

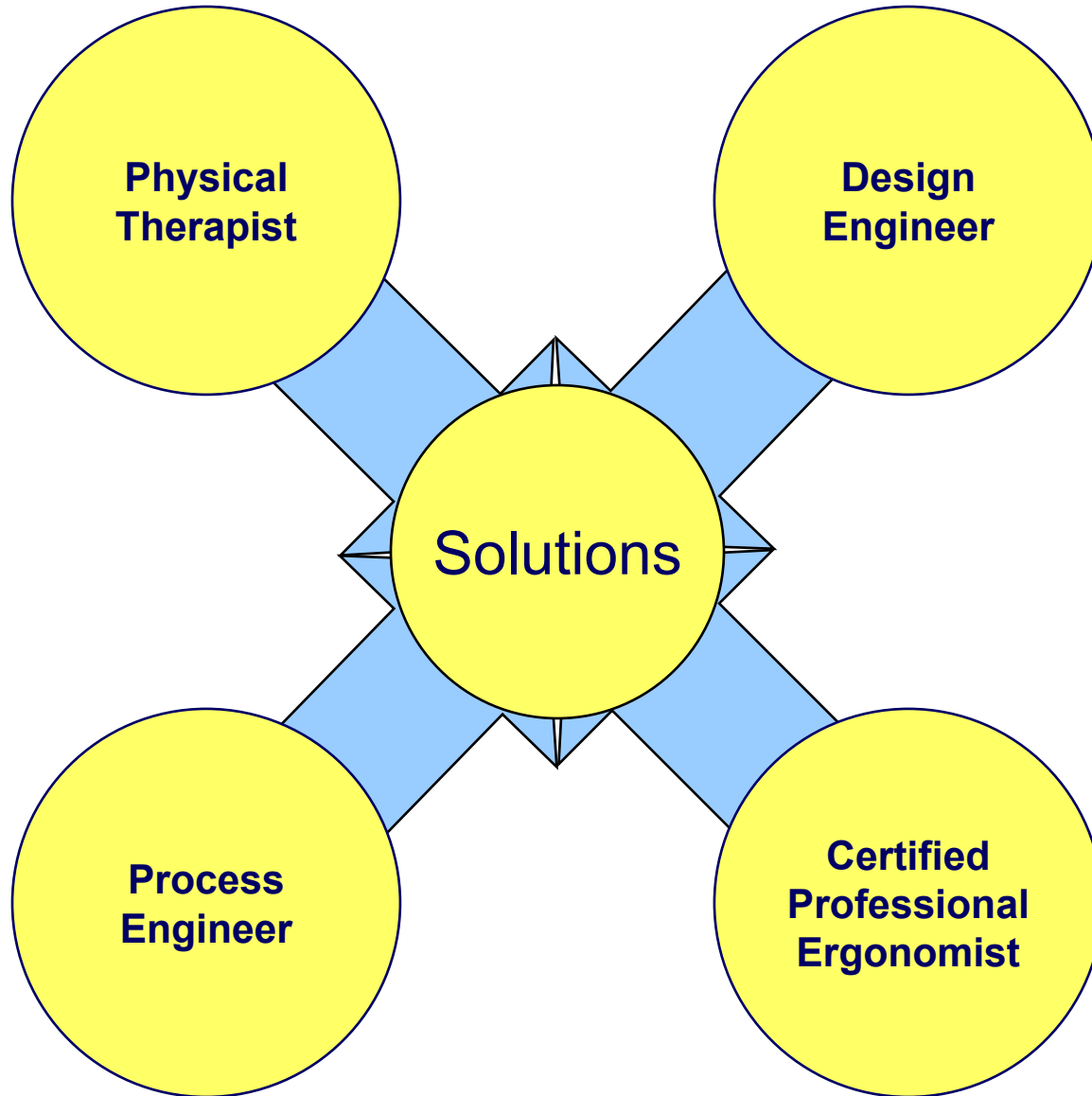
A blurred background image of a large, modern building with a glass facade, possibly a convention center or a corporate headquarters. The image is out of focus, creating a sense of depth and atmosphere.

# **Sacramento Ergo Round Table Ergonomics: At the Crossroads...**

**May 9, 2006  
Drew Bossen, PT, MBA  
Atlas Ergonomics**

- Who we are and what we do
- The implications for the industry
- Fitting
  - Basic Tenets of Fit
  - Active vs. Passive Sitting
  - Forward Head Postures
  - The Lumbar Spine
    - Intervertebral Disc
    - Vibration
  - Seat Position
  - Seat Tilt Issues
  - UE Unloading

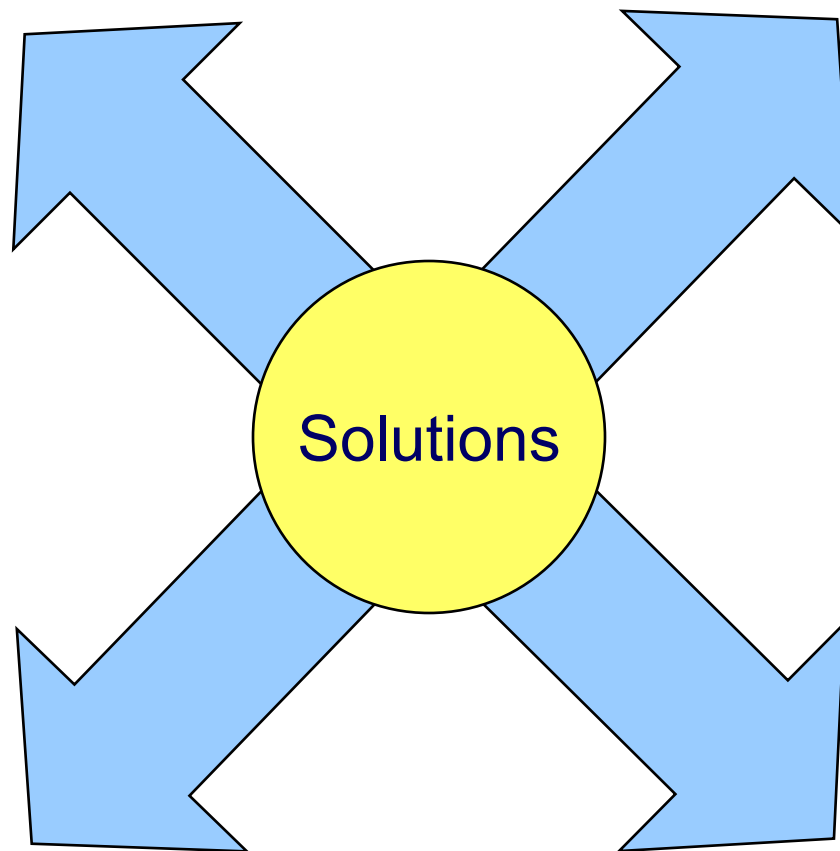






**Industrial**

**Transportation**



**Office**

**Health Care**





# Underpinning of Success...

- Systematic approach
- Engineering principles
- Data driven decision making
- Measured outcomes



**It's about people...**



**It's about dollars...**



It is about dollars...



It is about dollars...

## **Injury Prevention**

- 7 out of 100 employees injured every year
- \$84,000 - \$168,000 for a neck/back injury
- Lost work days and lost revenues opportunities

## **Accident Prevention**

- Occupation with highest fatality rate (12% of all)

## **Turnover Prevention**

- Industry average of > 120%
- Direct correlation: accident rate and experience

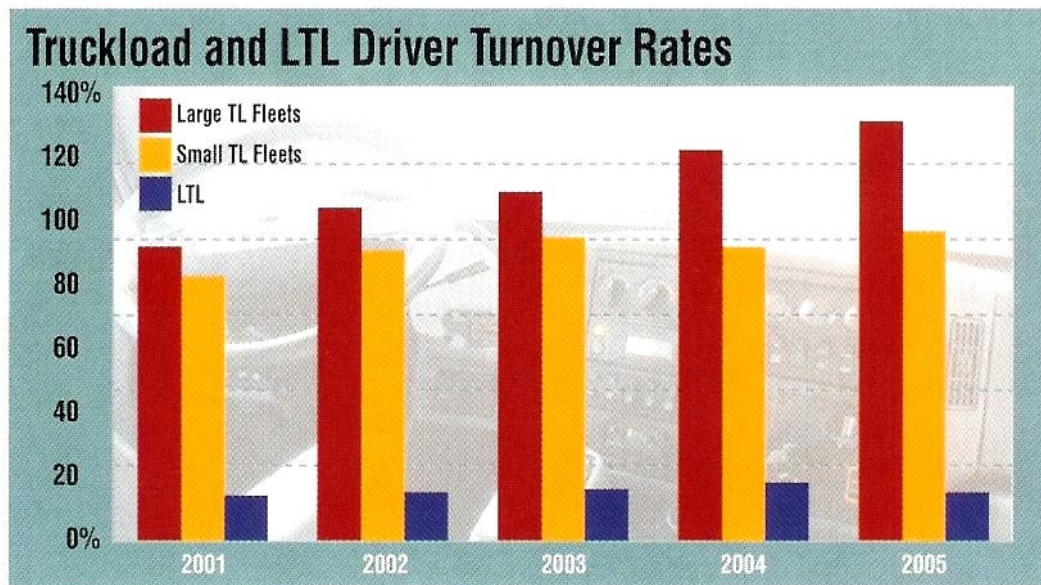


# Transport Topics

Week of March 27, 2006

## TL Churn Rates Hit Record

*'05 Driver Turnover at Large Fleets Rises to 130%*



Graphic by Transport Topics

Source: American Trucking Associations



- Stability
- Clearance
- Support



# The Essence of Fit...

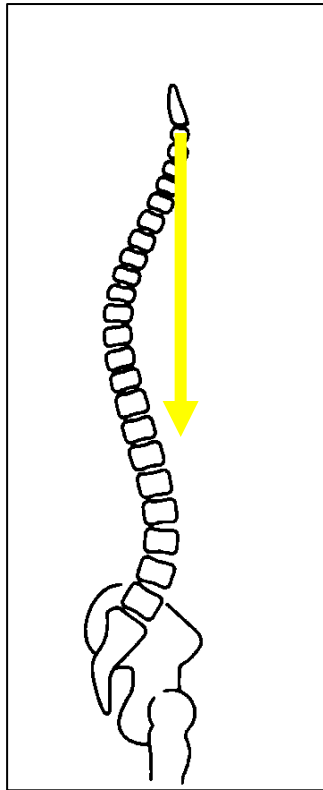
- Lumbar support must be maintained
- “Clutching” / Leg Length will dictate position of the seat
- Seat Tilt... When and Where
- Upper Extremity unloading



Lets begin...

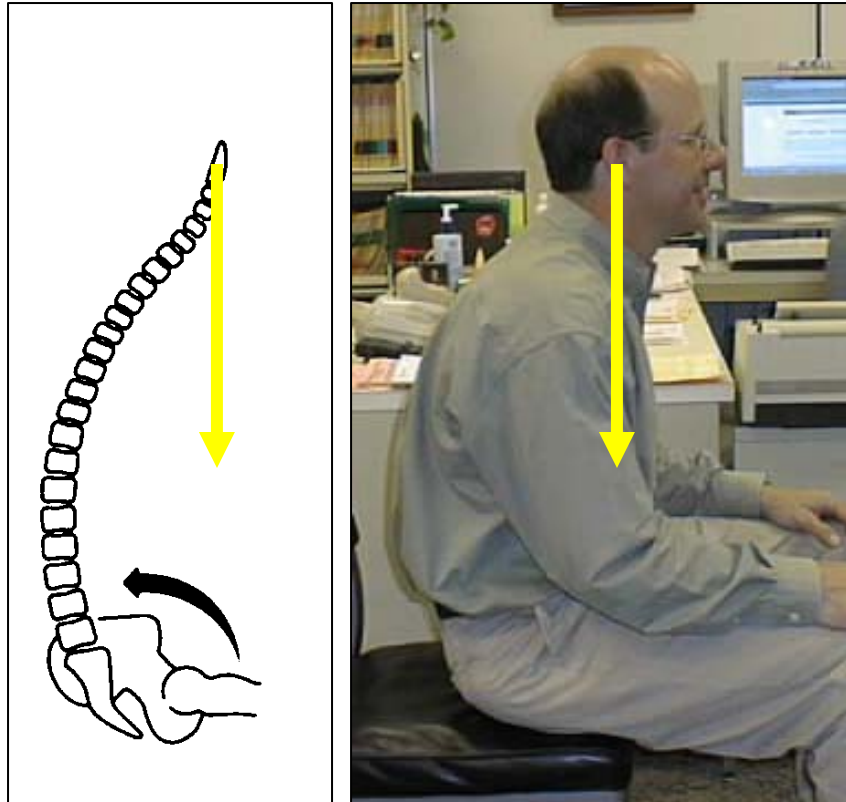
- Lumbar support must be maintained

# Back Support...



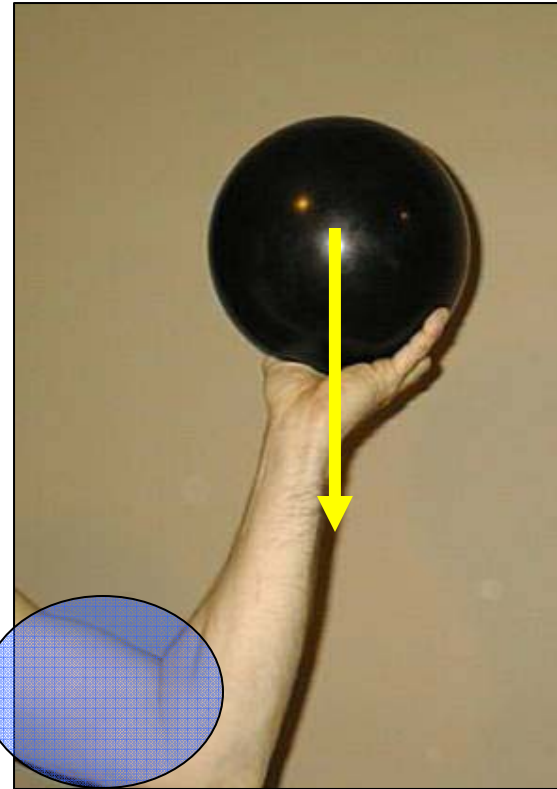
- The lumbar spine is the foundation of the entire spine
- An upright posture provides an optimal position for the head and neck

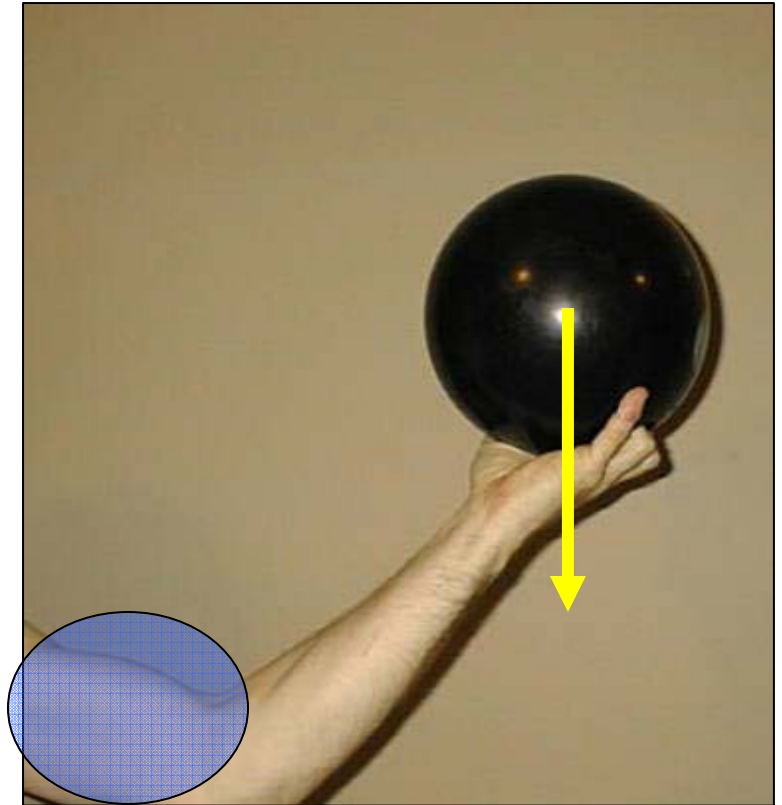
# Back Support...

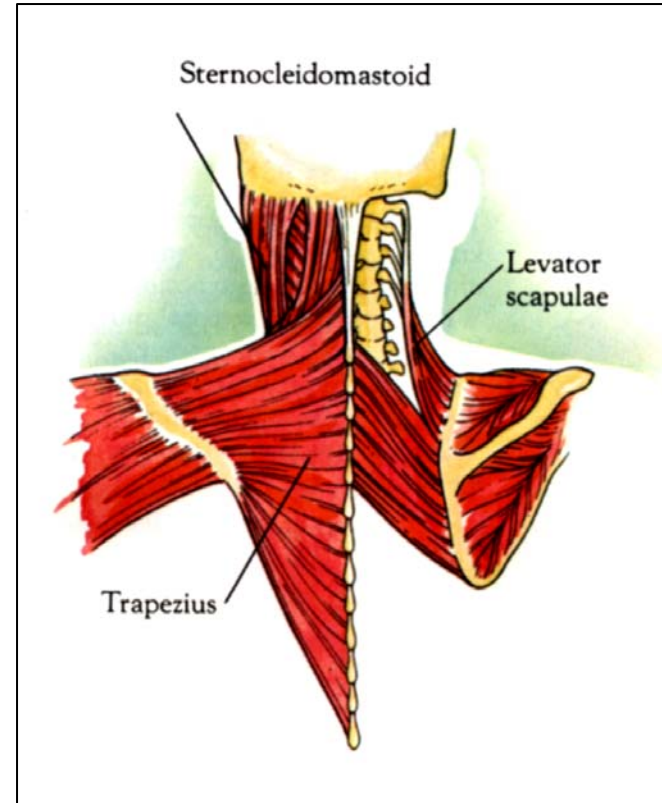


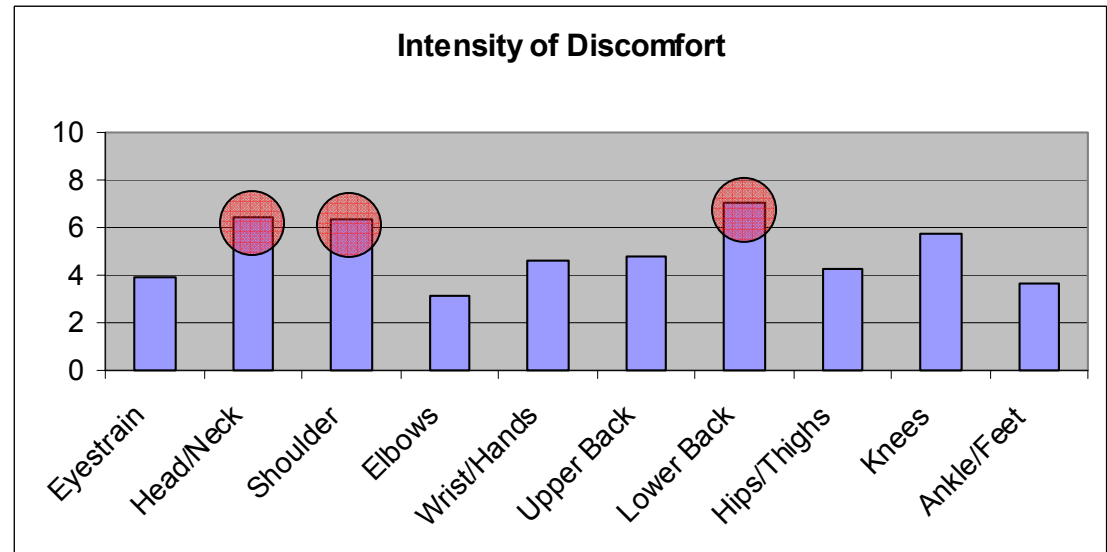
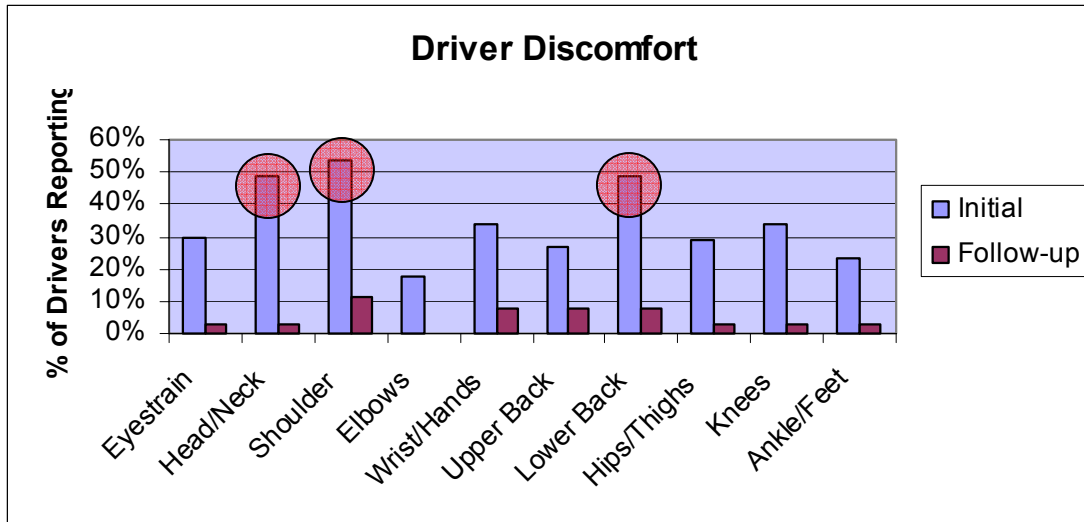
- When we lose the support of the lumbar spine, the head moves into a forward head posture
- Places significant stress across the posterior muscles of the neck and shoulders

# The similarities are striking...



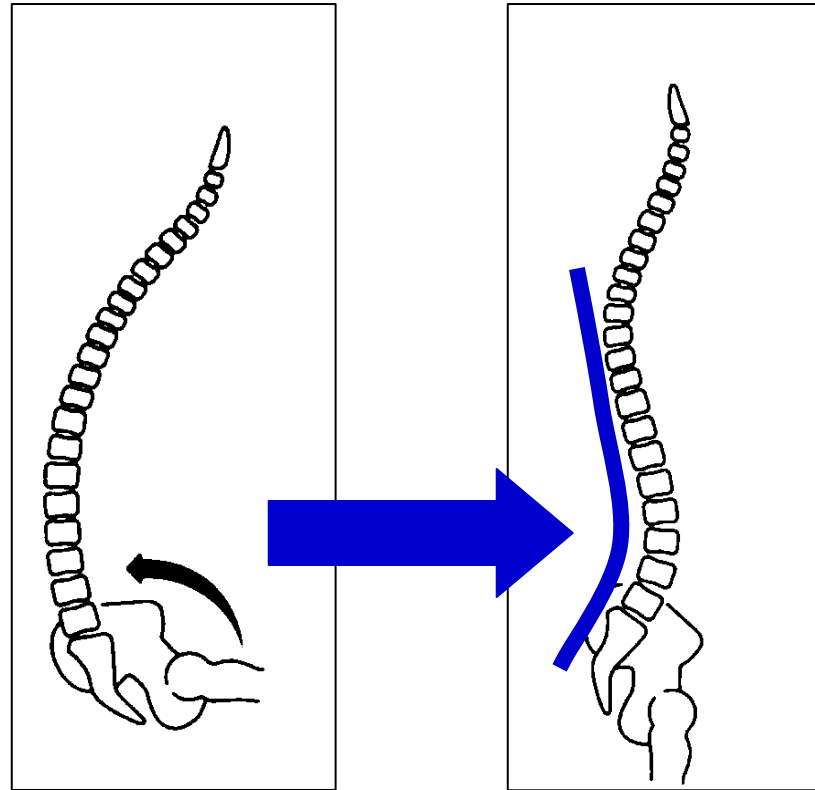




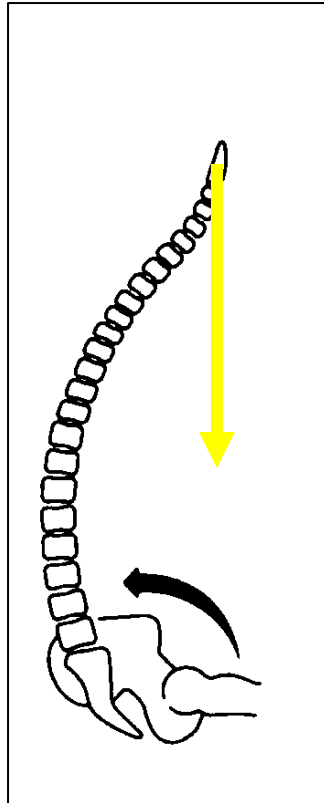


# Lumbar Support is Key...

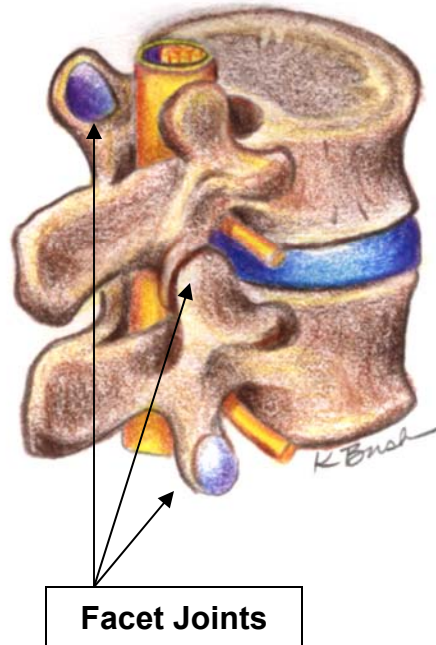
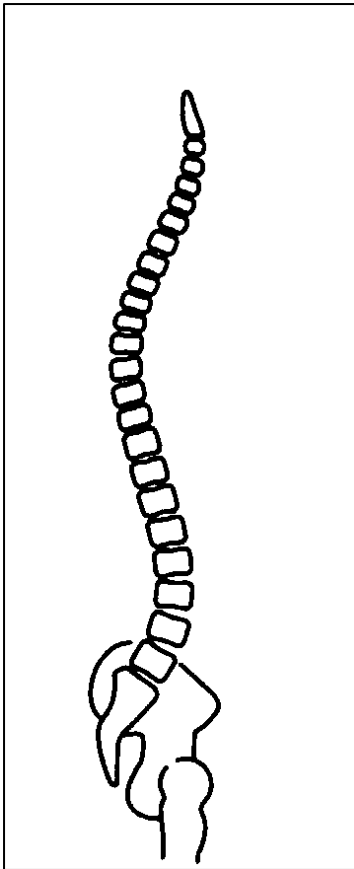




# So what are the implications...

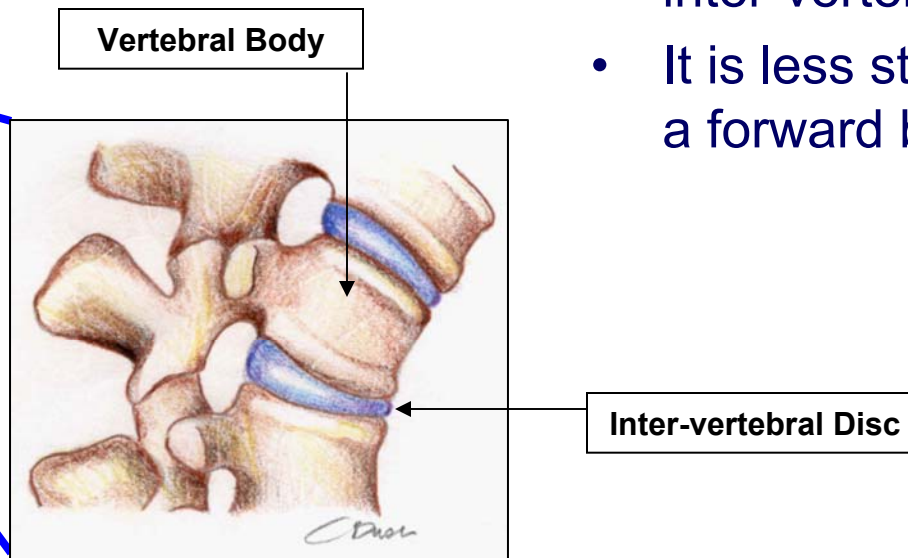


# Posterior Column of Support...



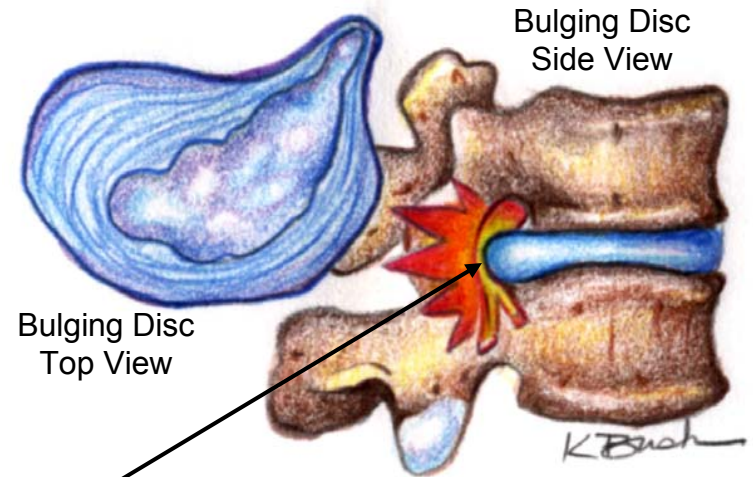
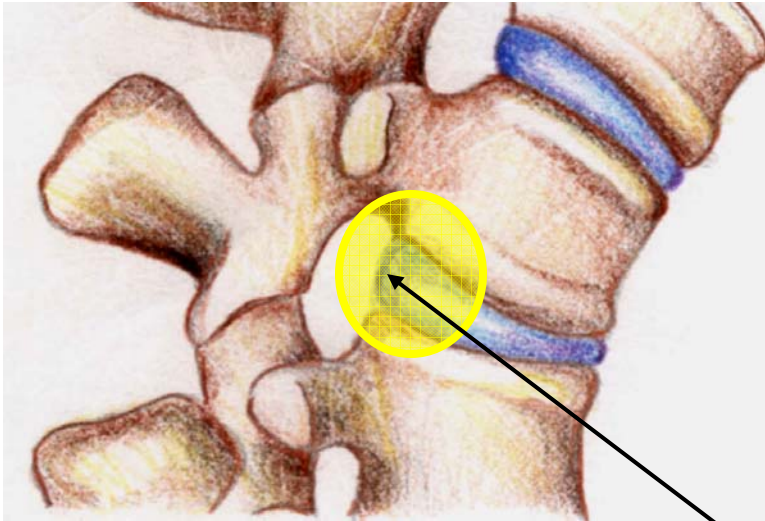
- As noted, the spine is made up of two columns of support
- The posterior column of support is made up of a series of interlocking joints known as the facet joints
- The facet joints are very stable and reflect an up-right posture

# Anterior Column of Support...



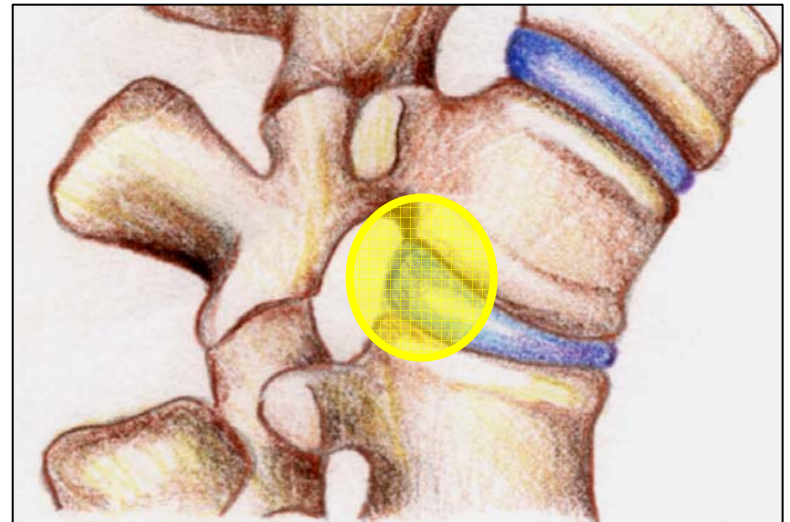
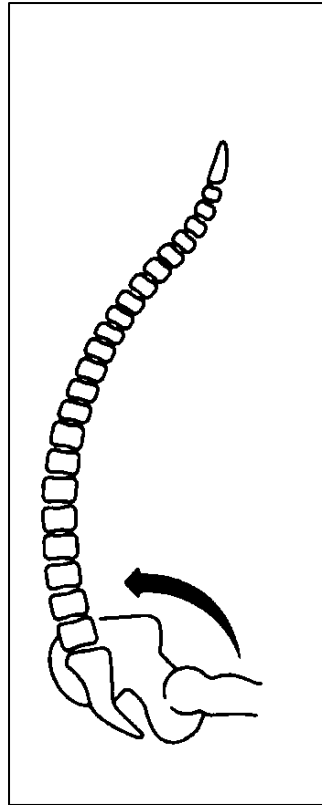
- The anterior column of support is made up of the vertebral body and the inter-vertebral disc
- It is less stable and reflects a forward bent posture

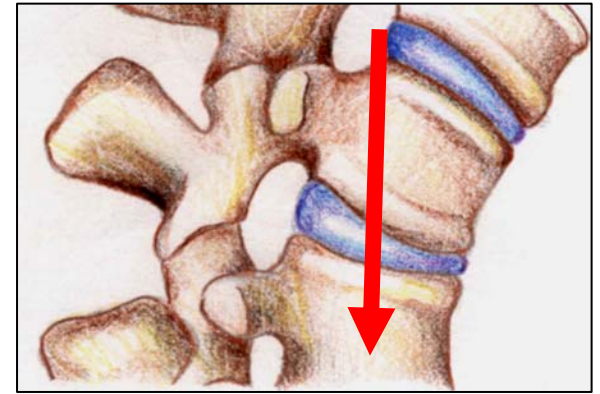
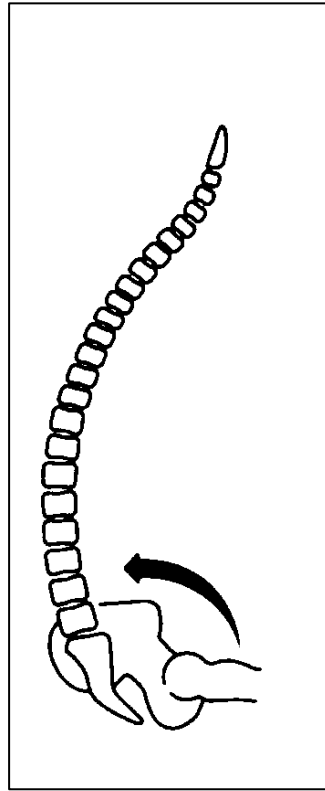
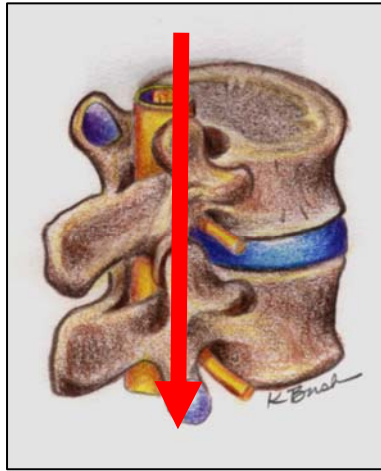
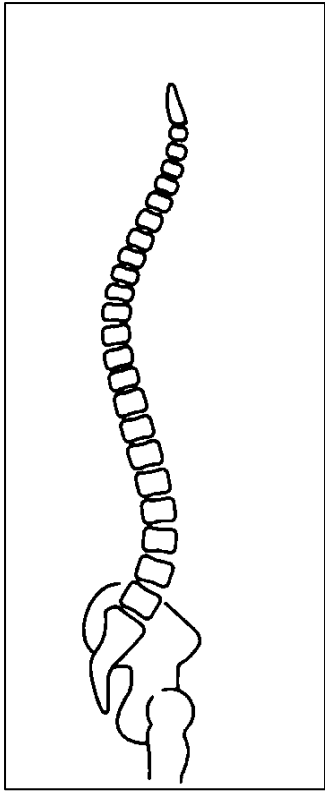
# Forward Bending...



- Repeated flexion of the spine place significant stress upon the posterior wall of the inter-vertebral disc. Repeated wear and tear of this structure can lead to bulging of the disc.

# Prolong Sitting...



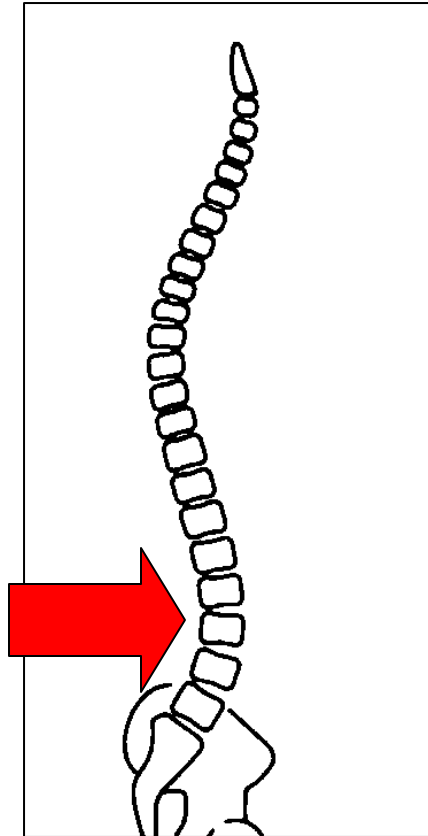


# Lumbar Support...

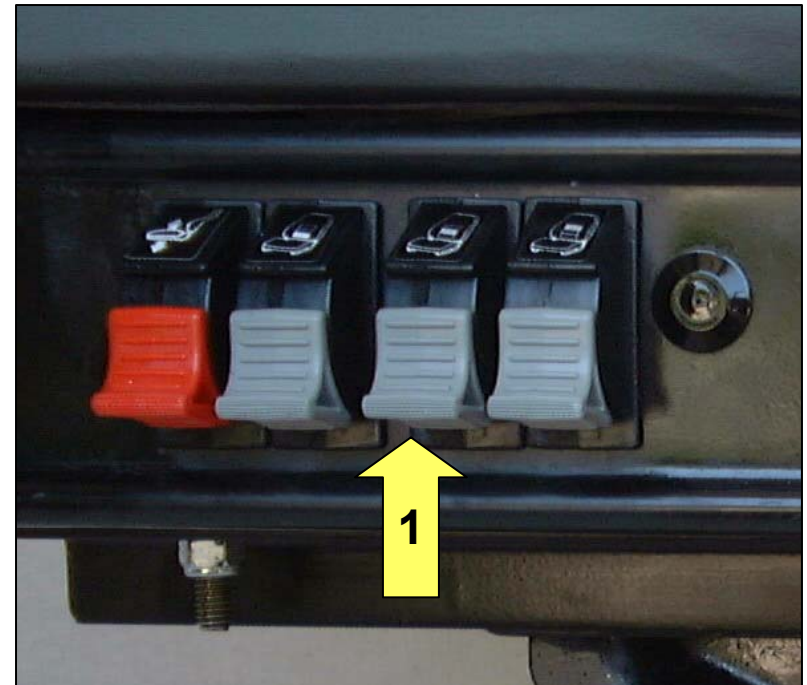
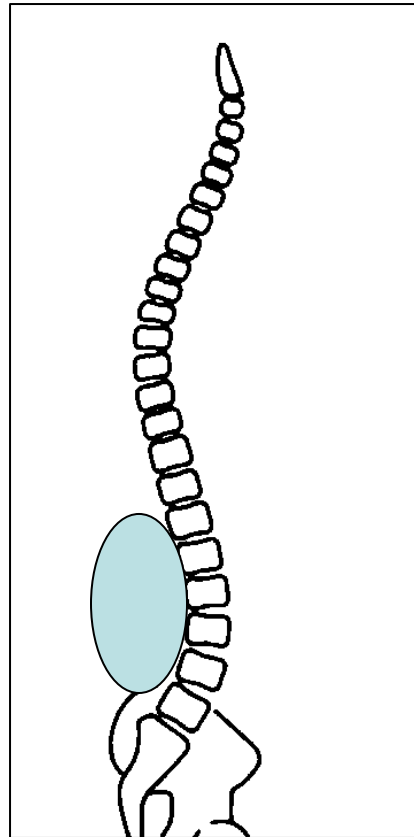


- Controlled via the lumbar cushion

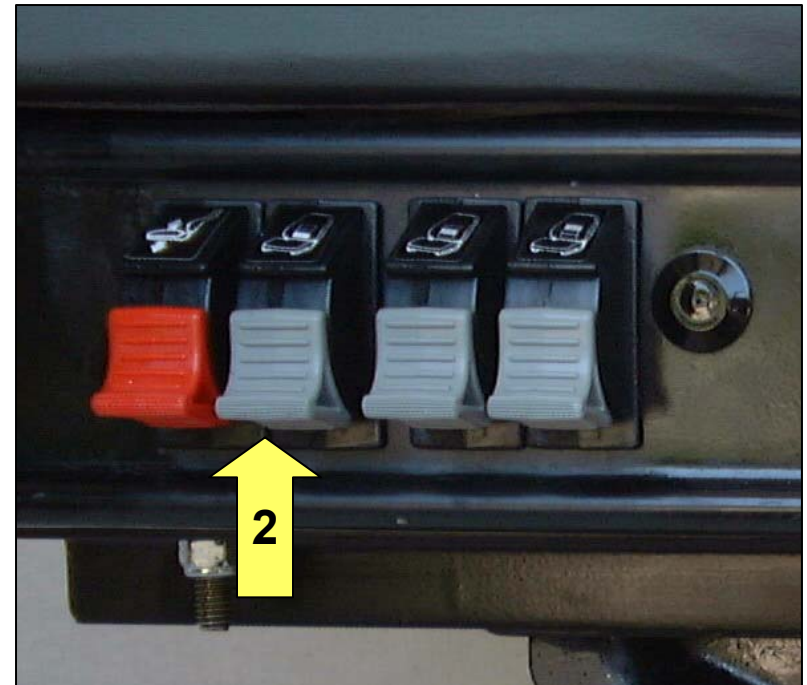
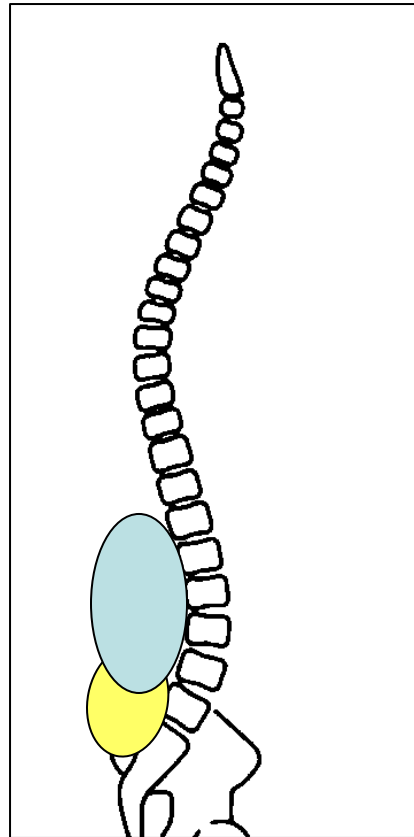
# Lumbar Cushion...



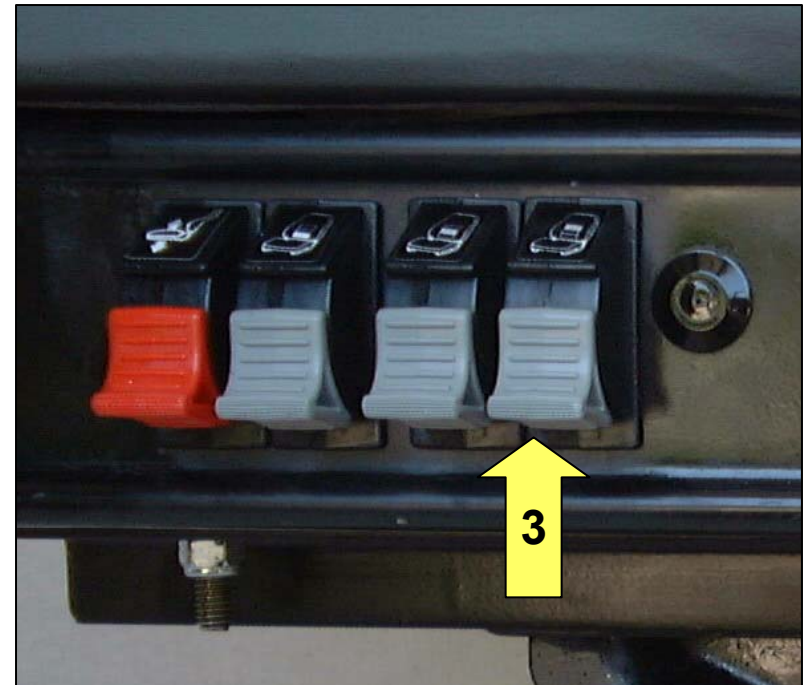
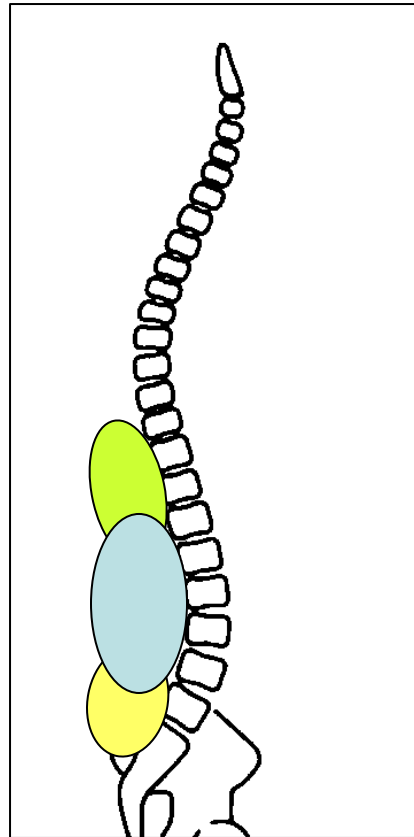
# Lumbar Cushion...



# Lumbar Cushion...



# Lumbar Cushion...





# Vibration

- Every object has a “Resonant Frequency”



**Small Bell = High Frequency**



**Big Bell = Low Frequency**

- Rule of Thumb
  - The less the mass, the higher the resonance frequency

# Vibration Basics...

- Individual body organs have their own resonant frequencies and do not vibrate as a single mass
- Whole Body Vibration (WBV) may create chronic stresses and permanent damage to the affected organs and body parts
- Hand / Arm Vibration may cause damage to the structure of the hand, arm, & fingers

# Frequency of Concern...

0.5 Hz to 80 Hz

Whole Body Vibration



6.3 Hz to 1250 Hz

Hand / Arm



# Whole Body Vibration...

- WBV may occur in workers who regularly operate:
  - Trucks
  - Buses
  - Heavy Equipment
  - Forklift Trucks
  - Trains
  - Helicopters
  - Fixed Wing Aircraft
  - Ships

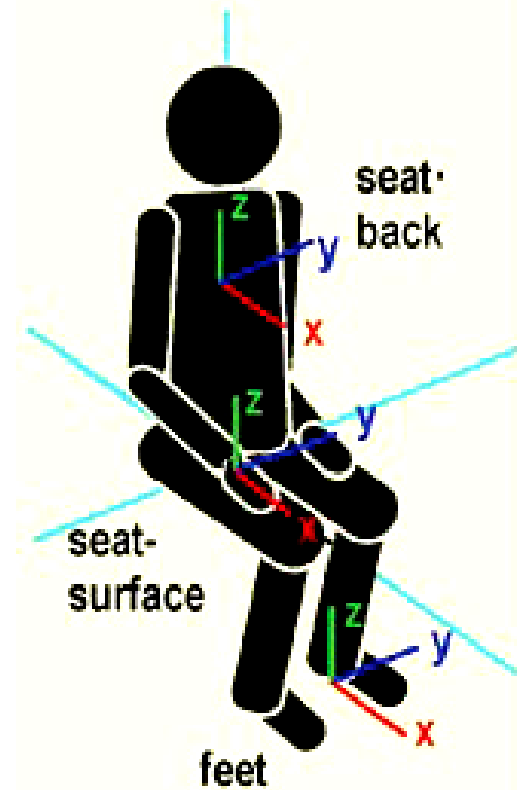


# Whole Body Vibration...

- The three main sources of whole body vibration from heavy equipment are
  - low-frequency vibration caused by tires and terrain
  - high-frequency vibration from engine and transmission
  - shock from running into potholes or obstacles

# Whole Body Vibration...

- WBV is transmitted through:
  - supporting surfaces such as the feet of a standing person
  - the buttocks of a seated person
  - the supporting areas of a reclining person



# Whole Body Vibration...

- Short Term Exposure
  - Abdominal pain
  - Chest pain
  - Headaches
  - Nausea
  - Loss of balance



- Long Term Exposure
  - Degenerative spinal changes
  - Disc disease
  - Degenerative disorders of the spine
  - Herniated discs
  - Disorders of the gastrointestinal system



# Whole Body Vibration...

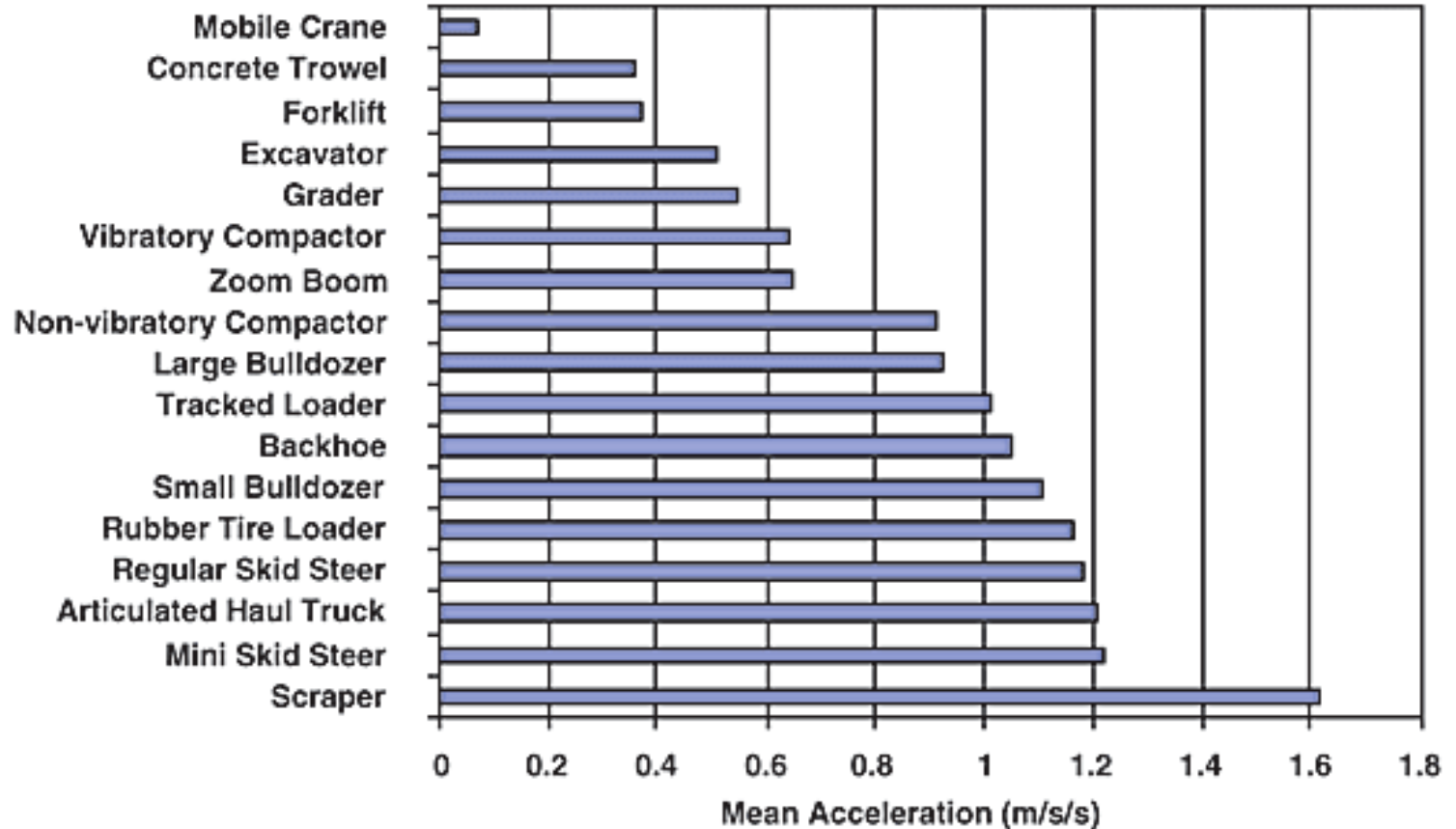


Figure 1: Vibration magnitude for each type of construction equipment tested. For seven hours of continuous work, the magnitude of vibration should not exceed 0.8 m/s<sup>2</sup>



# Back Angle...



- Lumbar support must be maintained
  - This will minimize forward head positioning
  - This will dampen the exposure of vibration
  - Sequencing of cushion is important
- Seat Angle must be positioned to optimize the support

# Lets Consider Seat Height...



- What are the implications when the seat height is too high???
- What are the implications when the seat height is too low???

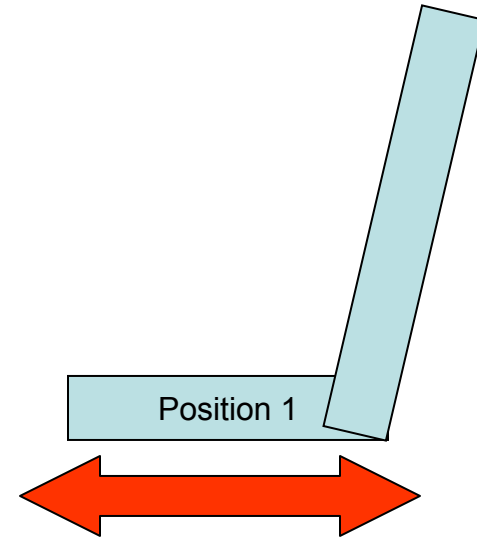
# Seat Height Provides...



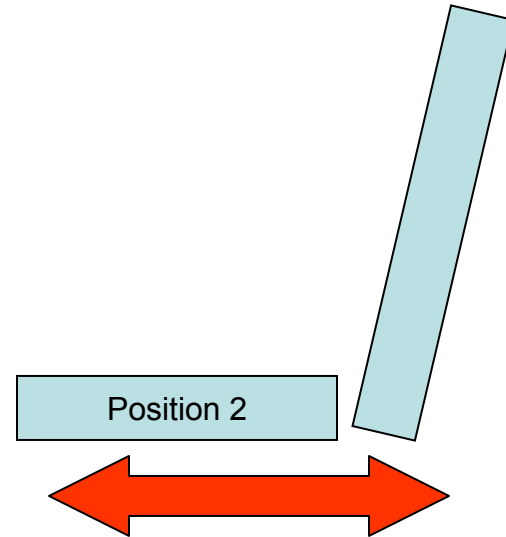
- Solid Footing
  - Lends support
  - Minimizes the slouch
  - Provides an axis to move around
- Our base of support



# Seat Depth...

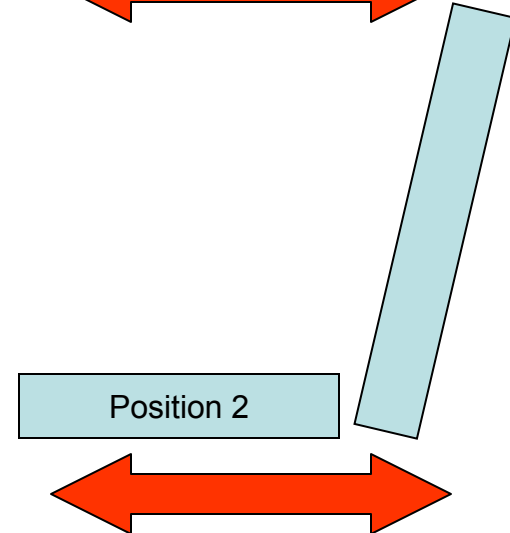
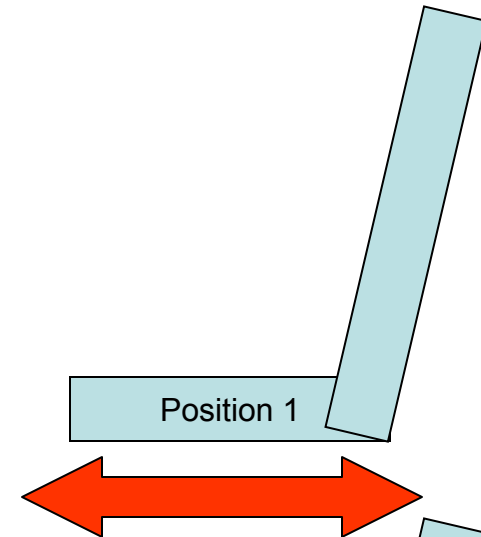


# Seat Depth...



# Consider the Requirements...

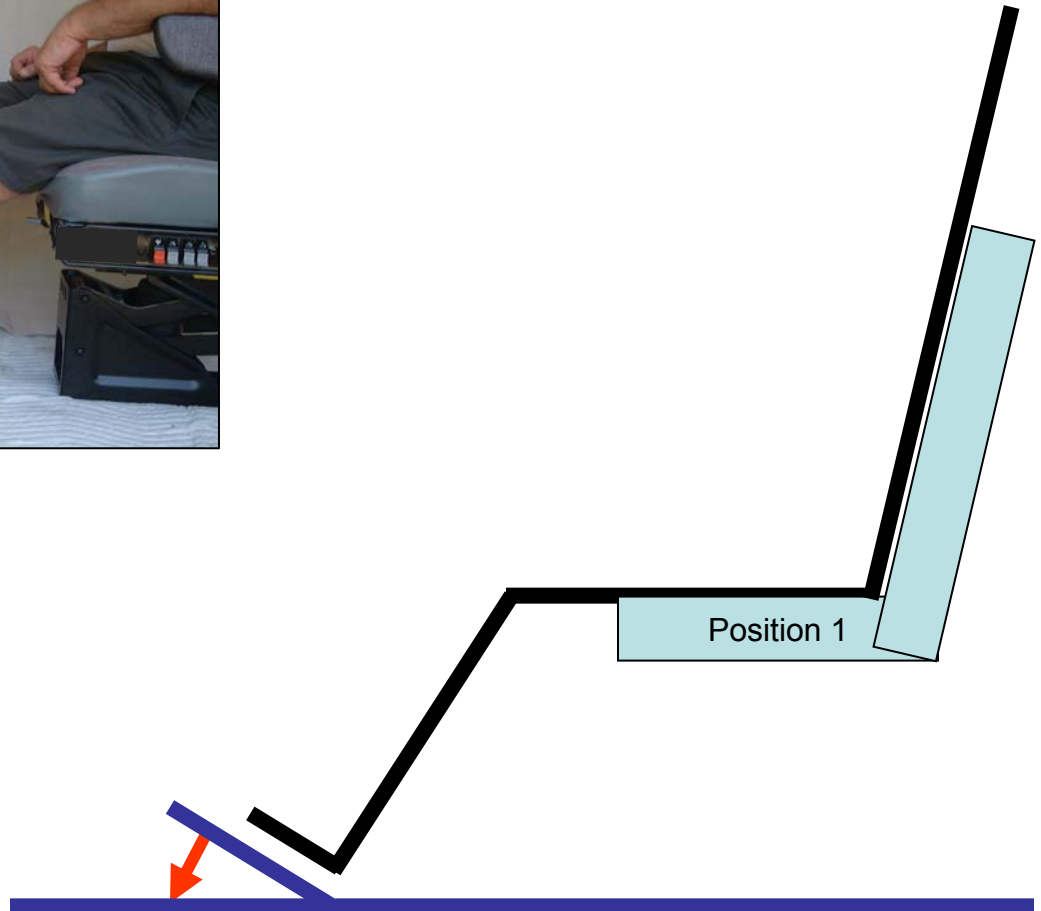
- So what happens when the seat depth is too short ?
- So what happens when the seat depth is too long ?



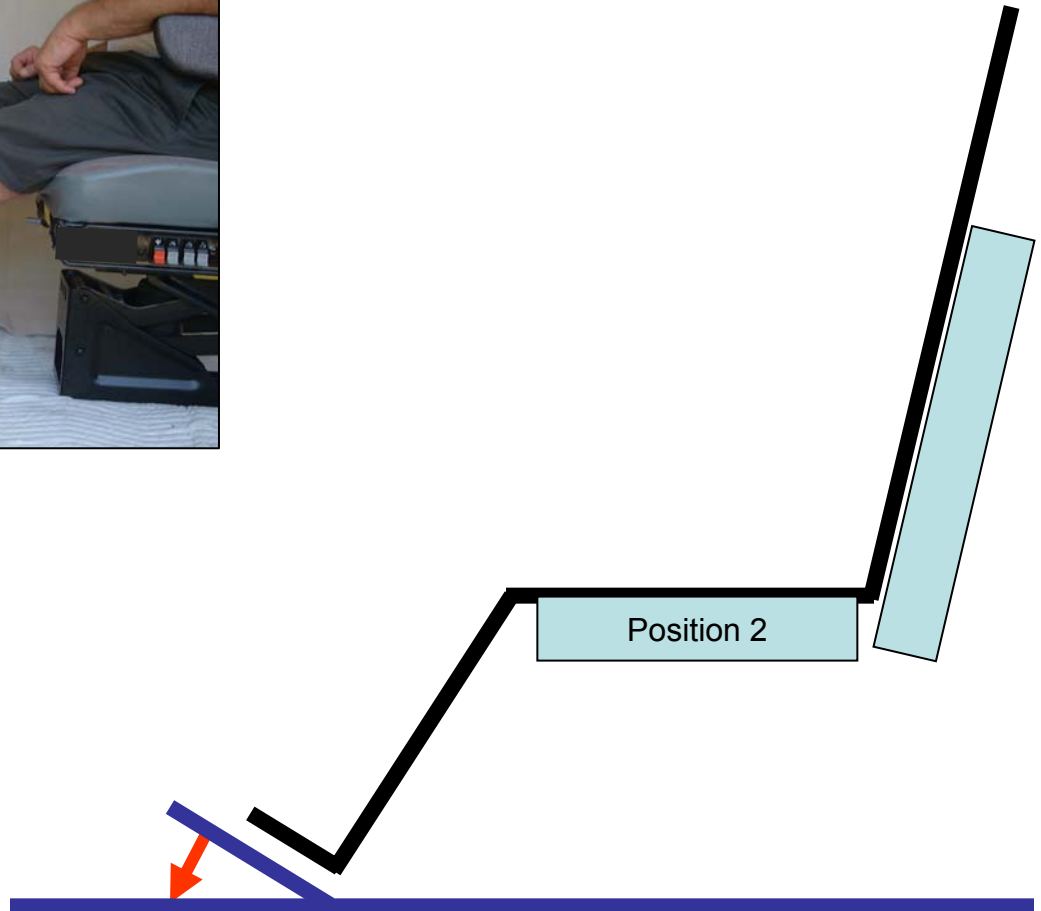
# What Actions are Required...



# Seat Depth...



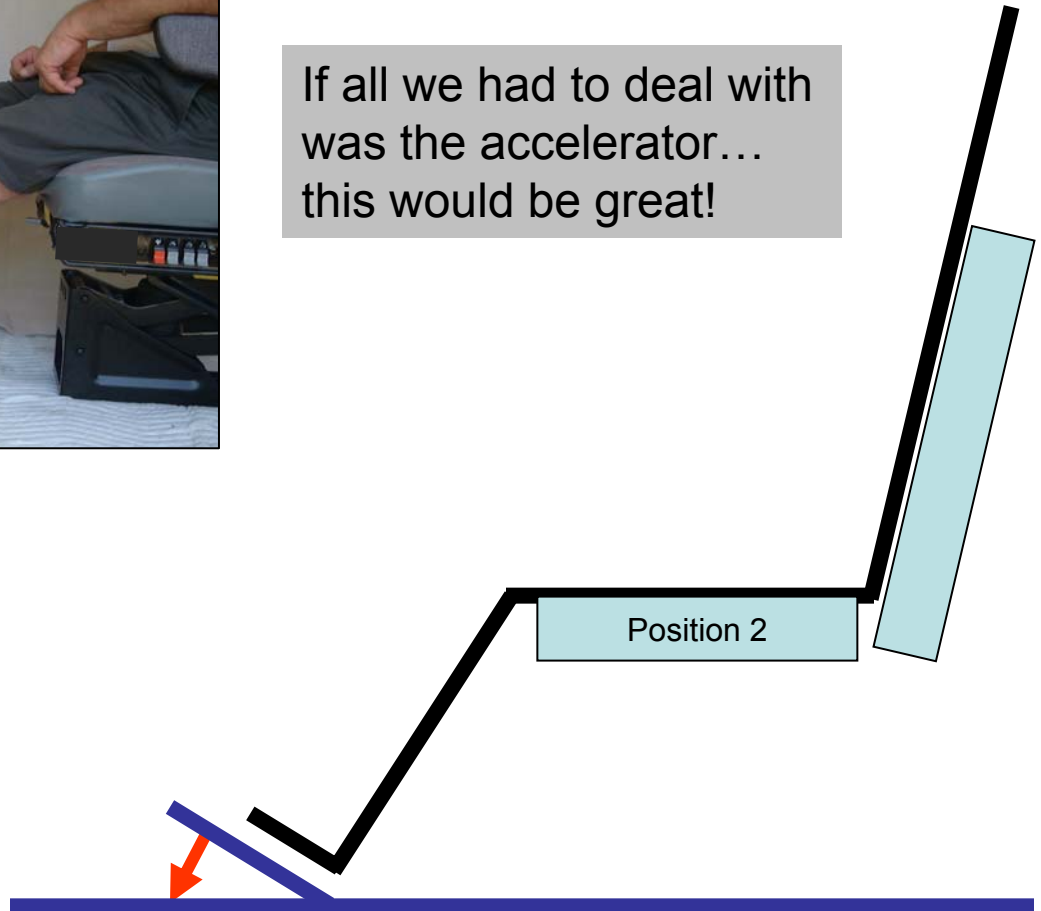
# Seat Depth...



# Seat Depth...

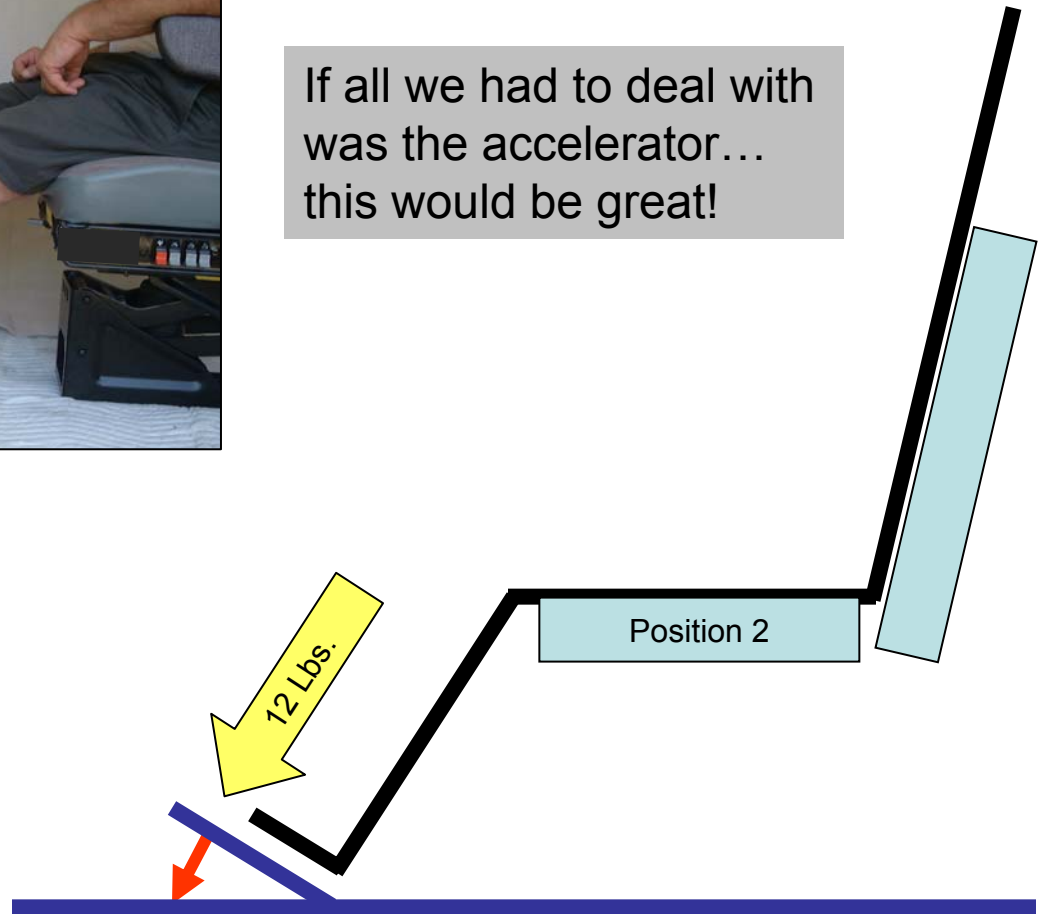


If all we had to deal with was the accelerator... this would be great!





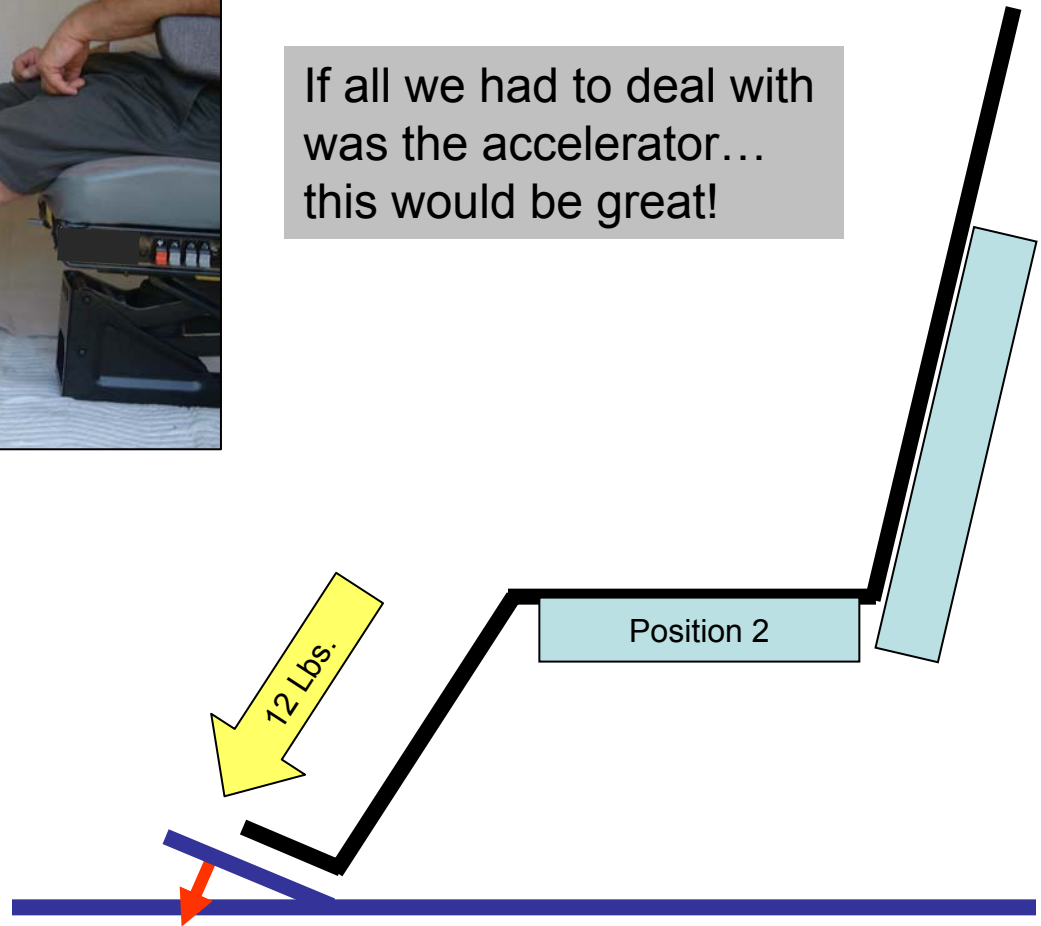
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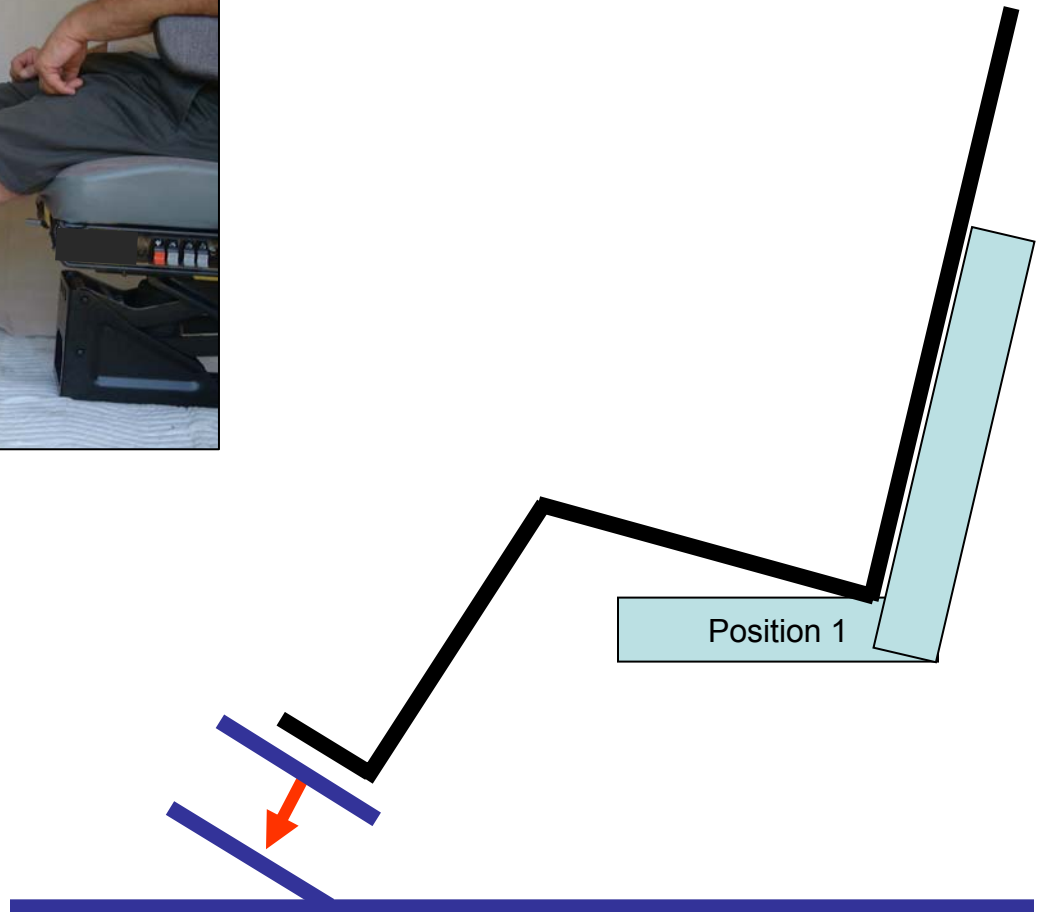
# Seat Depth...



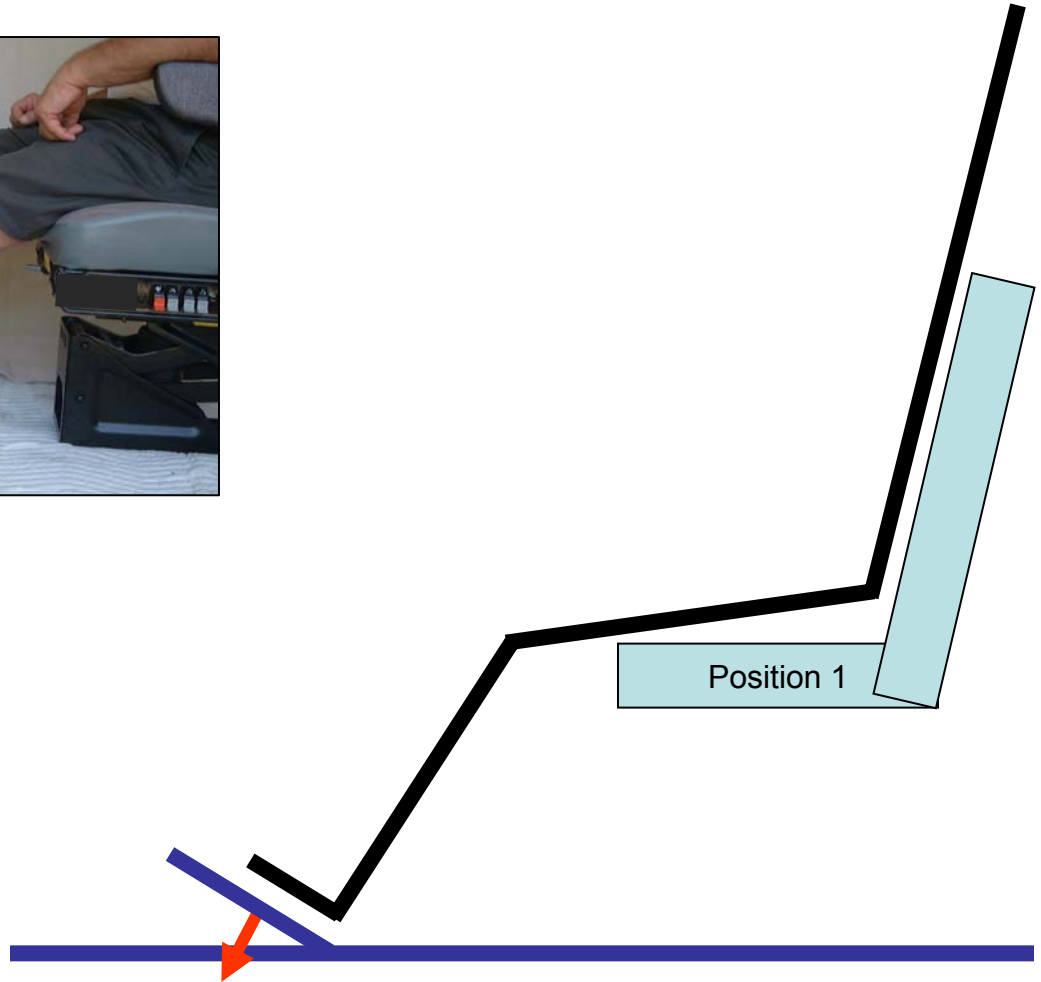
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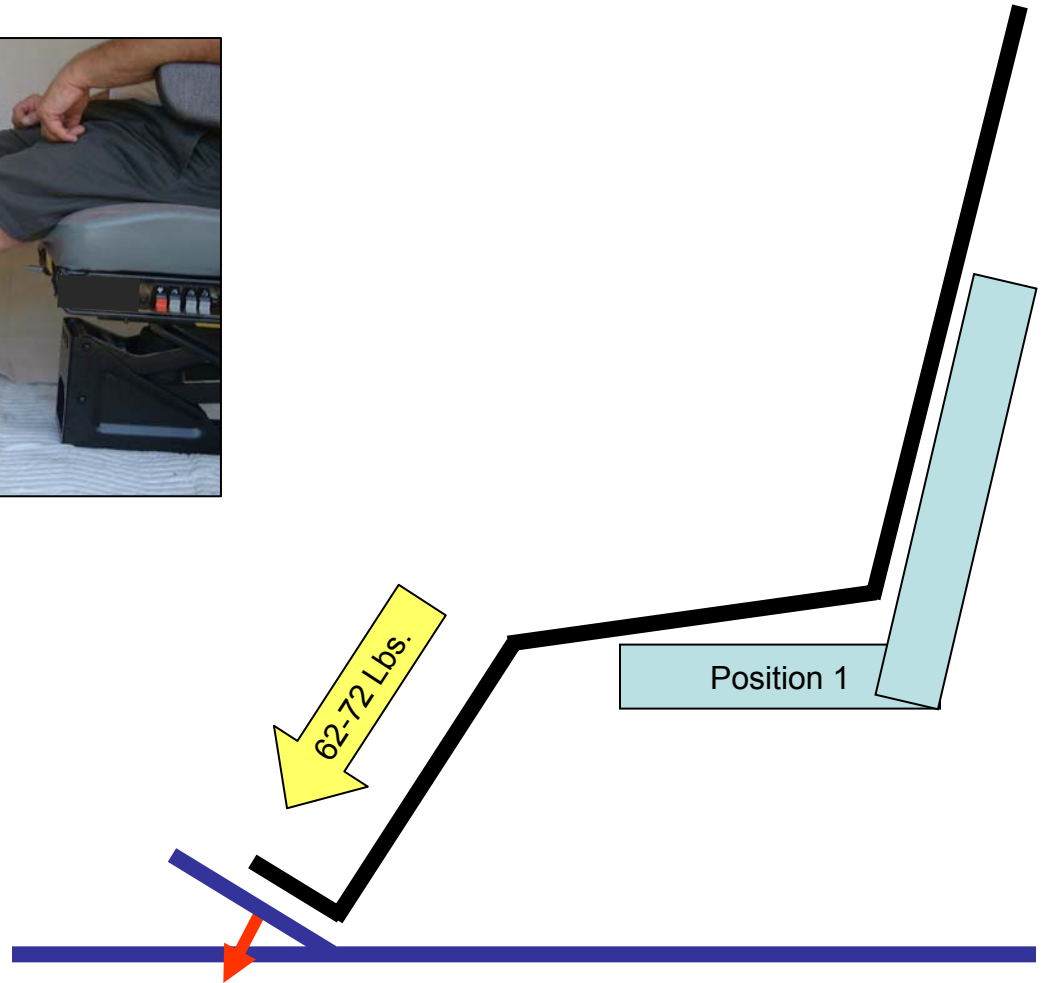
# Seat Depth...



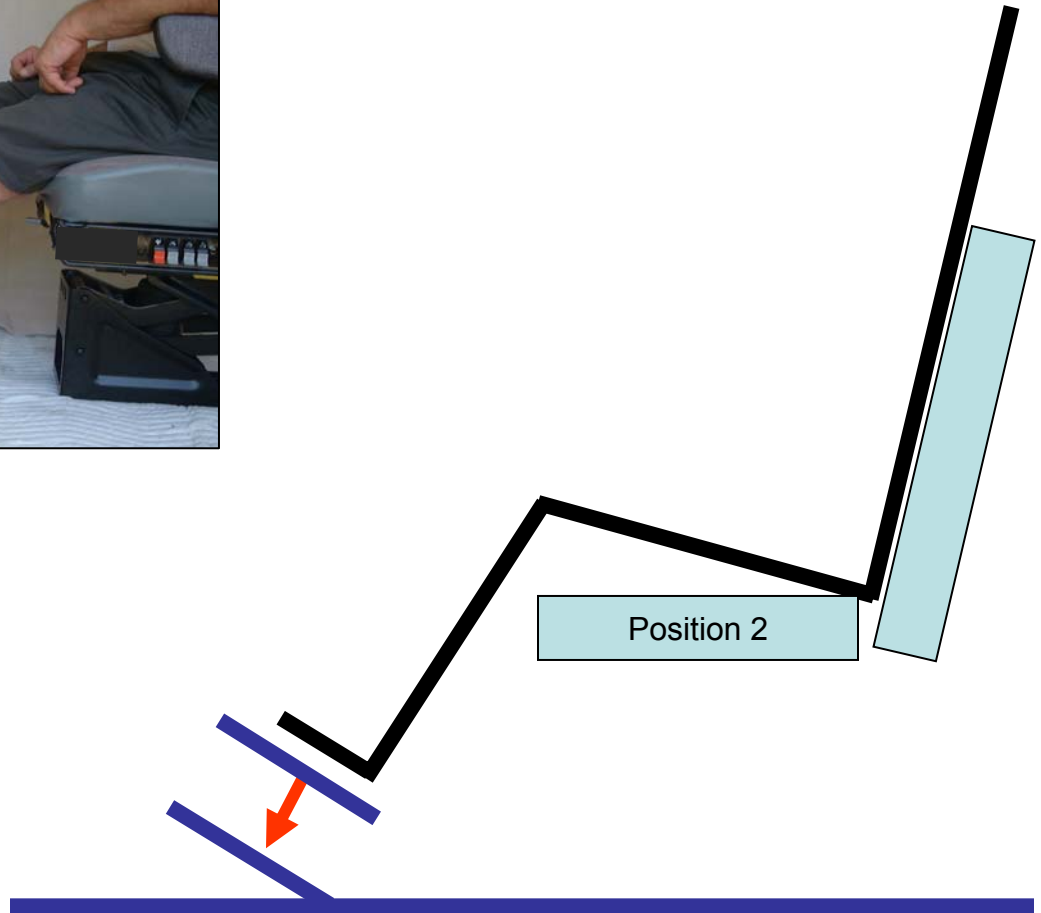
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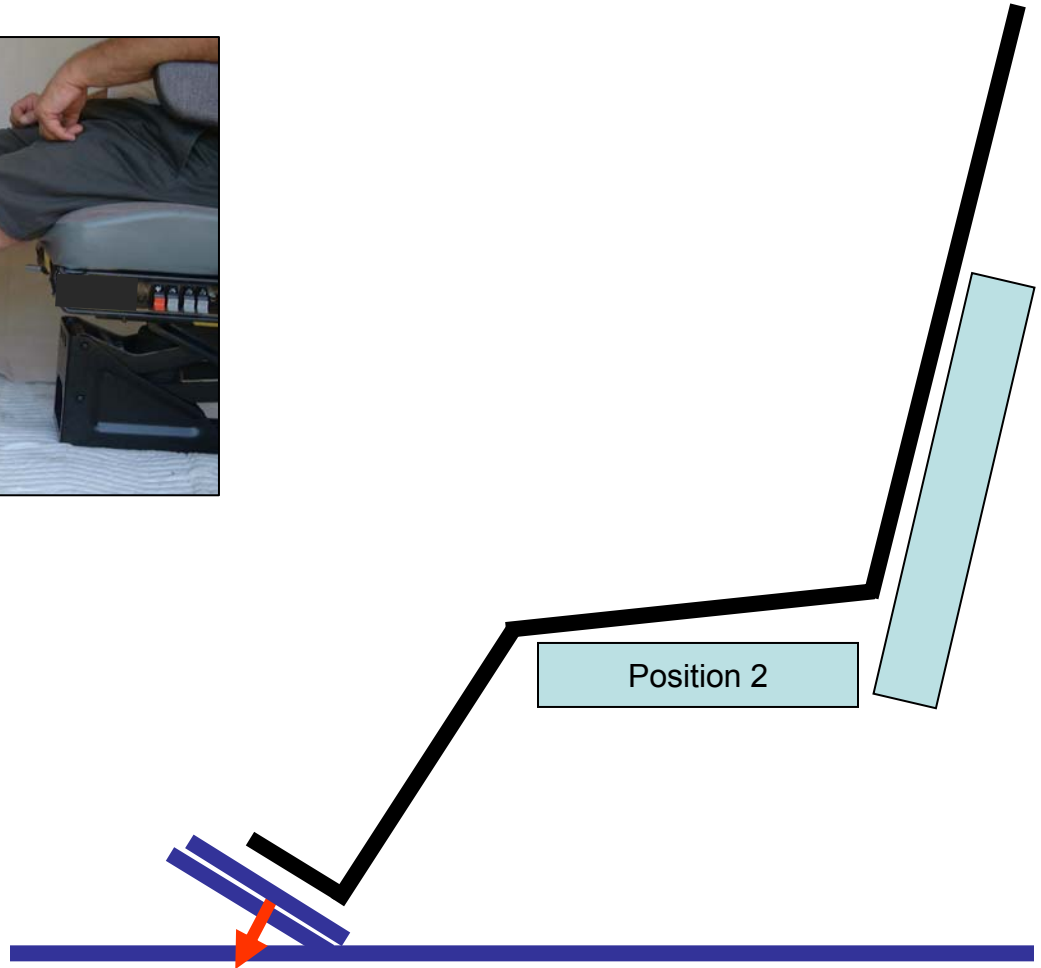
# Seat Depth...



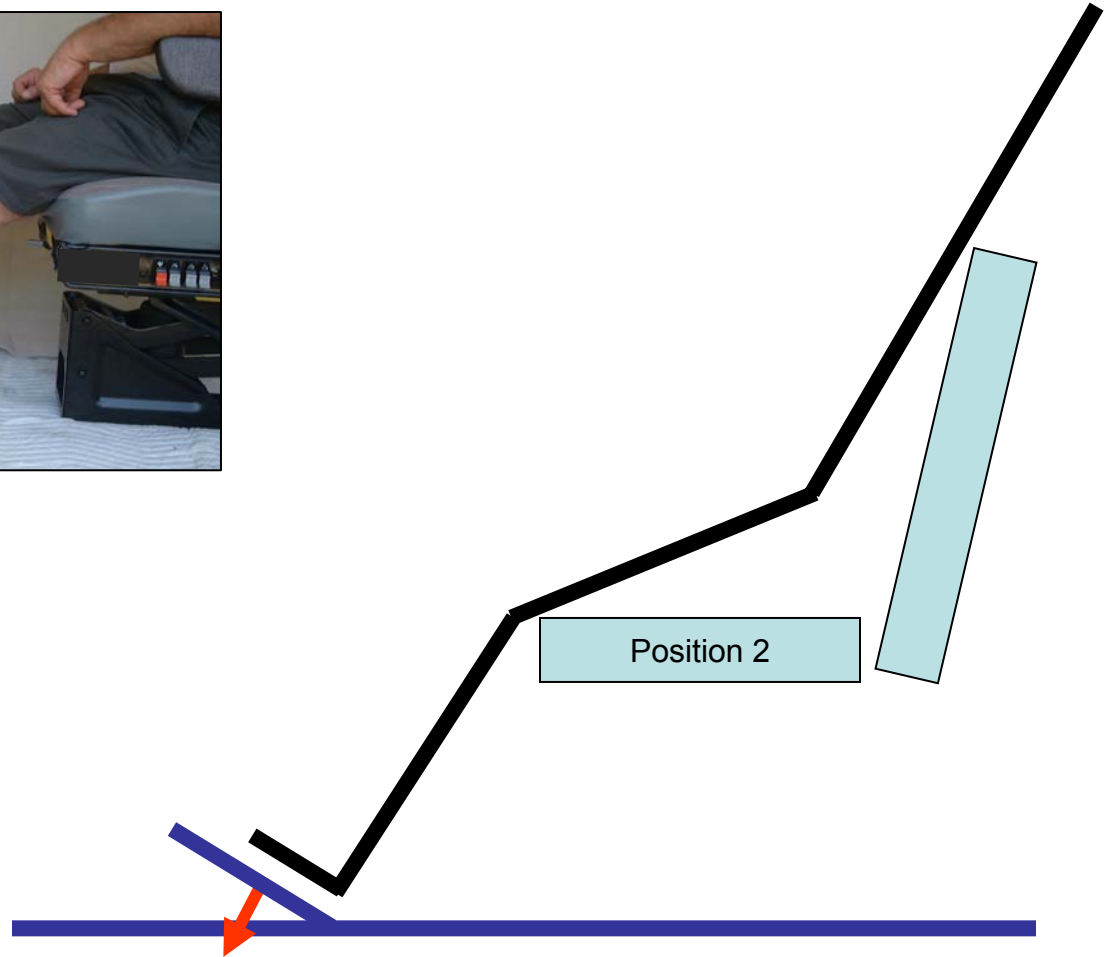
# Seat Depth...



# Seat Depth...



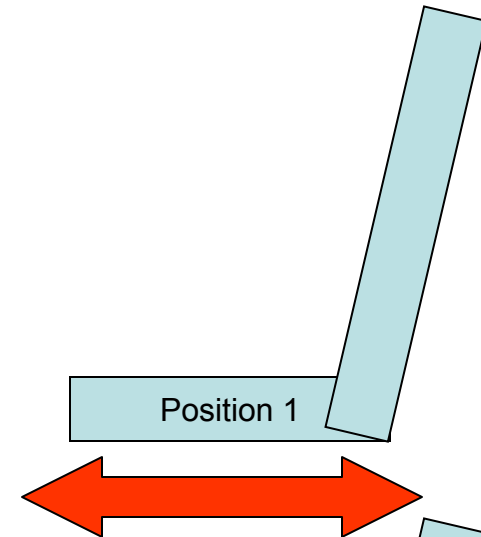
# Seat Depth...



# What Are the Implications...

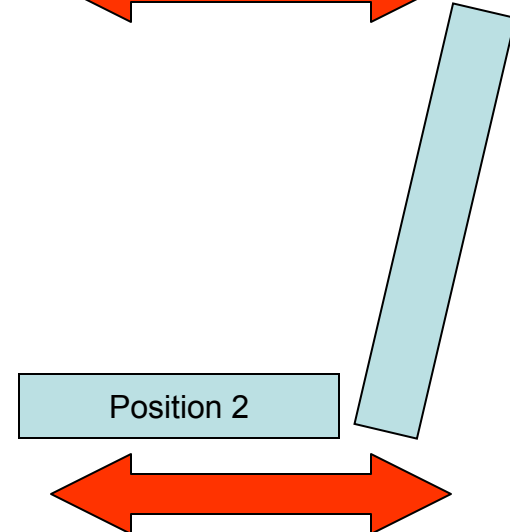
## Consider Position 1

- Essentially all females
- Males shorter than 5'10"



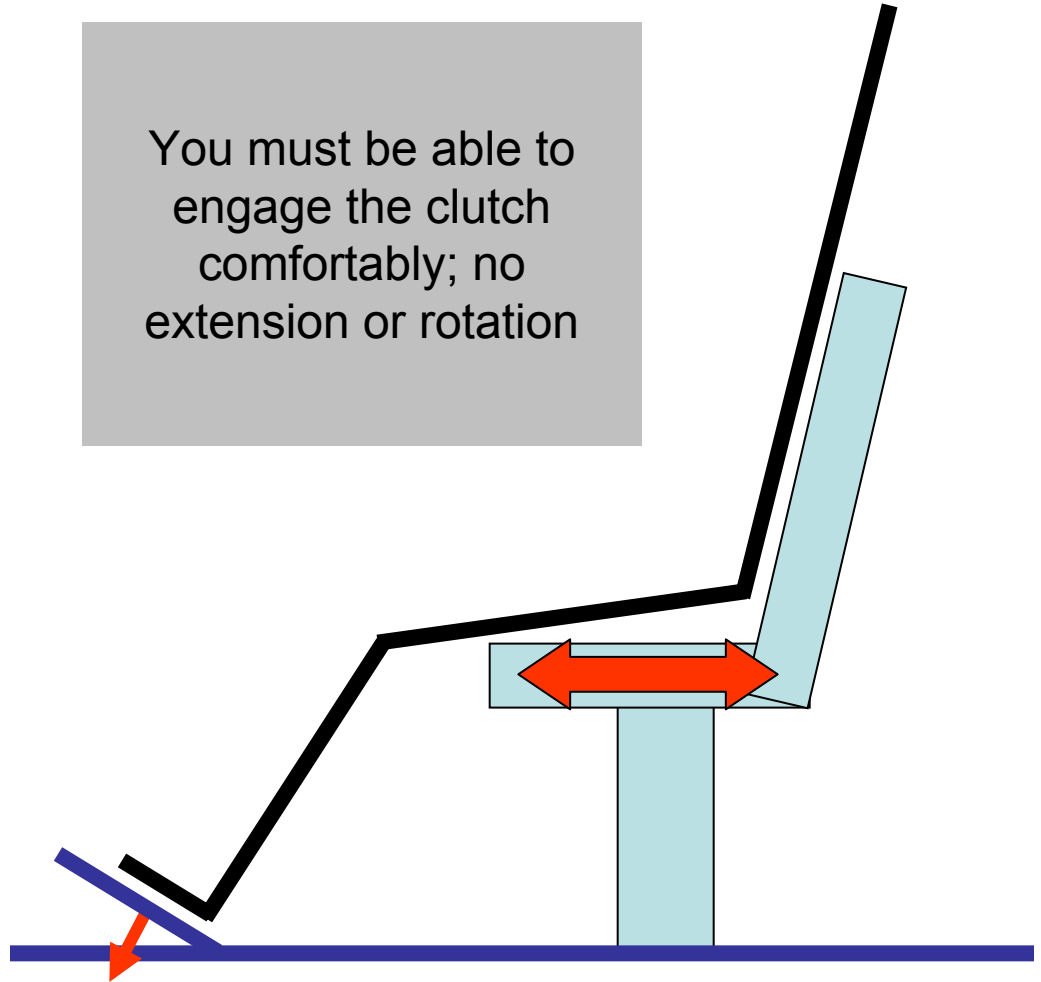
## Consider Position 2

- Only the tallest of females
- Males taller than 6'2"

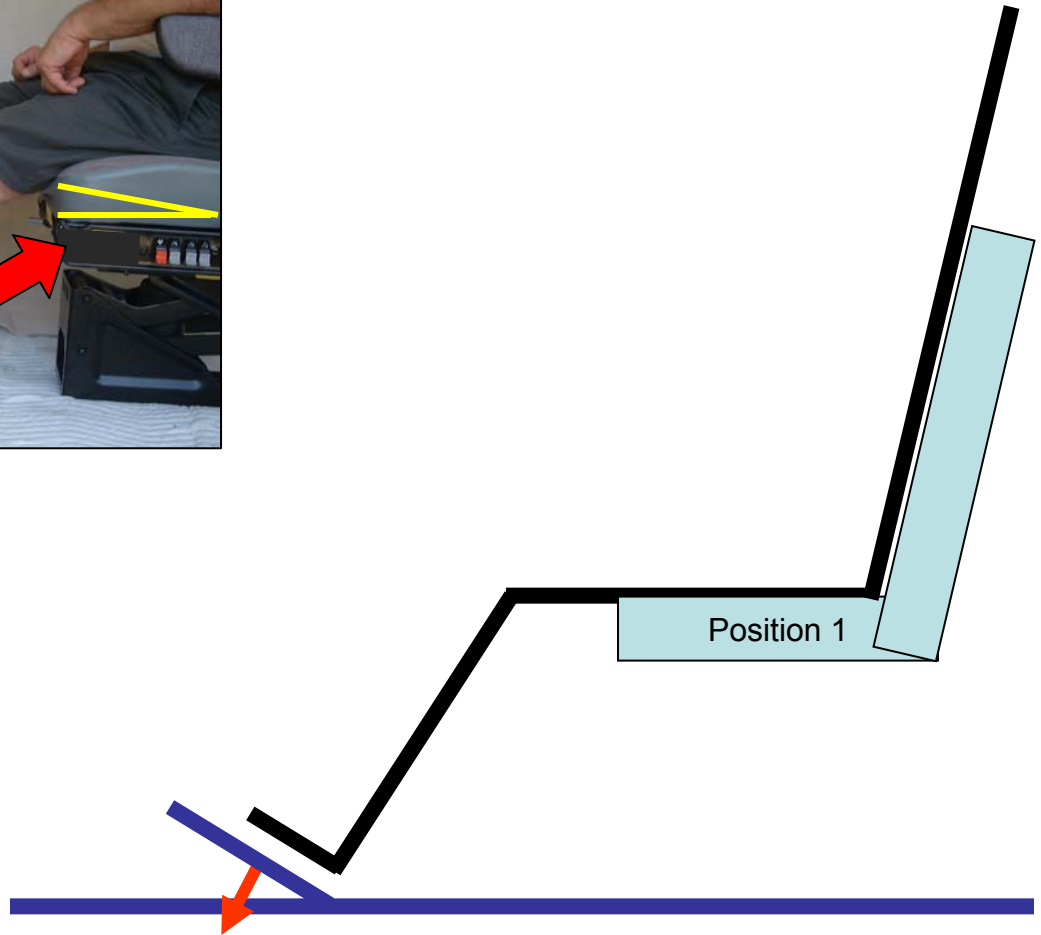




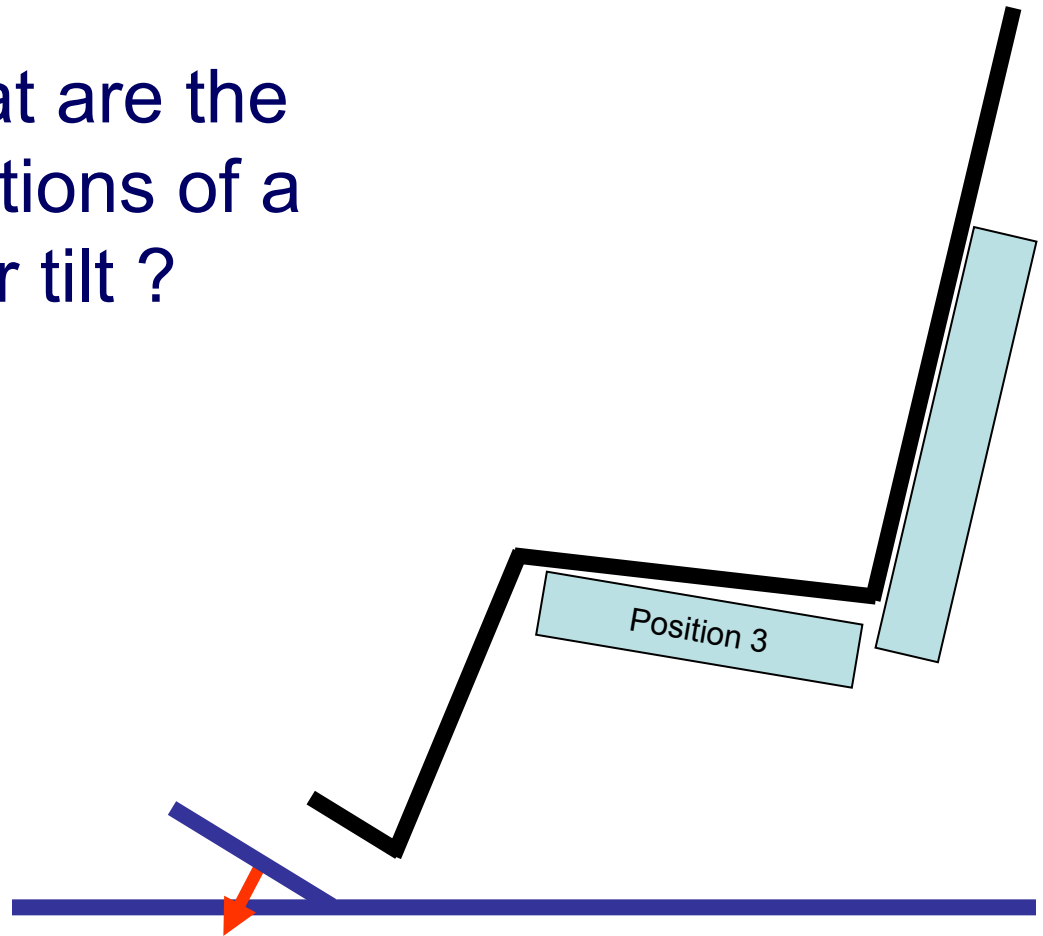
You must be able to engage the clutch comfortably; no extension or rotation



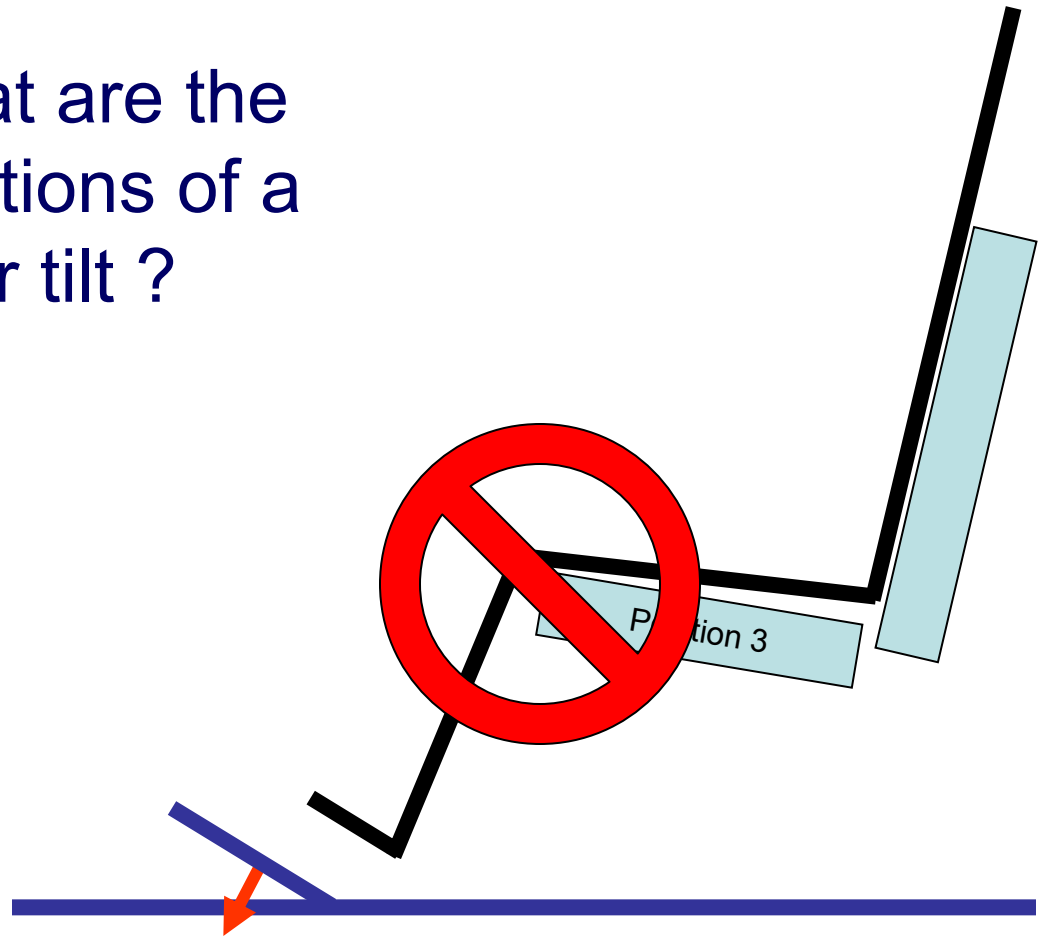
# Anterior Tilt...



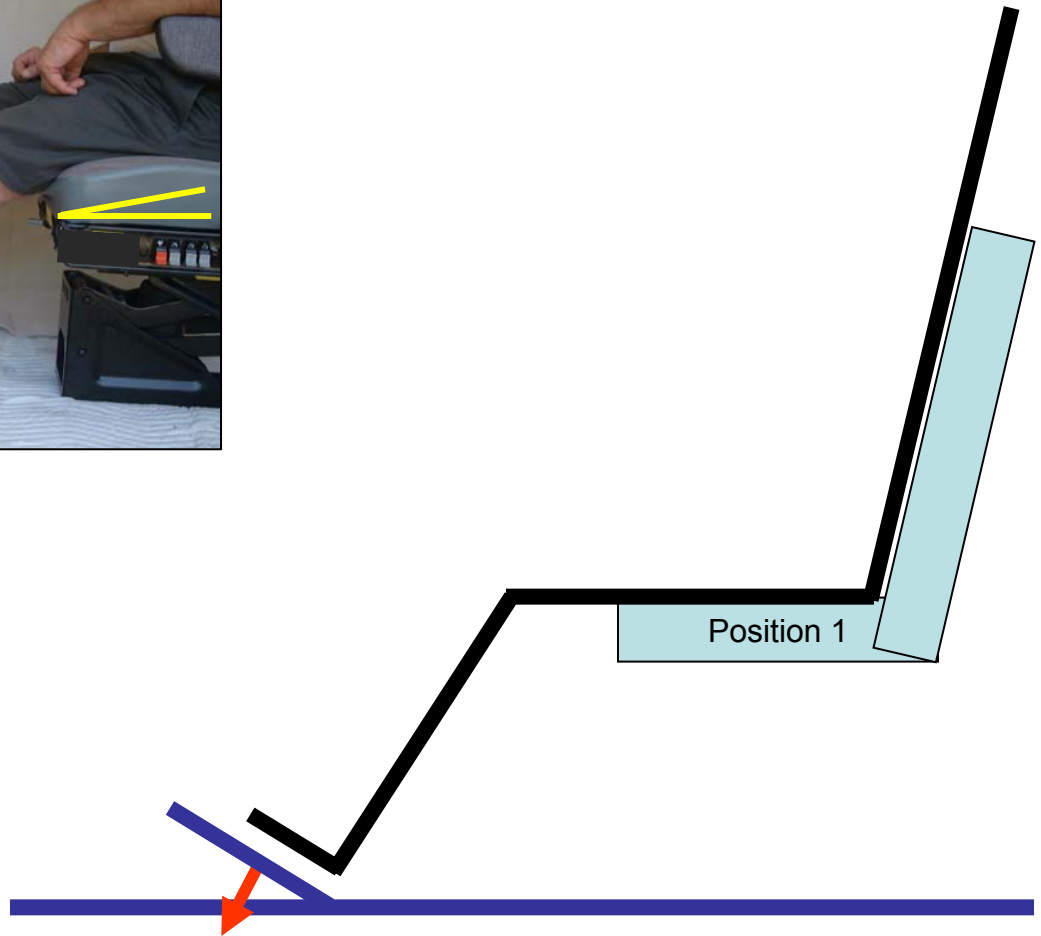
- So what are the implications of a anterior tilt ?



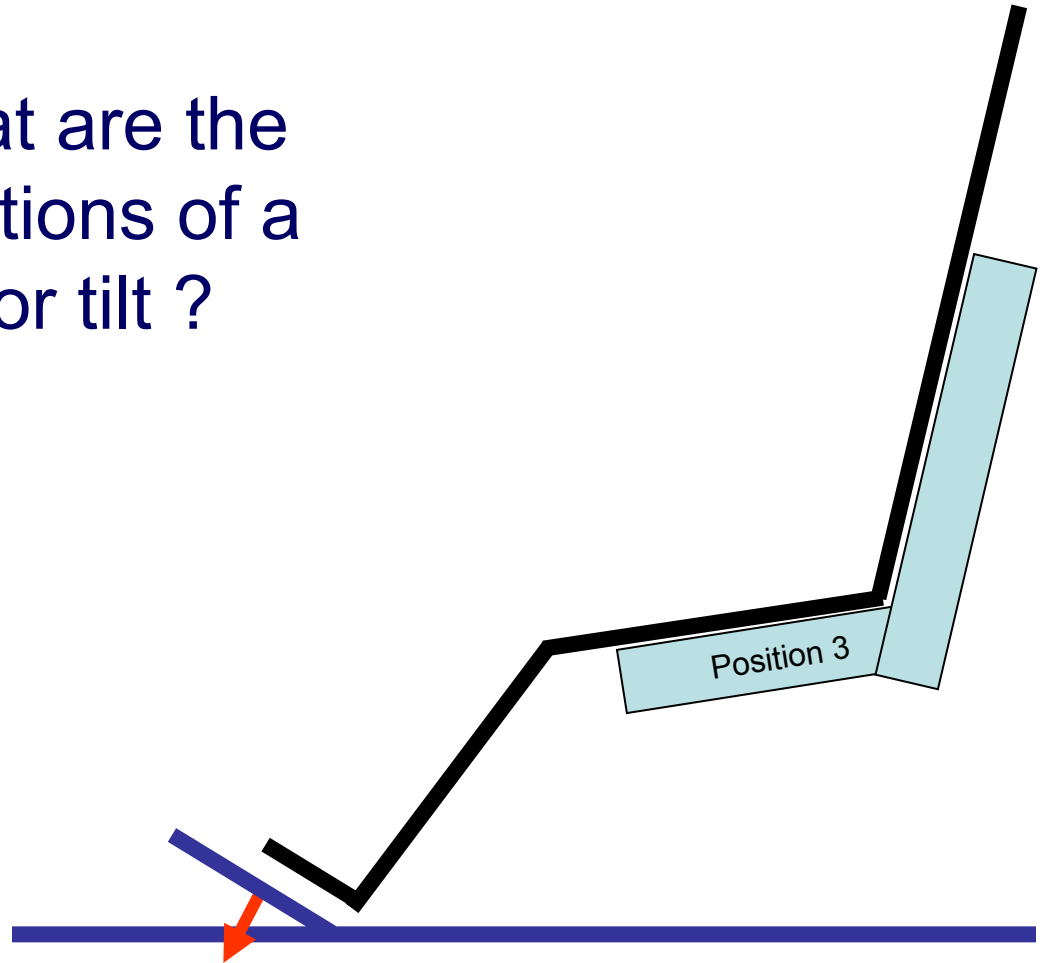
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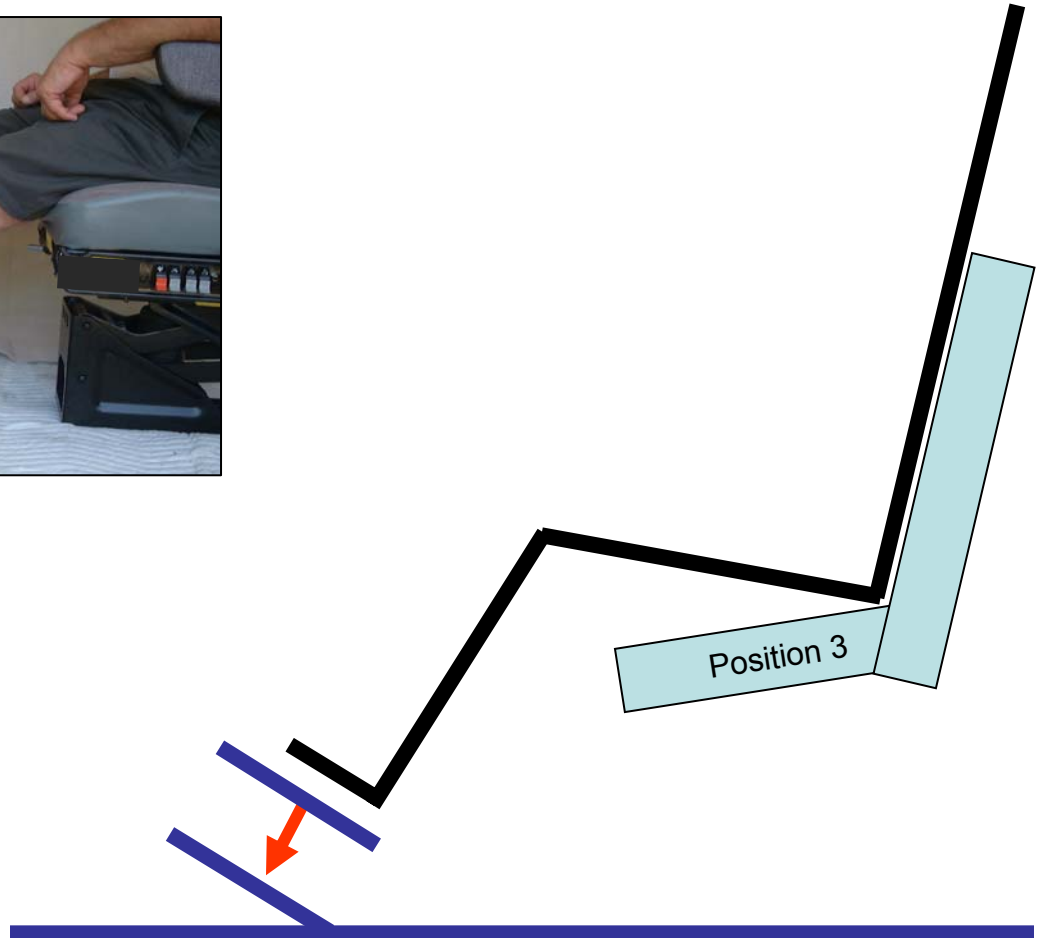
# Posterior Tilt...



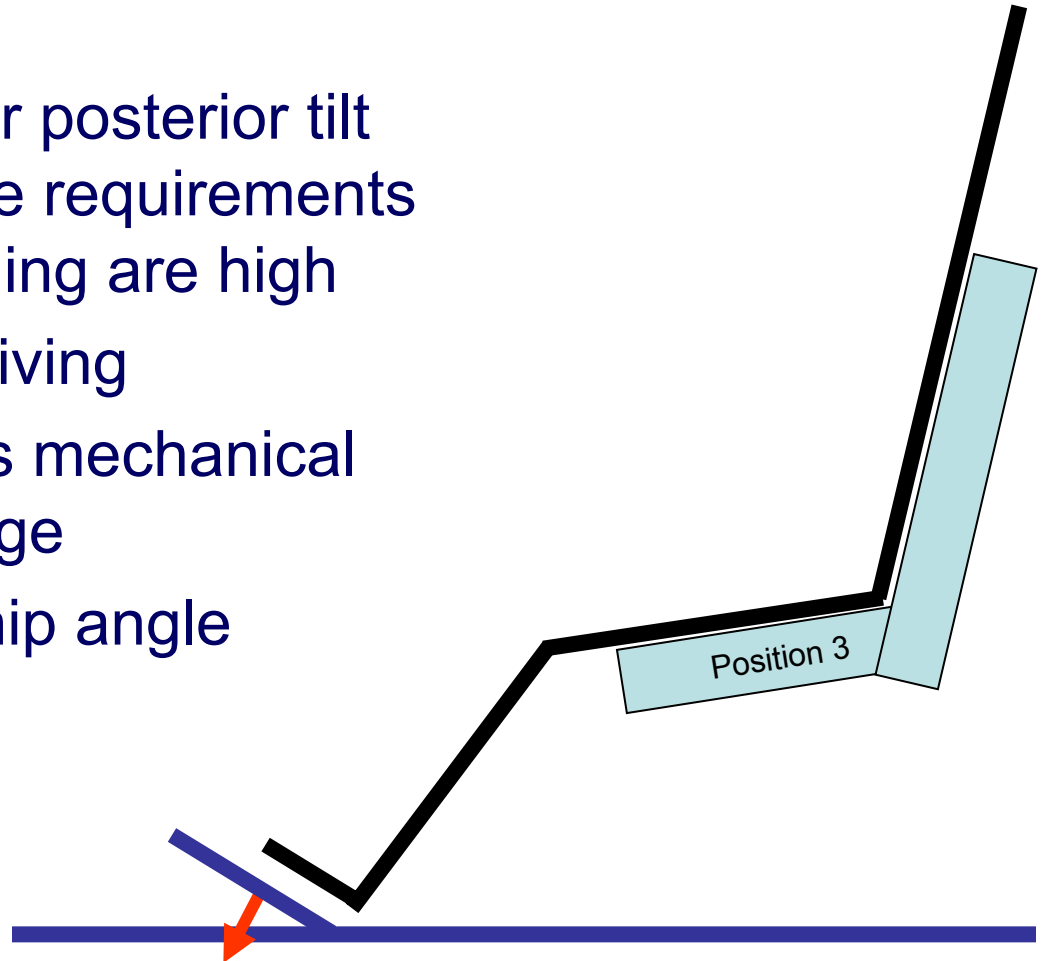
- So what are the implications of a posterior tilt ?



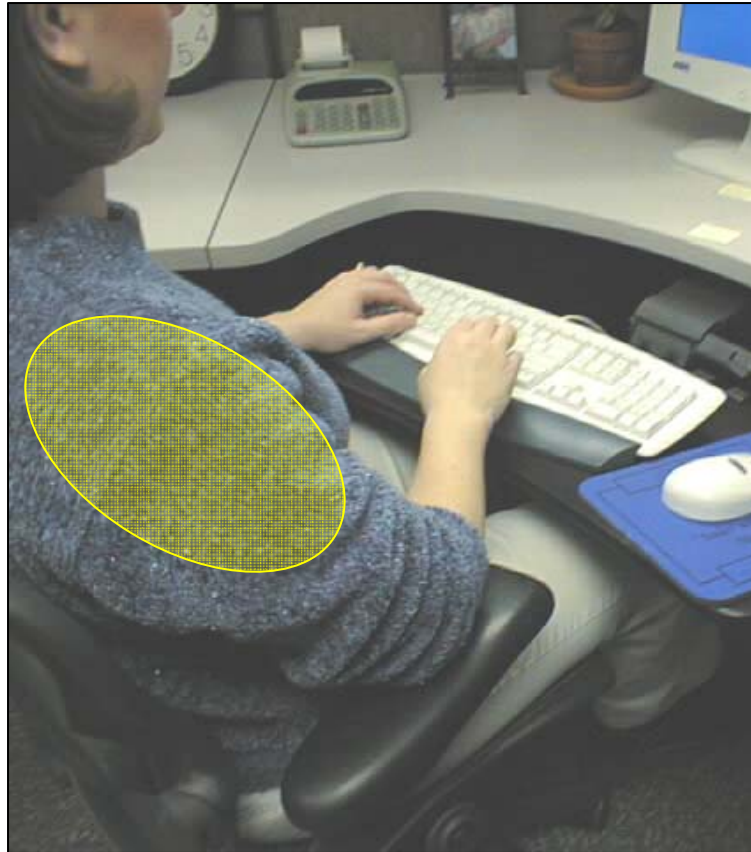
# Posterior Tilt...



- Consider posterior tilt when the requirements of clutching are high
- Town driving
- Provides mechanical advantage
- Opens hip angle



# Arm Support...



Arm support  
provides unloading  
of the shoulder

# Arm Support...



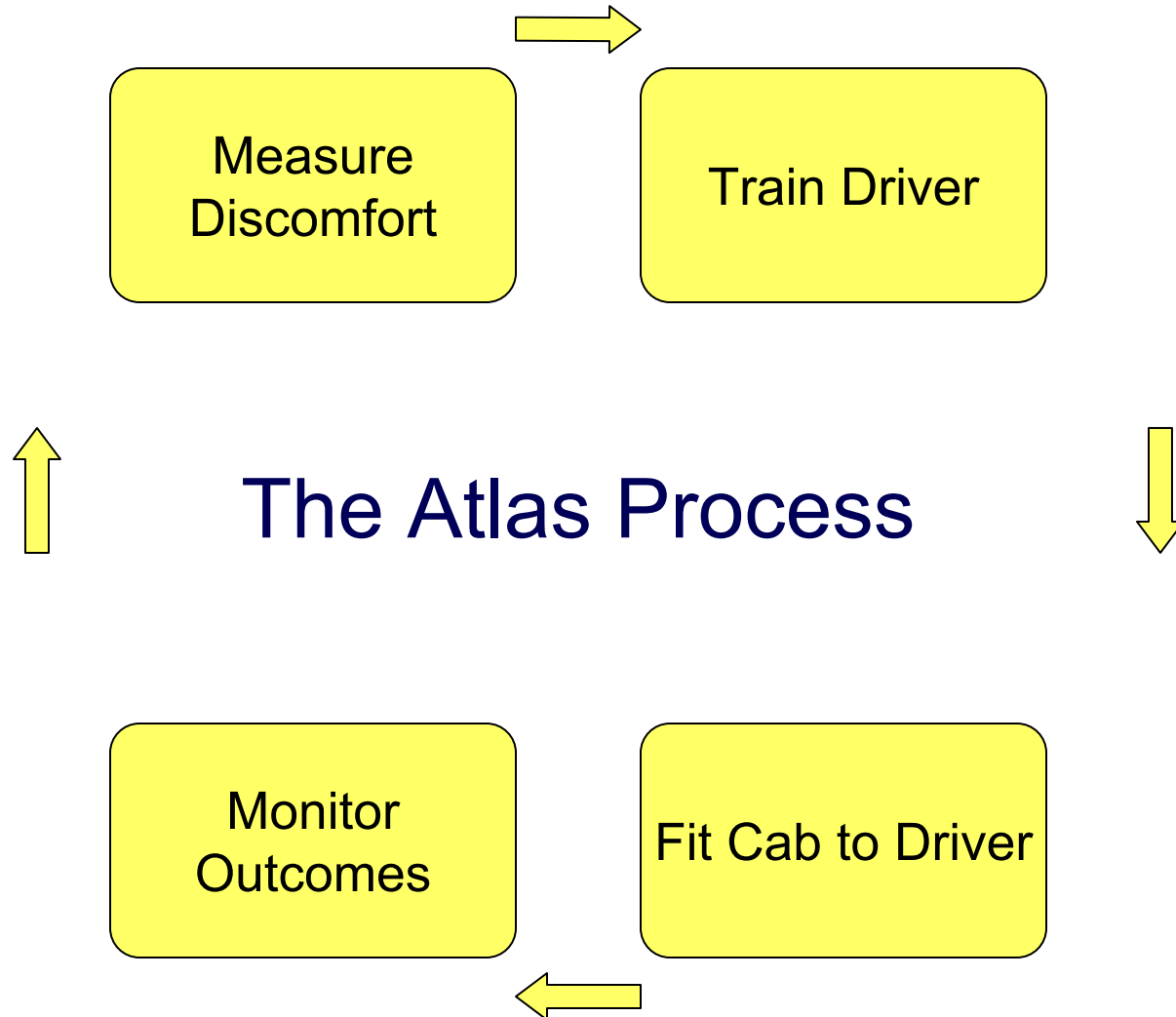
# The Final Piece...

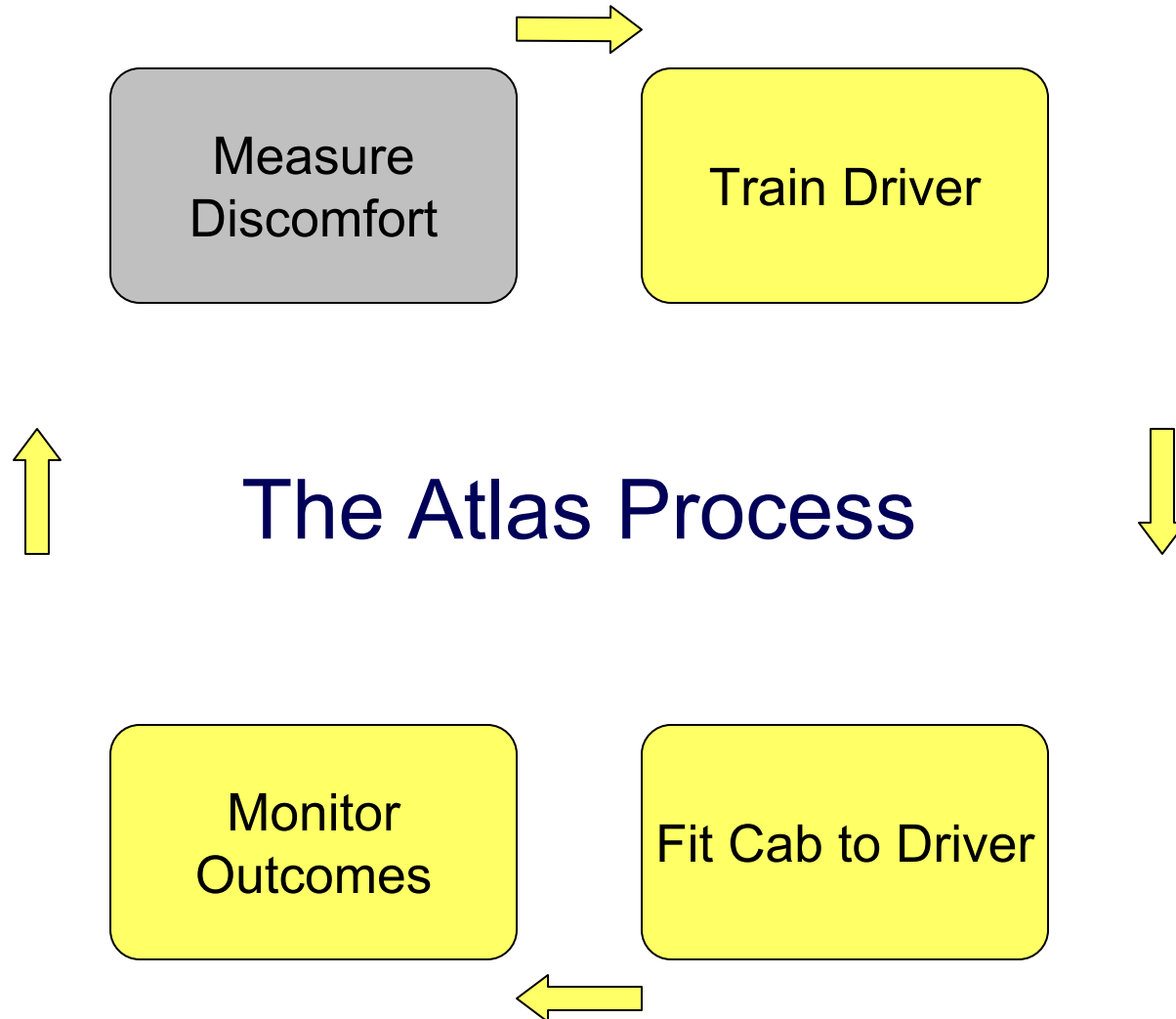


- Steering Wheel
  - Depth
  - Tilt
- Bring the wheel to the driver
- Lay it in their hands
- Hands at 9:00 and 3:00

# They understood the relationship...









# Measure Discomfort...

## Schneider National: Driver Discomfort Survey

Your Home Operating Center: \_\_\_\_\_ Today's Date: \_\_\_\_/\_\_\_\_/\_\_\_\_

Driver Number: \_\_\_\_\_ First Name: \_\_\_\_\_ Last Name: \_\_\_\_\_

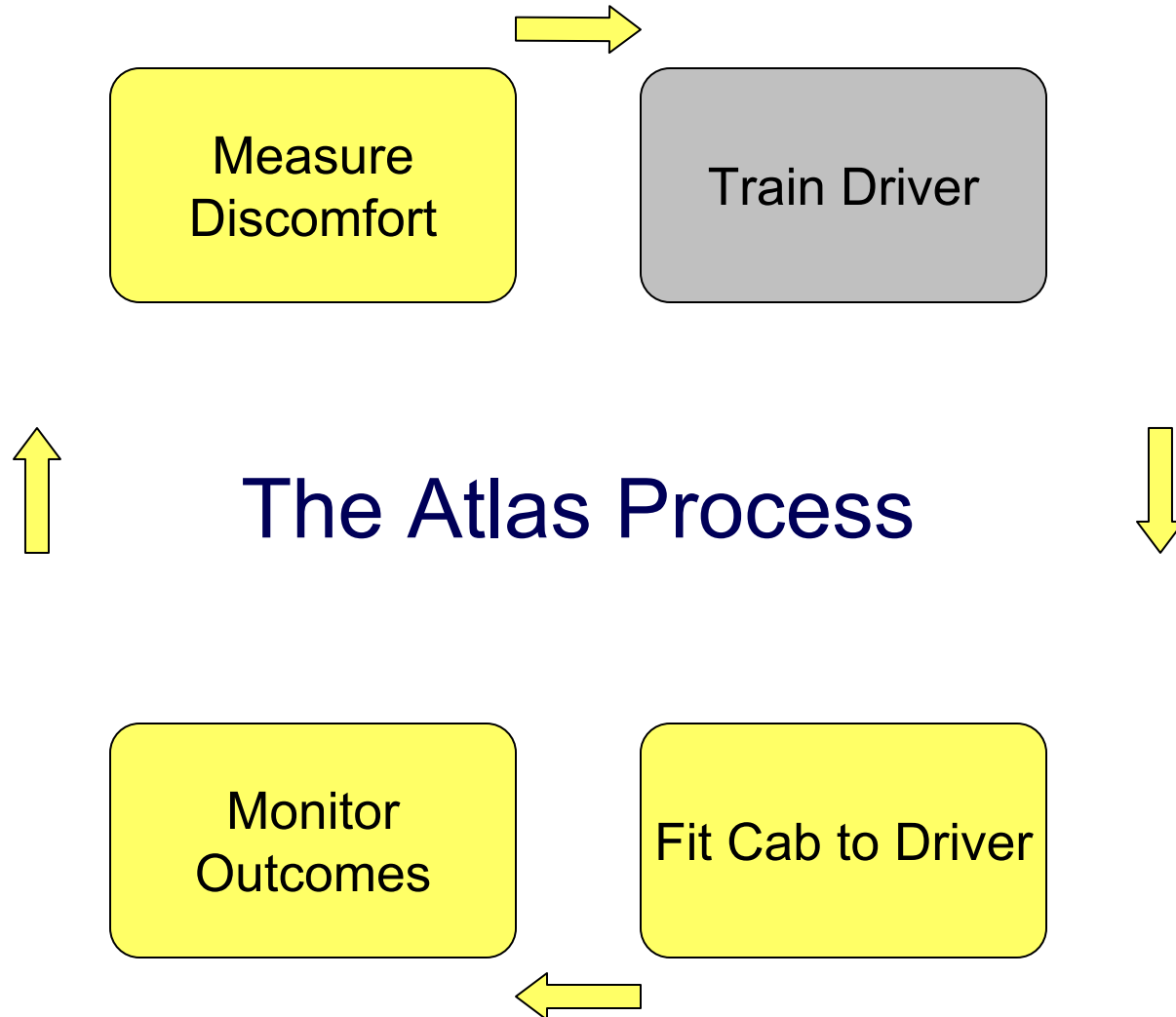
Height: \_\_\_\_ feet \_\_\_\_ inches Weight: \_\_\_\_\_ lbs. Birth Date: \_\_\_\_/\_\_\_\_/\_\_\_\_ Hire Date: \_\_\_\_/\_\_\_\_/\_\_\_\_

Job Type: \_\_\_\_\_ Driver Assist (use pallet jack) \_\_\_\_\_ Hand Unload (i.e. Family Dollar) \_\_\_\_\_ Does Not Apply / Unknown

Do you experience work related discomfort (circle yes or no)? YES NO Please Circle: Male Female

If you do experience discomfort: Please indicate the Location / Frequency / Severity of the discomfort (see below).

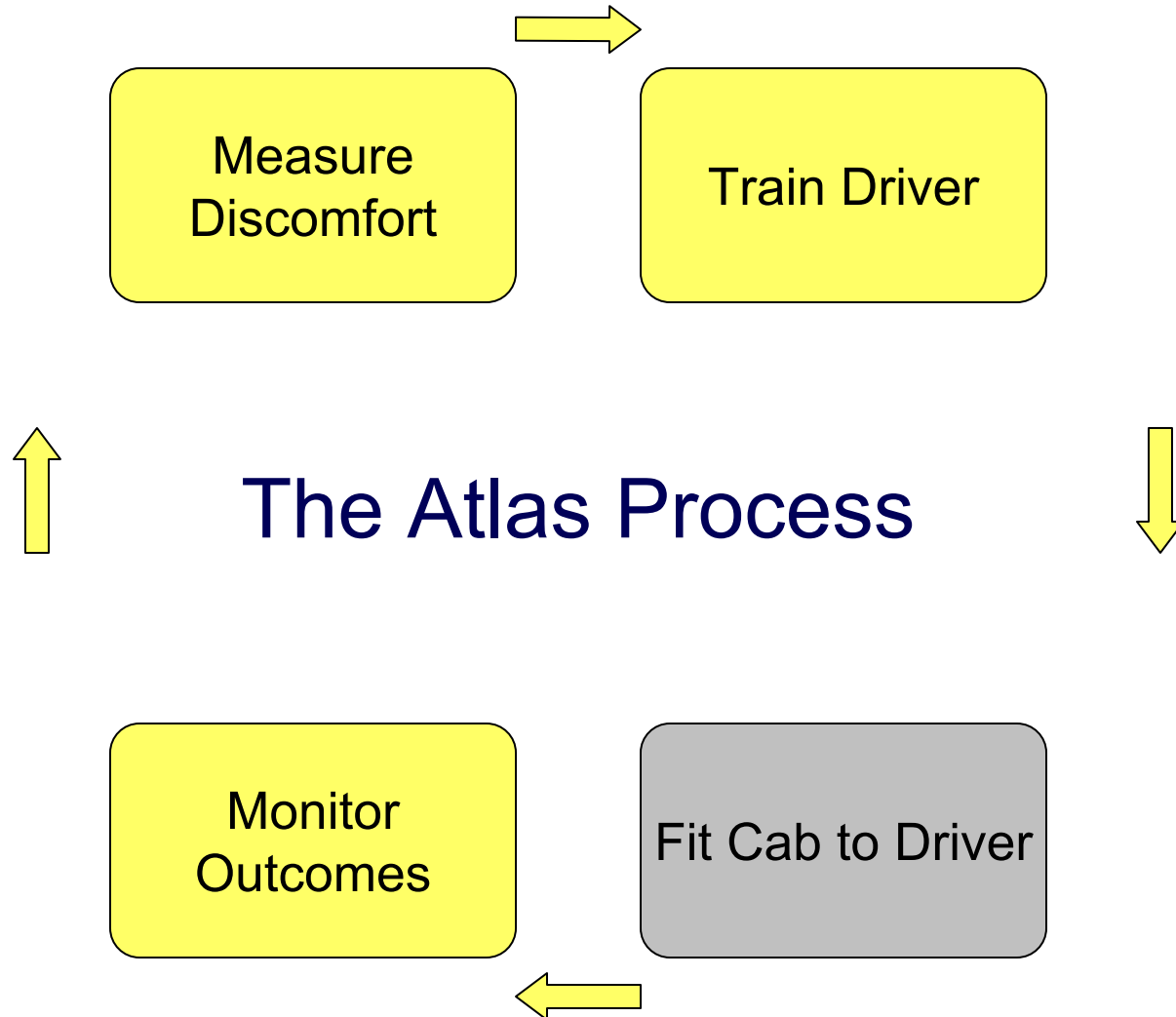
Location of Discomfort	Frequency of Discomfort					Severity of Discomfort				
	Never	Rarely	Occasionally	Frequently	Continuous	None	Minimal	Moderate	Significant	Intolerable
____ Eyestrain	1	2	3	4	5	1	2	3	4	5
____ Head & Neck	1	2	3	4	5	1	2	3	4	5
____ Shoulders	1	2	3	4	5	1	2	3	4	5
____ Elbows	1	2	3	4	5	1	2	3	4	5
____ Wrists / Hands	1	2	3	4	5	1	2	3	4	5
____ Upper Back	1	2	3	4	5	1	2	3	4	5
____ Lower Back	1	2	3	4	5	1	2	3	4	5
____ Hips / Thighs	1	2	3	4	5	1	2	3	4	5
____ Knees	1	2	3	4	5	1	2	3	4	5
____ Ankle / Feet	1	2	3	4	5	1	2	3	4	5



## Driver Training

- What Causes Pain
- How to Avoid Pain
- How to Use the Fit Report™





## Step One...

- Design the Labels
  - Quantify the settings
  - Flexible
    - All seats & all trucks
  - Auditable



# Fit Cab to Driver...



Copyright:

## Step Two...

- Label the Trucks

Copyright: Atlas Ergonomics, LLC  
 15901 Forest Park Drive  
 Grand Haven, MI 49417  
 www.atlasergo.com Patent Pending

### Seat Label Installation Instructions

#### 2000 Series

#### Driver's Seat - Door Side (Revision Level 1.0)

General Instructions
1. Assure all surfaces are clean
2. Press all labels flat
3. Align as shown

	Seat Depth/ Back Angle indicator
	Seat Back Angle 1. Turn knob until seat back is in its furthest upright position. 2. Align the #1 with the arrow.
	Front Seat Tilt Indicator
	Front Seat Tilt 1. Rotate the knob until the seat lies flat. 2. Align the #1 with the arrow
	Lumbar
	Seat Depth 1. Assure seat is in the furthest back position. 2. Align the #1 with the arrow


## Step Three...


- Fit the cab to the driver
- Record the settings



## Step Four...


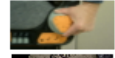











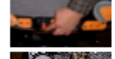















- Provide Fit Report™
  - Front of Report
    - How to use adjustments
    - How to recreate settings
    - How to adjust for city vs. highway driving



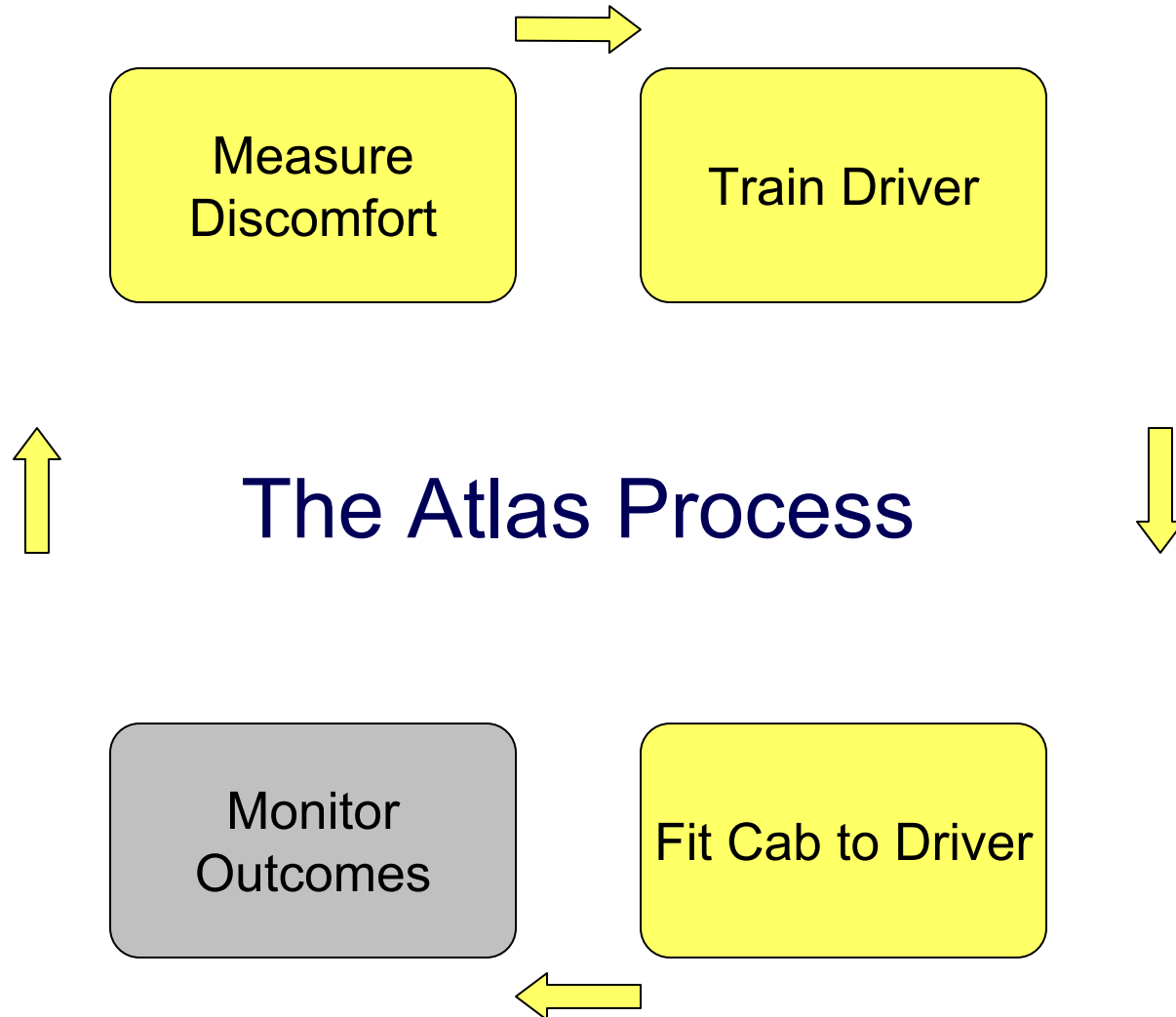


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Proper adjustments improve comfort, avoid injuries, reduce fatigue, and helps maintain the big picture!

Driver:		ID No:			
Date Fit:	Fit By (Initials):	What do I need to change?	How do I change the setting?	Where do I look for the setting?	Highway: setting
					City: setting
Standing Adjustment		Seat Back Angle			<input type="checkbox"/>
		Seat Cushion Anterior Tilt			<input type="checkbox"/>
		Seat Depth			<input type="checkbox"/>
		Seat Slide			<input type="checkbox"/>
		Seat Height			<input type="checkbox"/>
		Seat Cushion Posterior Tilt			<input type="checkbox"/>
		Seat Oscillator			<input type="checkbox"/>
		Arm Rest Height		None	See the back
	Lumbar Support				See the back
		Steering Wheel Depth			<input type="checkbox"/>
Steering Wheel Tilt			None	See the back	
Mirror Adjustment		Finally, once you have correctly positioned yourself in your cab, it is essential that you adjust your mirror to the correct position.			

Note: If the labels on your center steering column become damaged or lost contact your STL for replacement



## Discomfort Surveys

- Initial
- 6 months
- **12 months**

## Discomfort Surveys

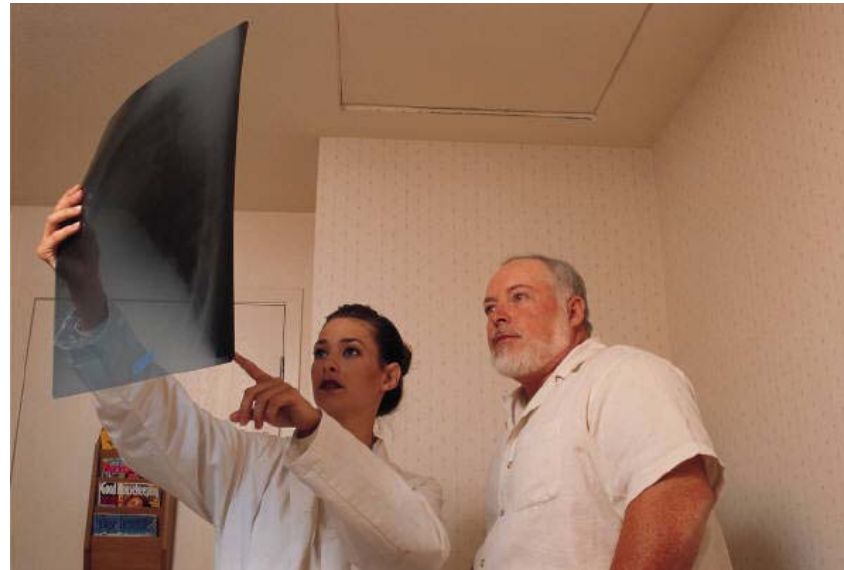
- Identify High Risk Drivers
- Correlative Studies of Risk
  - Job Type
  - Weight
  - Height
  - BMI
  - DOB
  - Hire Date
  - Gender



# The Bottom Line...

**It is about results**

# Implementation Results...



## Drivers Reporting Discomfort

Spring 2005

58%

Fall 2005

31%

Change

-46.55%

# Implementation Results...



## Drivers Reporting **High/Extreme Discomfort**

Spring 2005

22%

Fall 2005

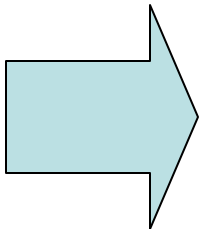
15%

Change

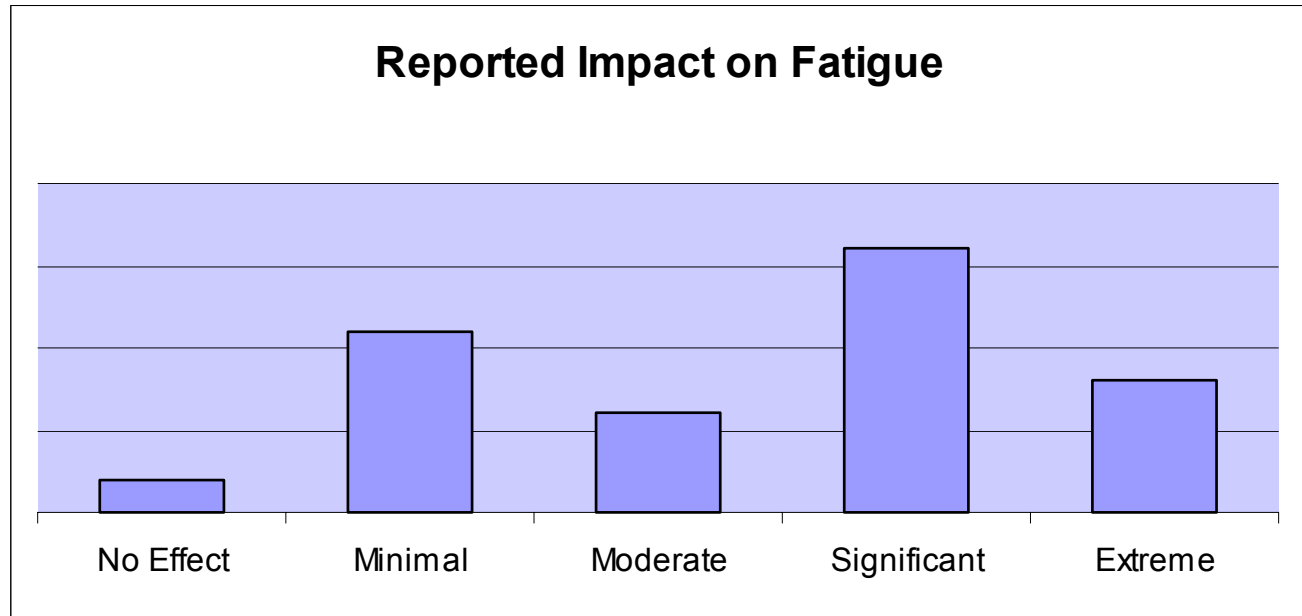
-31.81%

# Results we anticipated...

- Previously taking 2-4 Ibuprofens several times per day, now down to perhaps once or twice in the last 2-3 weeks, it has exceeded my expectations, I was skeptical coming in and now I am a believer, little things can make a big difference. My initial adjustments have been dead on.
- Neck hurts less, more comfort, not fighting the last few hours of the day, far less slouching, no more swelling in ankles
- Great for team drivers, help learning to drive, more comfortable now, used to take 1-1.5 hours to find a comfort zone, not it is automatic
- Good visual aid to remind me. Higher awareness of discomfort and my ability to control it.

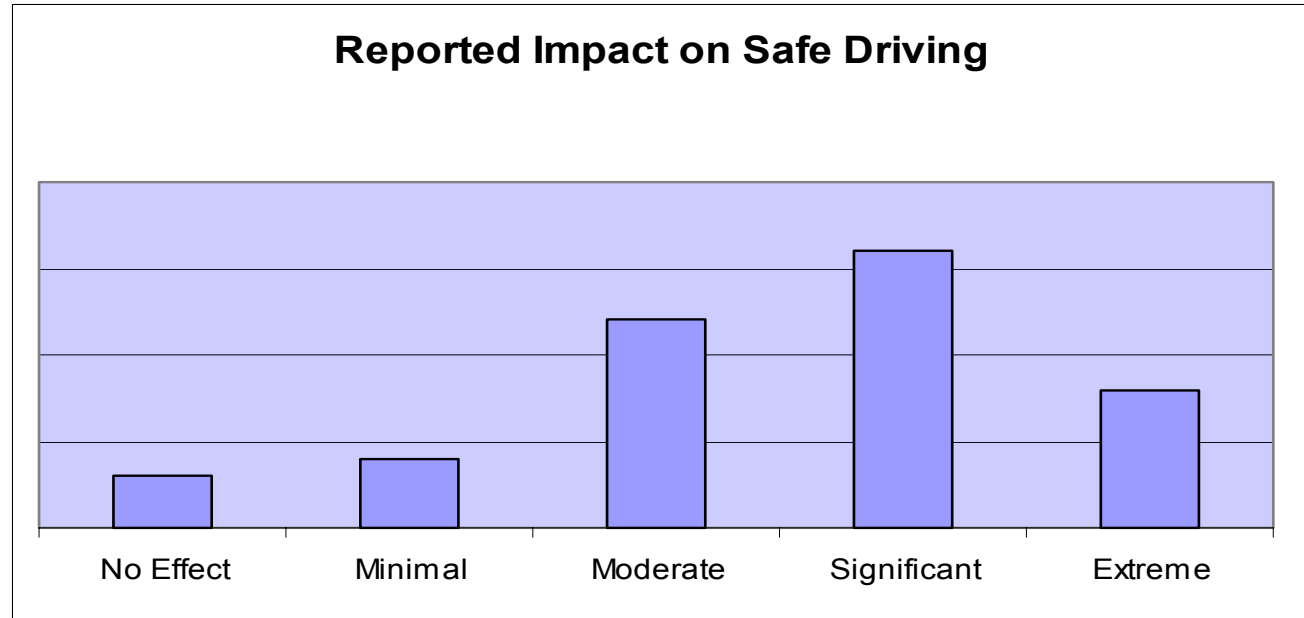


# Unanticipated results...



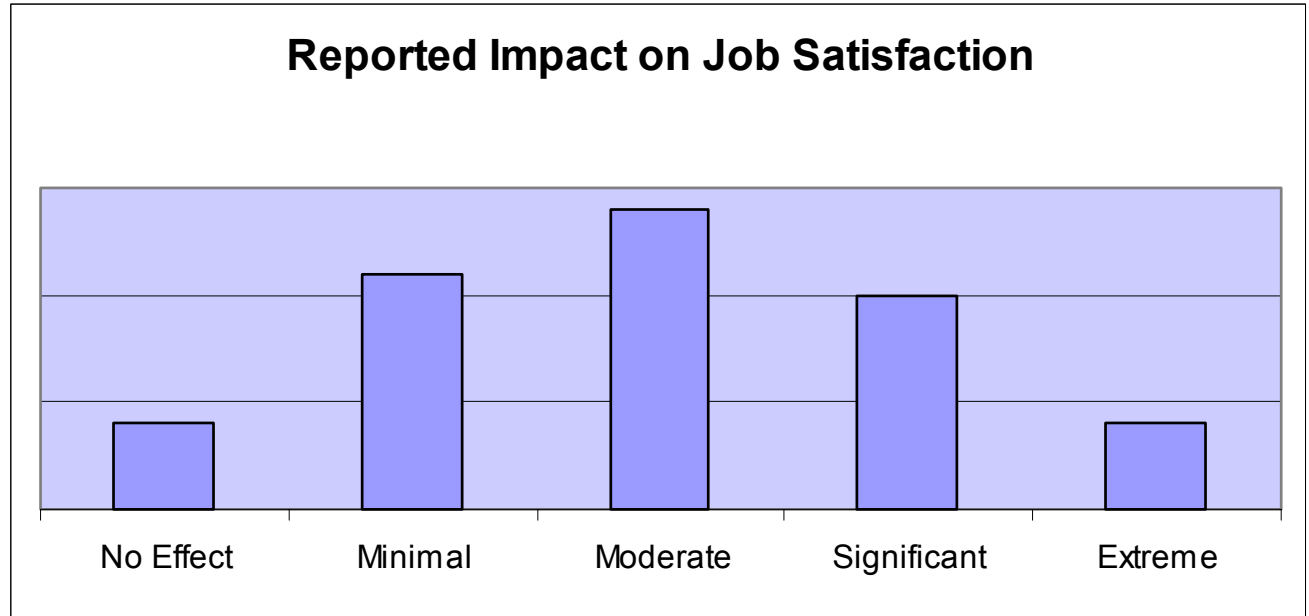
- 70% of this population noted that the improvement ranged from Moderate → Extreme

# Unanticipated results...



- 84% of this population noted that the improvement ranged from Moderate → Extreme

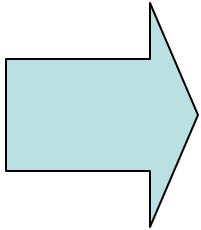
# Unanticipated results...



- 65% of this population noted that the improvement ranged from Moderate → Extreme

# Unanticipated results...

- I know where to position myself to minimize fatigue and stress; this would have been very helpful a year ago when I came out of training school
- I am able to sit here without my shoulder hurting and I am more alert on the road
- This is a good tool for new drivers; I have less fatigue and my awareness is up
- My fatigue is down and so is my pain over time; I have improved awareness



## Schneider Expected Impact

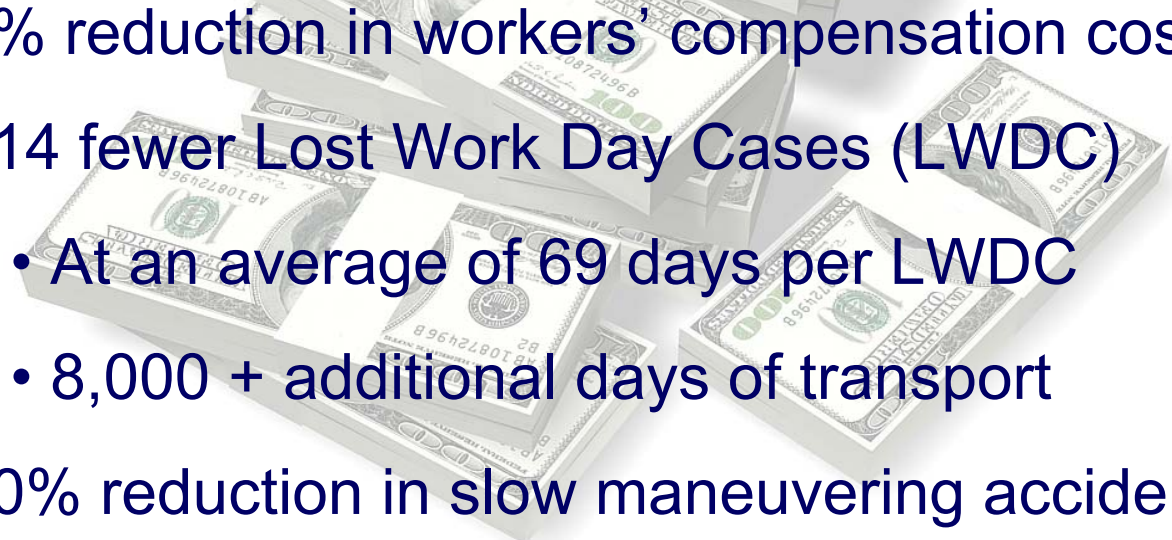
- Reduced costs associated with injuries
- Reduced accidents
- Reduced driver turnover



It is about dollars...

## Schneider 2005 Impact

(6 months of implementation)

- 
- A 3D rendering of several stacks of US dollar bills, including \$100 and \$20 bills, scattered across the center of the slide. The bills are shown in various orientations, some standing upright and others lying flat, creating a sense of depth and abundance.
- 9% reduction in workers' compensation costs
  - 114 fewer Lost Work Day Cases (LWDC)
    - At an average of 69 days per LWDC
    - 8,000 + additional days of transport
  - 30% reduction in slow maneuvering accidents
  - Bottom-line: favorable ROI in only 6 months



**It is about dollars...**



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