Changes in *In Vivo* Knee Kinematics Following Combined Revision ACL Reconstruction and Anterior Closing-Wedge Osteotomy

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ACWHTO and revision ACLR

What is known

- Favorable clinical outcomes and lower ACL graft failure rate in cases with increased PTS
- ATT is reduced in cadaveric studies, except when internal rotation or valgus torque applied

What is unknown

- The precise effect of ACWHTO on *in vivo* joint kinematics

Purpose

- To determine the changes in tibiofemoral kinematics in the operative knee following revision ACLR combined with ACWHTO at 6 months follow-up.

Hypothesis

- ATT would be decreased after ACWHTO
- ACWHTO would have no effect on other kinematics including knee flexion, internal/external rotation, or adduction/abduction.

Methods

- Ongoing prospective single cohort study

- Inclusion criteria
  - ACL graft failure
  - PTS > 12°
  - ACWHTO with ACLR

- Exclusion criteria
  - < 14 years of age
  - skeletal immaturity
  - previous osteotomy
  - primary ACL injury

Study Progress

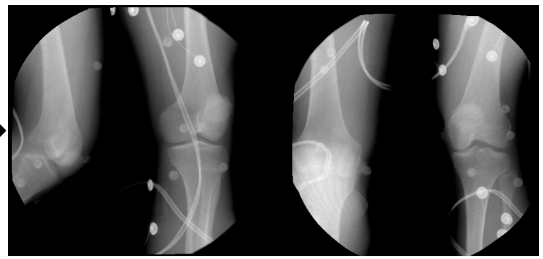
Subject	Pre-op	Surgery	6M FU	1Y FU
#1	✓	✓	✓	✓
#2	✓	✓	✓	✓
#3	✓	✓	✓	✓
#4	✓	✓	✓	✓
#5	✓	✓	✓	✓
#6	✓	✓	✓	Mar-Apr, 2026
#7	✓	✓	✓	Apr, 2026
#8	✓	✓	May, 2026	
#9	✓	✓	June, 2026	
#10	✓	✓	June, 2026	

Data Collection

A

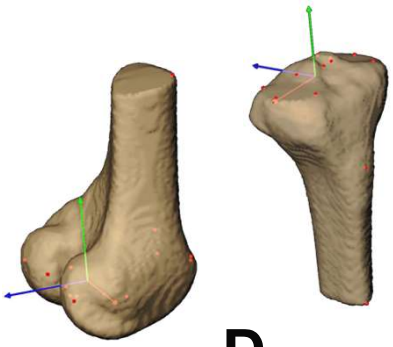
Walking
Downhill running

B

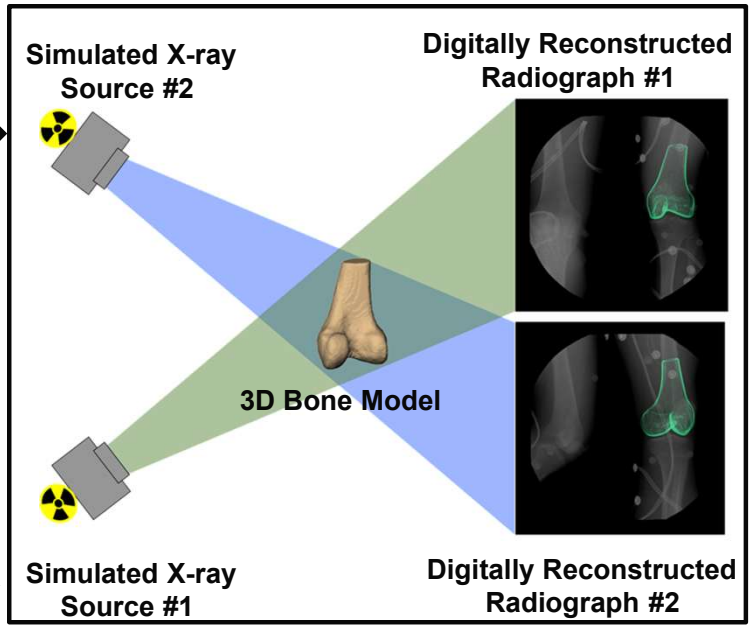


C

D



E



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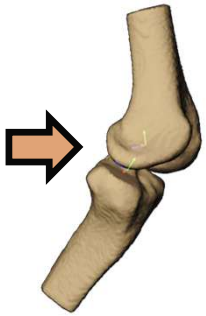
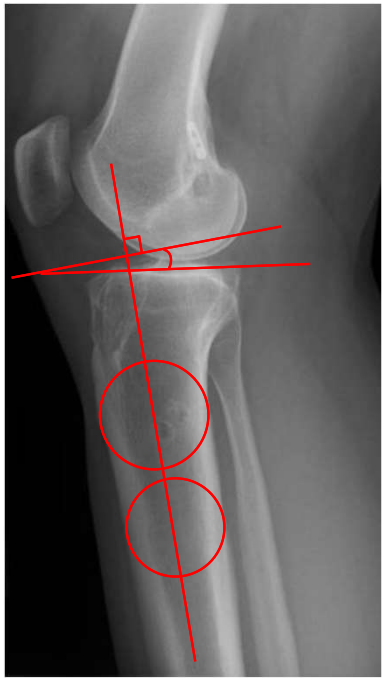


Radiographic measurement

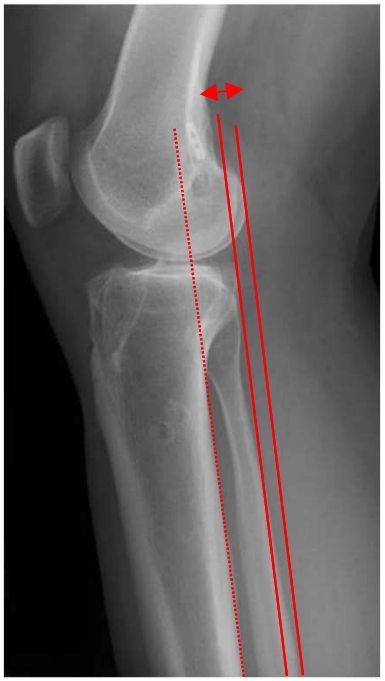
Posterior tibial slope (PTS)



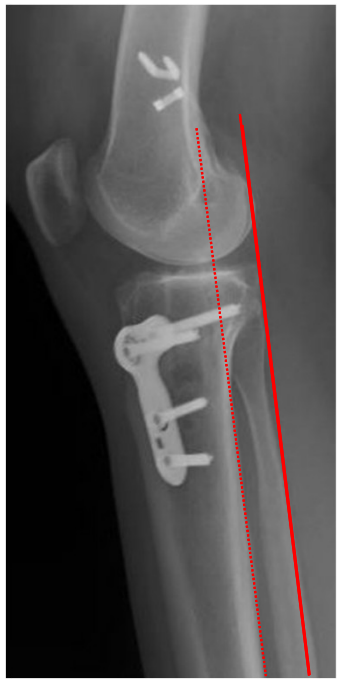
12°

5°

Static anterior tibial translation (SATT)



5.2 mm



0 mm

Data analysis

- Both knees imaged 3 times per activity using a biplane radiography, and the average values were used for data analysis.

- Post-op tibiofemoral kinematics in the affected knee were compared to pre-op and the contralateral knee.

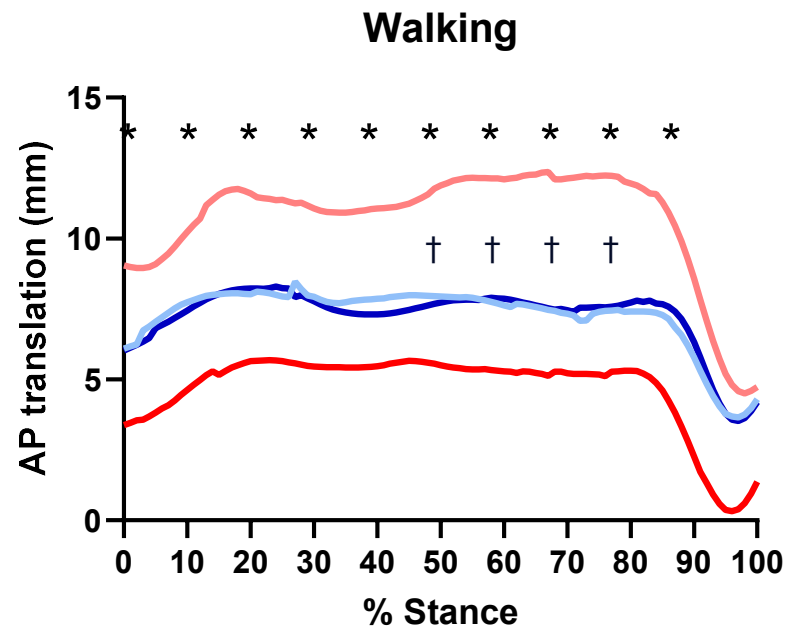
- Statistical analysis:
  Linear mixed model analysis were performed at every 10% increment in stance. ($p < 0.05$)

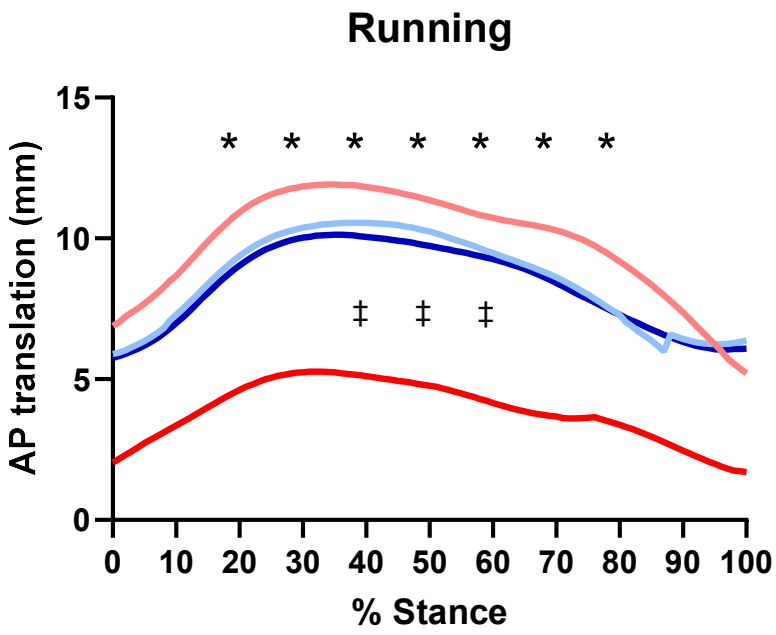
Results

- 5 pts (age 20-34 yrs)
- 4 supratuberosity
- 1 infratuberosity
- Pre PTS
  - 12-17deg
- Post PTS
  - 0-6deg

Subject	#1	#2	#3	#4	#5
Age	34	24	20	20	29
The number of ACLR	3rd	2nd	2nd	3rd	3rd
Osteotomy procedure	Infra-tuberosity	Supra-tuberosity	Supra-tuberosity	Supra-tuberosity	Supra-tuberosity
ACL graft	Allograft (Achilles)	Quadriceps autograft	Quadriceps autograft	Quadriceps autograft	Hamstring autograft
Concomitant procedure	partial medial meniscectomy	partial medial meniscectomy	lateral & medial meniscus repair	partial medial meniscectomy lateral menisus repair	lateral menisus repair
Contralateral knee	intact	intact	intact	after ACLR	intact
Radiographic measurement					
pre PTS (°)	12	17	14	12	14
post PTS (°)	5	6	3	0	5
Δ PTS (°)	**7**	**11**	**11**	**12**	**9**
pre SATT (mm)	5.2	5.2	5.8	7	3.9
post SATT (mm)	0	-2.8	0	n.a.	-2.8
Δ SATT (mm)	**5.2**	**8.0**	**5.8**	**n.a.**	**6.7**
pre MPTA	86	88	85	87	88
post MPTA	86	89	84	87	87
Δ MPTA (°)	**0**	**1**	**-1**	**0**	**-1**

Anterior tibial translation (ATT)





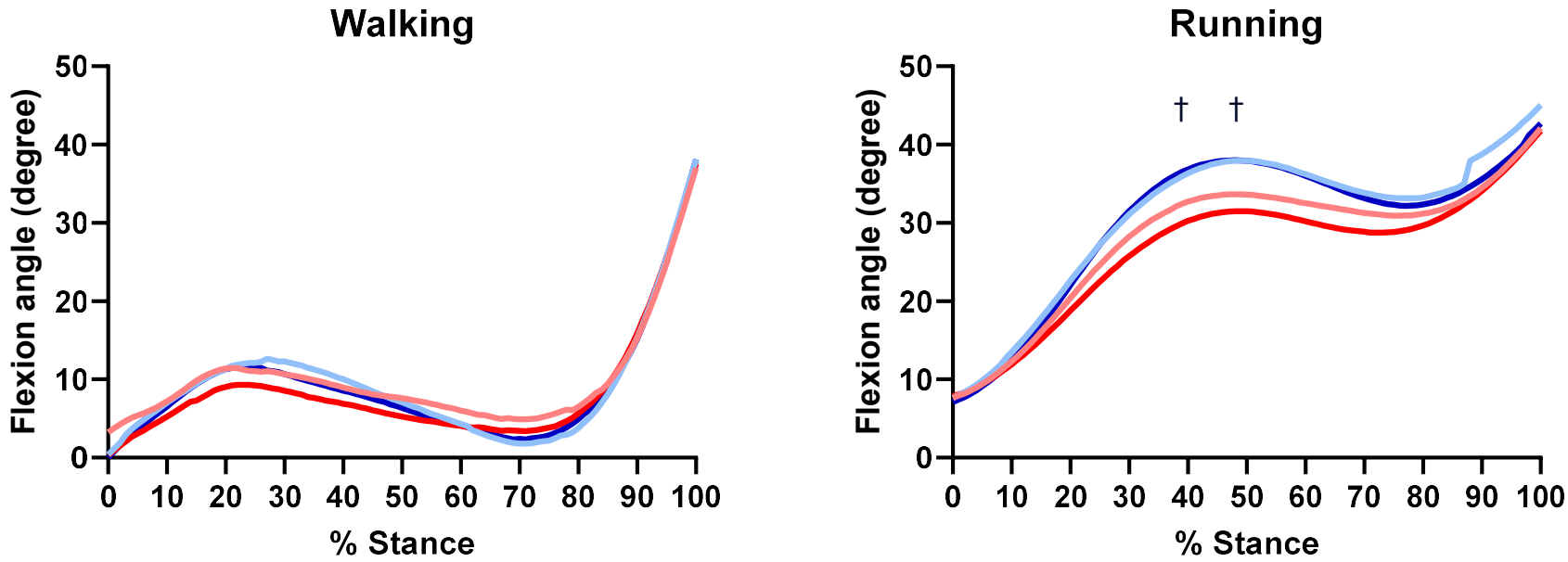
Pre-Op Affected
Pre-Op Contralateral
6M post-op Affected
6M post-op Contralateral

* Significant difference between pre-op affected and post-op affected

† Significant difference between pre-op affected and contralateral

‡ Significant difference between post-op affected and contralateral

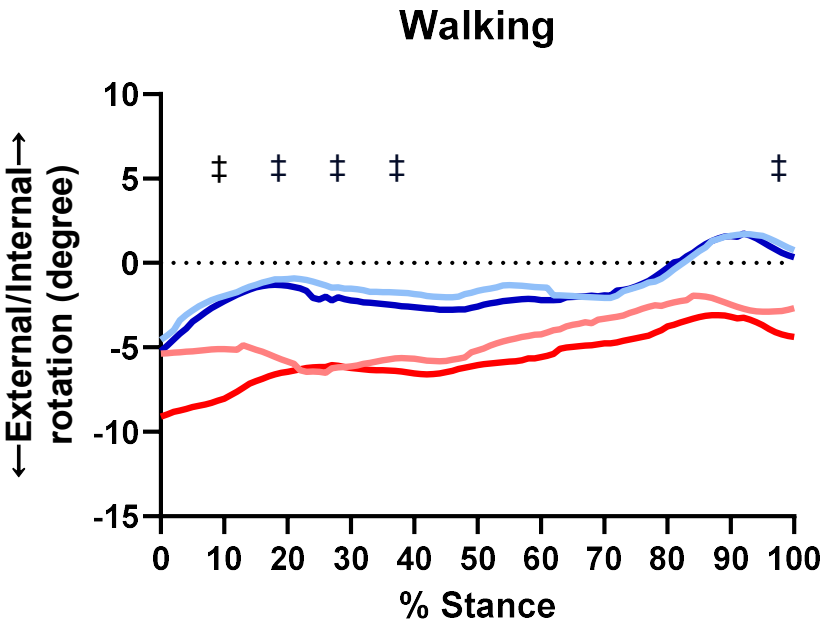
Flexion / Extension

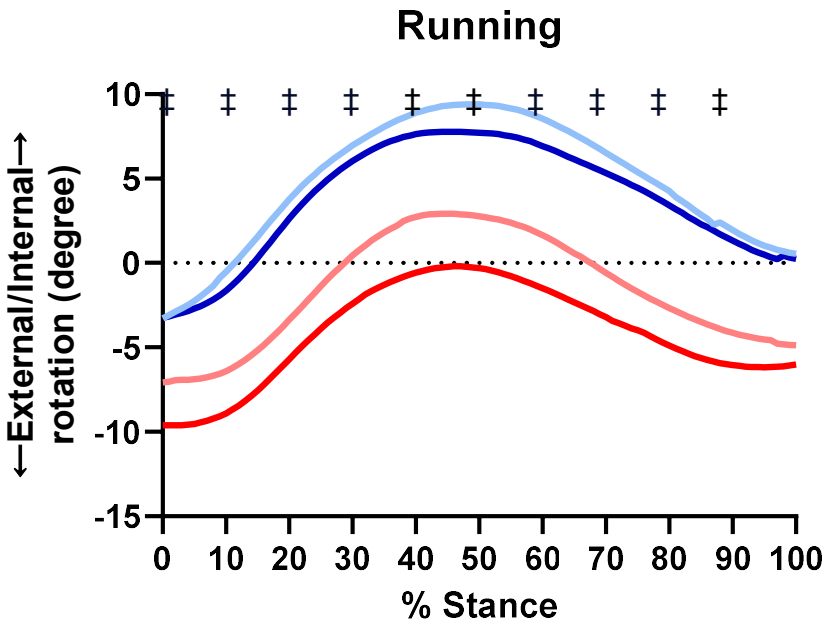


Pre-Op Affected
Pre-Op Contralateral
6M post-op Affected
6M post-op Contralateral

† Significant difference between post-op affected and contralateral

Internal / External rotation

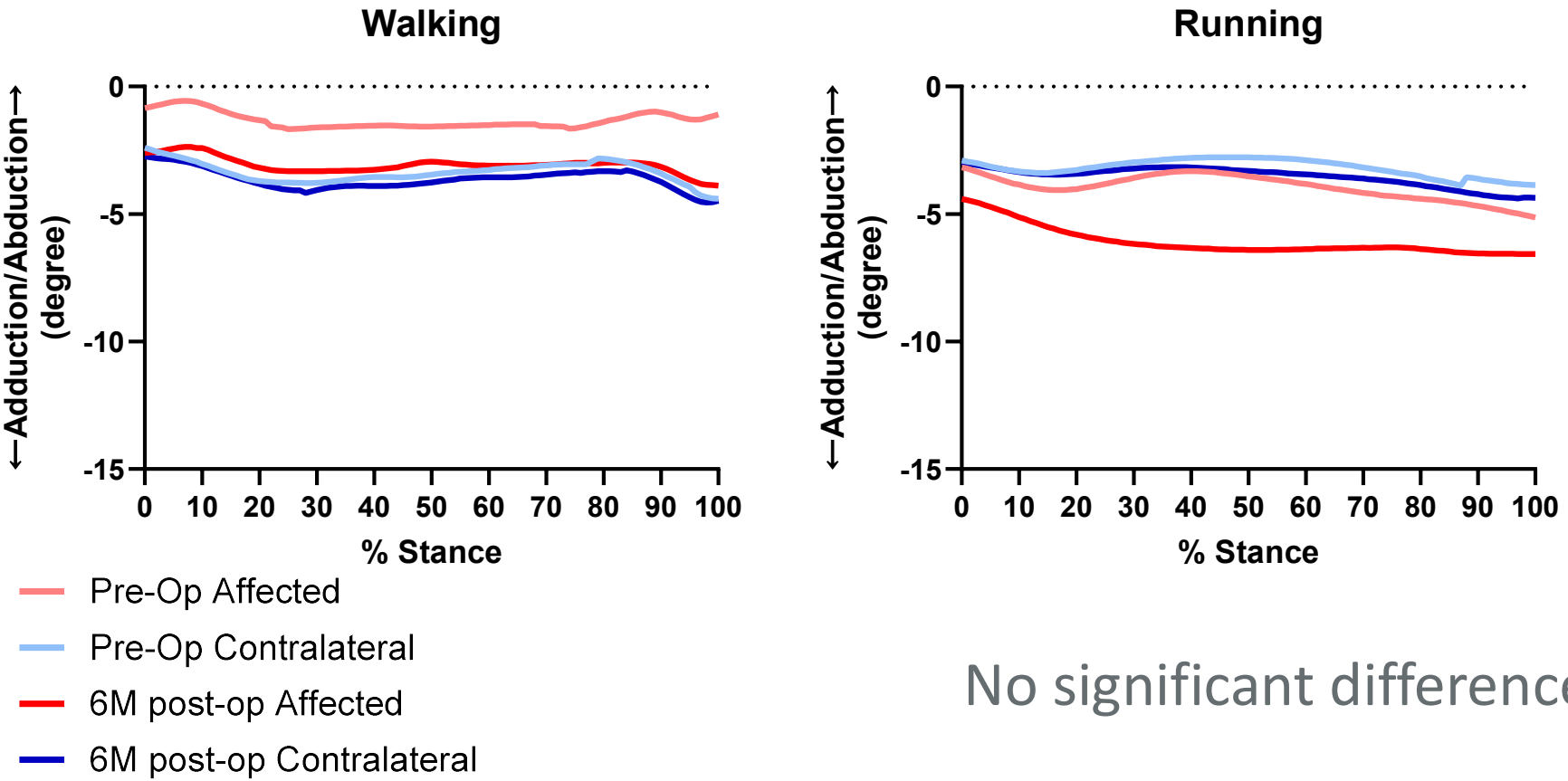




Pre-Op Affected
Pre-Op Contralateral
6M post-op Affected
6M post-op Contralateral

‡ Significant difference between post-op affected and contralateral

Adduction / Abduction



No significant differences

Discussion

ATT

- ACW HTO + revision ACLR led to:
  - Reduction in ATT during walking and running
  - ATT lower in contra knee than in preop knee during walking
  - ATT higher than in postop knee during running
    - Downhill running may promote ATT even in knees with ↑ PTS
- Previous cadaveric studies
  - ATT ↓ only under specific loading (IR or valgus)

Yamaguchi, AJSM 2018
Amirtharaj, AJSM 2025

Discussion

ER:

- ACW HTO + revision ACLR led to:
  - Greater ER than contralateral knee
  - However ER was present preoperatively
- Previous studies:
  - residual ER after primary ACLR

Tashman AJSM 2004, Tashman KSSTA 2021

- ER deviation: protective adaptation or residual deficit?
  → requires cautious interpretation & further study

Conclusions

- Revision ACLR combined with ACWHTO reduces excessive ATT in ↑ PTS patients
  - May reduce potential ACL graft failure risk
- Increase in ER postop needs further study

Thank You