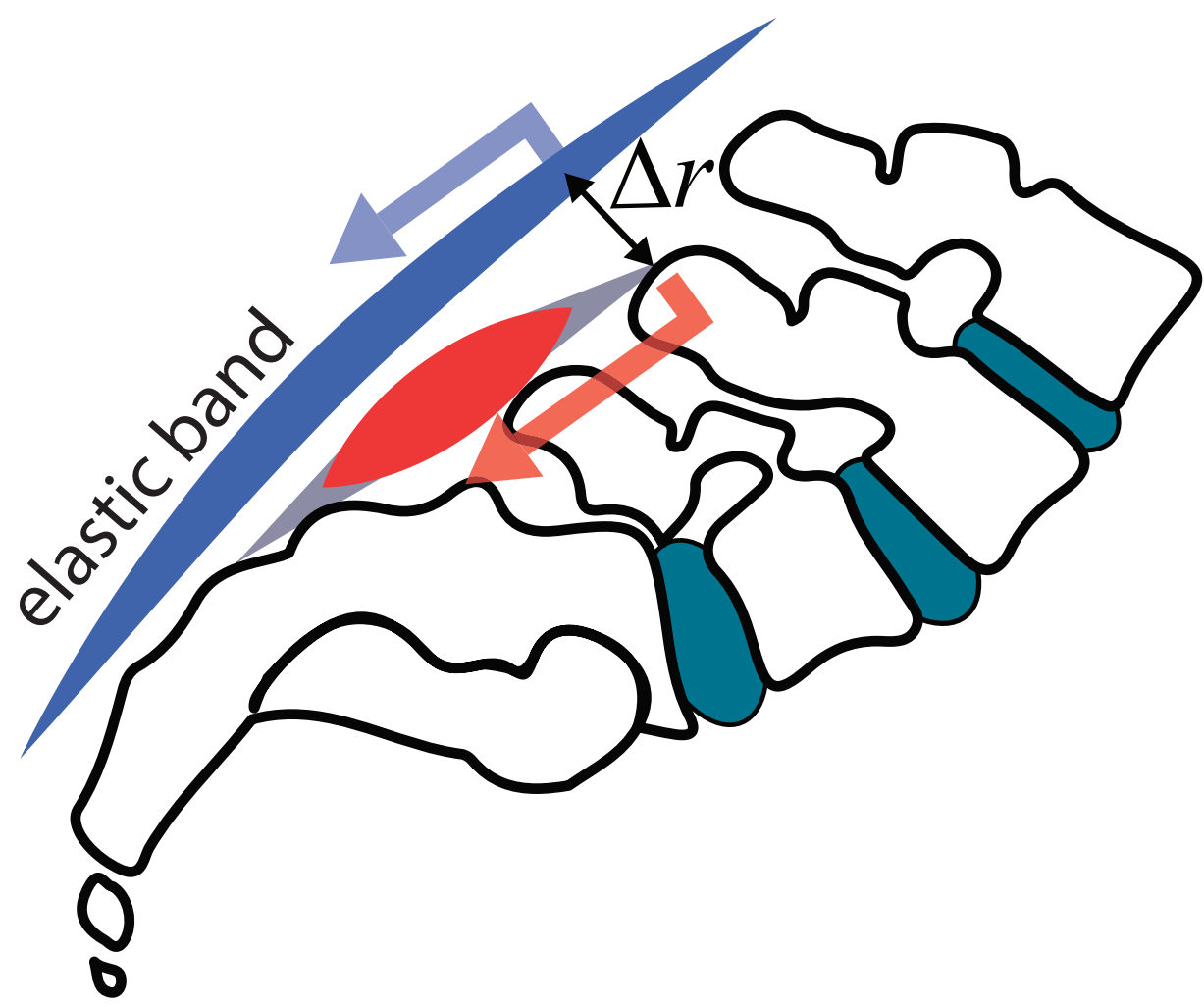


Biomechanically-Assistive Garment Offloads Low Back During Lifting & Leaning Tasks

Erik P. Lamers, Aaron J. Yang,
Karl E. Zelik, Vanderbilt Univ.

Fits Like Clothes, Acts Like Exoskeleton

How It Offloads Low Back



Elastic band:

- Stretches during leaning & lifting
- Offloads lumbar extensors
- Extends moment arm relative to muscle (Δr), reducing low back loading

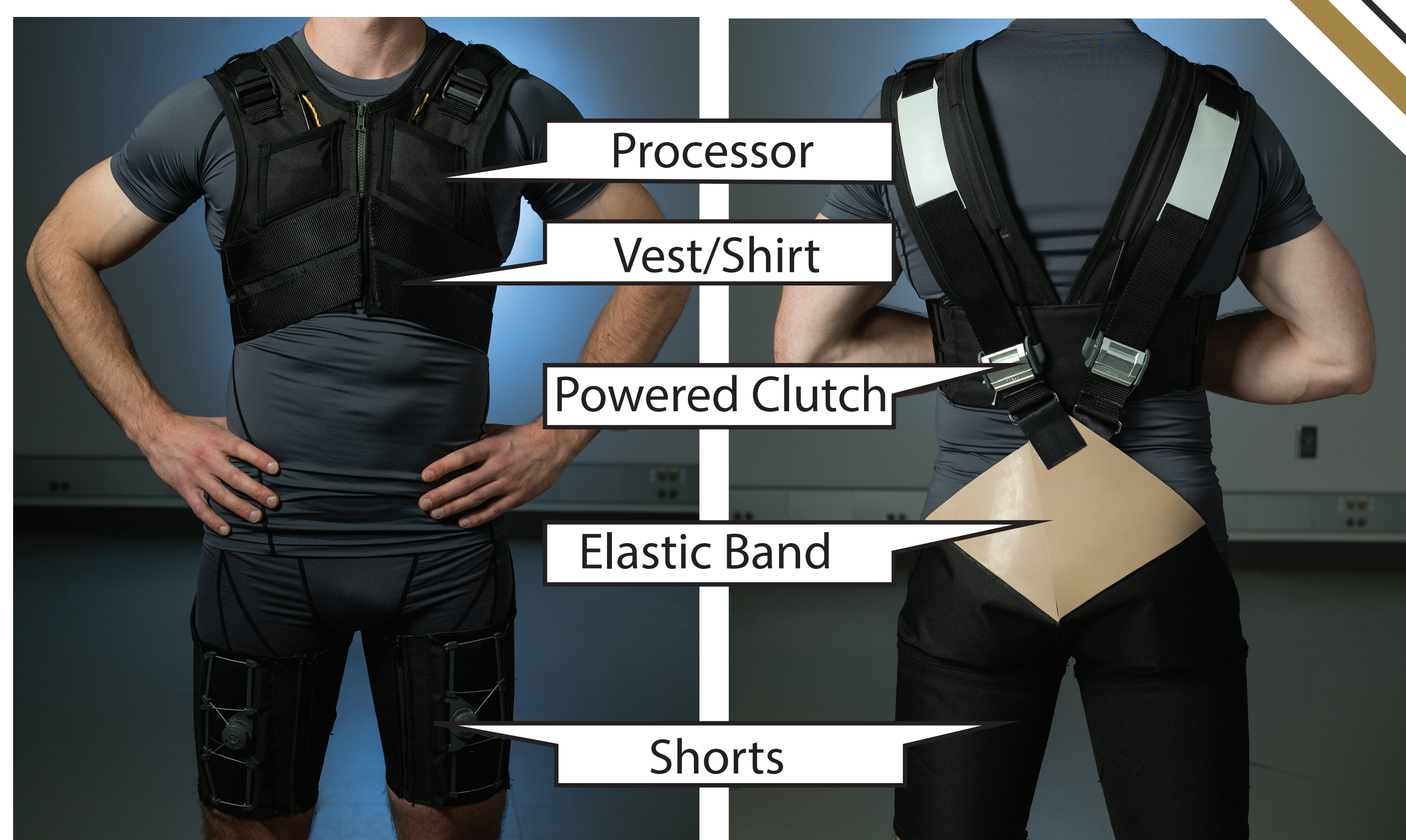
Motivation for Design

- Back belts don't work [Steffens et al. 2016]
- Industrial exoskeletons are too bulky & expensive for average person
- Lack of preventative solutions for non-industrial users (e.g. nurses, package handlers, caregivers, office workers, etc.)

Societal Problem Addressed

- 60-85% of adults will experience low back pain [Hoy et al. 2010]
- Repeated & elevated low back loading, such as occurs during leaning & lifting, increases risk of low back injury & pain [Heneweer et al. 2011]

Assistive Garment Prototype



Powered Clutch

Vest/Shirt

Processor

EMG Control

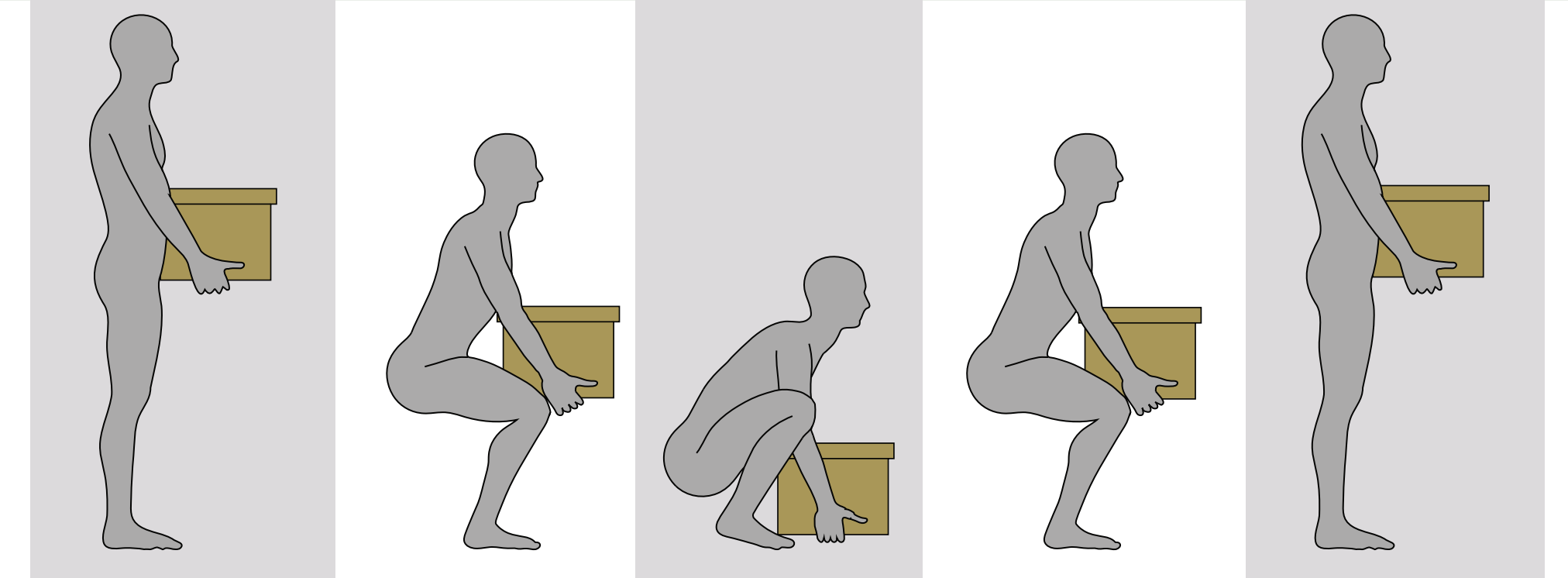
Elastic Band

Shorts

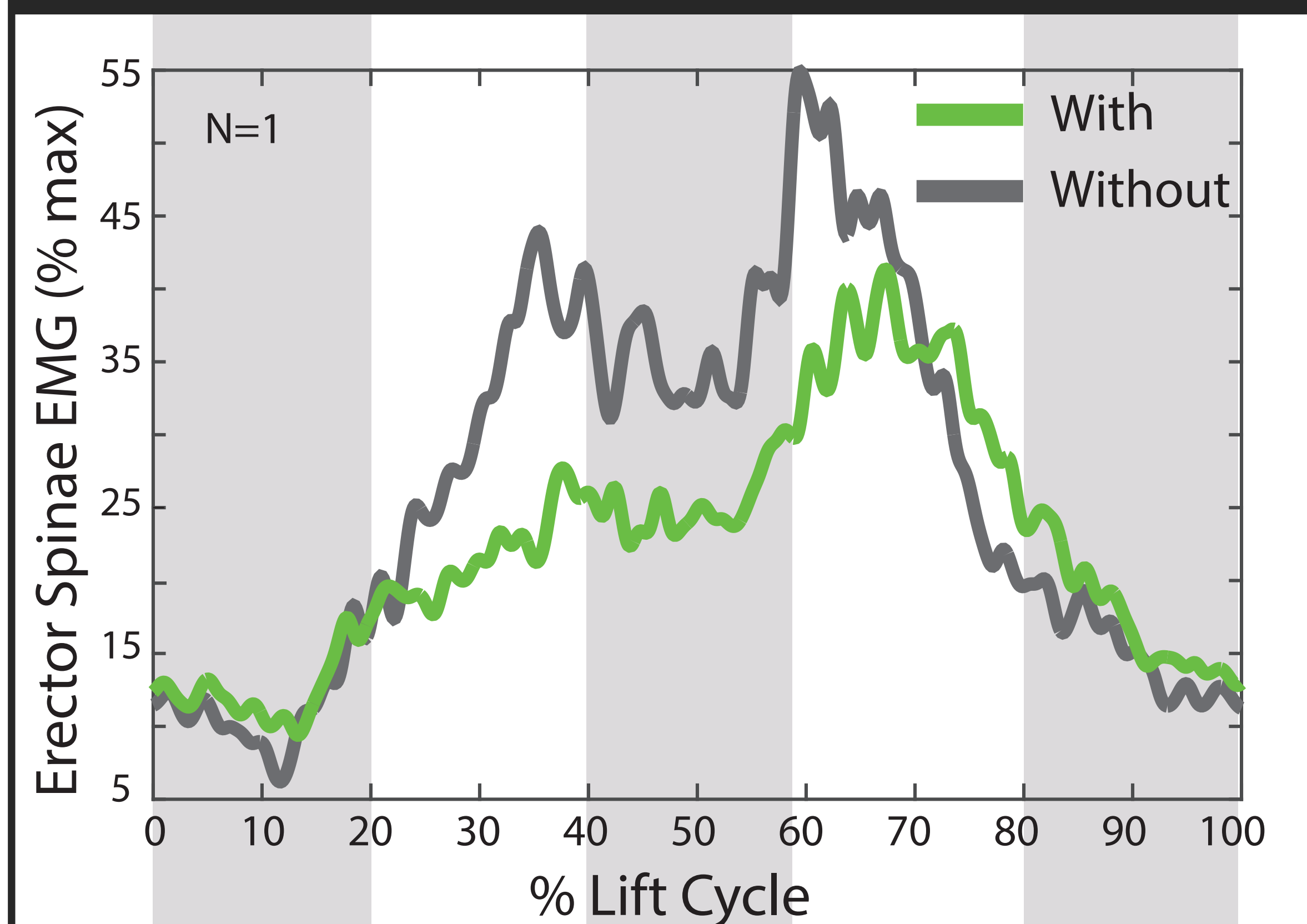
How It's Controlled

Elastic band can be engaged (clutched) or disengaged (unclutched) by smartphone, EMG control, or manual touch sensor

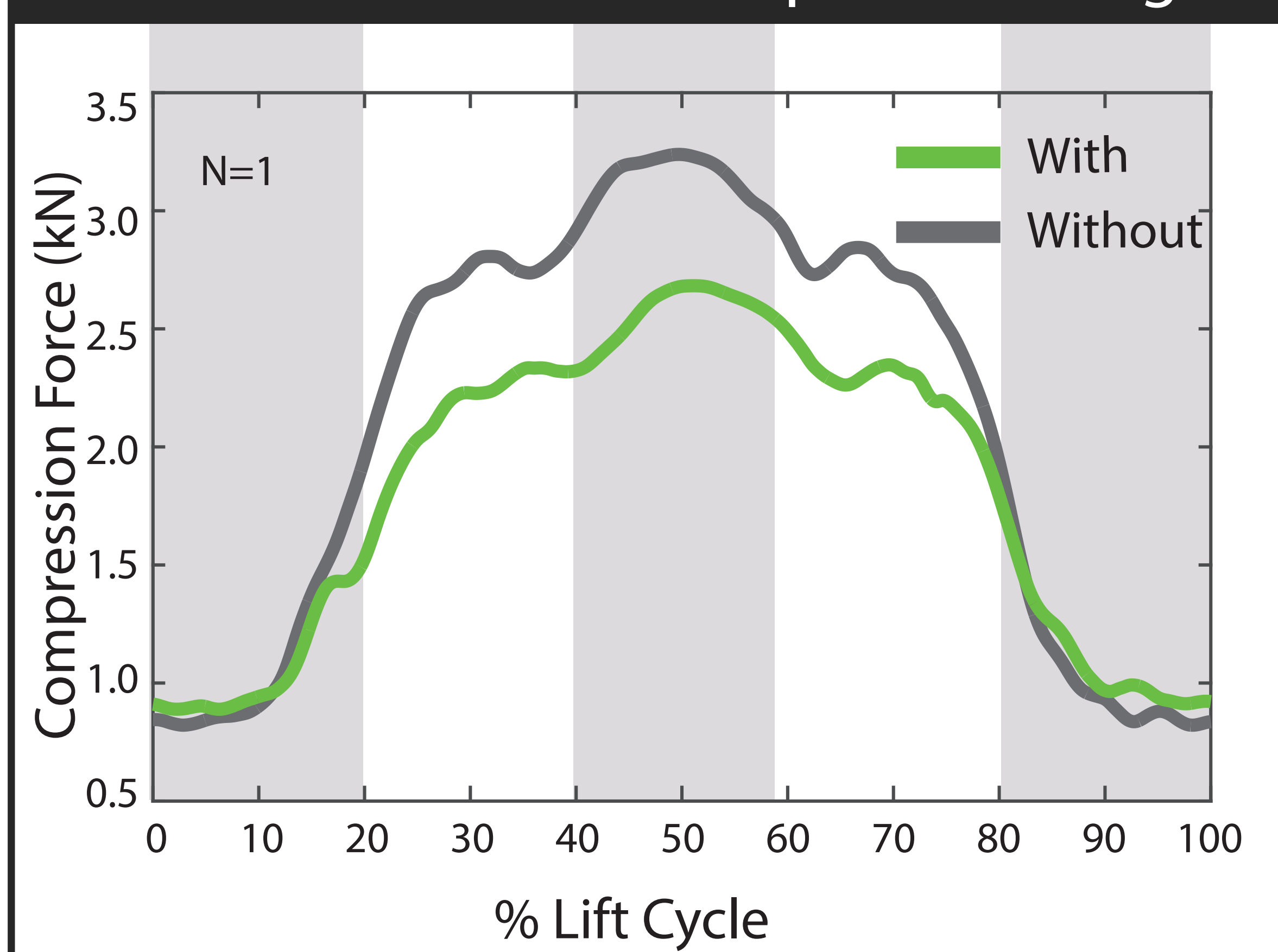
- Engaged: Elastic band assists in parallel with low back muscles during lifting & leaning
- Disengaged: Elastic band is slack, feels like normal clothes



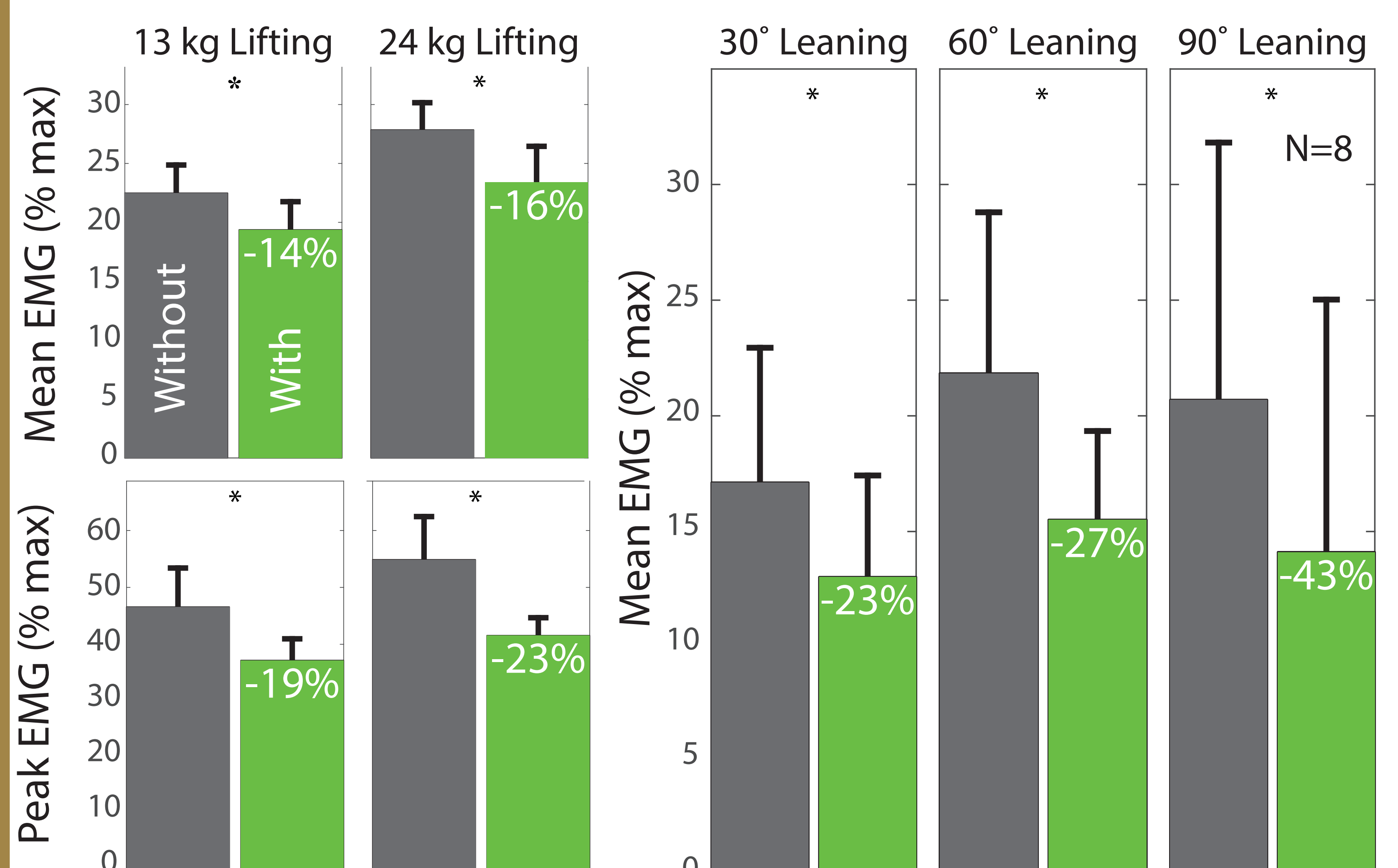
Reduces Low Back EMG During Lifting



Estimated to Reduce Spine Loading



Assistive Garment Reduced EMG 14-43% on Avg.



Methods and Analysis

- 8 healthy subjects (7 male, 1 female, 74 ± 9 kg, 1.8 ± 0.1 m, 23 ± 3 yrs.)
- Subjects performed lifting (13 kg & 24 kg weight) & leaning (30°, 60°, 90°) tasks with & without assistive garment
- Measured kinematics, elastic band force, & erector spinae EMG
- Computed EMG envelope, normalized to max activation
- Compressive L5-S1 disc loading estimated with simple spine model
- Paired t-test to compare with vs. without assistive garment, $\alpha=0.05$

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