Effect of PLL Resection on Kinematics of Cervical Artificial Disc Replacement: *To Cut Or Not to Cut?*

Conflict of Interest Disclosure

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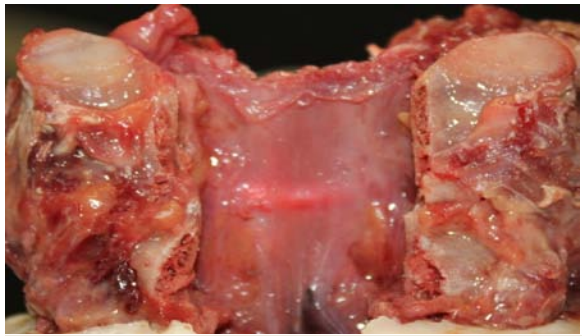
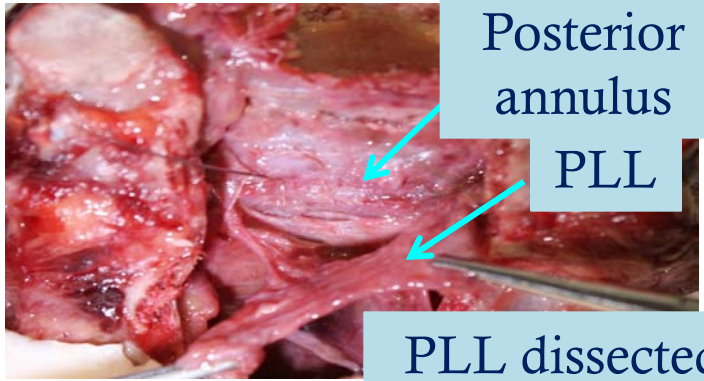
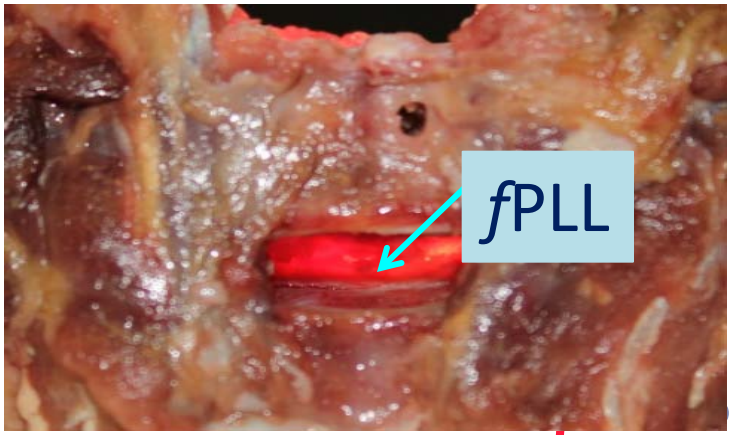
The Anatomy of PLL in the Lower C-Spine



P-A views



➢ functional PLL (*f*PLL) – includes thickened posterior annulus fibrosis



A-P view of disc space after discectomy

Role of *f*PLL in Cervical Disc Arthroplasty

- Debate: ***To Cut*** ***Or*** ***Not to Cut?***
  - ✓ Some advocate resection to facilitate a more parallel disc space distraction
  - ✓ Allows better decompression
  - ✓ May increase mobility in collapsed disc space
  - ❖ Others advocate its preservation for improved biomechanical stability if its entire removal is not required for neural decompression [McAfee et al. 2003]
- What about in 2-level disc arthroplasty?
  - *f*PLL resection at both levels may induce instability

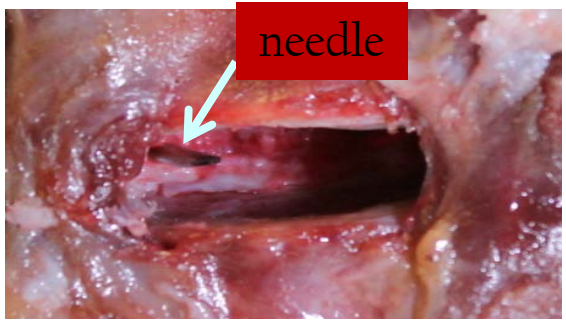
Purpose

- Investigate the effect of *f*PLL resection on the kinematics of implanted cervical motion segments in a 2-level disc arthroplasty model.

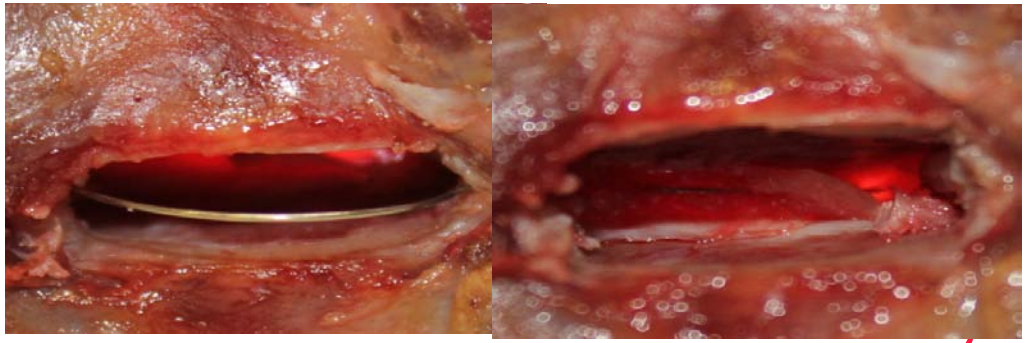
Implanted Segment	*f* PLL	
	Case I	Case II
C5-C6	cut	cut
C6-C7	intact	cut

Methods:

Our technique to resect *f*PLL without prosthesis removal



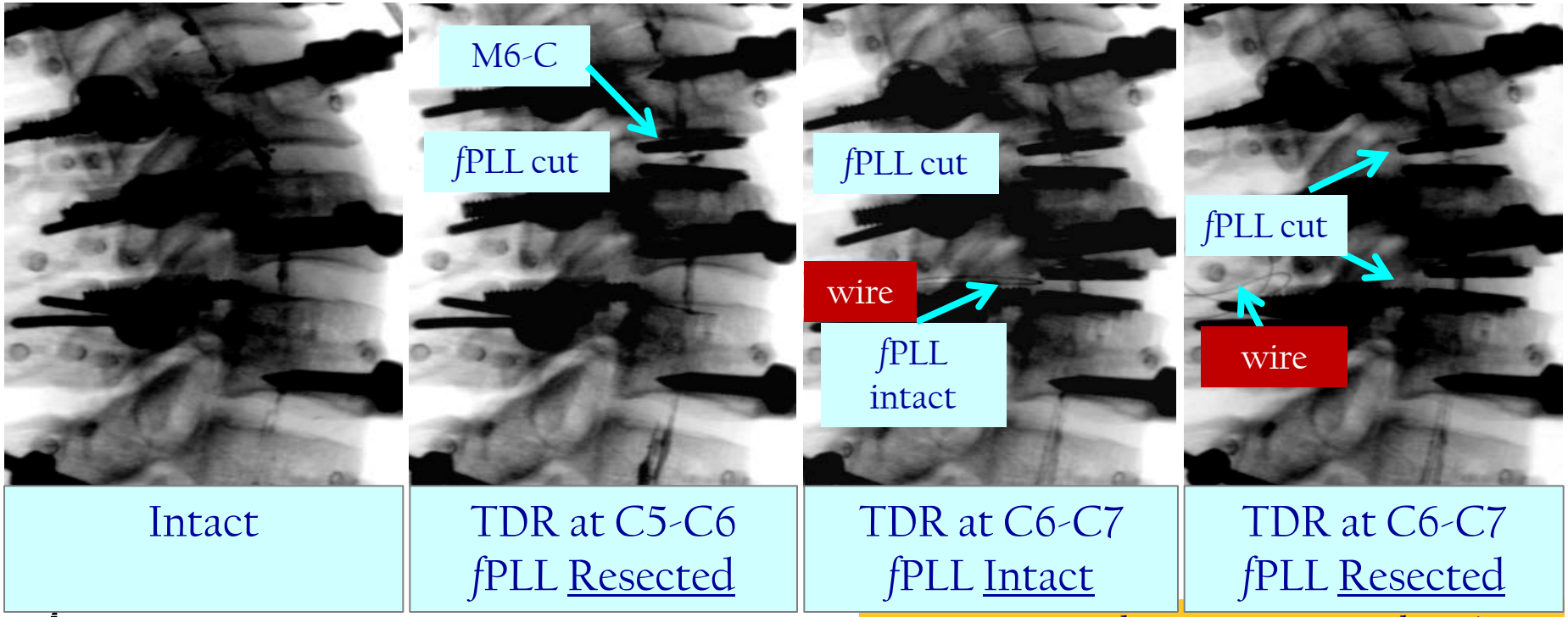
- after performing discectomy & prior to prosthesis insertion
- 0.36 mm stainless steel wire
- introduced posterolaterally through a needle via puncture hole in the LF



- looped around *f*PLL

Materials & Methods

9 Intact cervical spines (C3-T1; 46 ± 9.1 yr)
Flexion , Extension, Lateral Bending & Axial Rotation (±1.5Nm)

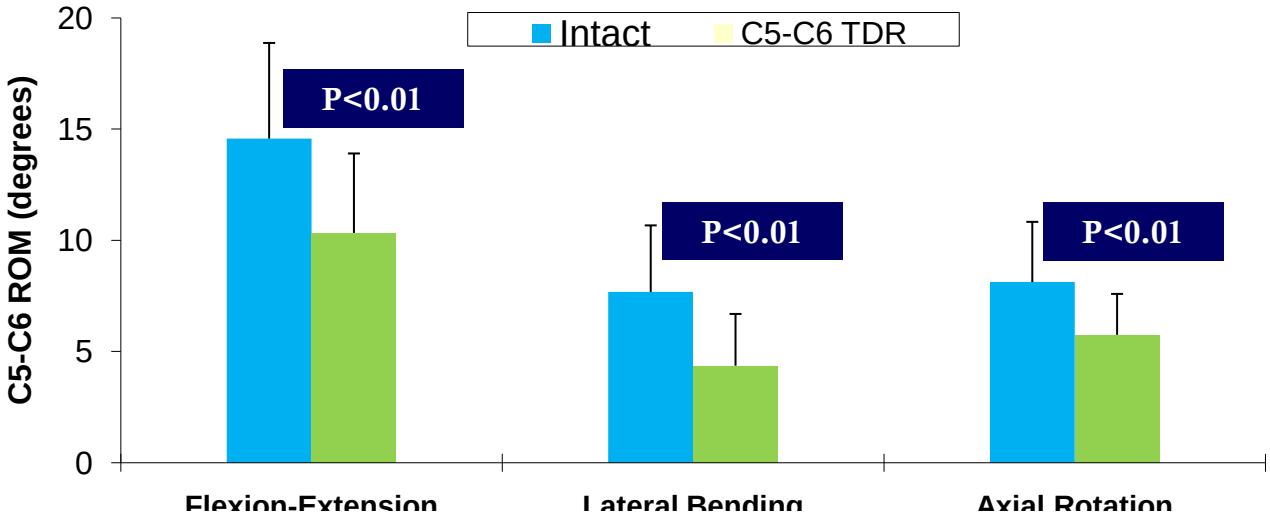


Intact	TDR at C5-C6 fPLL Resected	TDR at C6-C7 fPLL Intact	TDR at C6-C7 fPLL Resected

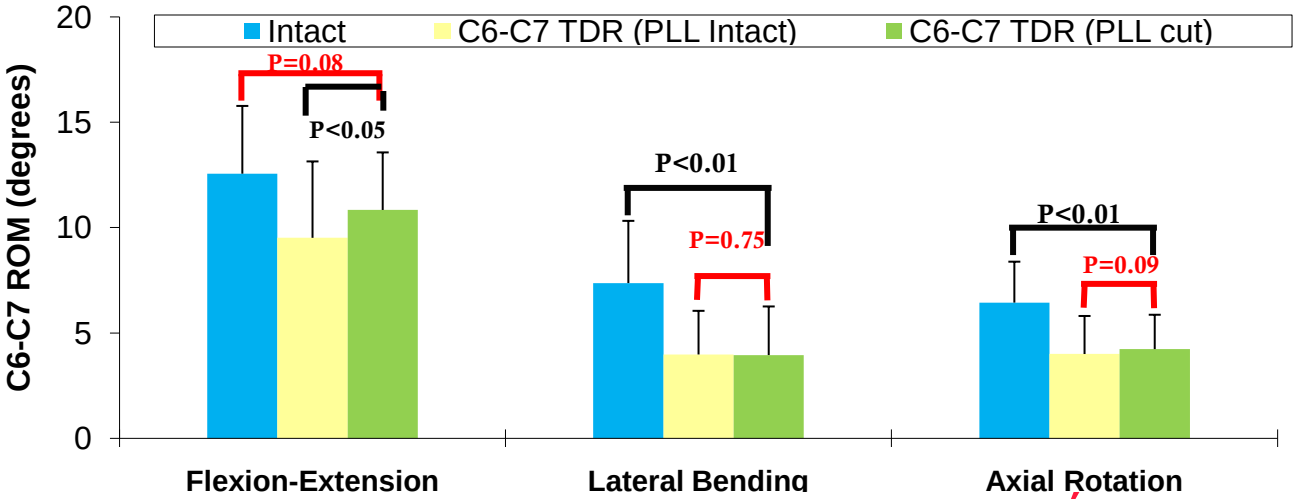
M6-C; Spinal Kinetics, Sunnyvale, CA

Results

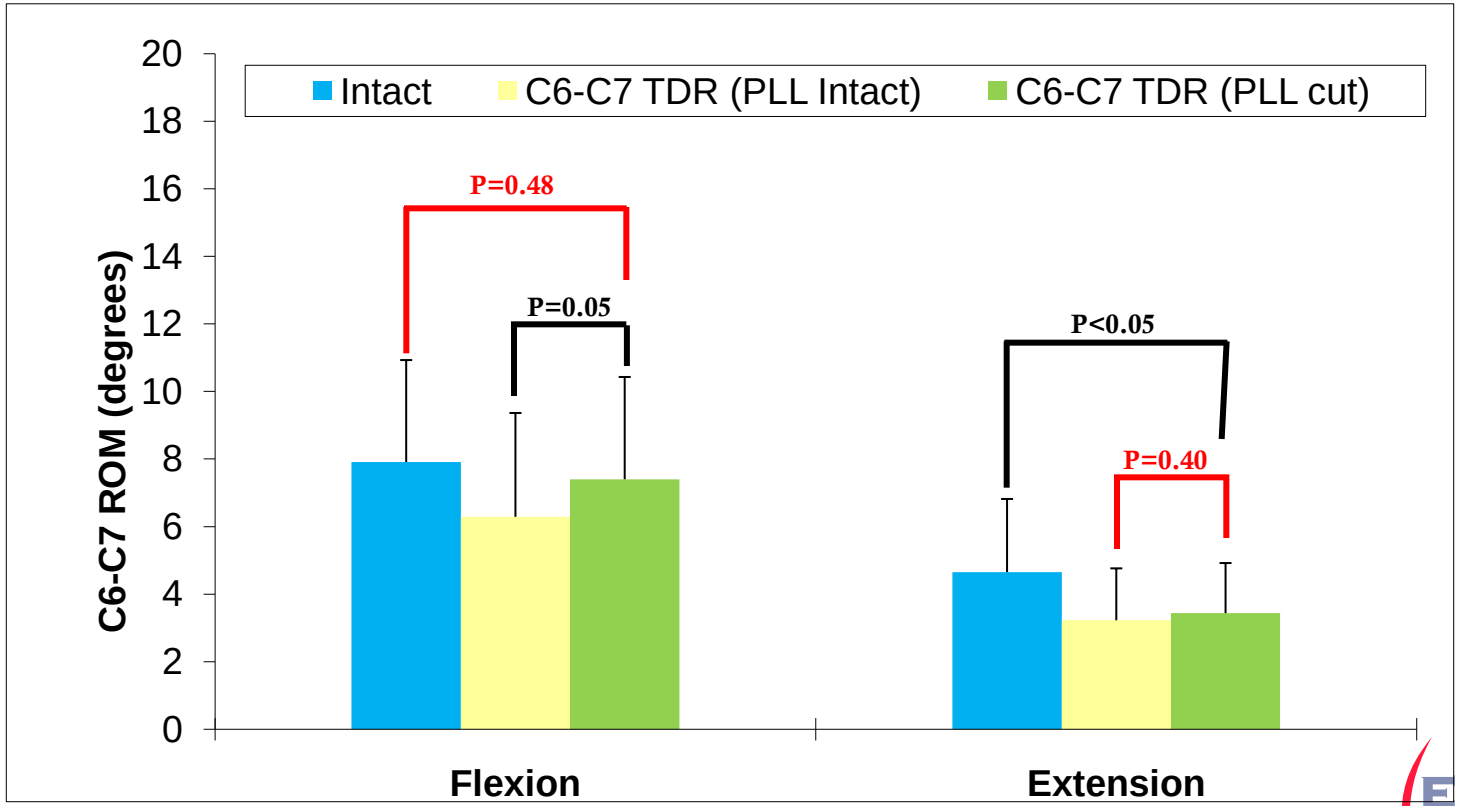
ROM: C5-C6



ROM: C6-C7



ROM: C6-C7


Intact
C6-C7 TDR (PLL Intact)
C6-C7 TDR (PLL cut)
C6-C7 ROM (degrees)
20
18
16
14
12
10
8
6
4
2
0
P=0.48
P=0.05
P<0.05
P=0.40
Flexion
Extension

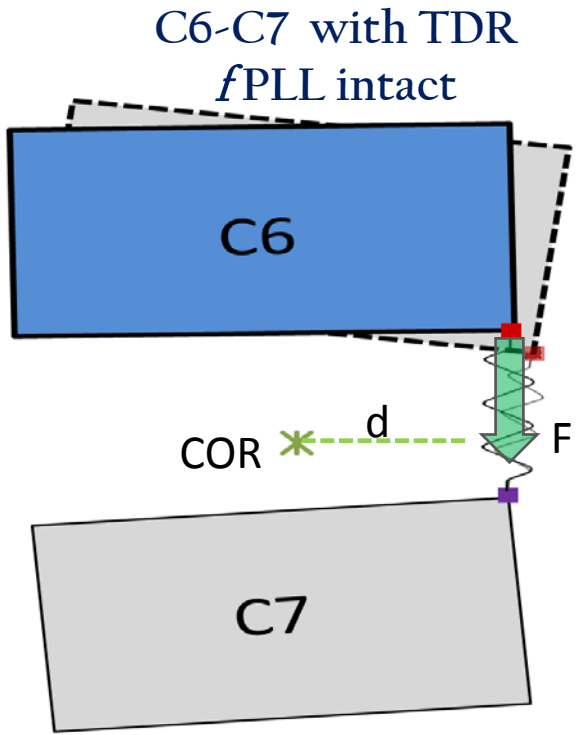
Discussion
Tensile Properties of *f*PLL in the Cervical Spine

- *f*PLL is a posterior tension band:
  - provides resistance to flexion
  - tensile properties are similar to ALL:

Parameter	*f*PLL	ALL	Reference
Cross-sectional Area (mm^2)	33 ± 18 15 ± 7	33 ± 10 12 ± 3	1, 2 3
Stiffness, K (N/mm)	65 ± 33 23 ± 2	57 ± 30 18 ± 3	1 3

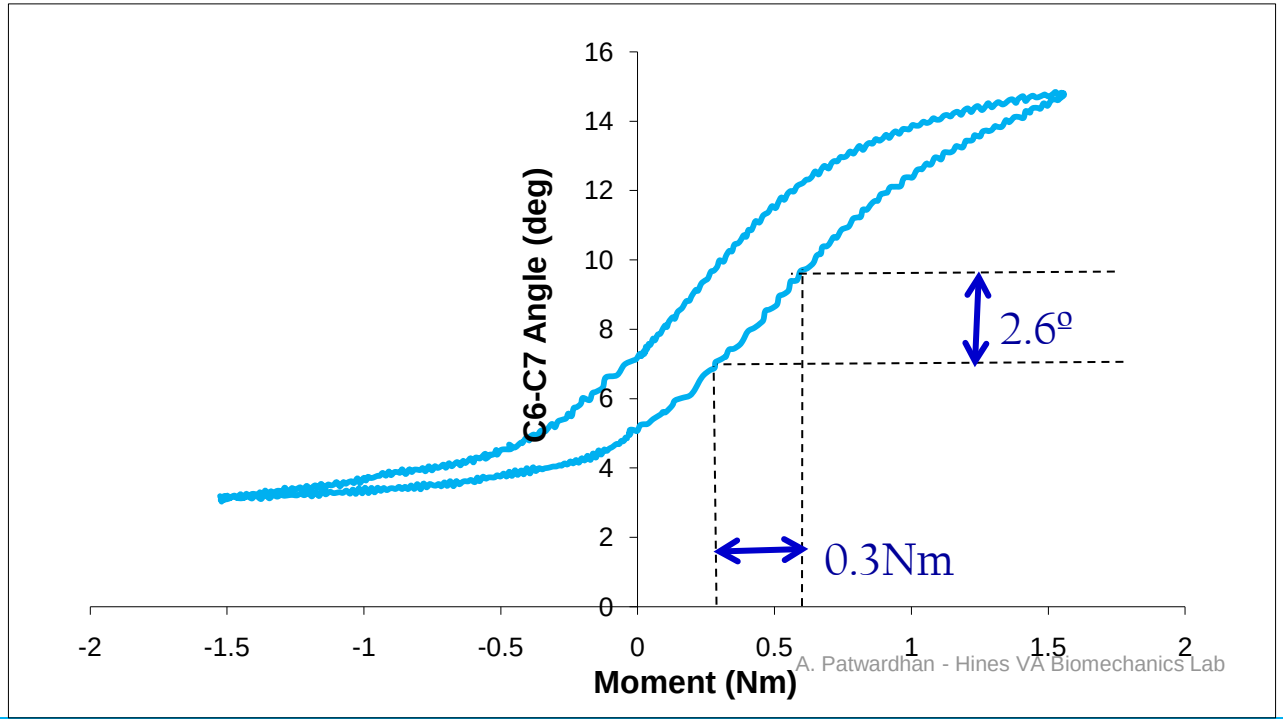
1. Przybylski et al., *J Orthop Res*, 1996;14(6):1005-1008.
2. Troyer and Puttlitz, *Acta Biomaterialia*, 2011;7:700-709.
3. Yoganandan, et al., *Spine*, 1989;14(10)1102-1110.

Discussion: Mechanics of *f*PLL in Flexion



- Stretch produced in *f*PLL: (Δl)
- Force produced in *f*PLL: (Δl) x (K_{PLL})
- Moment expended to stretch *f*PLL:
  - $M = (\Delta l) \times (K_{PLL}) \times d$
- For the sample specimen:
  - $\Delta M = 0.3$ Nm

Discussion: Mechanics of *f*PLL in Flexion



- For the sample specimen, estimated $\Delta\theta$ = 2.6 degrees
- Experimental data for this specimen: $\Delta\theta$ = 3.0 degrees

Conclusions

- *f*PLL provides resistance to flexion.
- *f*PLL resection increased flexion ROM without degrading segmental stiffness below intact values.
- Complete resection of *f*PLL at both levels in this 2-level arthroplasty model did not cause instability.
- Further studies: Other prosthesis designs