

# Posterior Cruciate Ligament

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# Agenda

- Historical PCL management and challenges
- Surgical repair protection/restriction
- Acute post op/non op management
- Dynamic bracing
- Rehab planning
- Our outcomes

# PCL Return to Sport

- 46 consecutive patients with MRI confirmed PCL gr 2 or 3. All managed conservatively.
- Reviewed until returned to sport and then at 5 years
- Ave 16.4 weeks to return to competitive sport
- 91% playing at same level or higher after 2 years vs 69% after 5 years
- Agolley et. al., 2017

**“Generally good results are reported after PCL reconstruction, but the long term studies available suggest that normal stability in the majority of patients is not restored ”**

*Hammond et al., 2010*

# PCL Natural History

- Natural history of PCL deficient knees:
  - Develop Medial and PF compartments osteoarthritis (Wijdicks et al., 2013, Kennedy et al., 2014, LaPrade et al., 2015)
- Few patients receive care looking for short to medium term solutions...

# Isolated and Combined Grade-III Posterior Cruciate Ligament Tears Treated with Double-Bundle Reconstruction with Use of Endoscopically Placed Femoral Tunnels and Grafts

Operative Technique and Clinical Outcomes

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*Investigation performed at the University of Minnesota, Minneapolis, Minnesota*

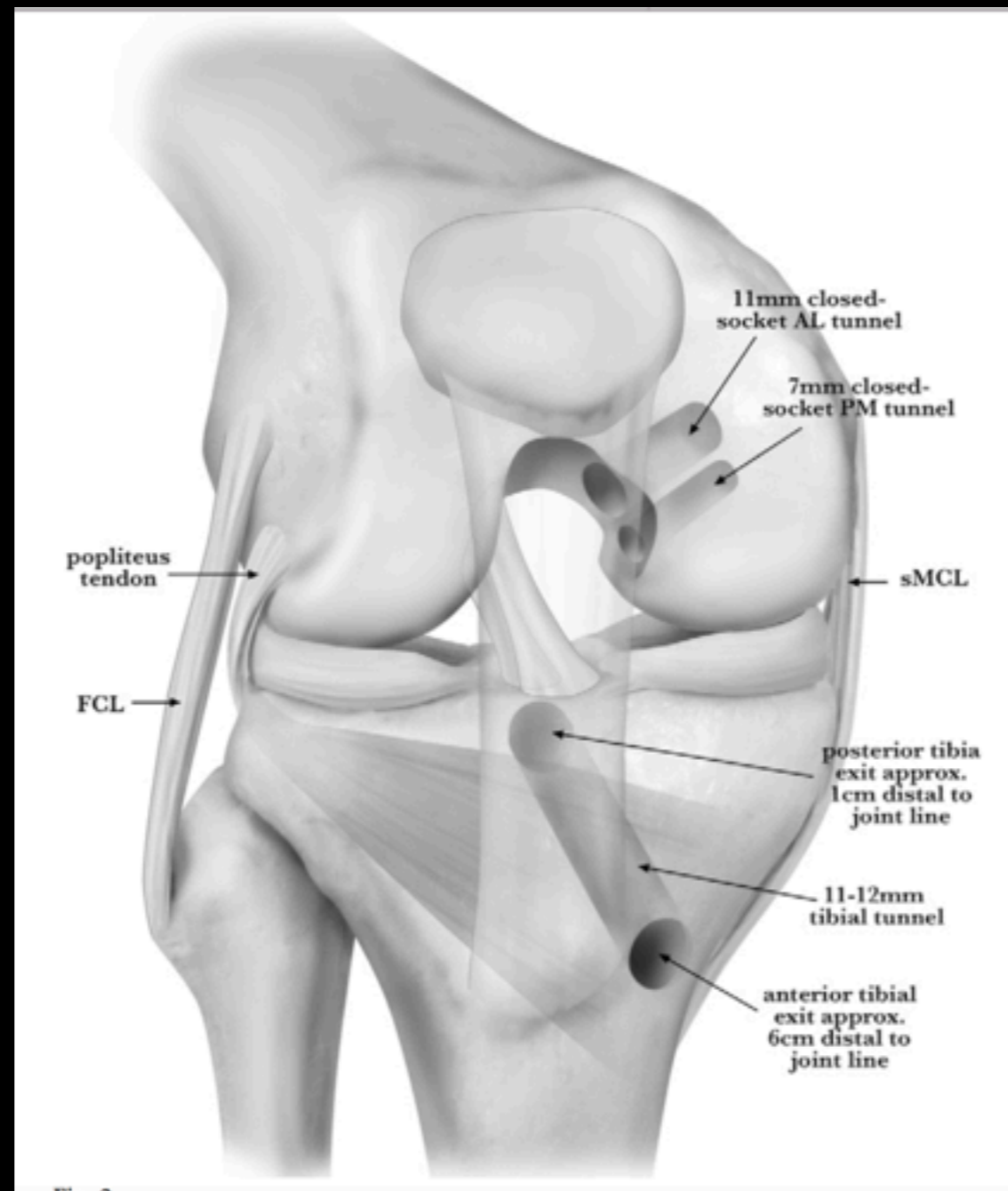


Fig. 2



# PCL Anatomy and Function

# PCL Post Op Restrictions

	ROM	Weight Bearing	Bracing	Hamstring
PCL Reconstruction	0-90 x 2 weeks then FROM	NWB x 6 wks	Immobilizer post op then Ossur rebound x 6 months.	No isolated HS contraction x 16 weeks

**No isolated HS contraction x 16 weeks**  
**No unsupported knee flexion x 16 weeks**

# Acute Goals

- In an acute post op PCL, what should we be trying to achieve?
  - Restore joint homeostasis ASAP
  - Manage the scarring process
  - Restore joint ROM
  - Retrain the quad
  - Create a plan

# Acute PT Management

- ROM - day 1
  - Prone passive ROM, Patellafemoral mobilisation, Bike @ week 7
- Quad - once nerve block is out
  - Quad initiation, Quad sets, TKE etc
- Restore Joint Homeostasis - day 1
  - Ice, elevation, responsible load management

# Complications



# Manage the Scarring Process

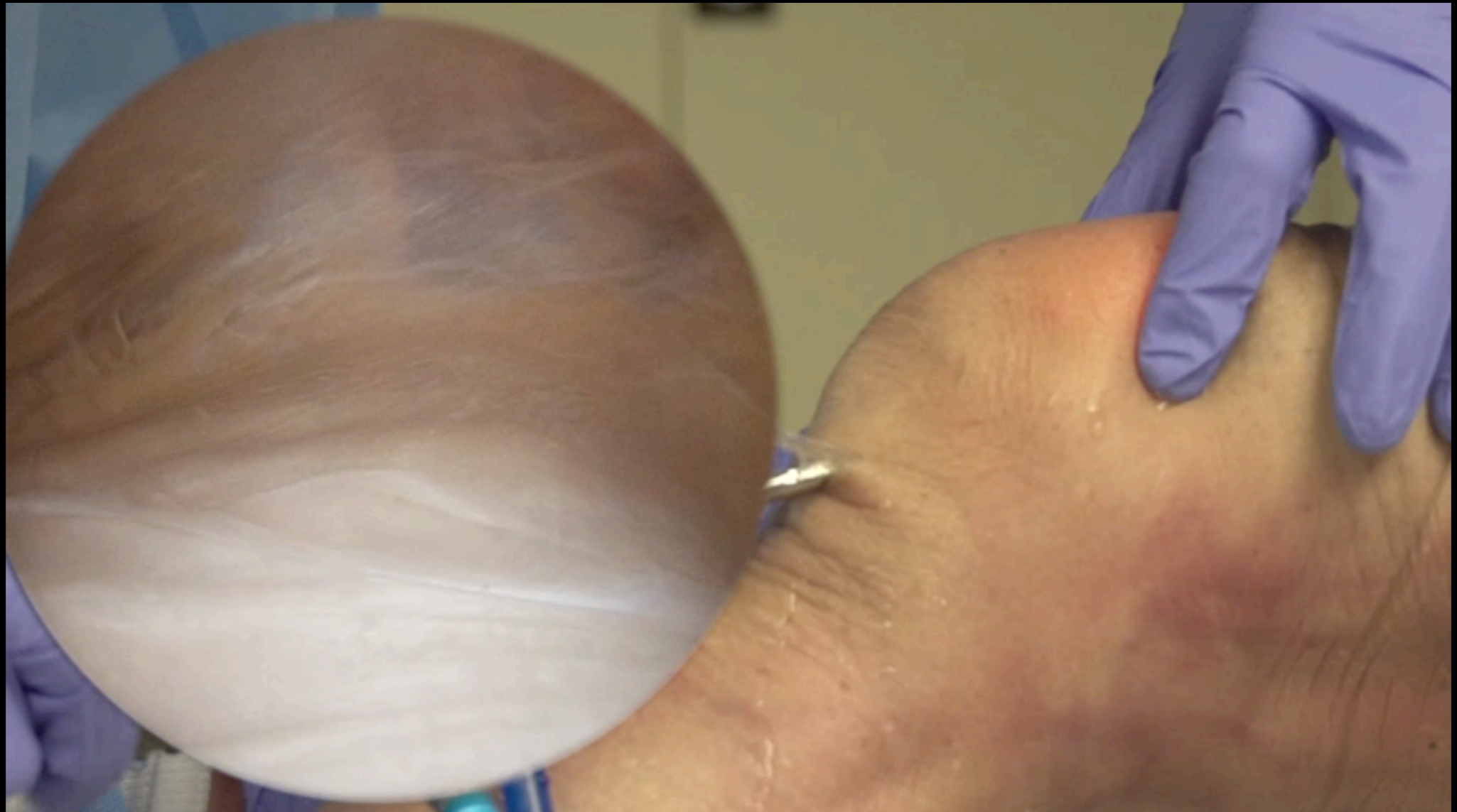
- To understand AF symptoms, you must understand the function/importance of joint spaces
  - Anterior interval
  - Suprapatellar pouch



# Manage the Scarring Process

- Increased PF and TF joint contact pressure as a result of AI adhesion (Ahmad et al, 1998)
- AI scarring decreases the moment arm of the extensor mechanism, resulting in decreased knee extension force generated by the quadriceps (Ahmad et al., 1998)
- Closure of either or both spaces related to anterior knee pain (Dragoo & Abnousi, 2008)

# Patellar Femoral Mobilisation





# Dynamic PCL Brace

- Evidence
  - 21 Patients with 1 year follow up, 17 with 2 yr follow up
  - Initial mean sag 7.1 ave vs 2.3 at 12 months
  - PCL has intrinsic healing capacity is knee is reduced in physiologic position and can heal with less attenuation (Jacobi et al., 2010)



# Dynamic PCL Braces

- Evidence
  - 8 fresh frozen cadaveric knees with intact cruciate ligaments
  - Reduce peak PFJ contact pressure in PCL deficient knees (Welch et al., 2017)



# Dynamic PCL Braces

- Post Injury
  - Conservative management - Rebound PCL brace
  - Post surgery - Immobilizer post op, then rebound as soon as swelling allows
  - Return to sport - CTI with PCL strap through 12 months

# Dynamic PCL Brace

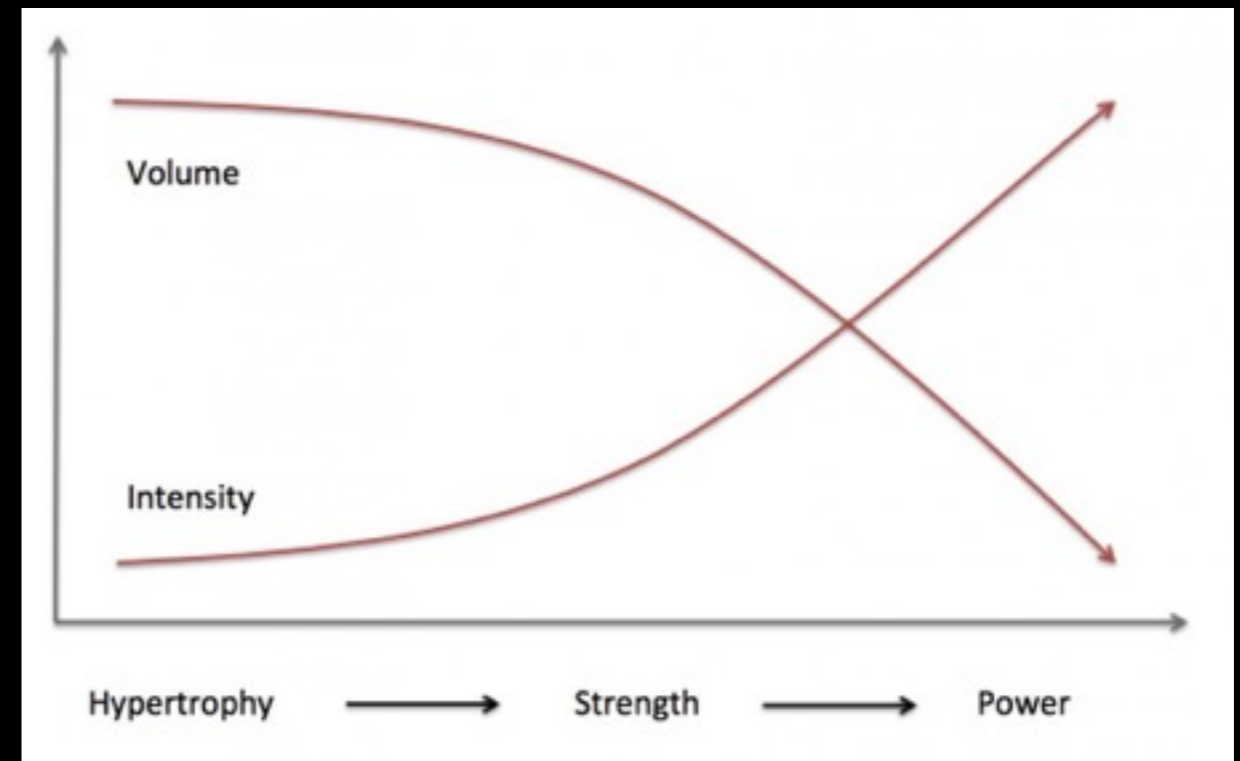
	Tension	ROM	RTP	Time
Brace Settings	4 - black key/ small patient 7 - grey key/ post op 10 - white key/ weight bearing	0-90 x 6wks 0-105 x 7+ weeks	Functional ACL brace with PCL attachment	24 hrs/day x 6 months Then functional brace for activities

# The Challenge of Long Term Rehabilitation

- How can you provide a plan that covers a 9+ month recovery
- How do you determine when it is appropriate to begin muscular strength, power, running, speed and agility, return to training etc?

# Periodisation

- Helps to structure a linear increase in training load (volume +intensity)
- Make physiological sense:
  - Type 1 fiber atrophies predominately following injury/ immobilisation (D'Antona et al., 2007, Thompson, 2002)
- Little information in rehab literature regarding optimal design of resistance training programs for injured athletes (Lorenz, 2010)
- Periodisation effective in improving strength and conditioning (Deschenes, 2002; Kraemer, 2000)



## 9 Rehab Phases That I Plan For:

ROM + Protection

Increase wt bearing tolerance

Muscular Endurance

Muscular Strength

Muscular Power

Running progression

Speed & Agility

Return to training

Return to play

PCL Reconstruction	Weeks From Surgery
ROM + Protection	0-6
Increase wt bearing tolerance	7-8
Muscular Endurance	9-16
Muscular Strength	17-22
Muscular Power	23-28
Running progression	25-28
Speed & Agility	29-32
Return to training	33-36
Return to play	36+



PCL Conservative Management	Weeks
ROM + Protection	0-6
Increase wt bearing tolerance	-
Muscular Endurance	7-12
Muscular Strength	13-18
Muscular Power	19-24
Running progression	20-24
Speed & Agility	25-28
Return to training	29-32
Return to play	33+

# Criteria Based Progressions

ROM	Endurance	Strength	Power	Running + Speed & Agility
PROM >130	Quad index (>80%)	Quad index (>90%)	Hop test: SL to DL	Agility T Test <11s
15 mins ambulation	DorsaVi: Single leg squat.	DorsaVI: Box drop	DorsaVi: Vertical hop	DorsaVi: AGRF within 10%
Symmetrical active knee extension	Leg press 80% body weight 10RM	Leg press 90% body weight 10RM	Leg press 100% body weight 10RM	
	Y-Balance - Anterior reach < 8cm	Y-Balance Anterior reach <4cm		

# Our Outcomes

All PCL Reconstructions (N=100)	Preoperative Outcomes Scores	Postoperative Outcomes Scores	P-Value
Legner Activity Scale	2.5 (range, 0-9)	5.1 (range, 1-10)	<0.001
Lysholm Score	49.1 ± 25.1	79.8 ± 25.1	<0.001
Western Ontario and McMaster Universities Arthritis Index Total	38.7 ± 27.9	9.9 ± 27.8	<0.001
Short Form-12 Physical Health Composite Score	37.6 ± 10.9	50.3 ± 10.8	<0.001
Patient Satisfaction	2.5 (range, 0-9)	7.5 (range, 0-9)	N/A

Pre- and postoperative outcome scores for all patients who underwent double bundle Posterior Cruciate Ligament Reconstruction (DB PCLR).

# Our Outcomes

Preoperative Outcomes Scores	Isolated PCL Reconstruction (N=31)	PCL Based Multiligament Reconstruction (N=69)	P-Value
Legner Activity Scale	2.8 (range, 0-9)	2.5 (range, 0-9)	0.441
Lysholm Score	58.3 ± 21.7	49.1 ± 25.3	0.058
Western Ontario and McMaster Universities Arthritis Index Total	31.5 ± 20.7	41.6 ± 30.1	0.072
Short Form-12 Physical Health Composite Score	38.7 ± 10.8	37.4 ± 11.1	0.748
Postoperative Outcomes Scores	Isolated PCL Reconstruction (N=31)	PCL Based Multiligament Reconstruction (N=69)	P-Value
Legner Activity Scale	5.0 (range, 1-10)	5.0 (range, 1-10)	0.796
Lysholm Score	80.6 ± 16.5	78.6 ± 17.8	0.304
Western Ontario and McMaster Universities Arthritis Index Total	9.9 ± 13.7	10.0 ± 10.8	0.891
Short Form-12 Physical Health Composite Score	50.3 ± 10.6	50.1 ± 9.6	0.759
Patient Satisfaction	7.5 (range, 1-10)	7.4 (range, 1-10)	0.817

Pre- and postoperative outcome score data for patients who underwent isolated or combined (with additional cruciate or collateral ligament reconstruction) DB PCLR.

# Our Outcomes

- Pre op posterior tibial translation
  - PCL only - 8.7mm
  - PCL + other ligamentous injury - 11.9mm
- Post op posterior tibial translation
  - PCL only - 1.2mm
  - PCL + other ligamentous injury - 1.7mm

# Multi Ligament Outcomes

- 167 Patient seen between 2010-2014, 2 year follow up

	Tegner	Lysholm	WOMAC
Pre Surgery	2.3	46.1	41.4
Post Surgery	5.6	84.1	7.4

- No difference between ACL or PCL based MLI
- No difference between medial or lateral structures  
(LaPrade et al., unpublished)

# Conclusion

- DB PCL reconstruction restores joint stability
- Restoring ROM is key to great outcomes
- Dynamic bracing plays an integral role in avoiding graft elongation
- Create a plan!