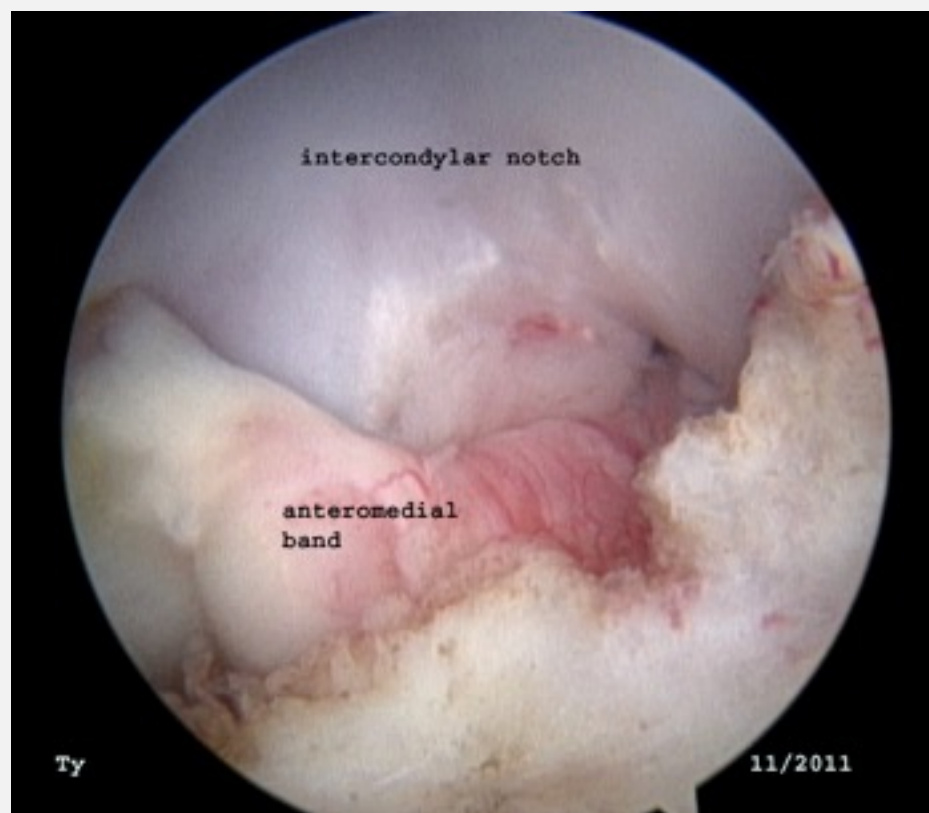


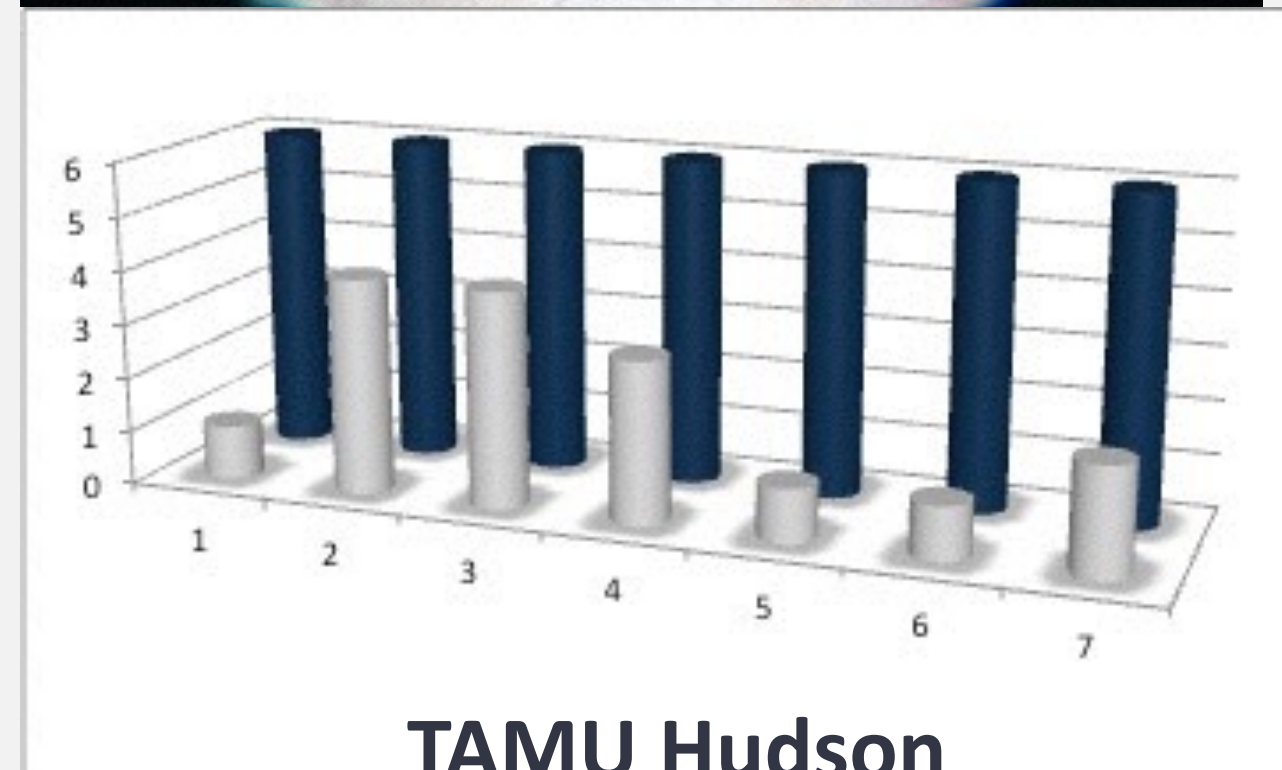
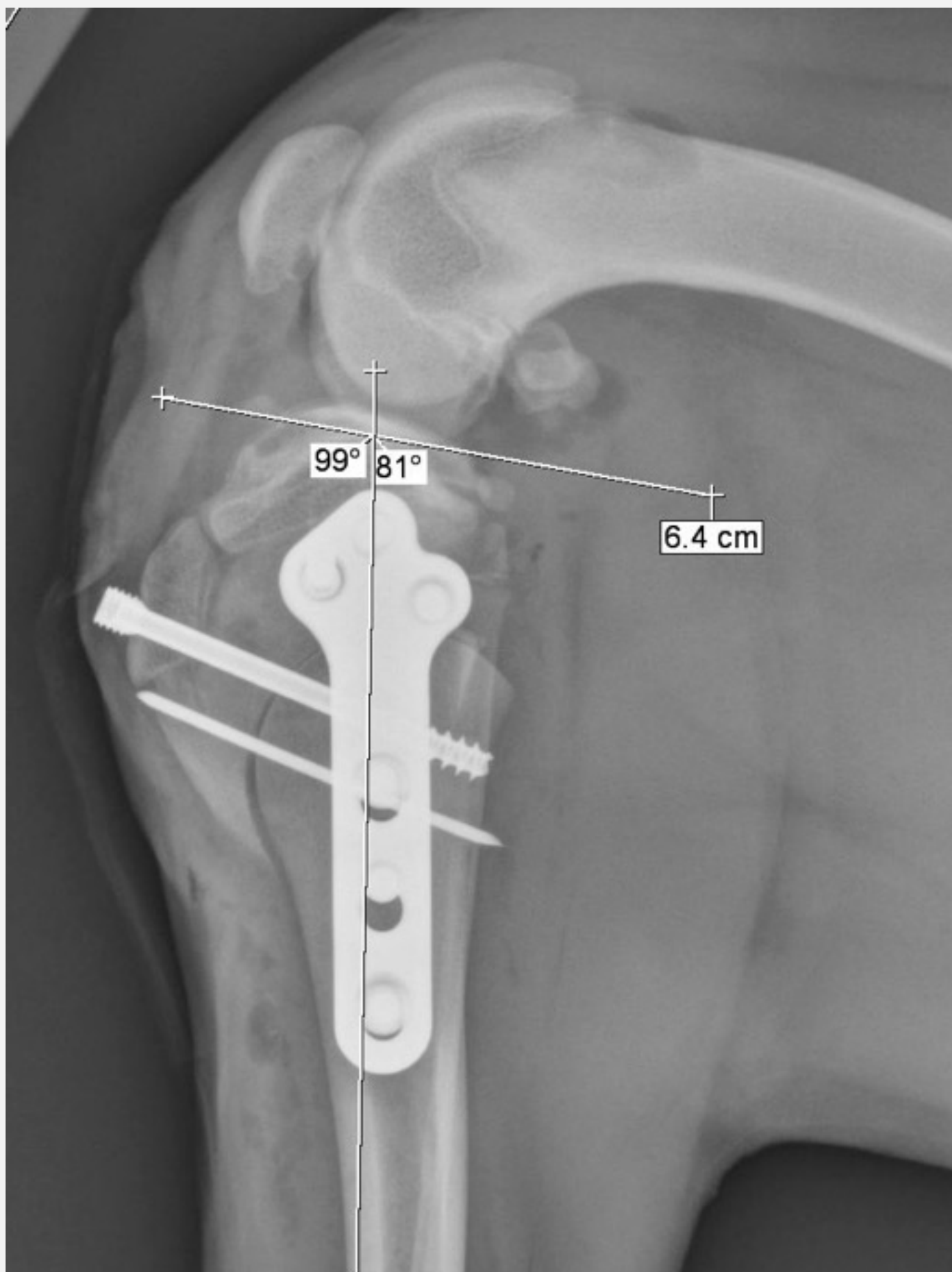
1 yr, stable, full function

“Ty”

- 5 month Fe
- Labrador
- 42 lbs





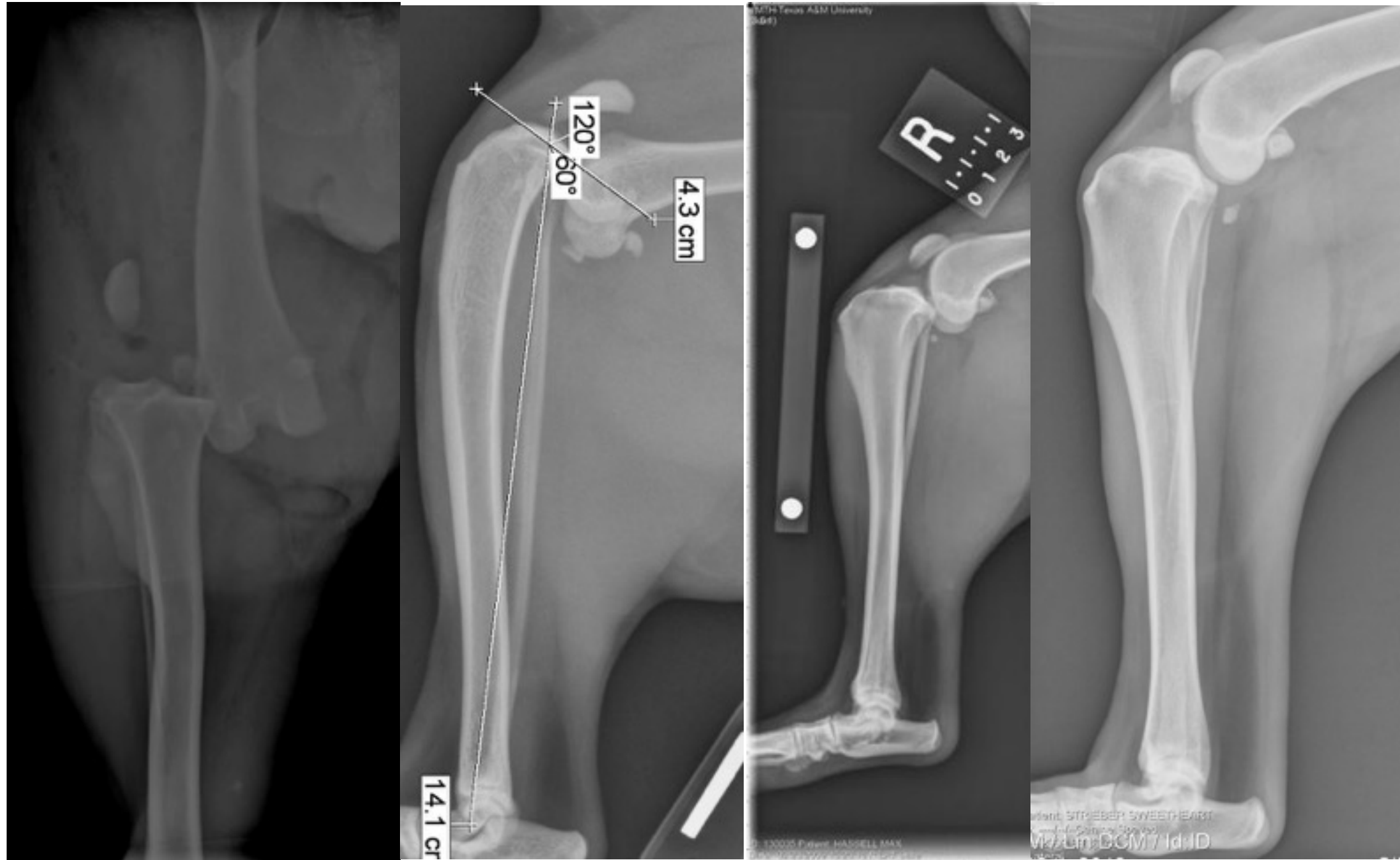


TAMU Hudson
10 months PO

8 yr PO Client reports full function as field trial dog



Multiple Restraint Injury



Transarticular pinning

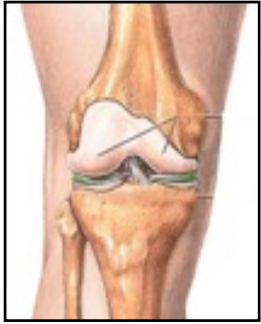


- Pin size - 2.4-3.2mm
- Coaptation (splint or external fixator for 4-8 weeks)
- Remove pin in 4-8 weeks

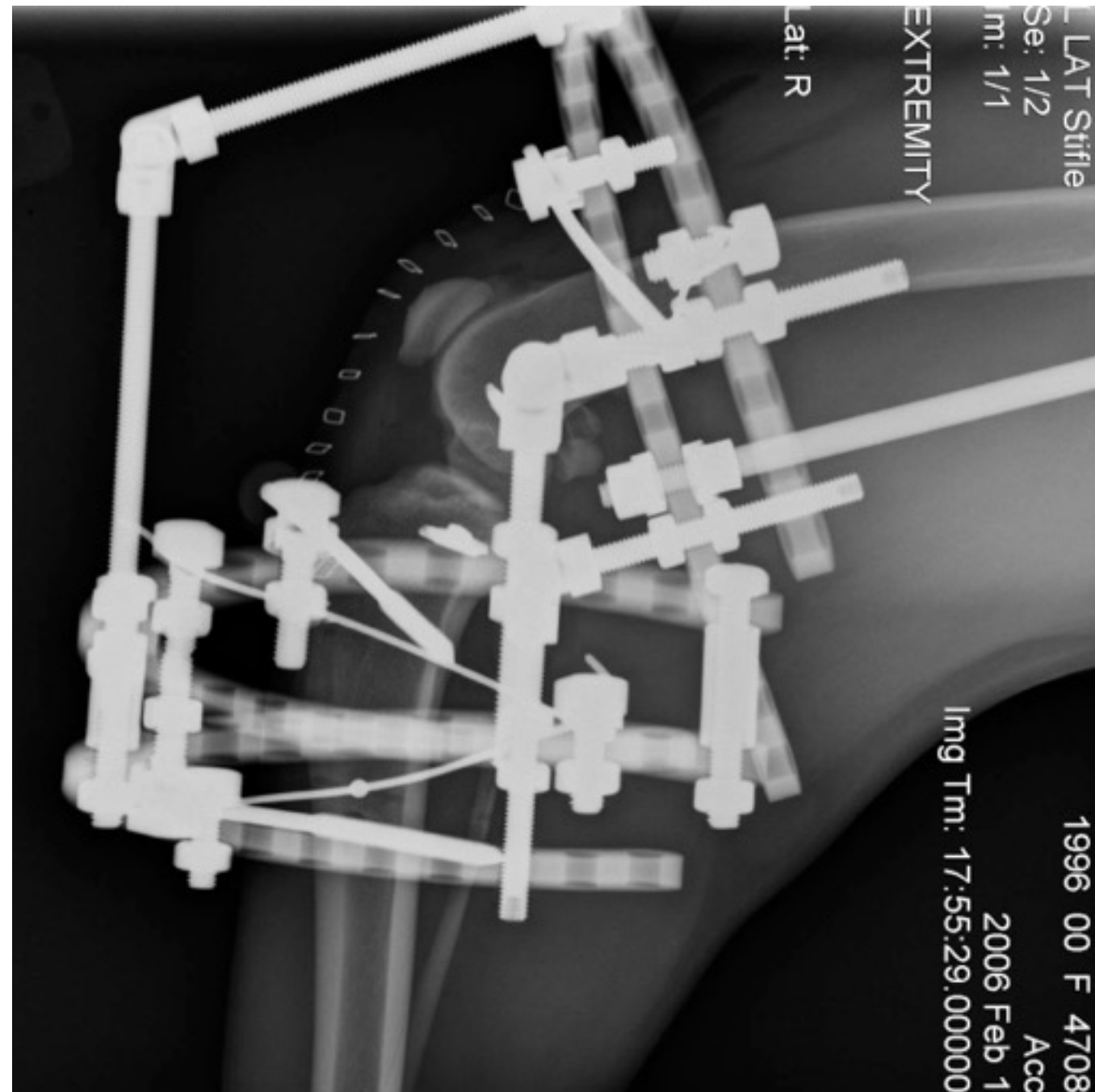
Stifle Luxation

- Transarticular Pin
- One (or two) temporary pins across stifle
- Complications - migration, loosening, bending
- 7 cats - excellent 4, good 1, poor 1, LTFU 1
- 3 small dogs - excellent 3
- *Welches C.D. & Scavelli T.D Transarticular pinning to repair luxation of the stifle in dogs and cats: a retrospective study of 10 cases (1990) 26,207-214*





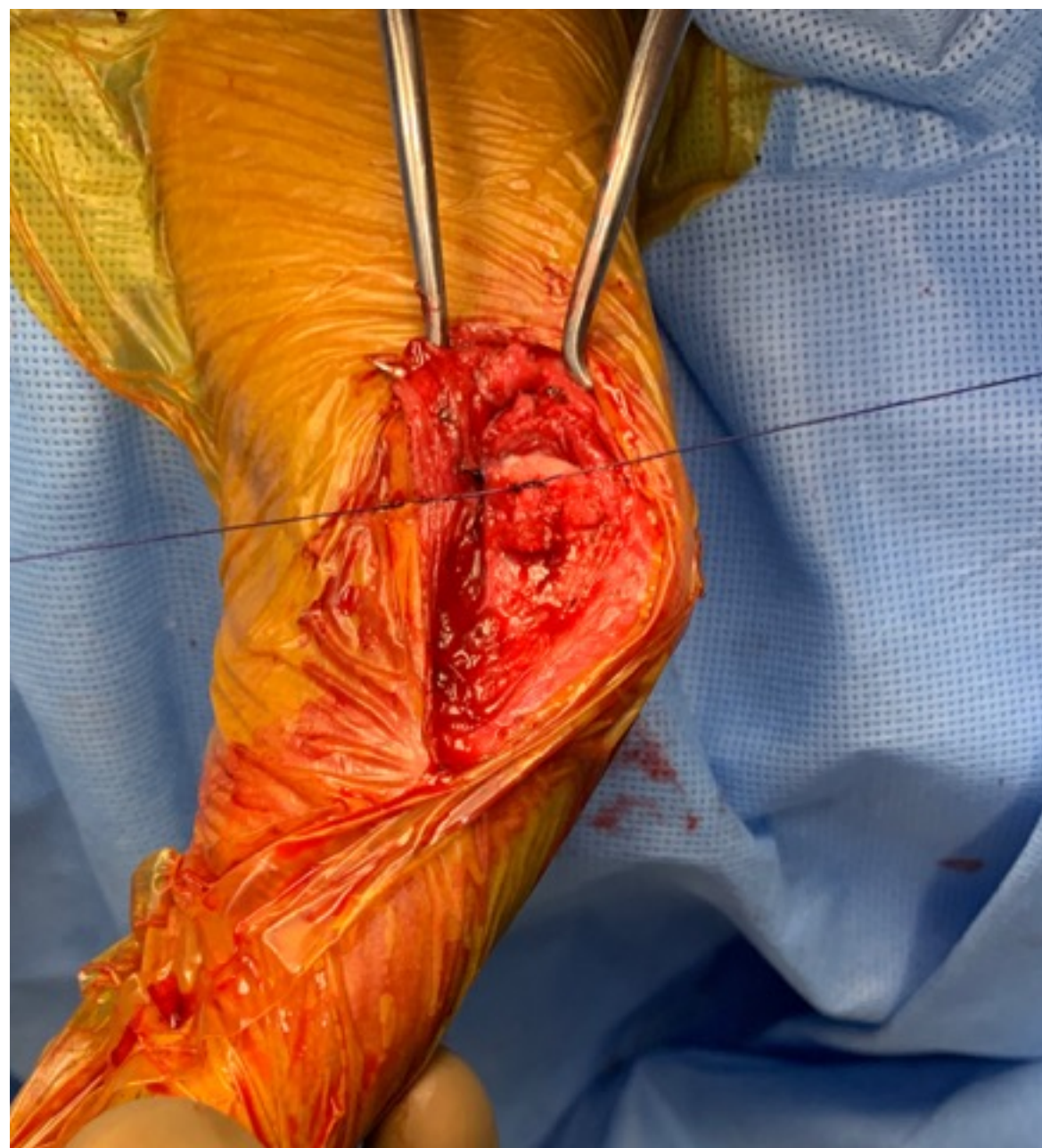
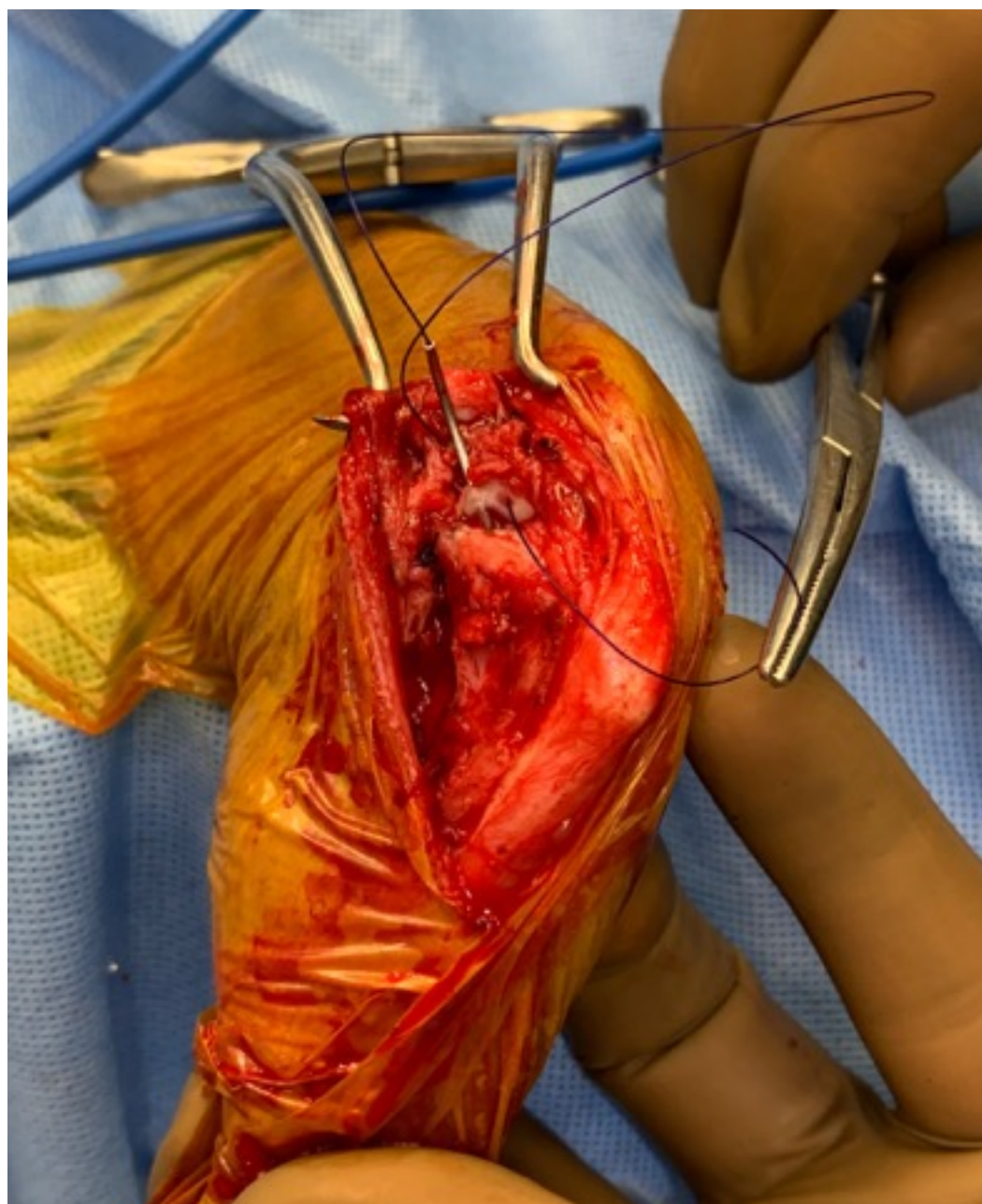
Post-op Hinged Fixator



Stifle luxation - TESH

- Treatment Options TESH
 - Reduction & repair of individual ligaments & TESH
 - 4 cases, 100% complication rate
 - Good to excellent outcome in all cases
 - Stifle thickening, good ROM, minimal instability
- *Bruce W.J. Stifle joint luxation in the cat: treatment using transarticular external skeletal fixation JSAP (1999) 40, 482-488*





Ortho-Stā

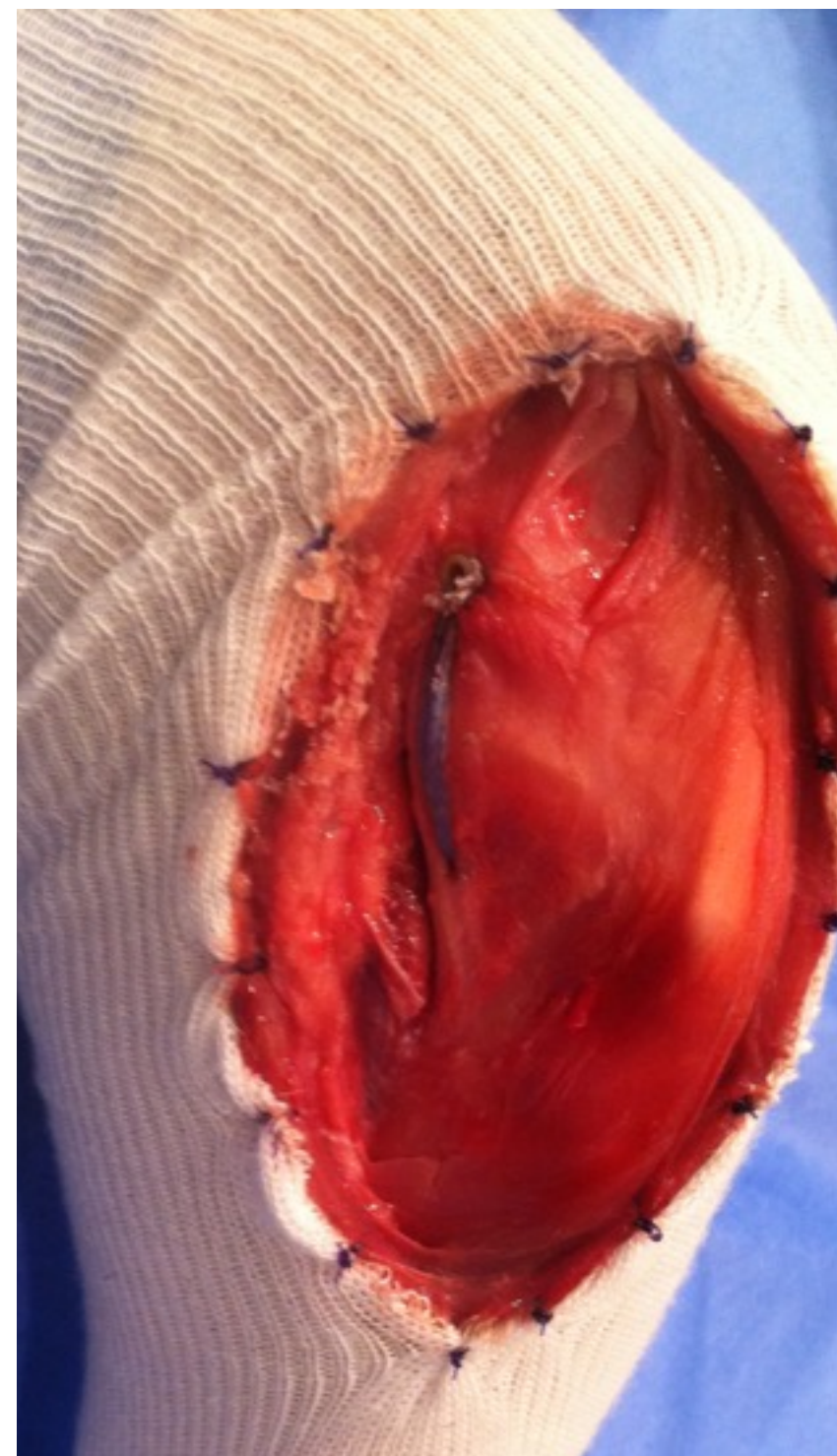
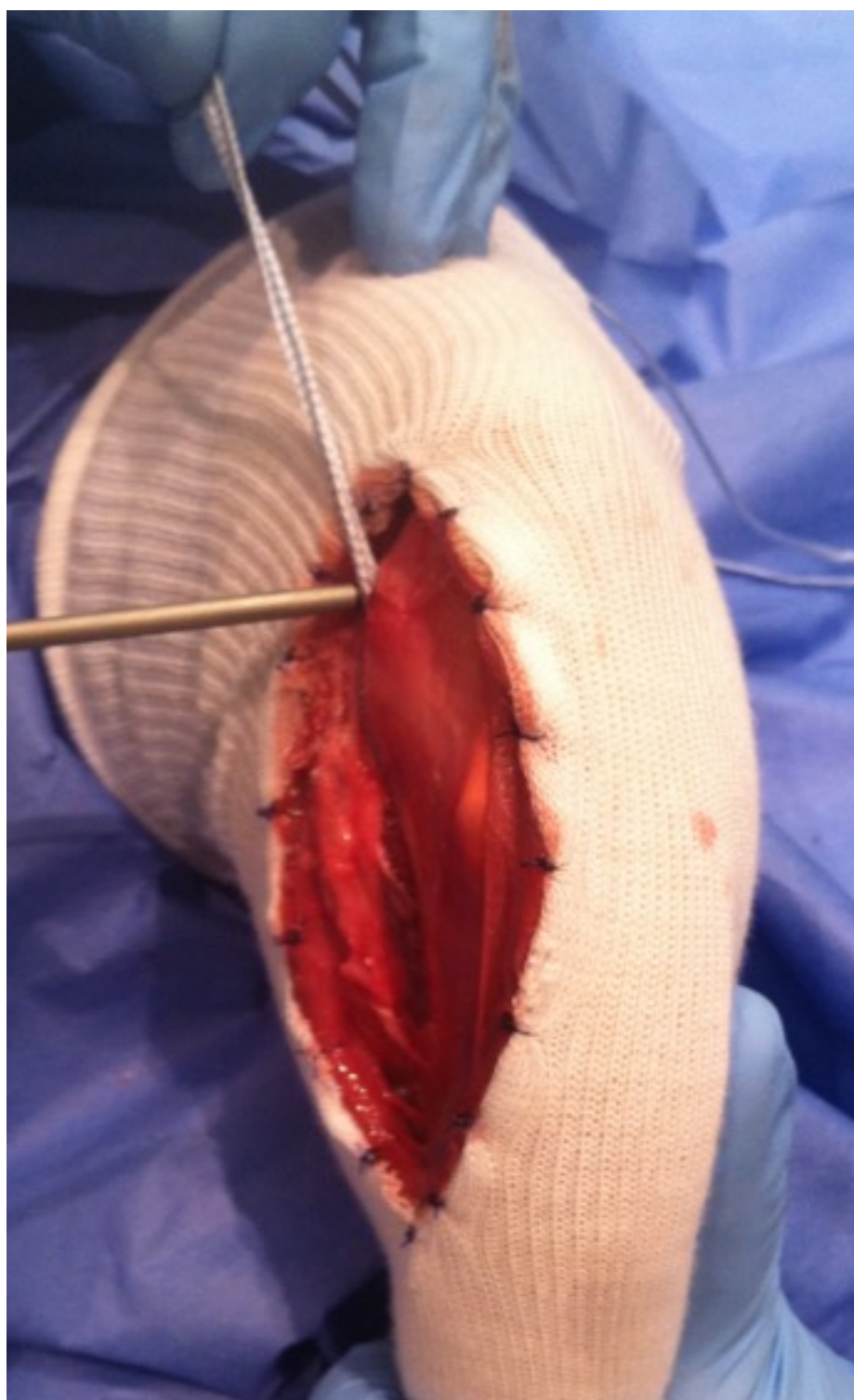
KNOTLESS LIGAMENT REPAIR SYSTEM

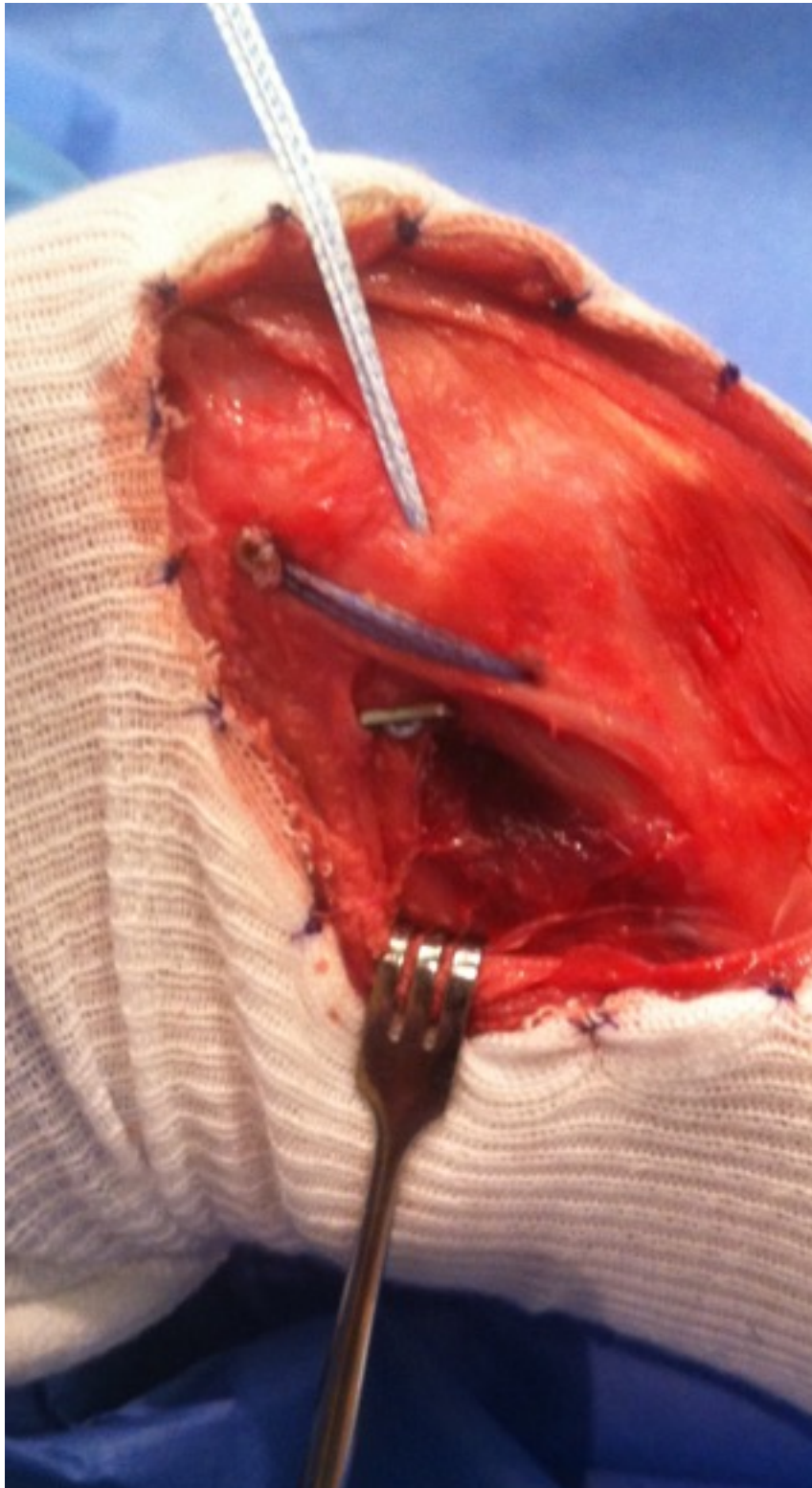


 **VETERINARY**
ORTHOPEDIC
IMPLANTS

Ortho-Sta

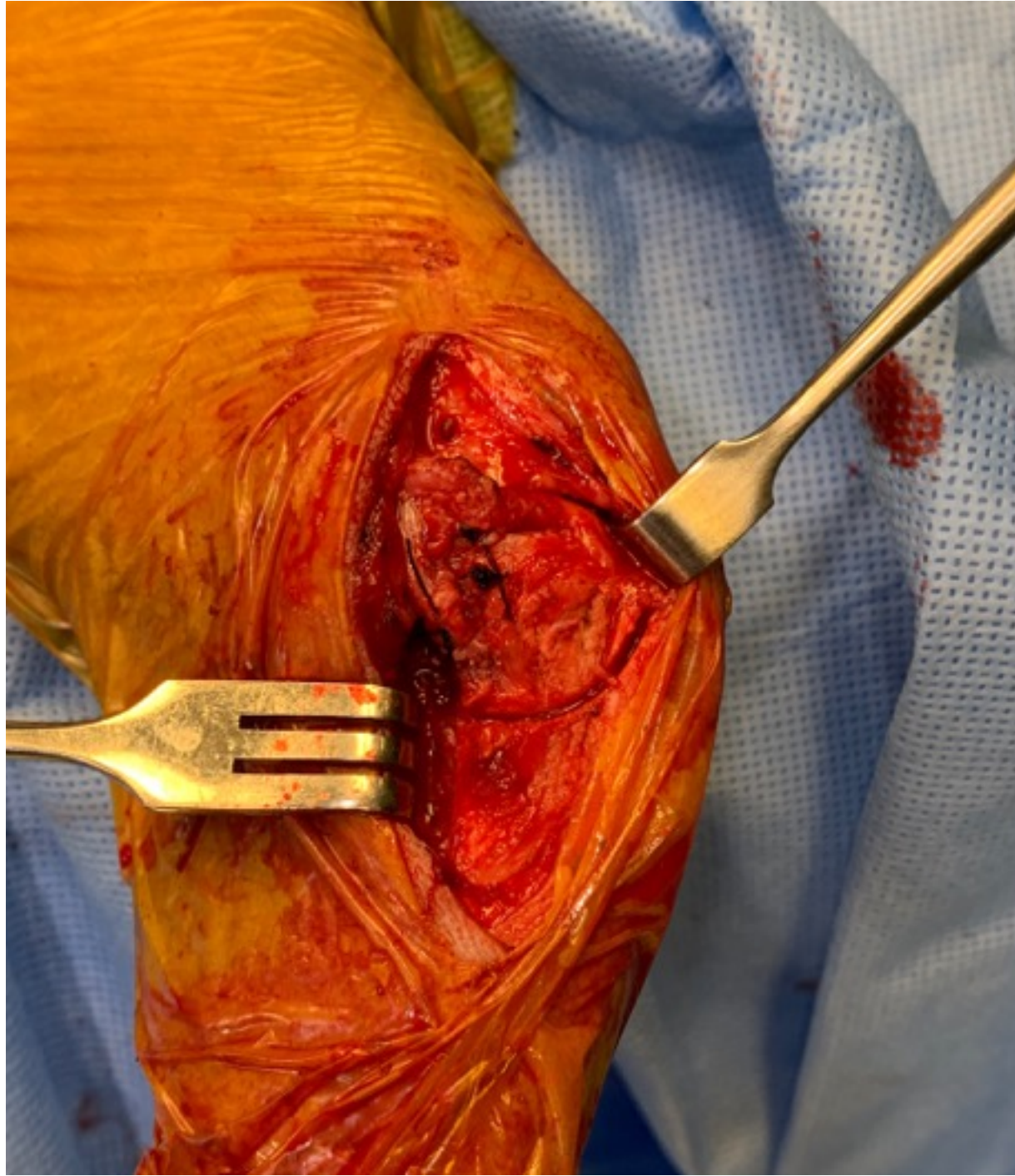












IA Autograft

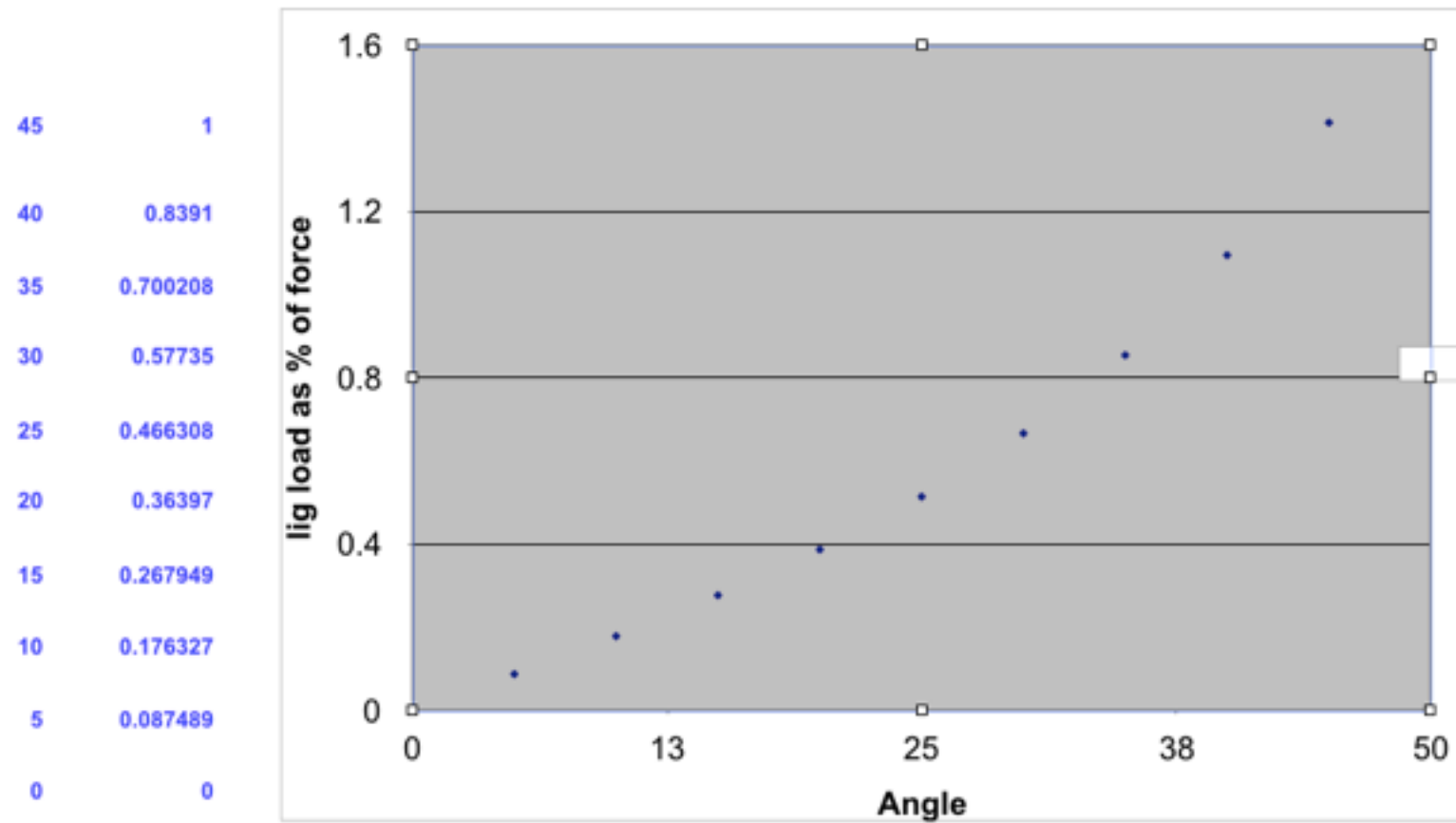


Ortho-Sta

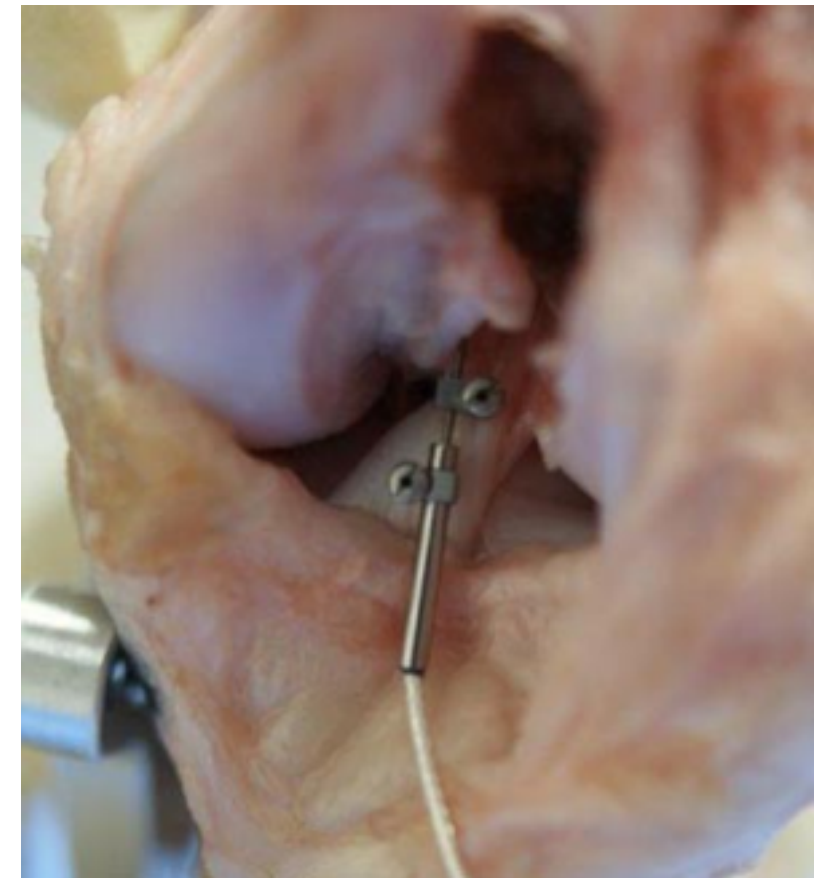


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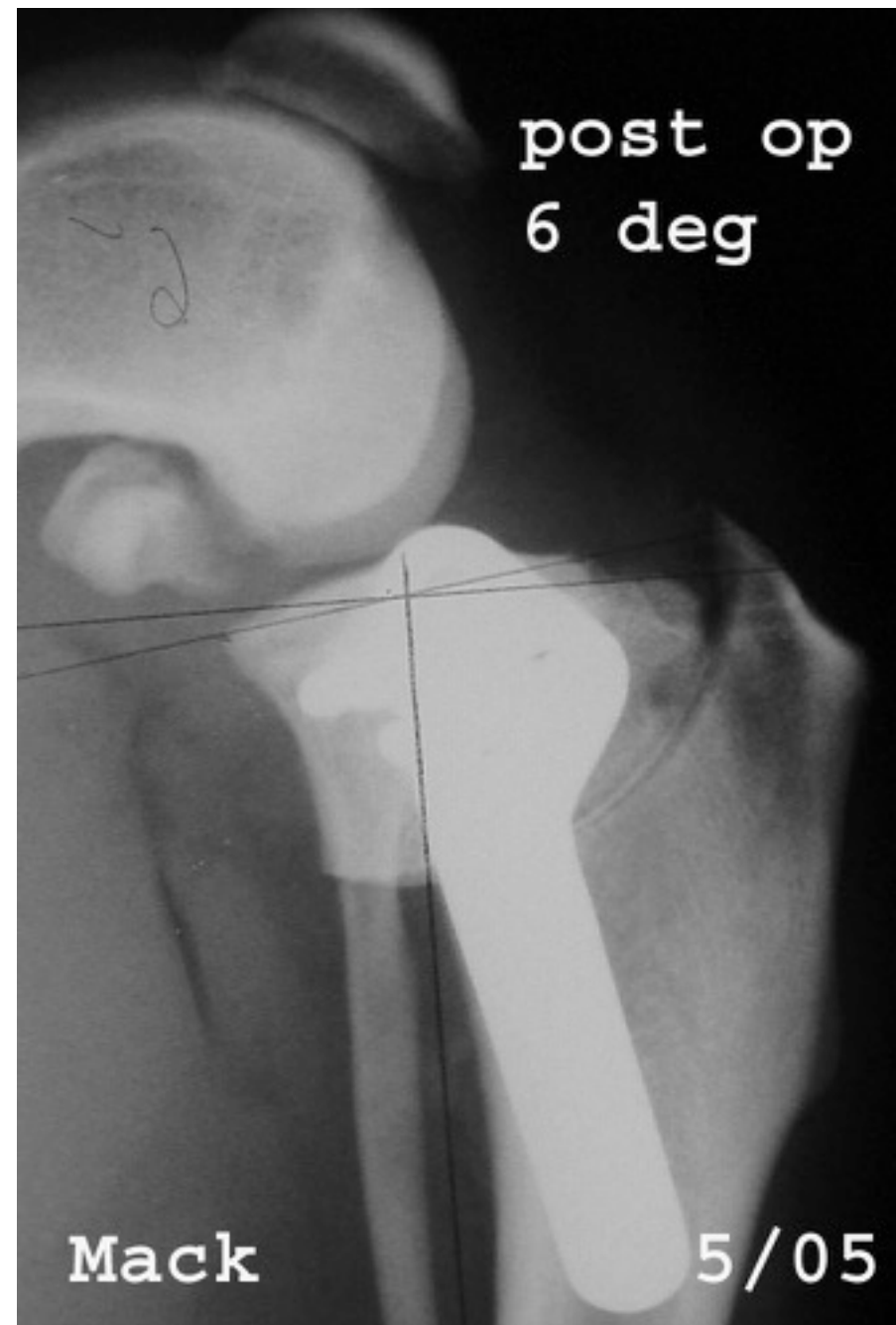
$$FL\ H/F = (\sin(\theta))/\cos(\theta)$$



Haynes & Conzemius et. al

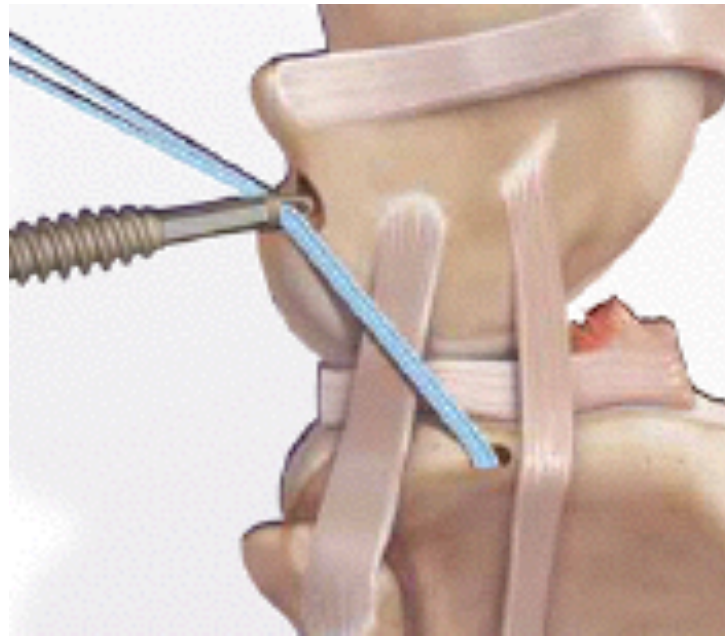


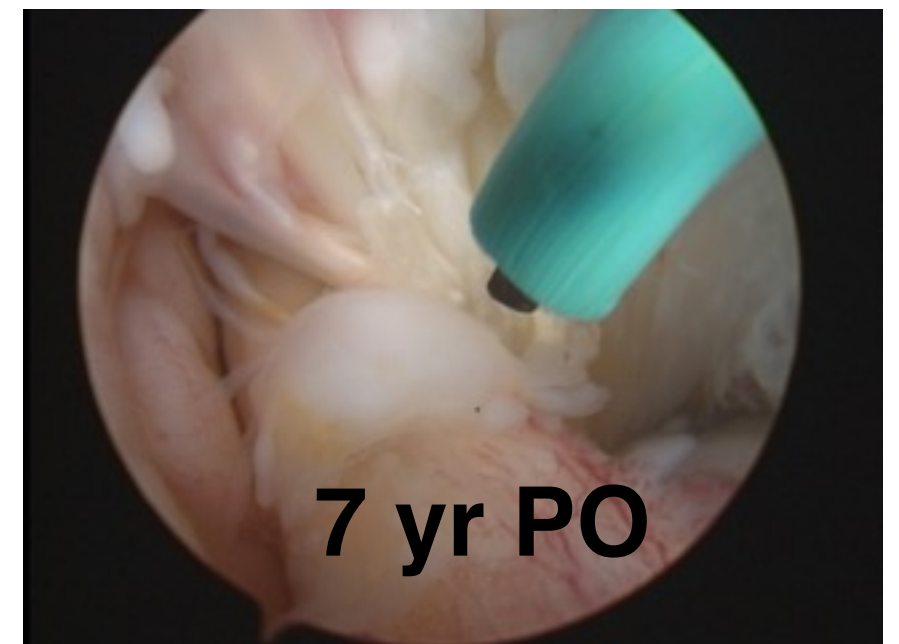
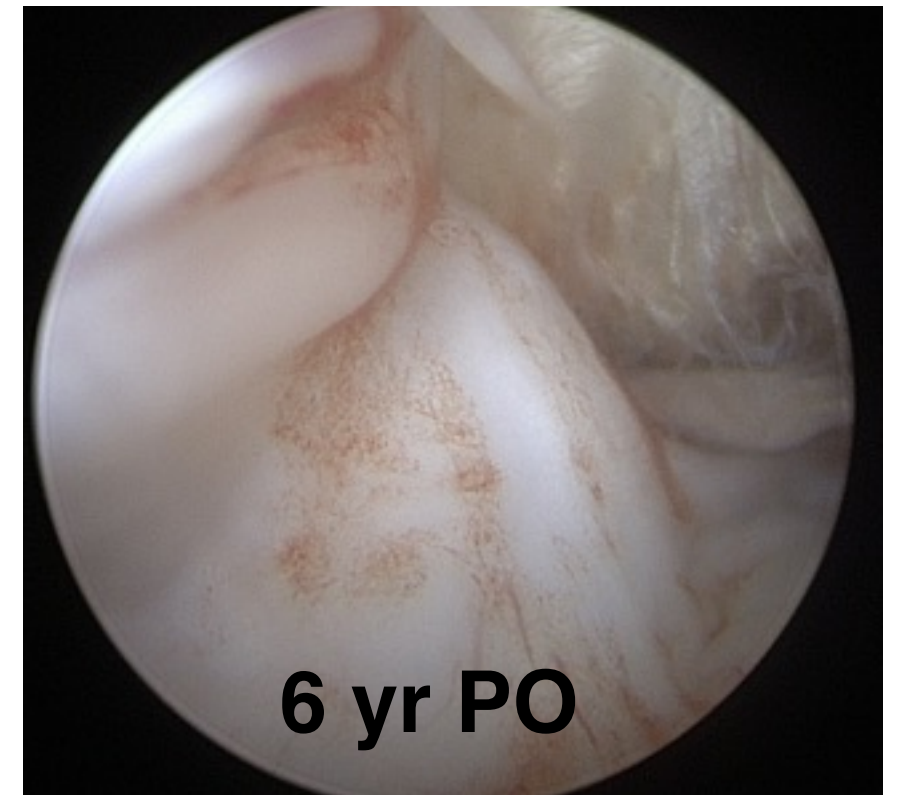
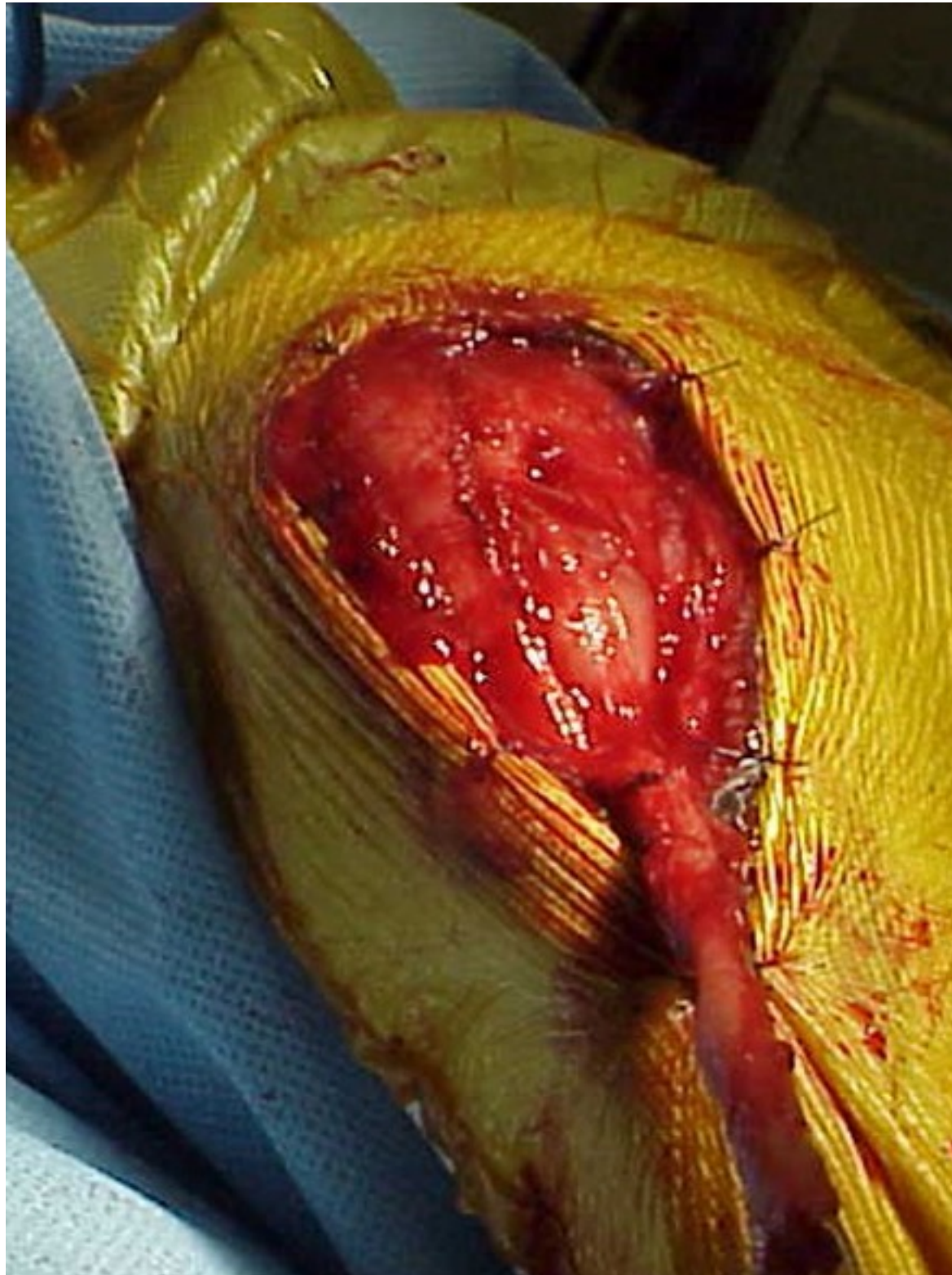
TPLO: 10 years experience: >1800 cases

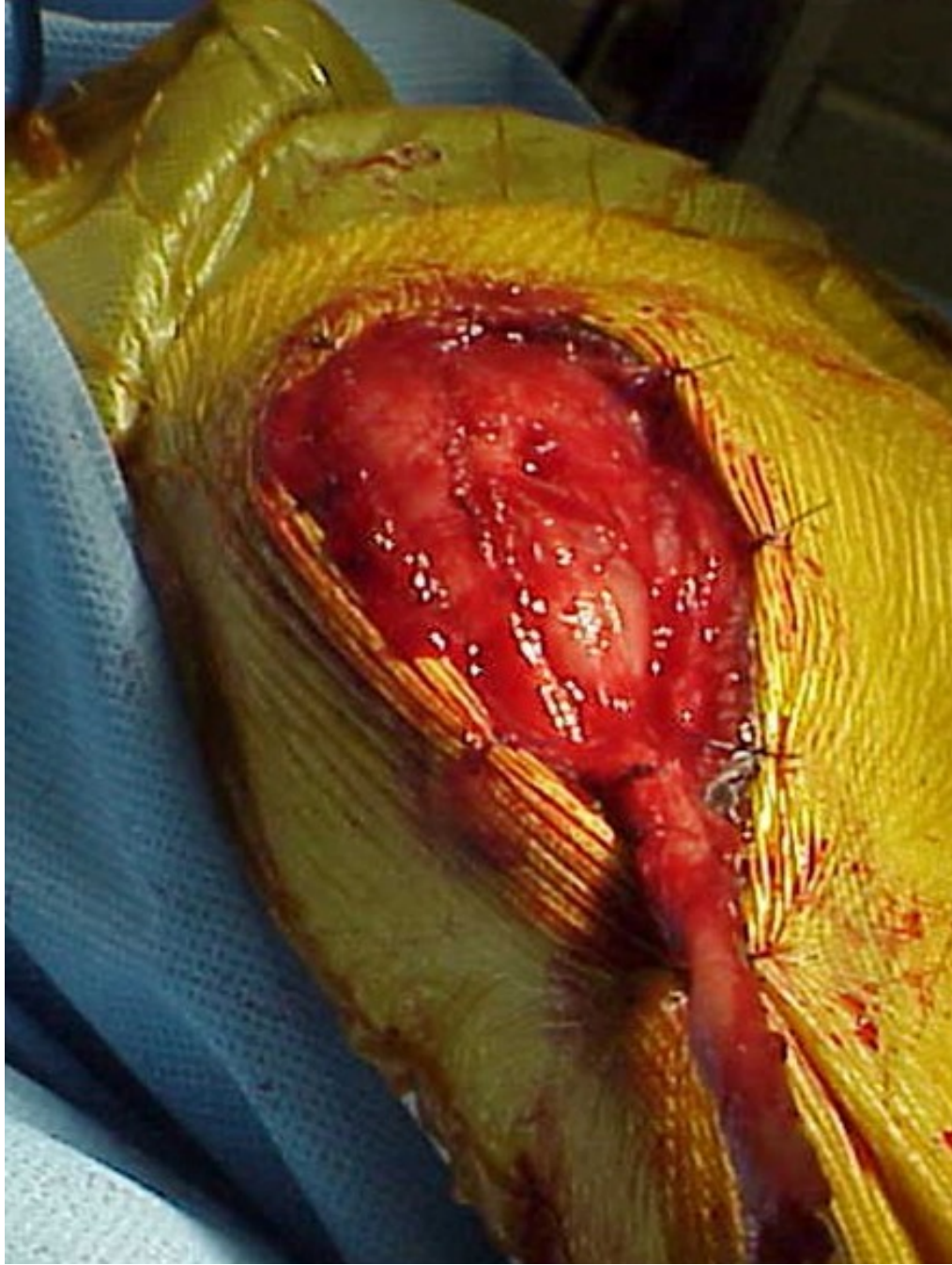


TPLO: small target for EA or IA ancillary procedures

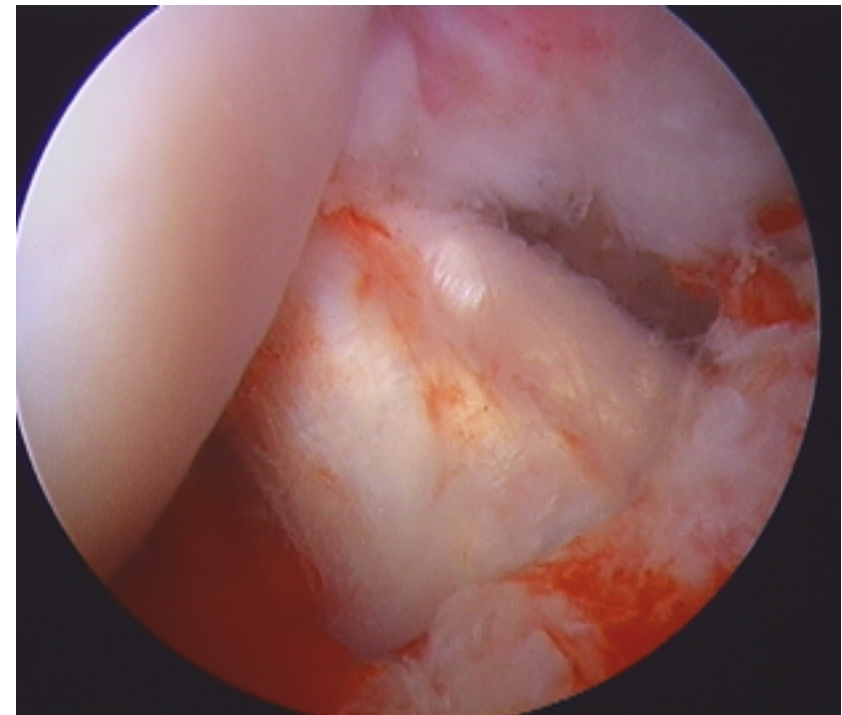
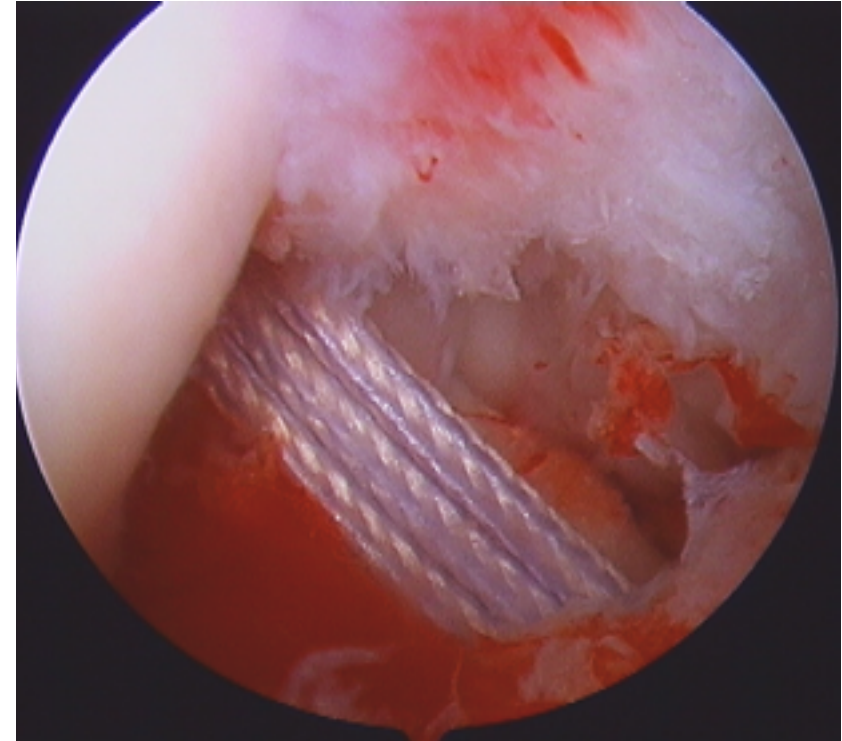
Preserve proximal tibial epiphysis with leveling osteotomy using CORA methodology

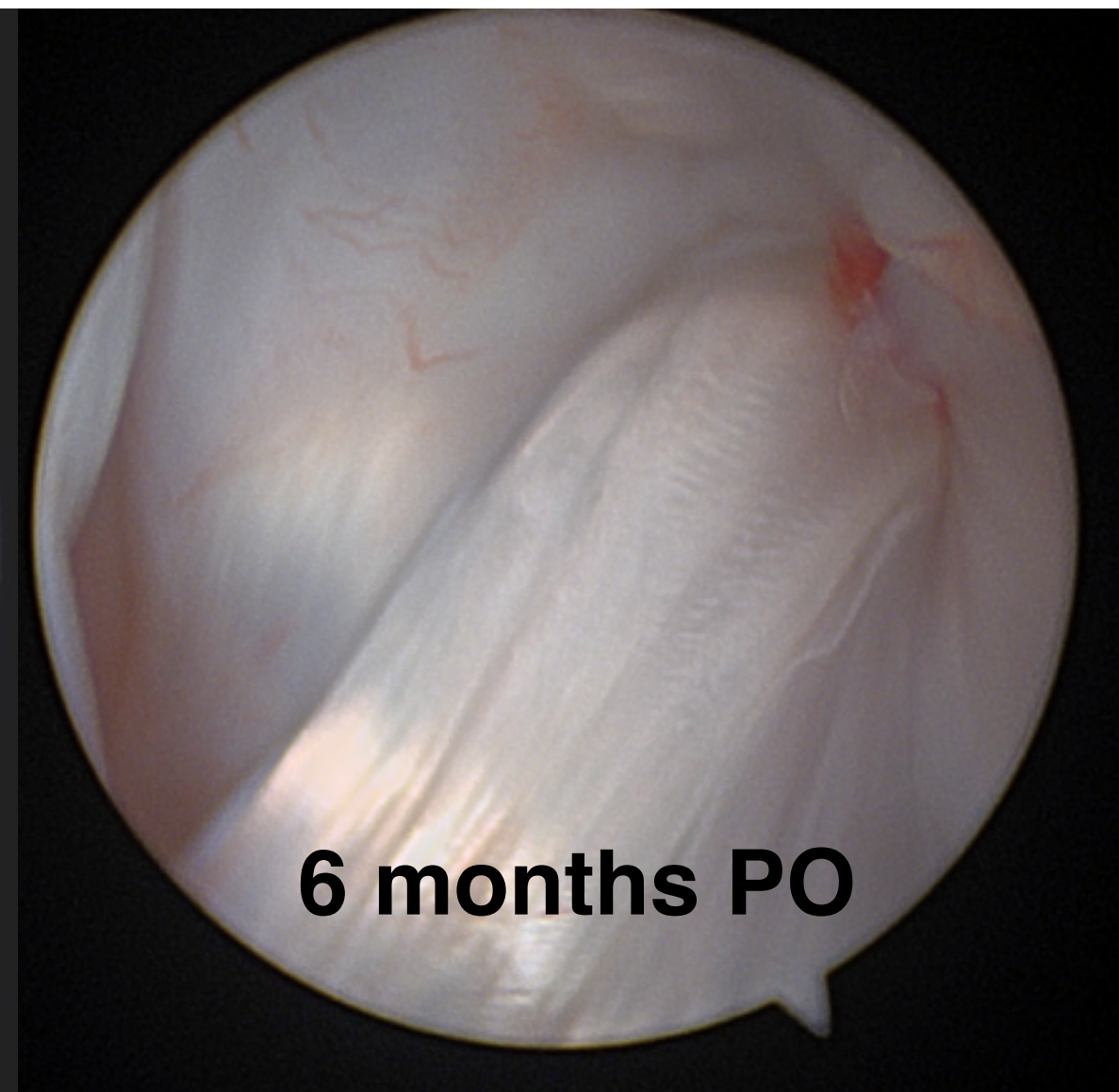
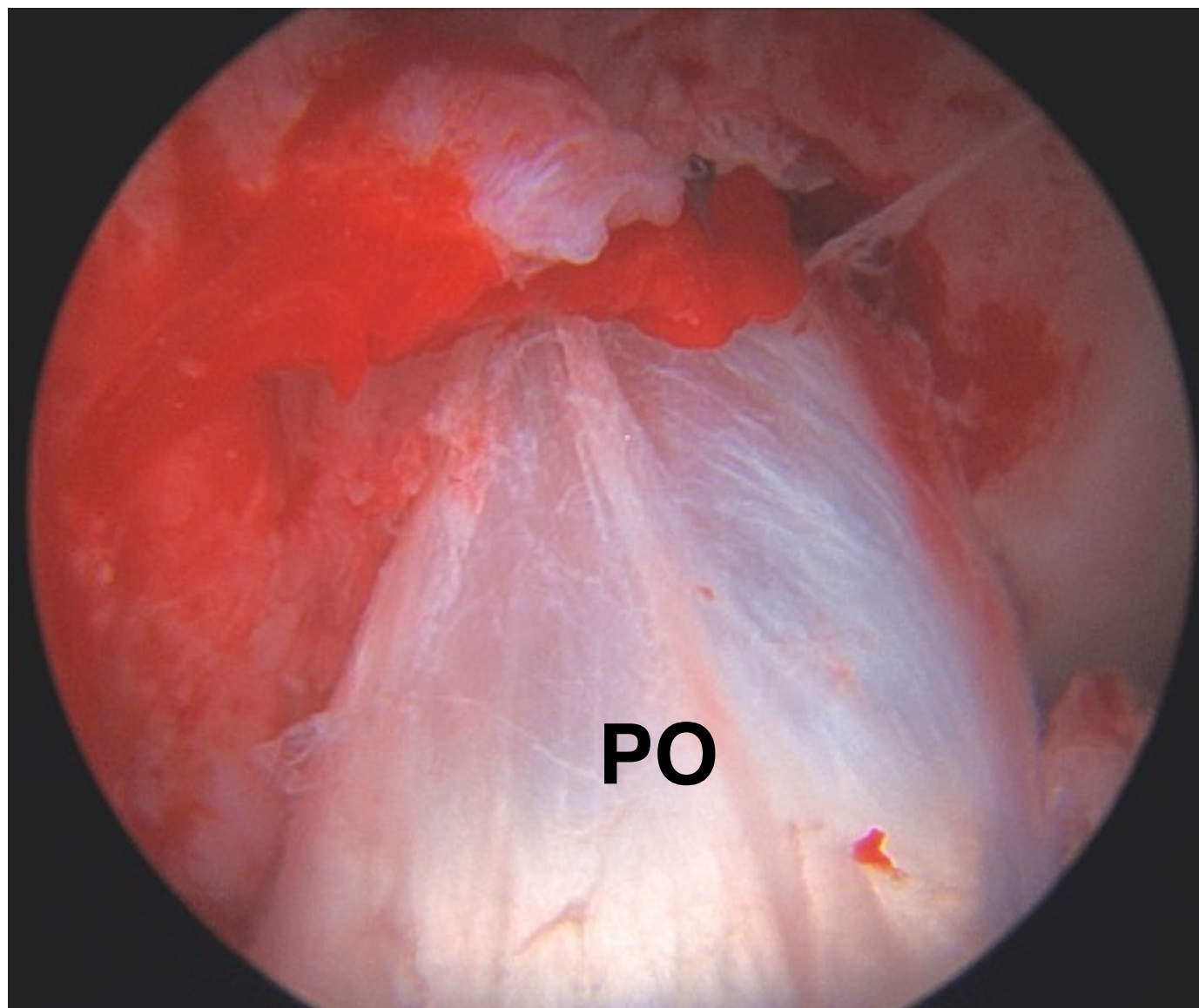






allograft





Monroe 6 months

Weight Distribution



Hind Limbs

41%

Front Limbs

59%



Left Front

30%



Right Front

29%



Left Hind

21%



Right Hind

21%

Limb	Side	Weight Distribution (%WD)	Vertical Force		Braking Force		Propulsion Force	
			Peak Force (%BW)	Impulse (%BW*s)	Peak Force (%BW)	Impulse (%BW*s)	Peak Force (%BW)	Impulse (%BW*s)
Front	Right	29%	95.0	16.1	-11.8	-1.1	10.4	0.8
	Left	30%	99.9	17.0	-12.3	-1.2	10.7	0.8
	% Difference (Right vs. Left)	5%	5%	5%	4%	9%	2%	3%
Hind	Right	21%	68.7	8.9	-3.1	-0.1	11.0	1.0
	Left	21%	68.8	9.8	-4.1	-0.2	8.2	0.7
	% Difference (Right vs. Left)	0%	0%	10%	28%	83%	30%	28%

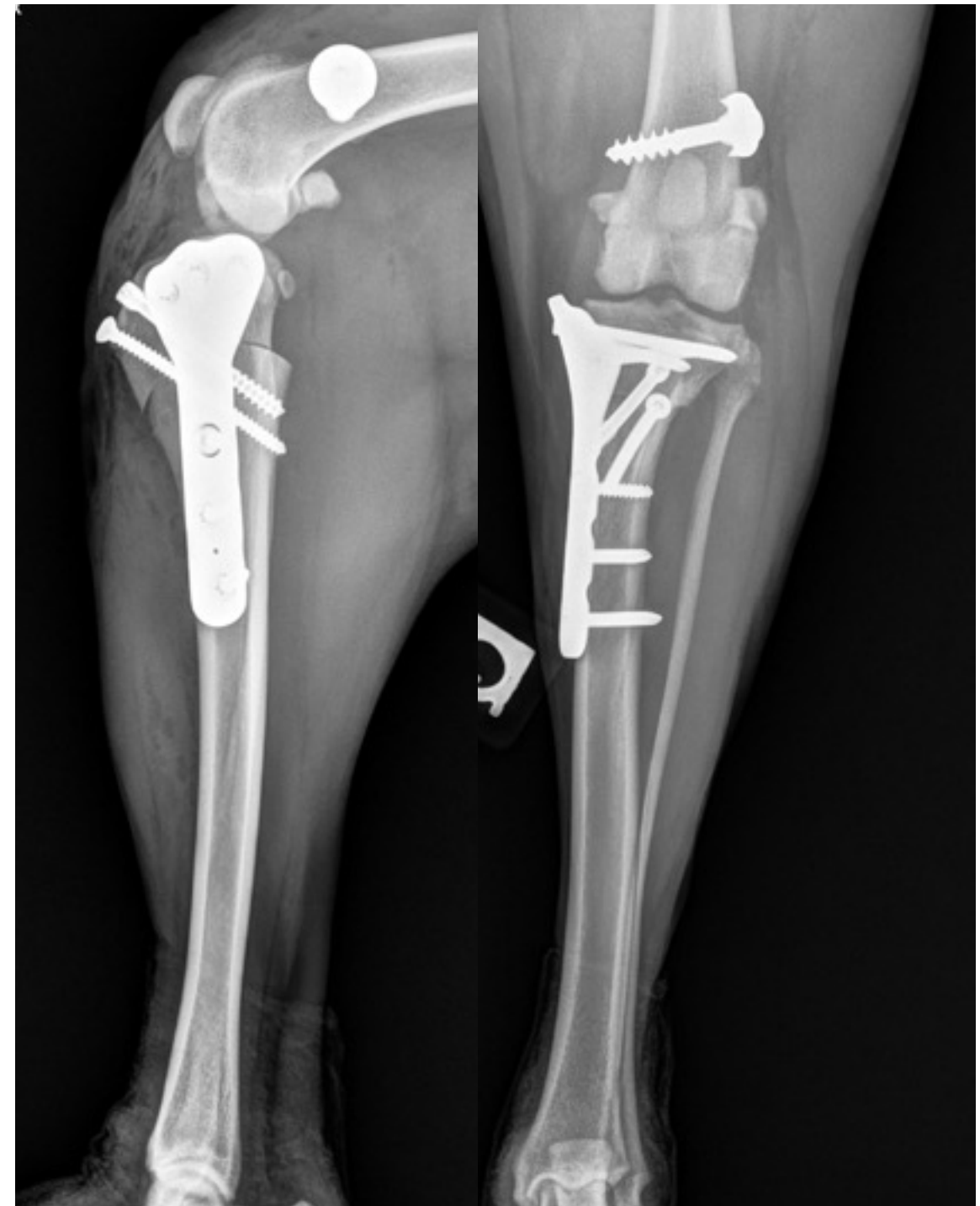
Deranged Knee

Millie

- complete tear ACL
- complete tear PCL
- bucket handle tear medial meniscus
- longitudinal tear lateral meniscus
- medial & lateral collateral ligament injury



- **Intra-articular graft**
- **excision bucket handle tear**
- **excision longitudinal tear**
- **augmentation MCL/LCL**
- **CBLO**



10 months PO



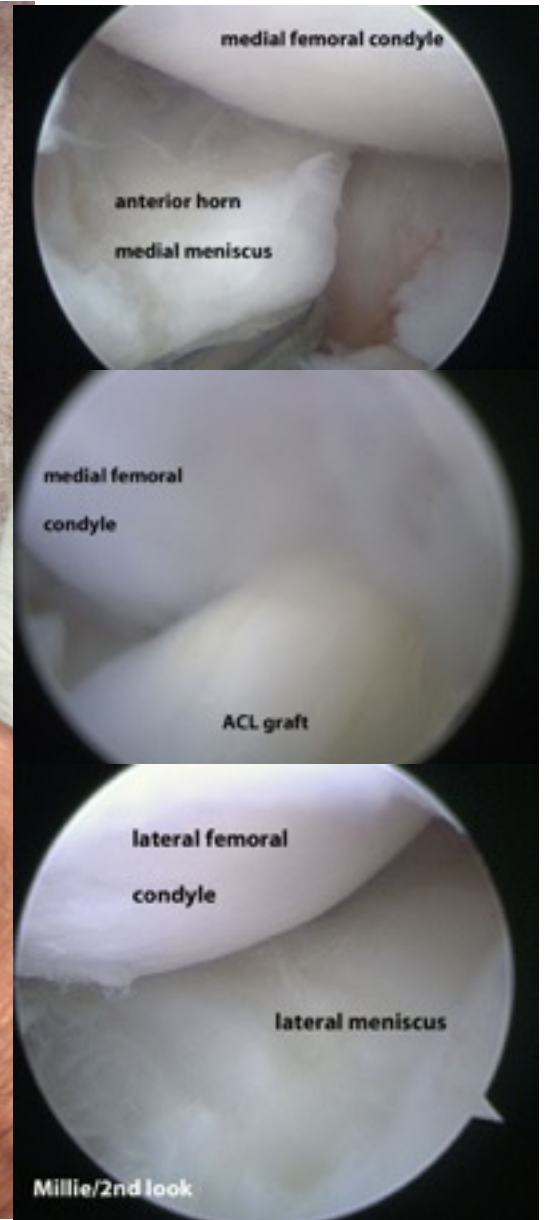
Standing film



excellent function



stable/NROM

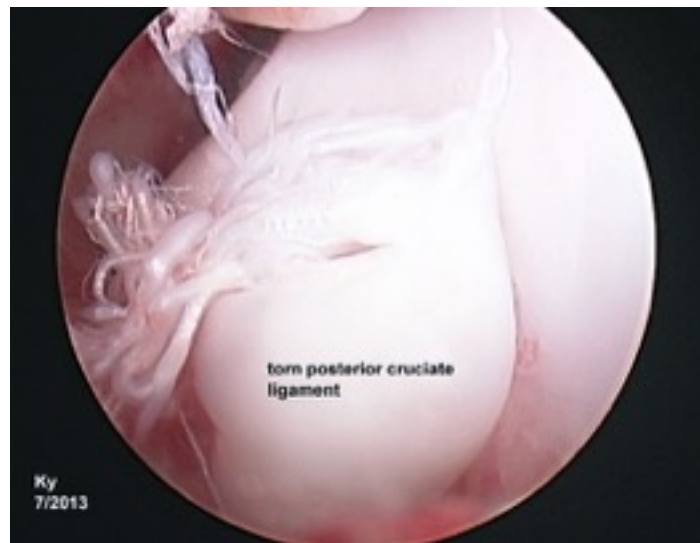


2nd look

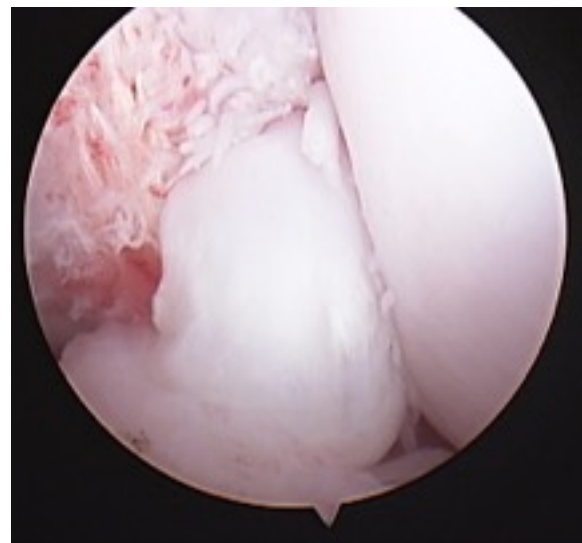
“Ky”

- * male/N
- * MB
- * 2yr
- * 79 lbs

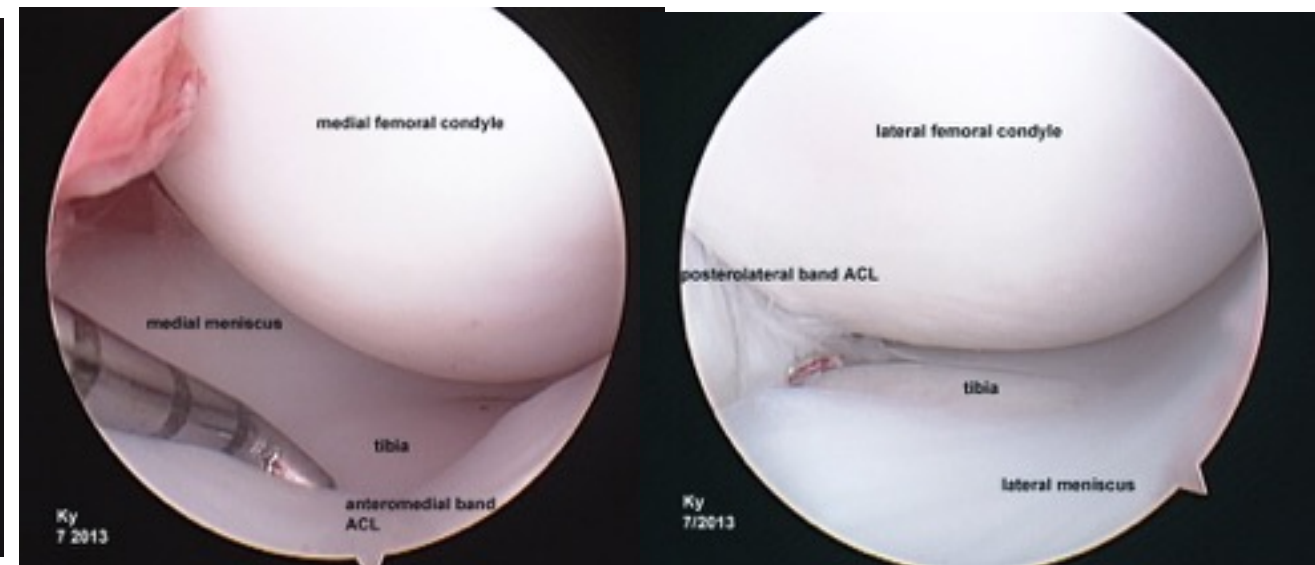
PCL....5.5 Arthrex Swivelock
ACL....IA graft, CBLO 12 degrees PO



PCL

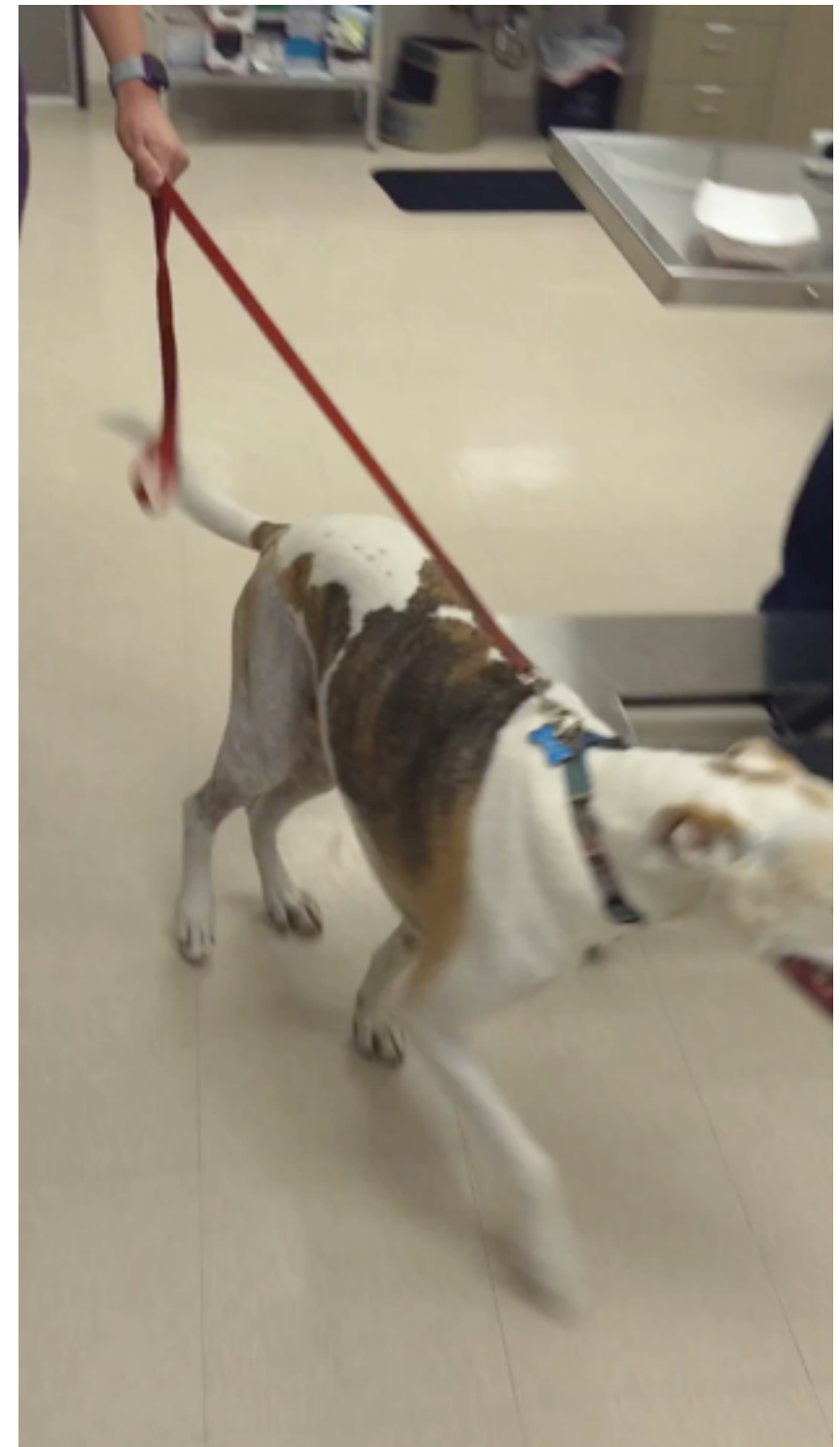


ACL



normal menisci

“Ky” 6 yrs PO



Client reports normal function