Evaluating PostureCoach During Patient Handling Transfers In Student Nurses

CRE-MSD Webinar: Apps supporting safe back care

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Toronto Rehab
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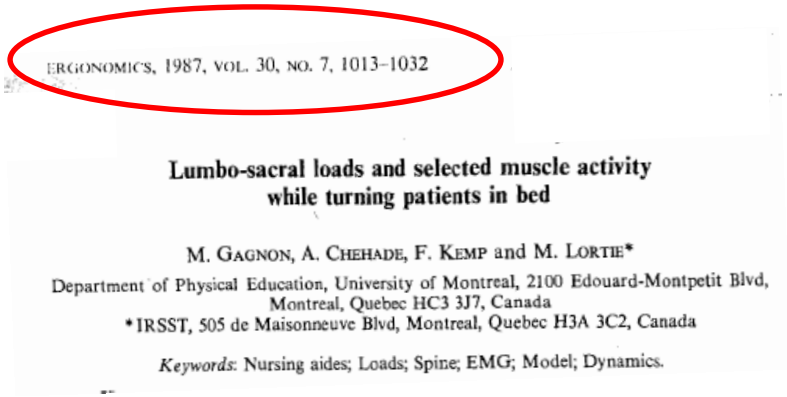
INTRODUCTION

- **37%** of Canadian nurses experience pain **serious enough to affect** normal daily activities (Statistics Canada, 2005)
- Patient handling linked to the high incidence of LBP in nurses

- Risk factors:
  - Low staffing ratios
  - Tight spaces (Village et al., 2005)
  - Bed height (Smith et al., 2011)
  - Patient's shape, deformities, level of fatigue, cognitive functioning, cooperation
  - Nurse's physical impairments or lower limb function, balance and coordination (Miller et al., 2006)

HISTORICAL PERSPECTIVE



ERGONOMICS, 1987, VOL. 30, NO. 7, 1013–1032

Lumbo-sacral loads and selected muscle activity while turning patients in bed

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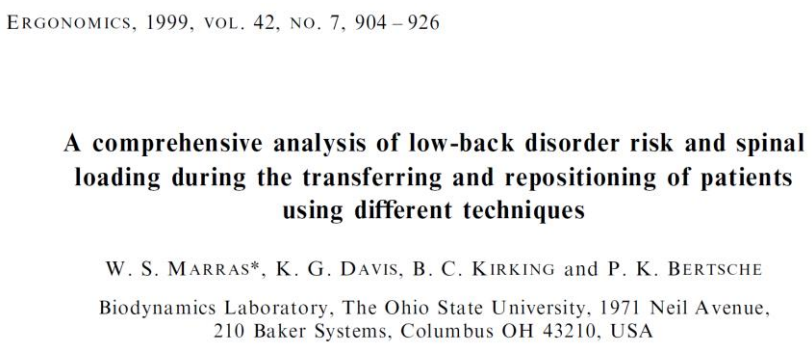
Keywords: Nursing aides; Loads; Spine; EMG; Model; Dynamics.



ERGONOMICS, 1999, VOL. 42, NO. 7, 904 – 926

A comprehensive analysis of low-back disorder risk and spinal loading during the transferring and repositioning of patients using different techniques

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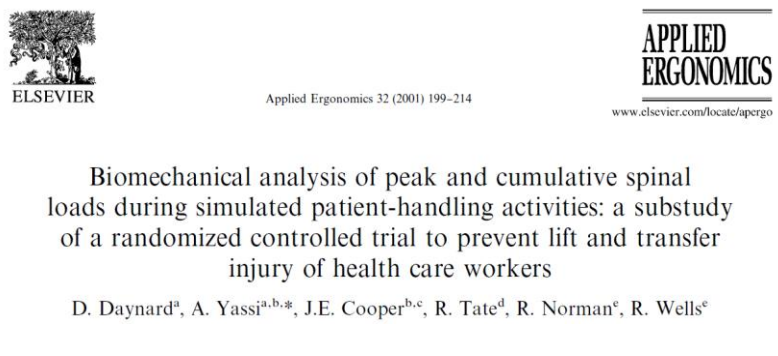


ELSEVIER

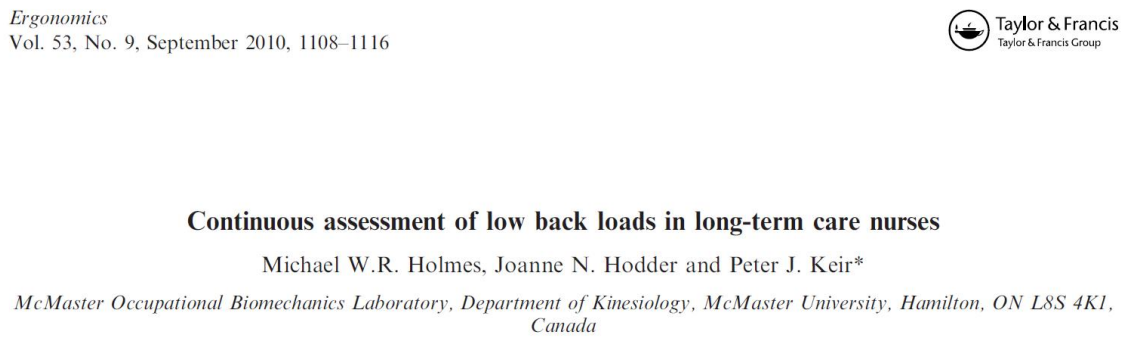
Applied Ergonomics 32 (2001) 199–214

APPLIED ERGONOMICS

www.elsevier.com/locate/apergo

Biomechanical analysis of peak and cumulative spinal loads during simulated patient-handling activities: a substudy of a randomized controlled trial to prevent lift and transfer injury of health care workers

D. Daynard[a], A. Yassi[a,b,*], J.E. Cooper[b,c], R. Tate[d], R. Norman[e], R. Wells[e]



Ergonomics
Vol. 53, No. 9, September 2010, 1108–1116

Taylor & Francis
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Continuous assessment of low back loads in long-term care nurses

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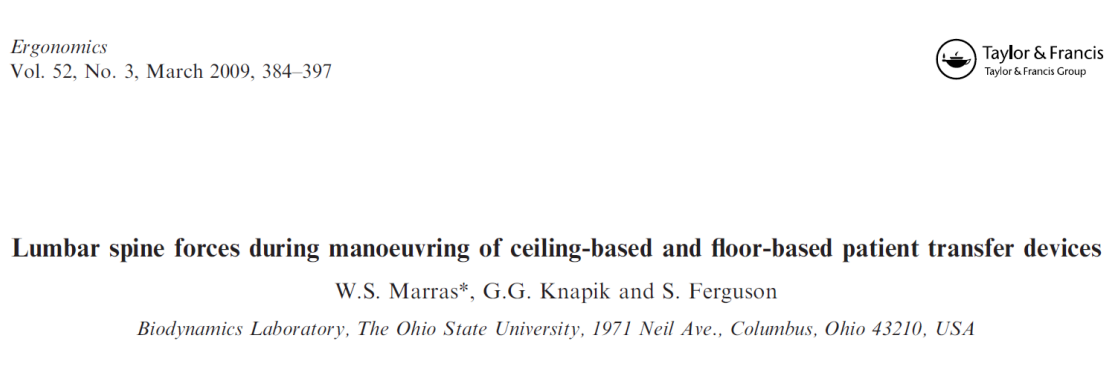

Ergonomics
Vol. 52, No. 3, March 2009, 384–397

Taylor & Francis
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Lumbar spine forces during manoeuvring of ceiling-based and floor-based patient transfer devices

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Take home:

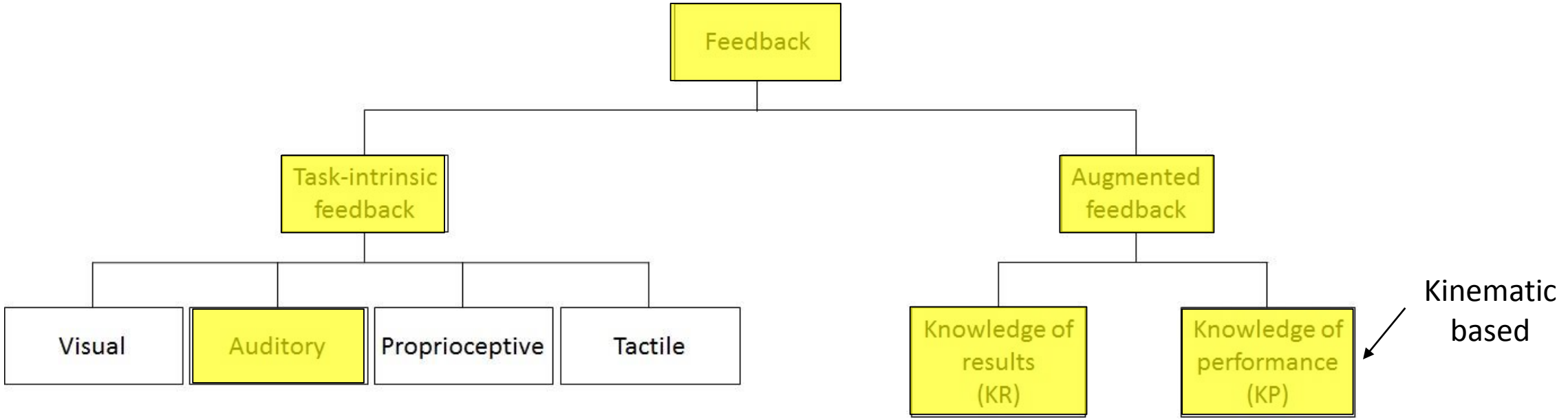
- High spine loads during patient handling
- Mechanical patient handling devices have been a major focus of injury prevention efforts
  - Drawbacks include time requirement and less productivity (Keir & MacDonell, 2003)

INTERVENTION STRATEGIES?

- Awareness of physical demands associated with caregiving have been well established. Numerous intervention strategies have been implemented:
  1) Education and training (Huang et al., 2012; Hinton, 2010; Hodder et al., 2010; Jaromi et al., 2012)
  2) Equipment evaluation/design (Smith et al., 2011)
     - Mechanical lifts evaluated (Zhuang et al., 1999; Santaguida et al., 2005; Pellino et al., 2006)
  3) Work environments redesigned (Nelson et al., 2003)
  4) Policies and procedures reviewed (Dawson et al., 2007)
     - Multi-dimensional interventions may be a better solution
  5) Workplace inspections (Grant et al., 2017)
  6) Feedback during lifting (Lavender, 2000)
  7) …….

Despite these approaches, injury rates remain high in the profession…

Using Feedback for Motor Learning



Effective feedback program → permanent improvement/ retention

Using Feedback for Motor Learning

- Lavender (2000)
  - Concurrent feedback and coaching during lifting task
  - First condition = graphical; second = audible; third = none
  - Side-bending moments reduced the most
  - Marginal reductions in twisting and forward bending

- Belbeck et al. (2014)
  - Shoulder musculature examined during 5 handling tasks
  - Training protocol consisted of graphical and verbal instructions
  - Sit-to-chair and turn toward tasks were most demanding
  - Reduction in RPE for shoulder and low back following training

NEXT STEPS?

- Knowledge and practice gaps must be identified (van Wyk et al., 2010)
  - Gap in the training approaches between student nurses and staff nurses
  - Address both academic and clinical environments and training provided

- Experienced nurses may develop lifting techniques over time
  - Might be good, Might be bad!
  - Therefore, we think **nursing students** should be the focus

PURPOSE

- There has been a large focus on quantifying spine loads during patient handling and implementation of back injury prevention programs
- Nursing students receive little training on proper safe handling techniques

To explore the use of feedback (posture coaching) to improve patient handling techniques in a student nurse population

Can a simulation-based educational practice and feedback session in a **student-nursing population** improve lifting techniques?

METHODS

Participants.

Protocol.

Instrumentation.

METHODS

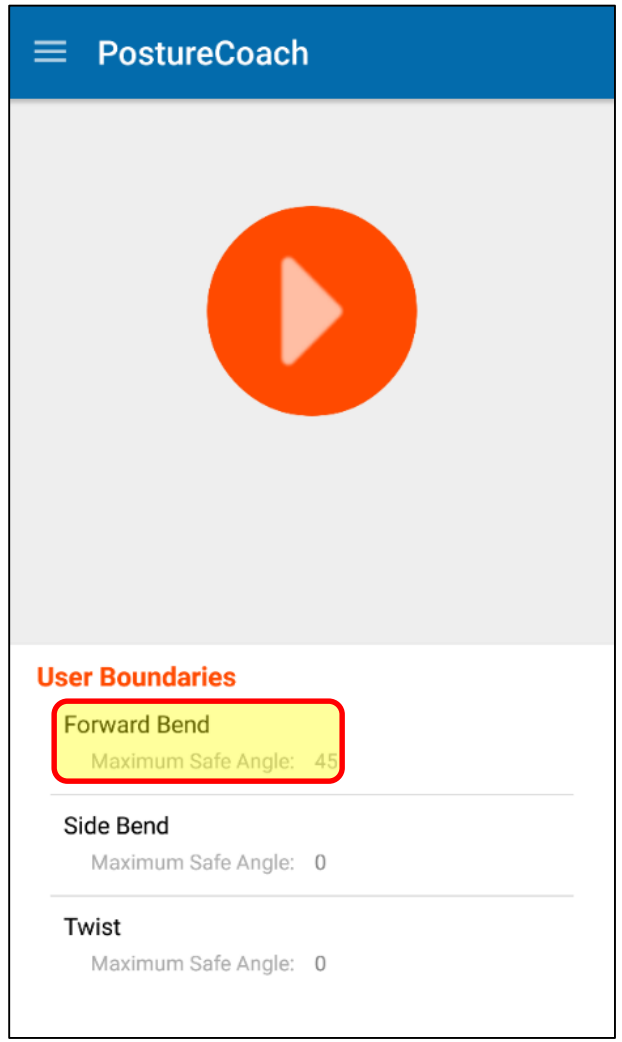
- Participants
  - 10 female nursing students (age: 26.1 ± 9.1 years; height: 166.2 ± 7.7 cm; weight: 61.7 ± 13.5 kg)
  - 2.2 ± 1.2 years into a 4 year program

- 3D kinematics of the thorax and pelvis tracked via **2 methods**:
  - 2 accelerometer-based sensors (Shimmer, Dublin, Ireland)
  - 2 rigid bodies for motion capture cameras (3D Investigator, NDI, Waterloo, Ontario, Canada)
    - Rigid bodies placed on top of shimmers

METHODS – POSTURECOACH

- Accelerometer sensors (Shimmer, Dublin, Ireland)
  - Connected via Bluetooth to an Android smartphone

- PostureCoach application (Toronto Rehabilitation Institute)
  - Provided real-time trunk angles
  - Haptic/auditory feedback



Methods – Motion Capture

- Custom-molded rigid bodies with infrared light emitting markers
  - Placed posteriorly on pelvis (L5-S1) and thorax (T3-T4)

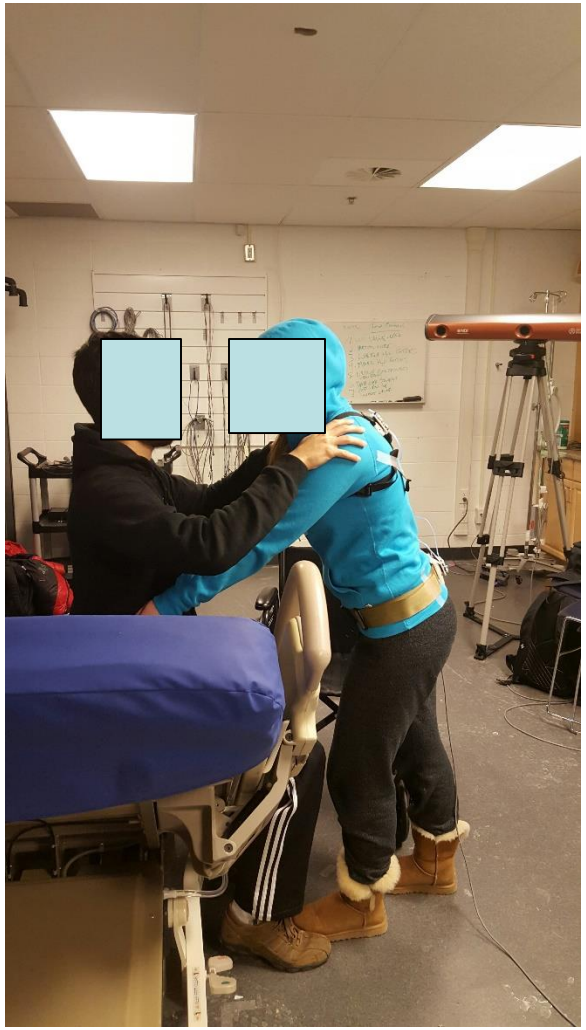
- Kinematics (3D Investigator, Northern Digital Inc., Waterloo, ON, Canada)

Methods – Data Collection

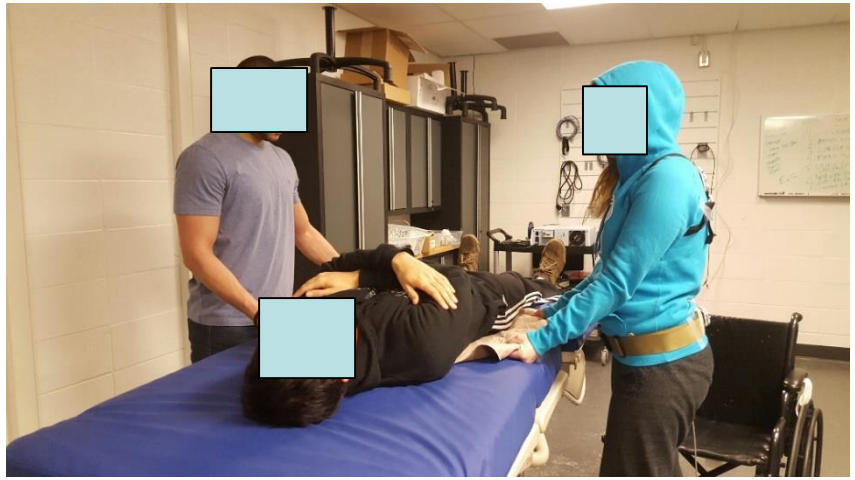
- Participants performed 3 different patient transfers
- Mock-patient: Male, 73.5 kg, 187.96 cm

Task 1: Sling Under

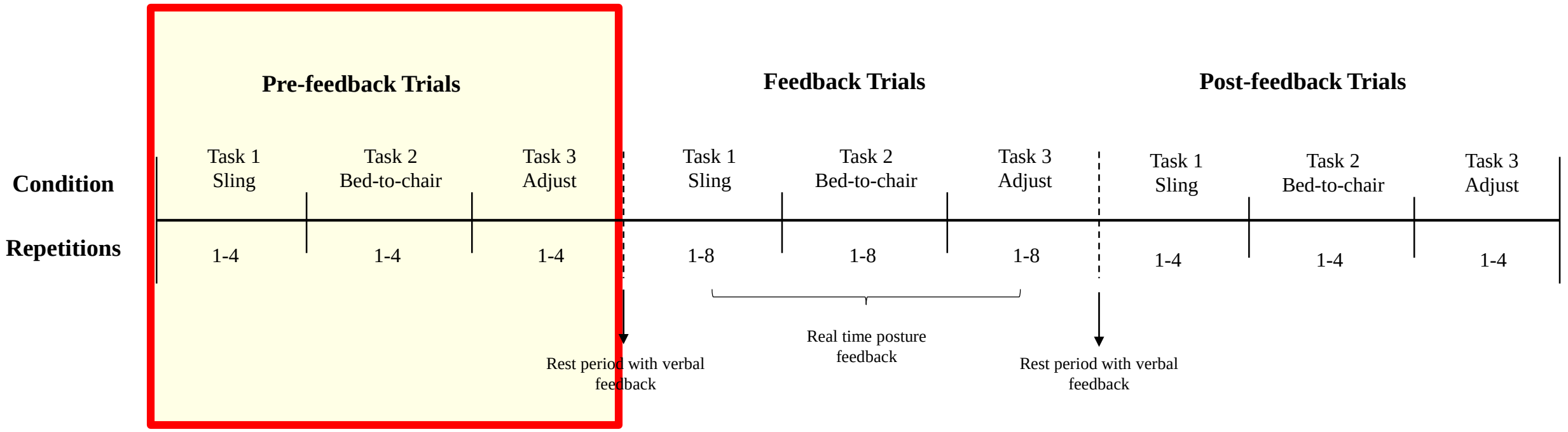
Task 2: Bed-to-chair



Task 3: Reposition (adjustment)



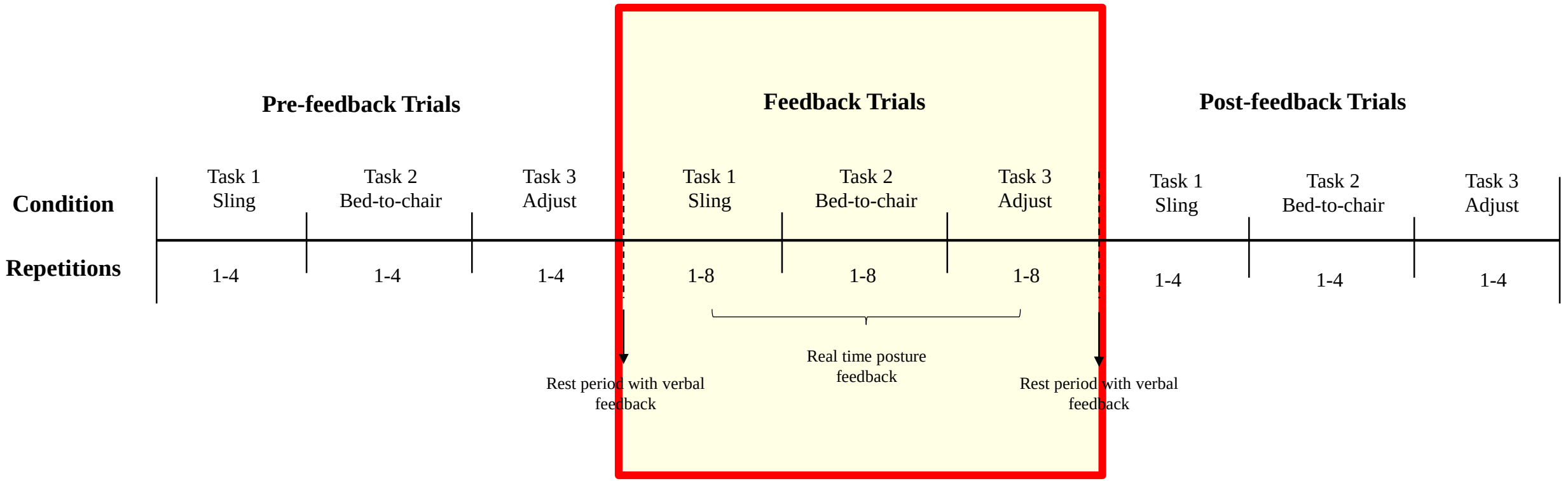
METHODS – DATA COLLECTION



Rest given after completion of every task

No PostureCoach feedback

METHODS – DATA COLLECTION

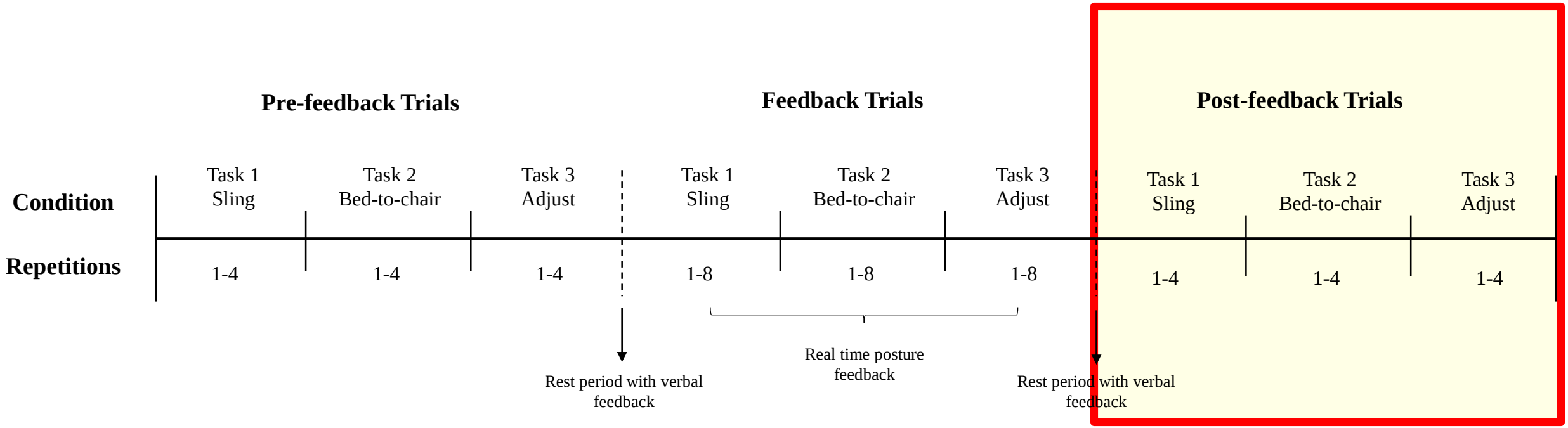


Rest given after completion of every task

PostureCoach during each rep

Feedback was enforced between repetitions

METHODS – DATA COLLECTION



Rest given after completion of every task

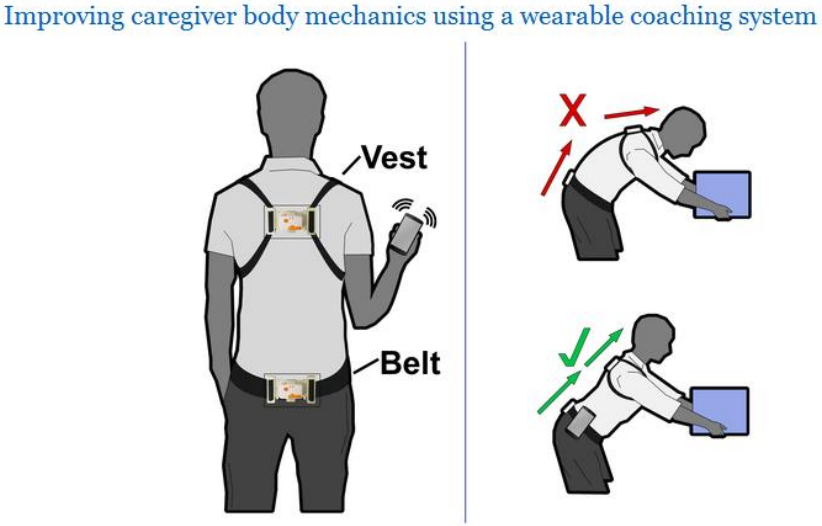
No PostureCoach feedback

Methods – Feedback Intervention

- Following “pre” trials, a certified personal trainer and ergonomics student discussed “proper lifting mechanics” with participant

- Nurses found to be between 20° and 45° for 18%-28% of their work day (Schall et al. 2016; Santaguida et al., 2005)

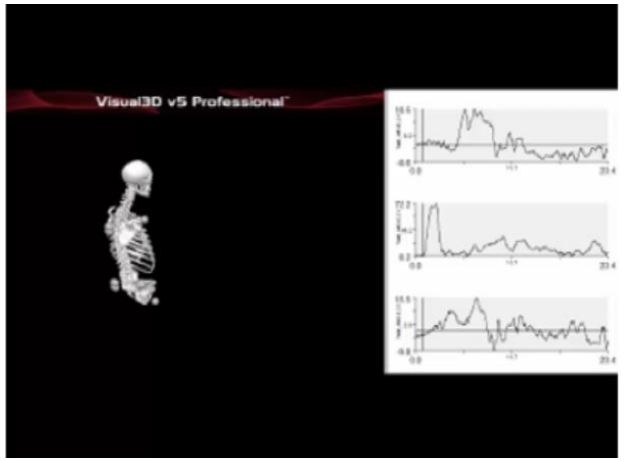
- Feedback given during each trial as both verbal and auditory (**45° trunk flexion threshold in PostureCoach**)
  - Verbal cues: keep patient close, straighten back, use legs, etc.

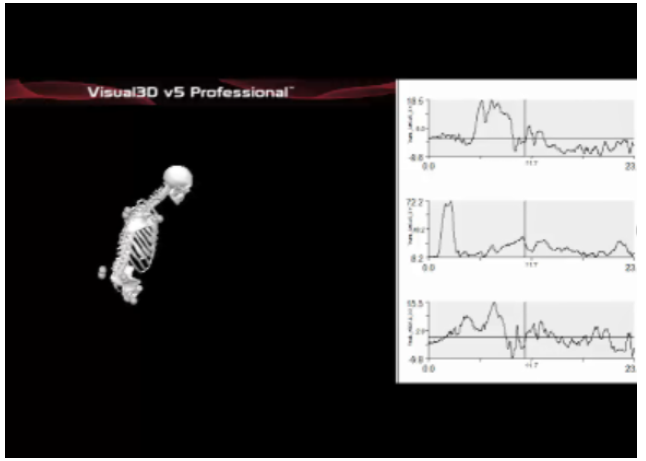


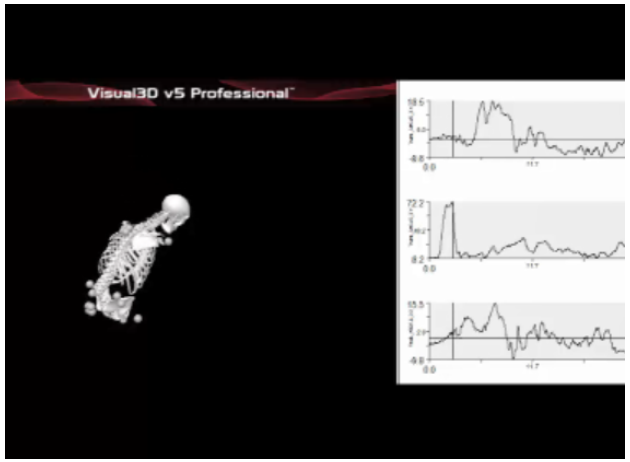
PostureCoach - https://trihomeandcommunity.com/projects/posturecoach/

METHODS – DATA ANALYSIS

- Trunk angles calculated as thorax relative to pelvis
- Calculation of trunk velocity and acceleration
- Average of all “pre” trials compared to average of all “post” trials



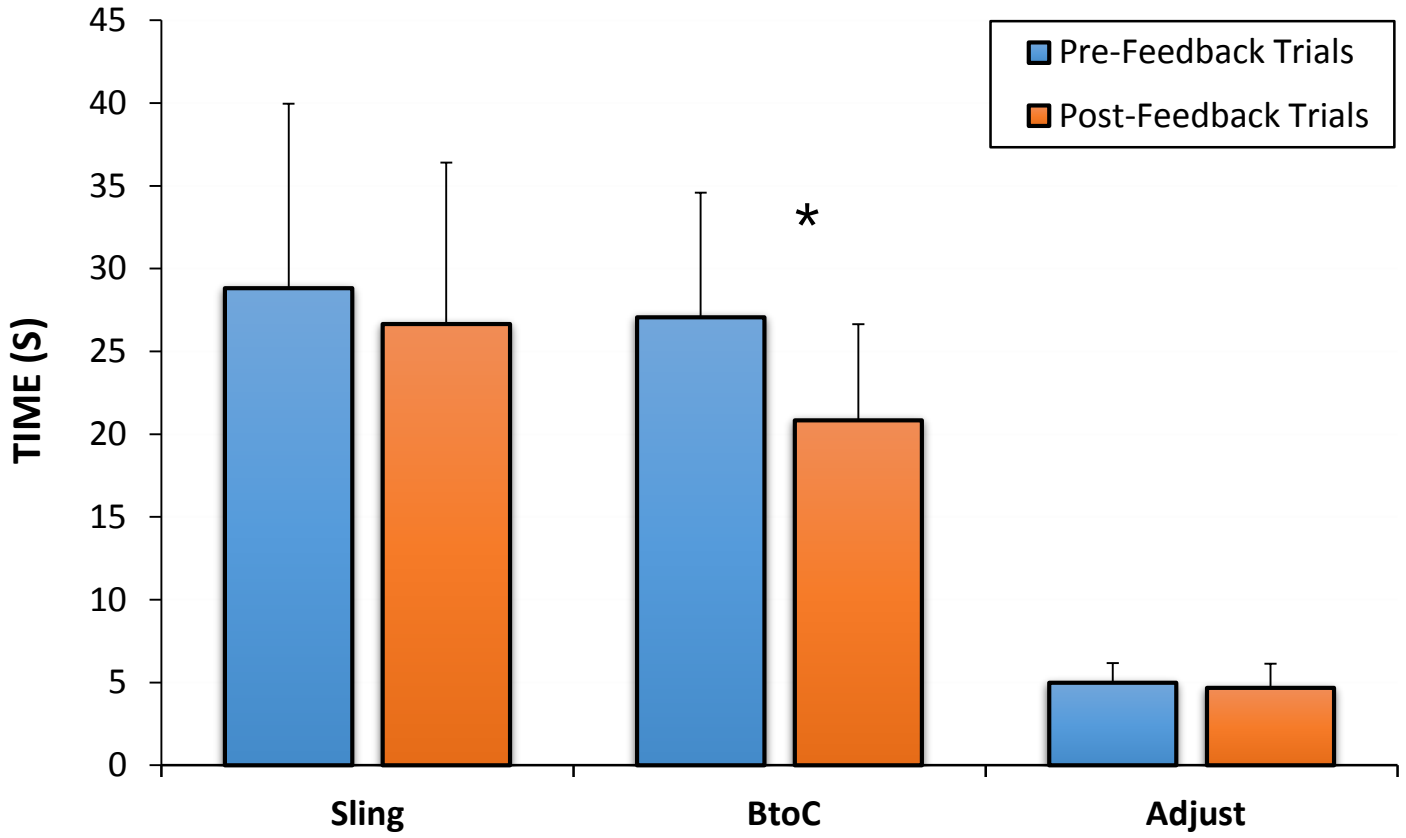




RESULTS

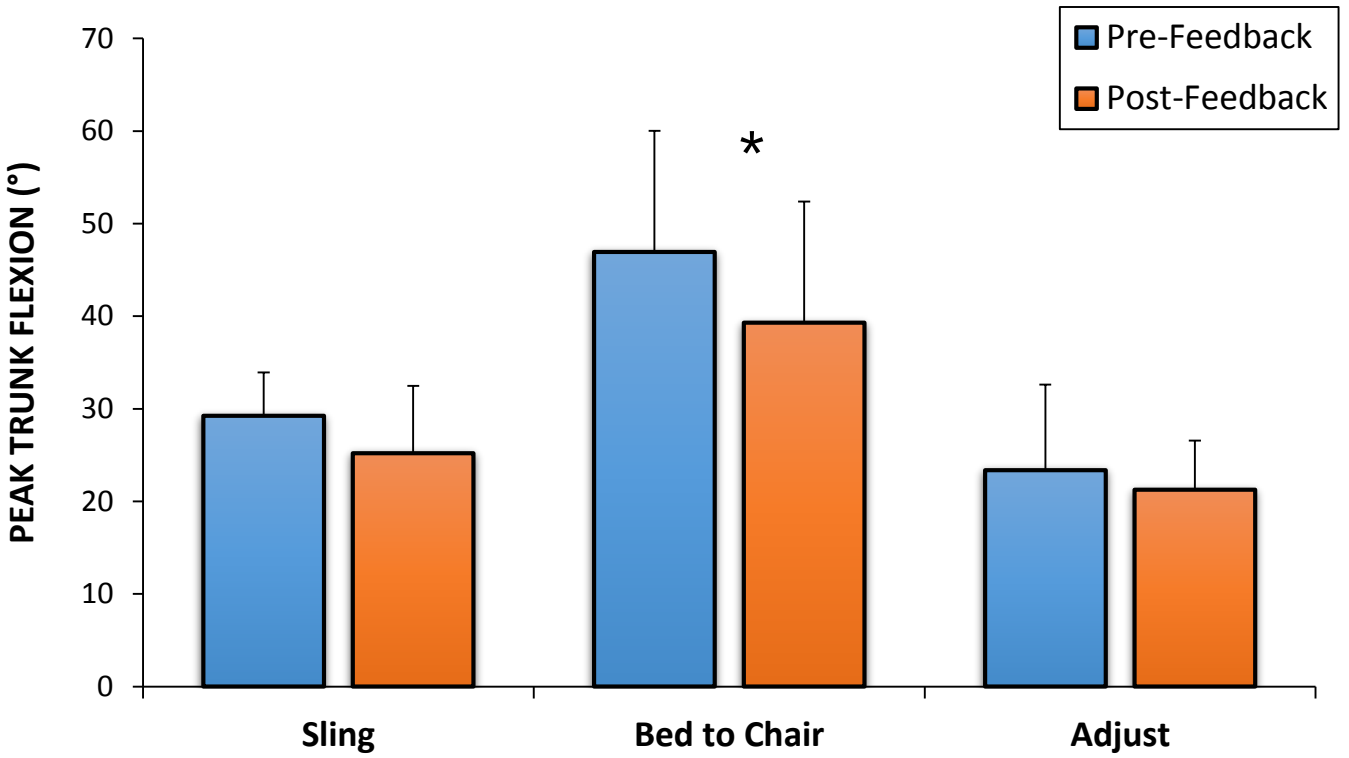
Angle.
Velocity.
Acceleration.

RESULTS – TIME TO COMPLETE EACH TASK



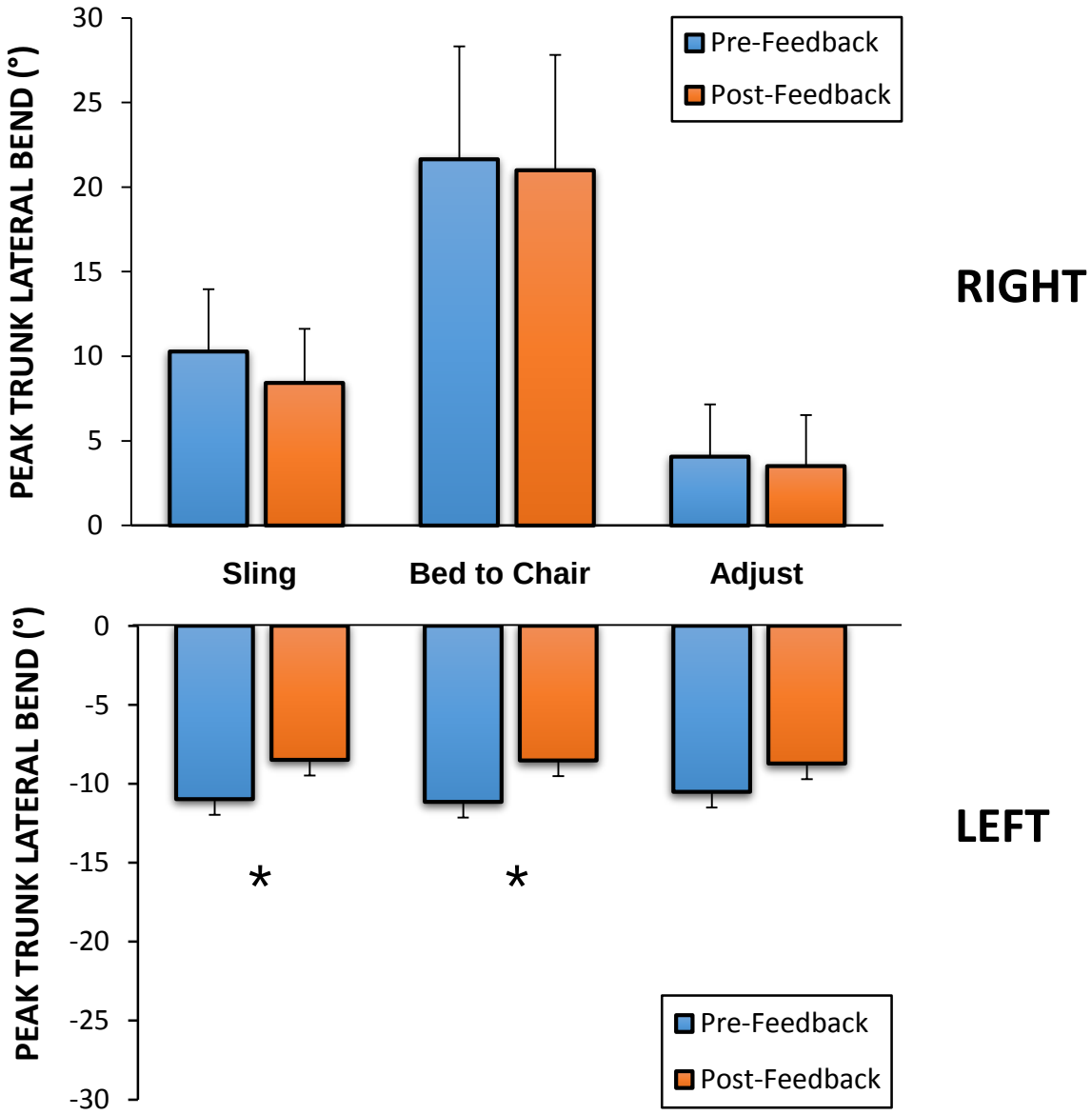
- The largest decrease found in the **bed to chair task**
  - **6.2 ± 4.4 s** reduction in task completion time
  - Sling task decreased by 3.6 ± 2.5 s

RESULTS – TRUNK FLEXION



- The largest decrease found in the **bed to chair task**
  - **8.0 ± 0.8°** reduction in trunk flexion
  - Sling under → 3.7 ± 1.6° decrease
  - Patient adjustment → 2.3 ± 3.0° decrease

RESULTS – TRUNK LATERAL BEND

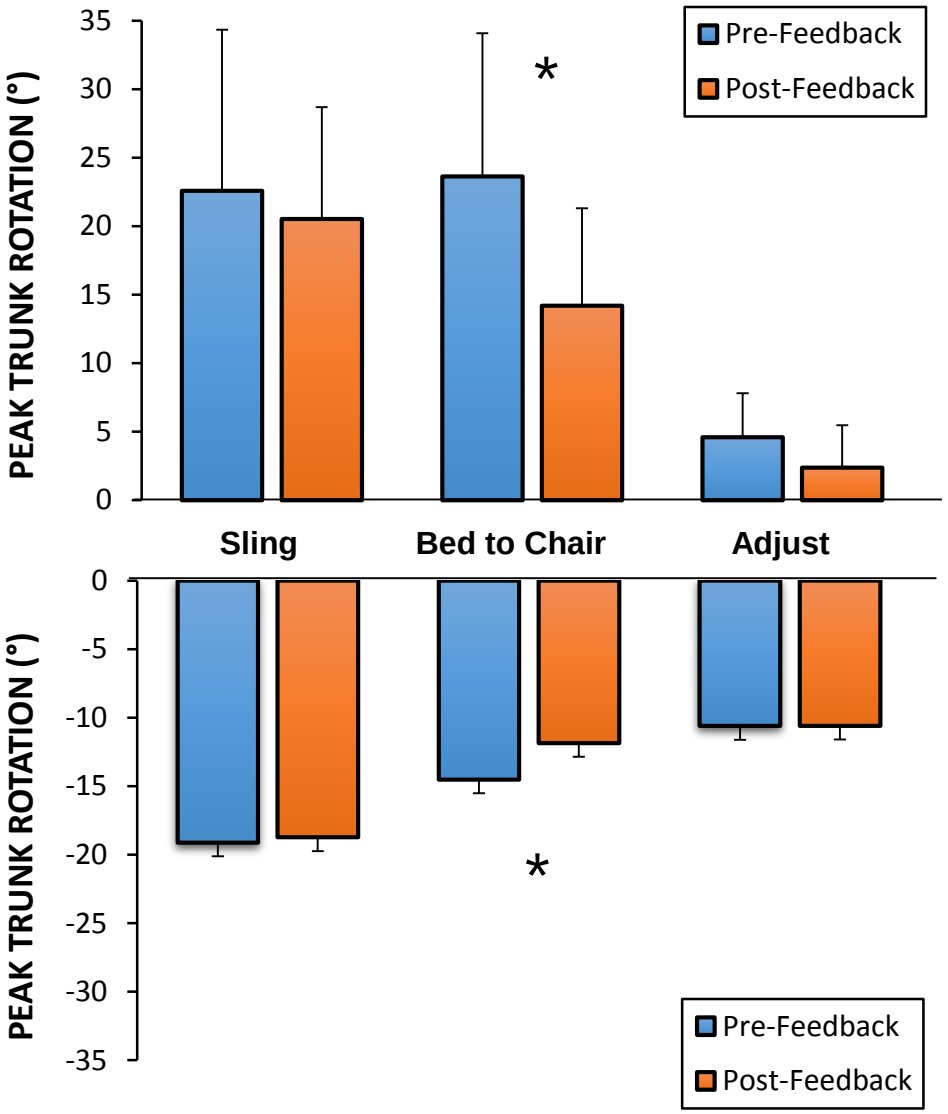


Minor reduction in lateral bend (both directions)

Sling under → **2.5 ± 0.1°** reduction

Bed to chair → **2.6 ± 1.5°** reduction

RESULTS – TRUNK ROTATION



LEFT

RIGHT

Largest reduction found in the bed to chair condition with a **9.4 ± 2.4°** reduction in trunk rotation to the left

RESULTS – TRUNK VELOCITY

		Trunk Velocity (°/s)					
		Flexion	Extension	Lateral Bend (right)	Lateral Bend (left)	Rotation (right)	Rotation (left)
Condition							
Task 1							
	Pre	53.4 (8.8)	-55.9 (12.3)	38.5 (8.1)	-43.9 (12.1)	66.0 (13.9)	-65.8 (20.3)
	Post	62.2 (12.8)	-50.4 (13.2)	46.3 (9.8)	-44.2 (7.9)	67.7 (29.1)	-71.8 (26.2)
Task 2							
	Pre	61.1 (8.0)*	-69.5 (11.9)*	58.8 (10.7)*	-69.2 (15.3)*	62.5 (14.9)*	-64.0 (9.3)*
	Post	51.2 (12.5)	-50.9 (16.2)	46.9 (7.1)	-49.8 (7.3)	45.5 (8.4)	-52.0 (11.6)
Task 3							
	Pre	35.9 (10.1)	-39.1 (10.3)	34.4 (9.5)	-38.1 (8.5)	41.2 (7.2)	-38.7 (11.0)
	Post	39.6 (9.6)	-43.3 (18.1)	37.8 (8.1)	-34.6 (7.7)	39.3 (13.1)	-39.0 (15.7)

Note: Task 2 = bed-to-chair; * = significant pre-post difference

RESULTS – TRUNK ACCELERATION

		Trunk Acceleration (°/s²)					
		Flexion	Extension	Lateral Bend (right)	Lateral Bend (left)	Rotation (right)	Rotation (left)
Condition							
Task 1							
	Pre	1112 (292)	-1076 (414)	936 (478)	-749 (199)	1111 (405)	-1107 (454)
	Post	1343 (667)	-1236 (593)	858 (391)	-807 (257)	1161 (481)	-1100 (540)
Task 2							
	Pre	3302 (841)*	-3130 (904)*	3106 (905)*	-3042 (926)*	2687 (1051)*	-2611 (835)*
	Post	1754 (786)	-2109 (1009)	1917 (960)	-1569 (661)	1499 (849)	-1214 (834)
Task 3							
	Pre	1150 (740)	-1156 (713)	894 (614)	-812 (416)	902 (627)	-927 (615)
	Post	1105 (588)	-1253 (844)	646 (147)	-653 (154)	753 (300)	-792 (345)

Note: Task 2 = bed-to-chair; * = significant pre-post difference

DISCUSSION

- Feedback during patient handling tasks can have a positive effect on lifting behaviors. *A single feedback intervention session* reduced trunk angle, velocity and acceleration in a student nurse population

- The largest reductions were found in the bed to chair condition with an **8.0 ± 0.8°** reduction in trunk flexion and a **9.4 ± 2.4°** reduction in trunk rotation

- Although not significant, trunk flexion angles were reduced for the sling and adjust tasks

DISCUSSION

- No optimal lifting technique that universally fits all individuals

- Our intervention demonstrated small changes in peak trunk flexion
  - Given that posture greatly influences cumulative spine loading in patient handling (Holmes et al., 2010), **8-10°** changes in trunk posture suggest a more upright and neutral posture that could aid in the reduction of cumulative spine loads and musculoskeletal injury

Discussion – Trunk velocity

- Peak velocity showed significant decreases in the post-feedback session throughout all dependent measures

- Peak trunk rotation velocity above 38.0, 48.5 and 49.7 °/s are considered normative **low, medium and high risk** of MSDs, respectively (Marras et al., 1995)

- We demonstrated peak trunk rotation velocity of **62.5 ± 14.8 °/s** during pre-feedback and **45.5 ± 8.4 °/s** during post-feedback trials for the bed to chair task

DISCUSSION – CONCLUDING REMARKS

- The intervention decreased trunk velocity and acceleration, yet time to complete each task was also reduced
  - Suggest a more efficient movement strategy was used following feedback
  - Participants took less time to complete the bed-to-chair task, while also effectively changing body mechanics

- Participants were already comfortable with patient handling tasks (**2.2 ± 1.2 years of experience**) before the investigation
  - Results likely a consequence of the intervention trials (i.e. no learning effect)

DISCUSSION – CONCLUDING REMARKS

- Biomechanical evaluation and lift training can be effective for improving movement strategies. Many factors affect compliance with a patient handling program
  - Even with mandatory policy, student nurses need a proper lift culture and role models (Cornish & Jones, 2010)
  - For patient handling training and educational programs to be effective, there needs to be a top down organizational approach that emphasizes safety and lift culture

- Future work will include:
  - Long term retention of feedback (and training)
  - Novice (1st year) vs. Experienced (4th year) student nurses
  - More than eight repetitions during a feedback intervention

THANK YOU!

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