

Biorid Spine QA Stiffness Test Initial Trial

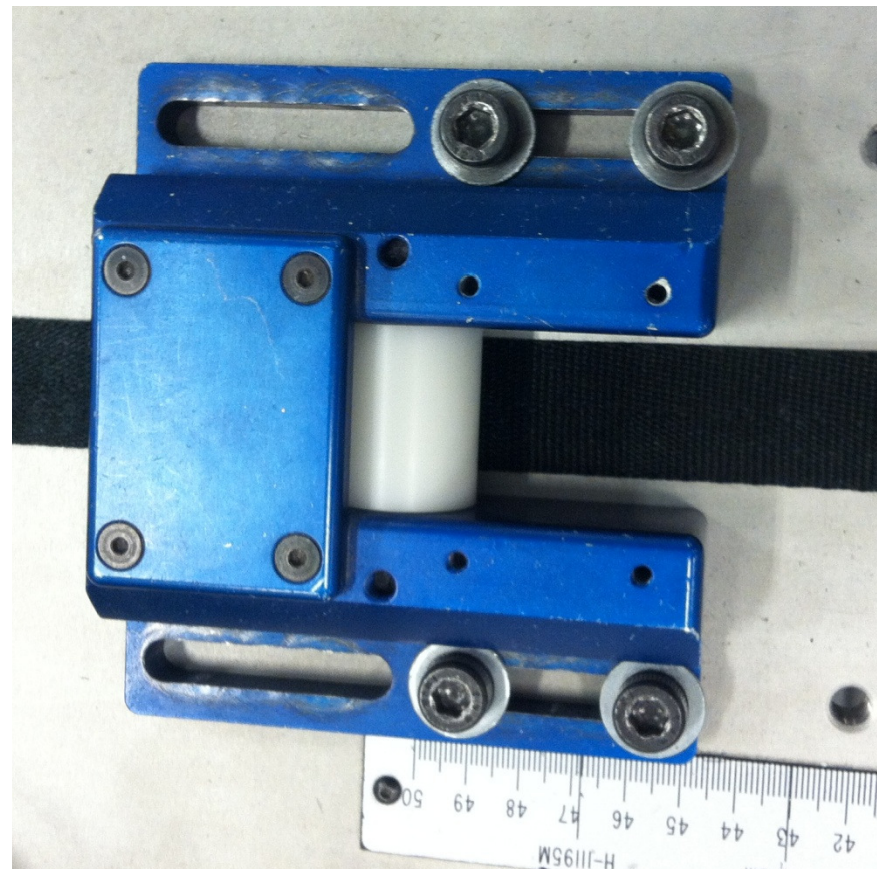


Goals

- ▶ Measure quasi-static spine stiffnesses
 - With and without torsion pins
 - Flexion and Extension directions
- ▶ Do not damage spine
- ▶ Simple test setup
- ▶ Using adapters to existing equipment

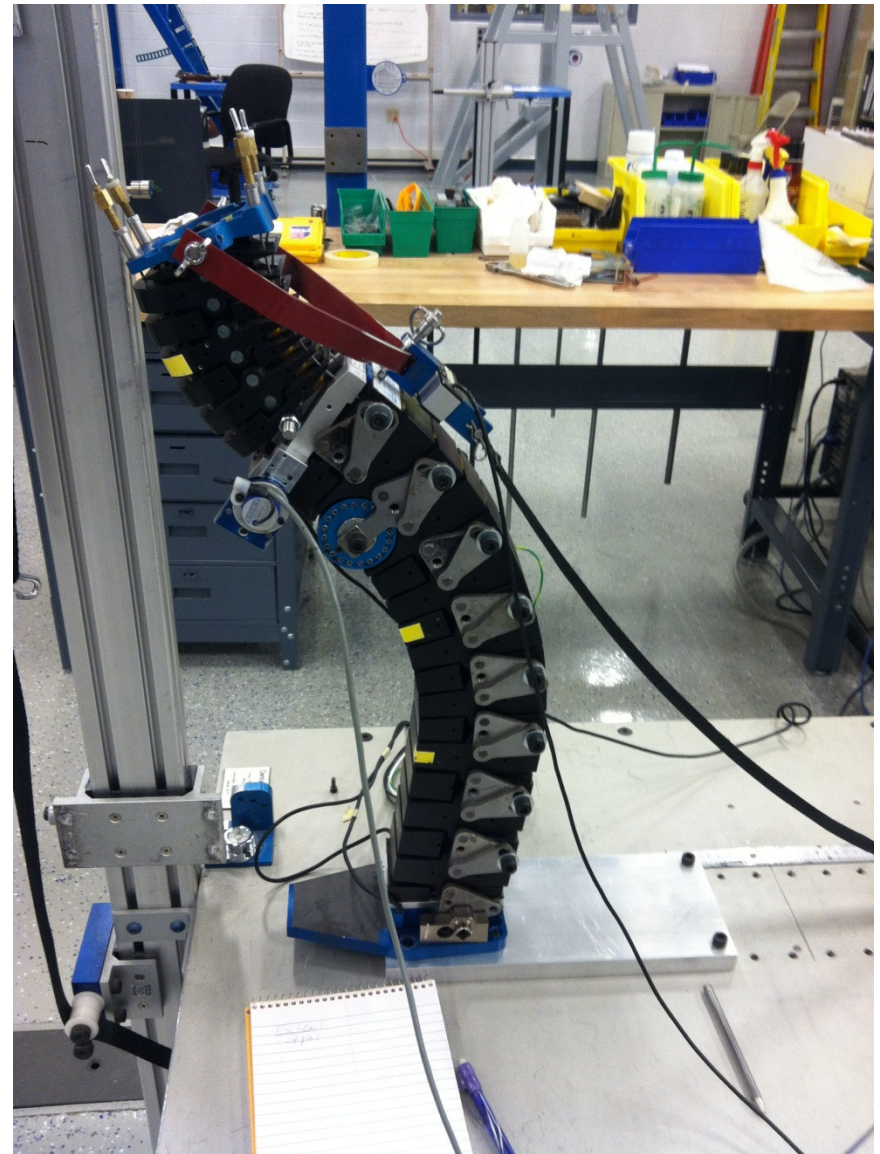
Extension with Pins

- ▶ Setup pull pulley as far back as possible



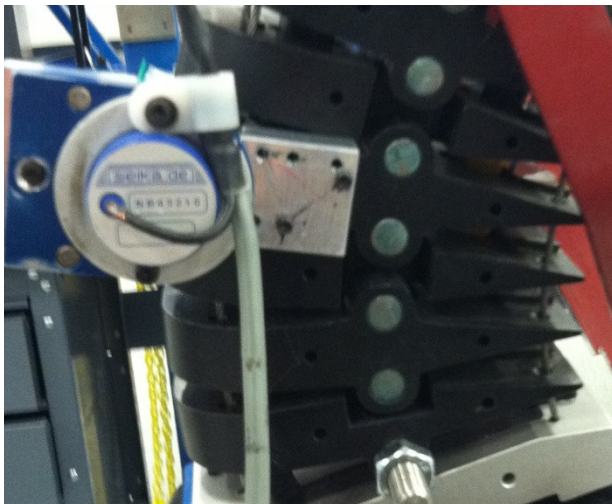
Extension with Pins

- ▶ Mount spine to stand as shown
- ▶ Adjust manual EOT limit to 100 N through menus
 - A max pull force of 100 N gives max lumbar loads of ~ 60 Nm for extension
- ▶ Put the torso stand into Manual Mode

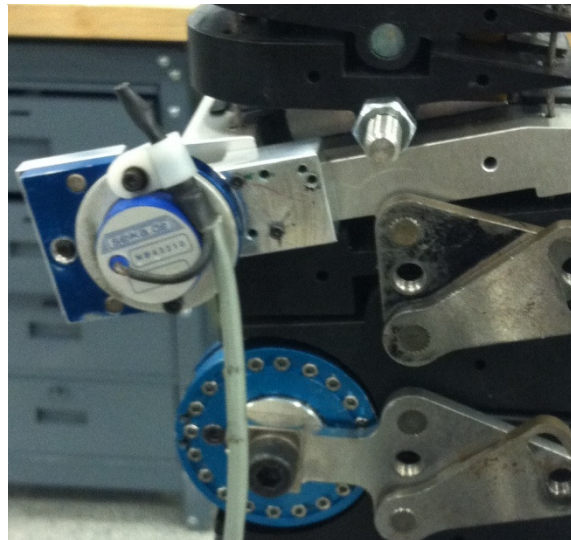


Extension with Pins

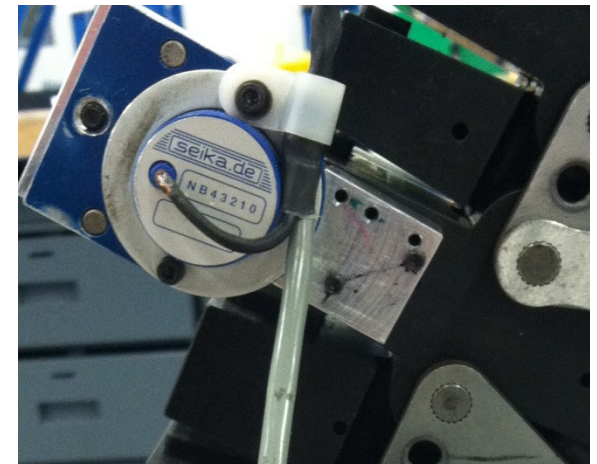
- ▶ Shake spine to center it
- ▶ Read initial position of C4, T1, T8, and L1 using inclinometer from stand or tilt sensors
- ▶ See photos for bracket screw positions



C4 location



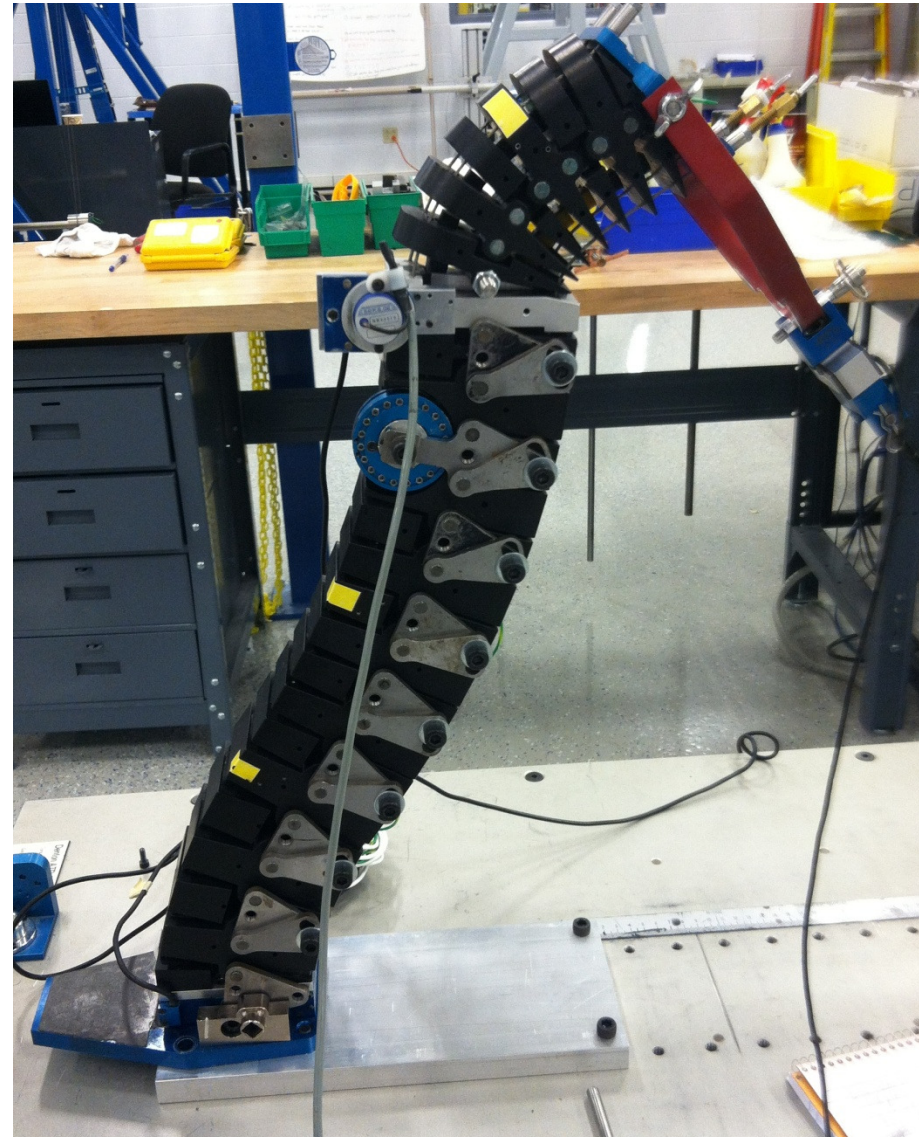
T1 location



T8 & L1 locations

Extension with Pins

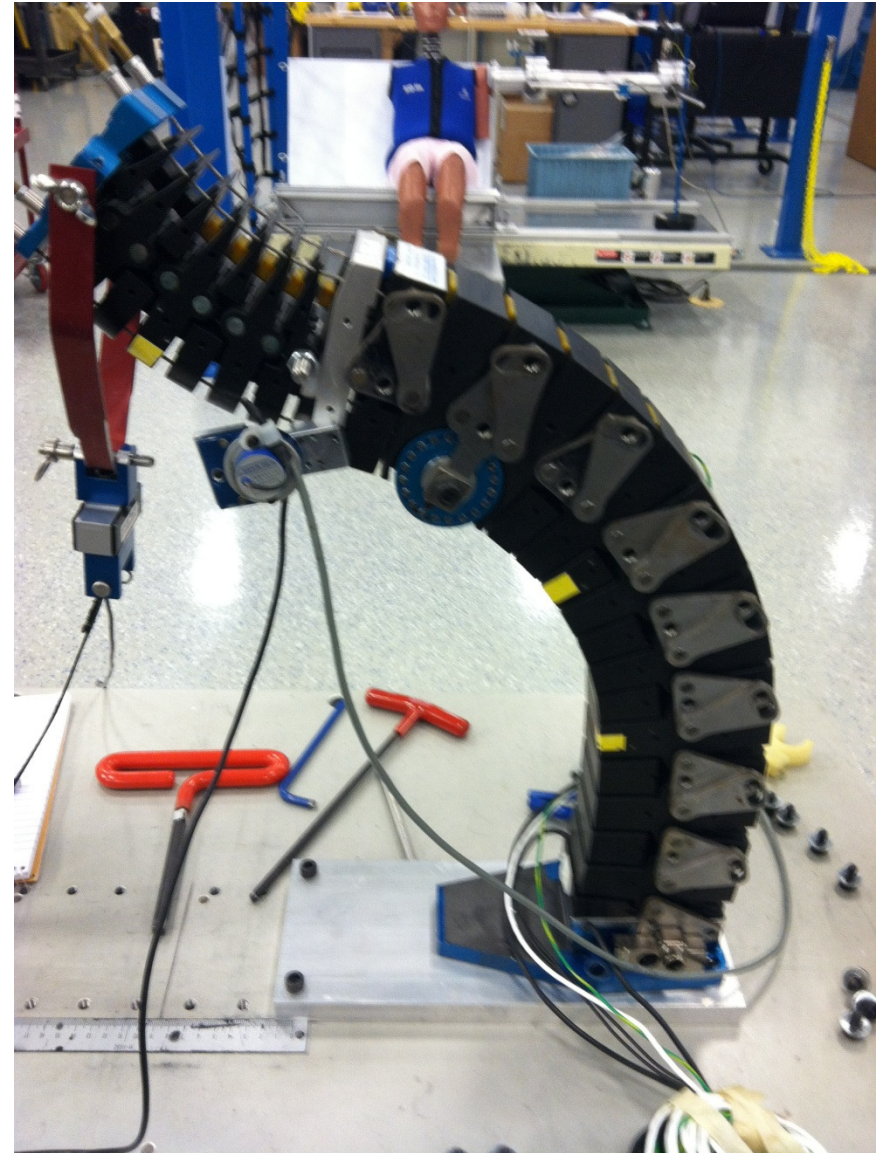
- ▶ Pull to 100 N and hold while measuring all locations



Flexion with Pins

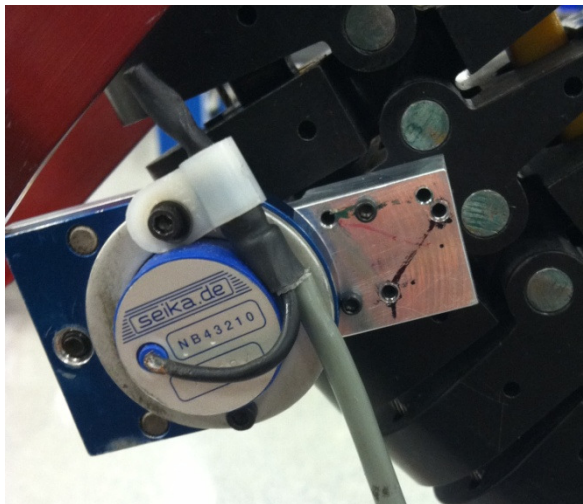
- ▶ Mount spine to stand as shown
- ▶ Adjust manual EOT limit to 100 N through menus
 - A max pull force of 100 N gives max lumbar loads of ~ 50 Nm for flexion
- ▶ Put the torso stand into Manual Mode

NOTE: picture is setup without screws which removes pins from system

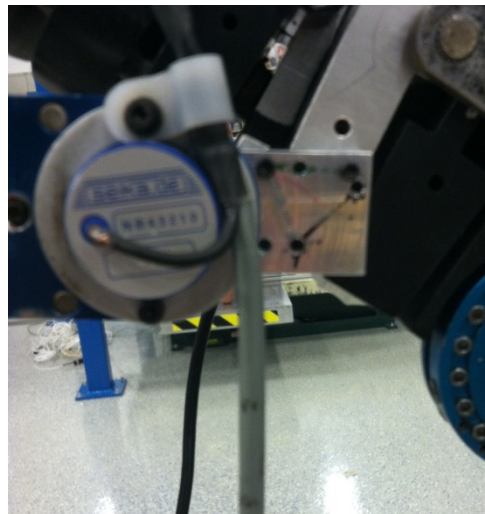


Flexion with Pins

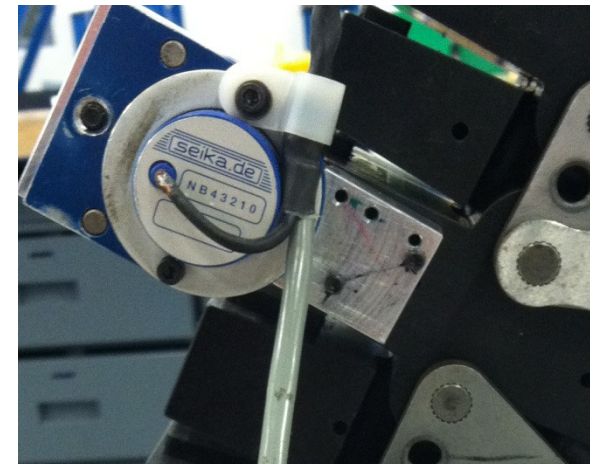
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C4 location



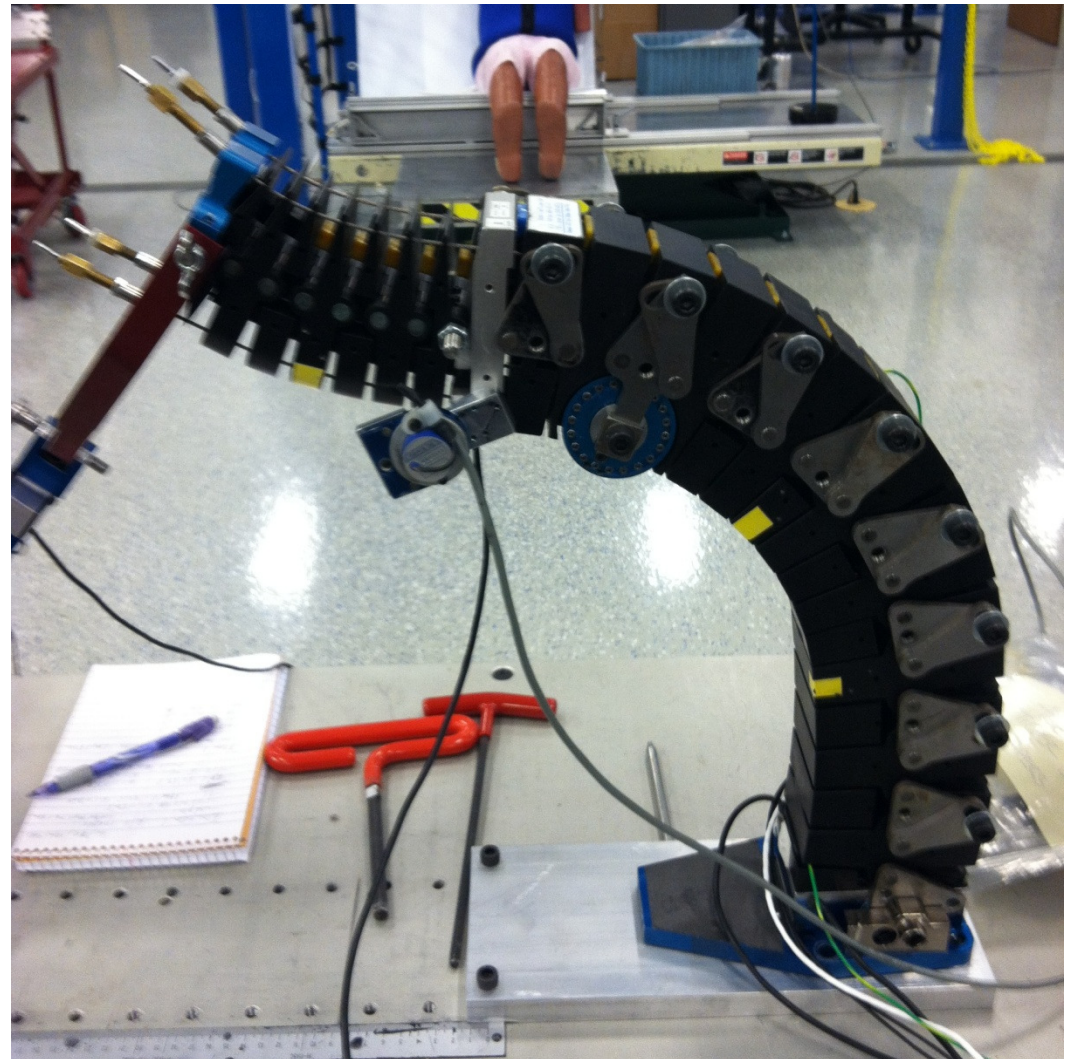
T1 location



T8 & L1 locations

Flexion with Pins

- ▶ Pull to 100 N and hold while measuring all locations



Tests WITHOUT Pins

- ▶ To remove the effect of pins, remove all screws from the washer plates so that all vertebrae move freely
 - see “flexion with pins” setup photo on page 7
- ▶ Repeat measurement process for
 - Flexion
 - Extension
- ▶ This measures effect of just bumpers

Results Lab Dummy (0071)

Parameter	Extension (w/pins)			Extension (without/pins)		
	Start	End	Change	Start	End	Change
C4 angle	24.4	-52.5	-76.9	-12.4	-62.9	-50.5
T1 angle	55.5	-2.4	-57.9	11.3	-13.7	-25
T8 angle	19.7	-24.9	-44.6	-19	-32.1	-13.1
L1 angle	-6.3	-35.2	-28.9	-33.3	-40.2	-6.9
calc T8-L1			-15.7			-6.2
calc T1-T8			-13.3			-11.9
calc C4-T1			-19			-25.5
Pk Lumbar My	0	-61 Nm		0	-57 Nm	
Pull force	0	100 N		0	100 N	

Parameter	Flexion (w/pins)			Flexion (without/pins)		
	Start	End	Change	Start	End	Change
C4 angle	15.3	50.9	35.6	31.6	57.1	25.5
T1 angle	-5.9	21.1	27	12.7	27.9	15.2
T8 angle	22.5	42	19.5	36.2	45.7	9.5
L1 angle	-4.7	7.3	12	4.8	9.6	4.8
calc T8-L1			7.5			4.7
calc T1-T8			7.5			5.7
calc C4-T1			8.6			10.3
Pk Lumbar My	0	53 Nm		0	54 Nm	
Pull force	0	100 N		0	100 N	

Possible Test Improvements

- ▶ Use 4 sensors to simultaneously measure all locations
- ▶ Do continuous data collection
- ▶ Measure rebound
- ▶ Measure lumbar My loads
- ▶ Try decreasing pull angle