

Transverse Process Hooks at Upper Instrumented Vertebra Provide a More Gradual Transition to Normal Motion in Long Posterior Spinal Fusion Constructs

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Proximal junctional kyphosis (PJK)



1st Surgery



2nd Surgery

PJK - Significance

Kyphosis $\geq 10^\circ$ at proximal transition level

- 17% – 39% risk of developing within 2 years
- Inconsistent association with hooks, wires, pedicle screws
- No difference in HRQOL
 - Kim 2012
- Normalization of sagittal balance lowers risk
 - Yagi 2011
- Risk factors
 - Pre-op hyperkyphosis
 - Thoracoplasty
 - Hybrid instrumentation (38%) vs hooks only (21%)
 - Kim 2005
- Effect of construct type remains controversial
 - Kim 2007, Helgeson 2010

Purpose

**To determine whether
transverse process hooks
at proximal end of long fusion construct
provide more gradual transition in mobility
compared to all pedicle screws**

Methods

- Specimens

- 13 spines

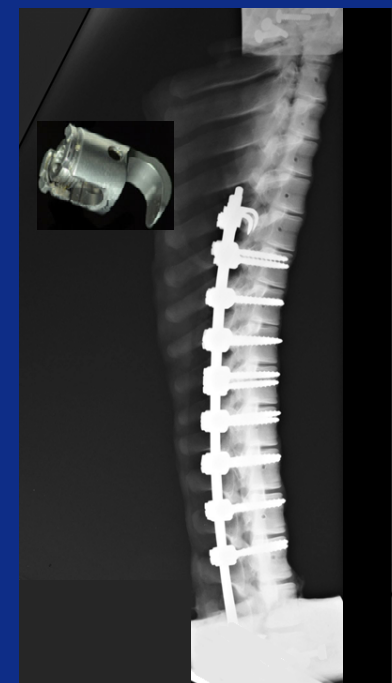
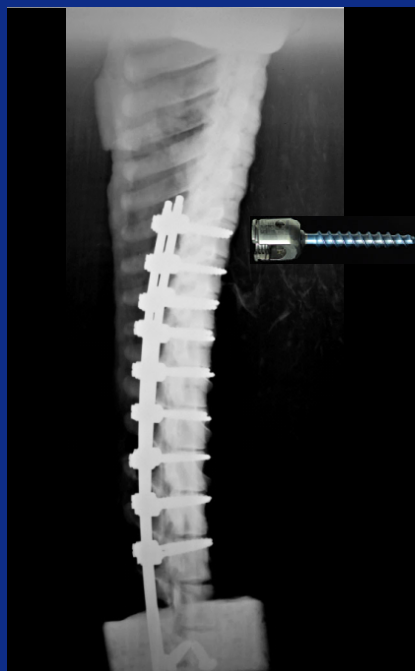
- Skeletally immature domestic pigs
~ 400 N
 - Posterior ligaments preserved

- Treatments

1. APS $n = 6$

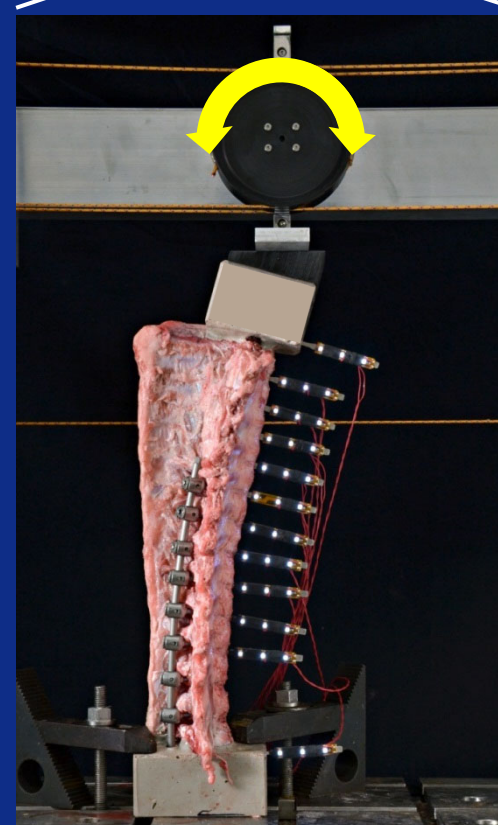
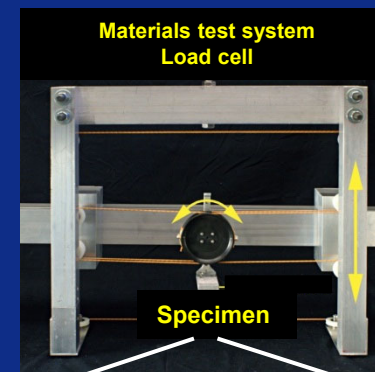
2. TPH $n = 7$

- Dual long rods – Co Cr
 - T7 - T14 pedicle screws
 - T6: UIV
 - PS or TPH



Methods

- **Applied moments ± 4 Nm**
 - LB Lateral bending
 - FE Flexion extension
 - Materials test system
 - Continuous through \pm ROM
 - Custom pulley-cable fixture
 - 5 cycles, 4th analyzed
- **Outcome measures**
 - Intervertebral rotations
 - Every level from T2-T11
 - Planar
 - LED arrays
 - Primary assessments at T6-7



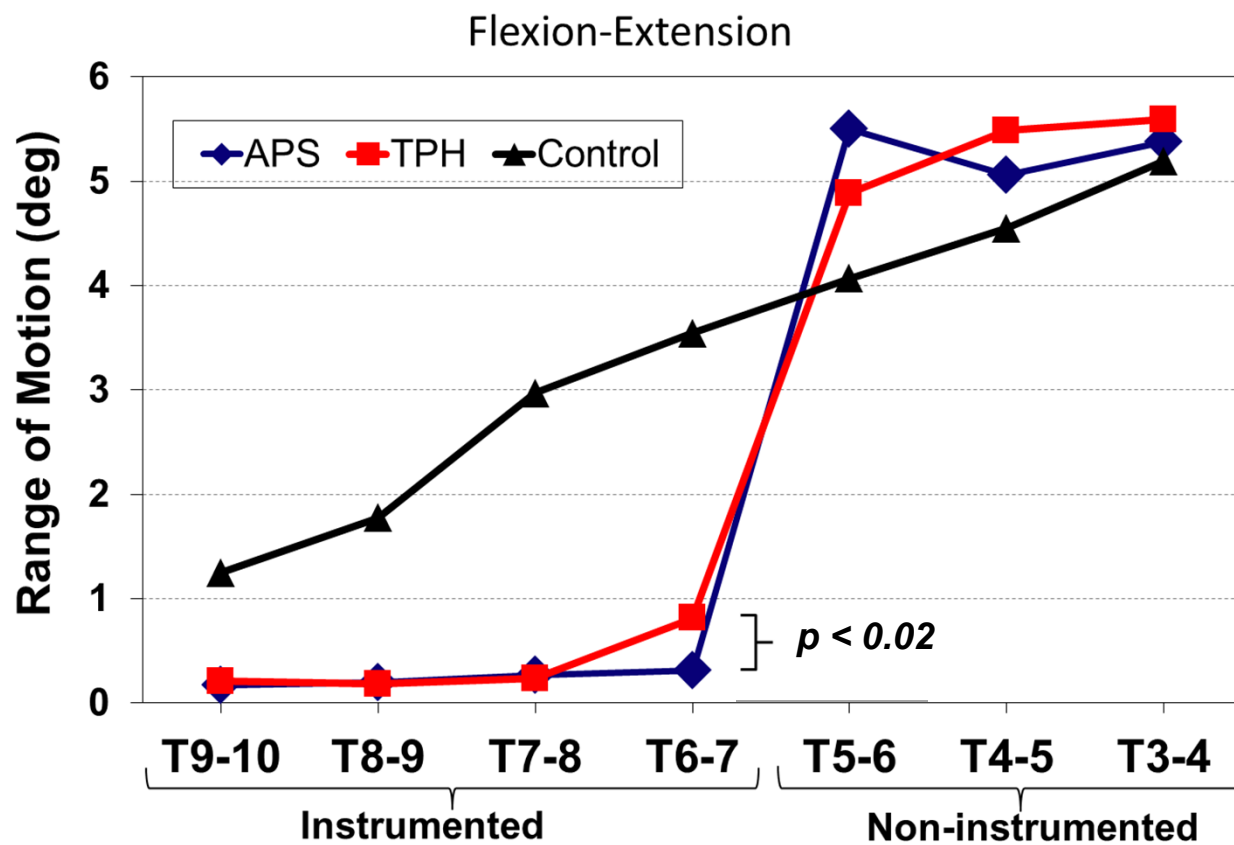
Methods – Video

Control

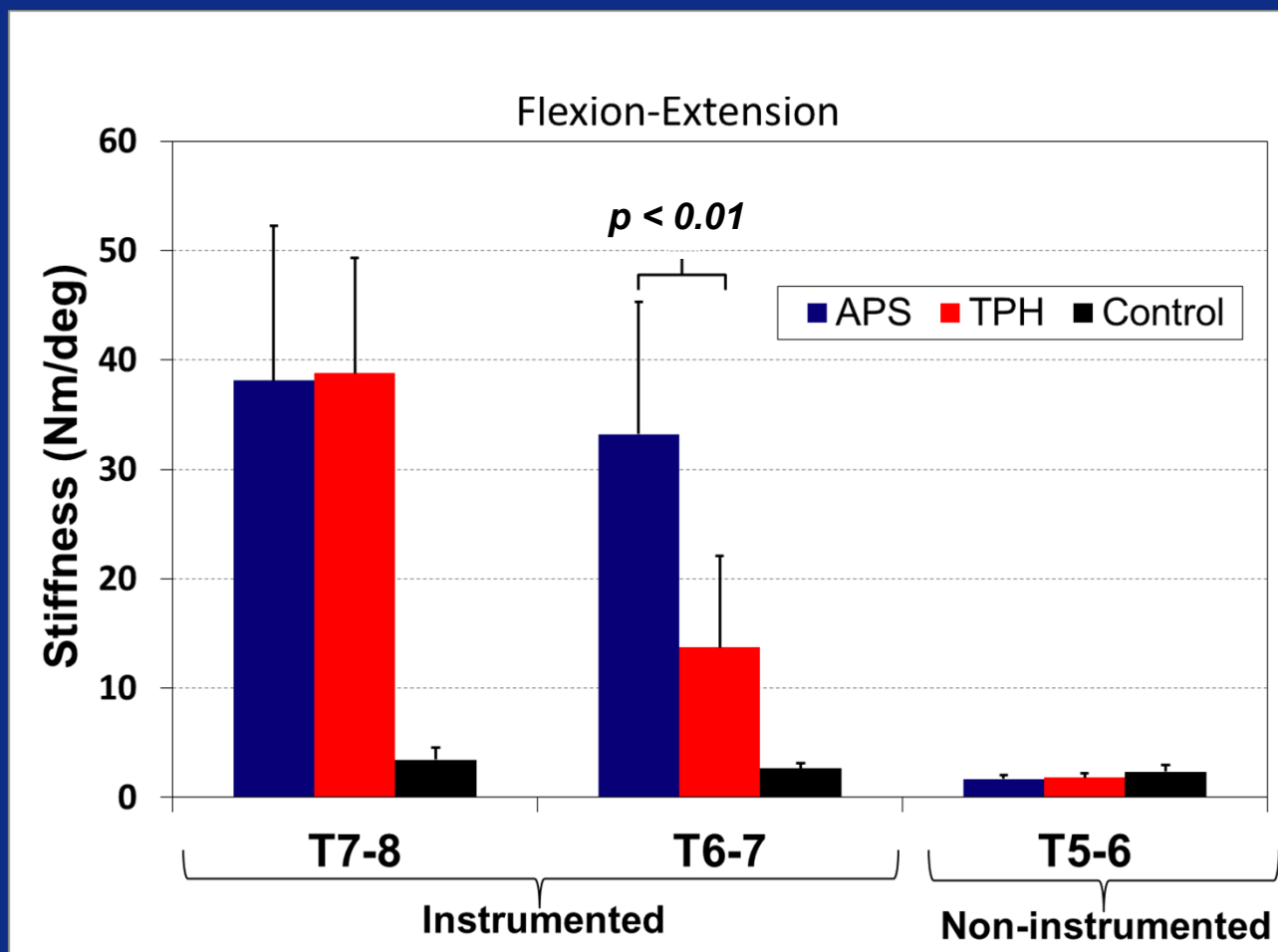
APS



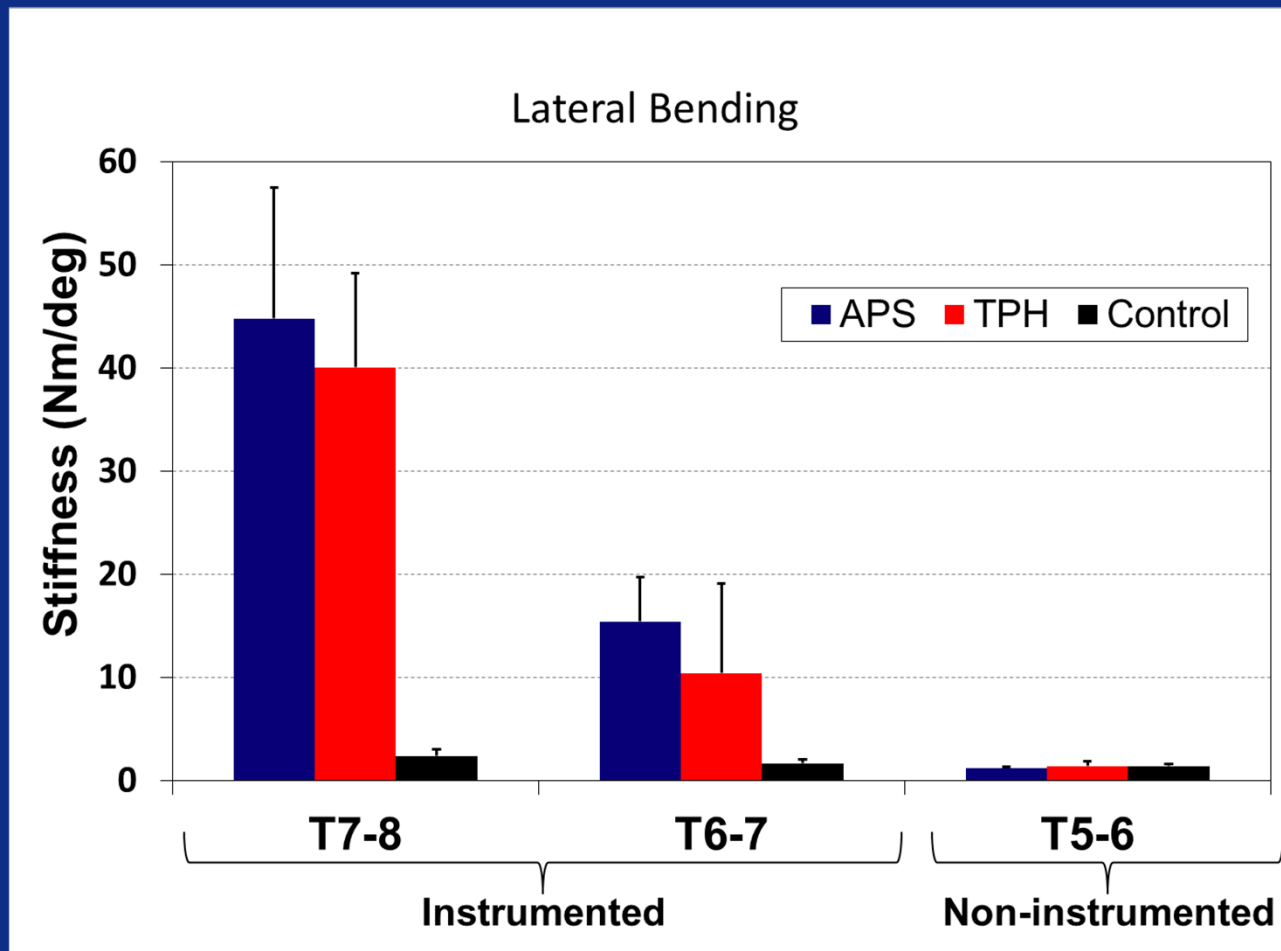
Results - ROM



Stiffness near proximal junction



Stiffness near proximal junction



Results

- **Non-instrumented control spines**
 - ROM gradually increased from T11 to T2
 - FE and LB similar in pattern
- **Instrumented spines**
 - Large stiffness changes across transition
 - TPH = 6x control
 - APS = 9x control
 - Flexion / Extension
 - ROM: TPH > APS *
 - Stiffness: TPH << APS **
 - Lateral bending
 - No significant differences

Discussion

- Type of end instrumentation significantly affected range of motion and stiffness of the spine near the proximal junction between instrumented and non-instrumented segments
- Abrupt discontinuity with both APS & TPH
- First biomechanical study of adjacent motion segment properties at the cephalad end of a long posterior spinal fusion construct

Conclusion

- Transverse process hooks at upper instrumented vertebra of long fusion constructs provided a more gradual transition to normal spine mobility than pedicle screws
- TPHs at cephalad end may decrease probability of progressive PJK compared to APS



Thank you