Duke University School of Medicine
Doctor of Physical Therapy

The Effects of Suspension Devices on Muscle Activation During Exercise: A Systematic Review

Krista Manzanares SPT; Kelly Mullahy SPT; Christina Jaimes SPT; Derek Volkel SPT, CSCS; Heather Myers PT, DPT, SCS, LAT, ATC; Chad Cook PT, PhD, MBA, FAAOMPT

Background

- Suspension devices have gained a great deal of popularity as a means of strength training with less equipment
- Manufacturers report that suspension training improves the recruitment of muscle fibers, thereby enhancing the effect of the exercise performed, as compared to traditional stable exercises

Purpose

- Compile the first systematic review on this topic, to our knowledge
- Compare upper extremity and core musculature activation during exercises performed with and without a suspension device
- Investigate the effectiveness of utilizing suspension devices in rehabilitation, fitness, and strength training settings

Methods

Study Design

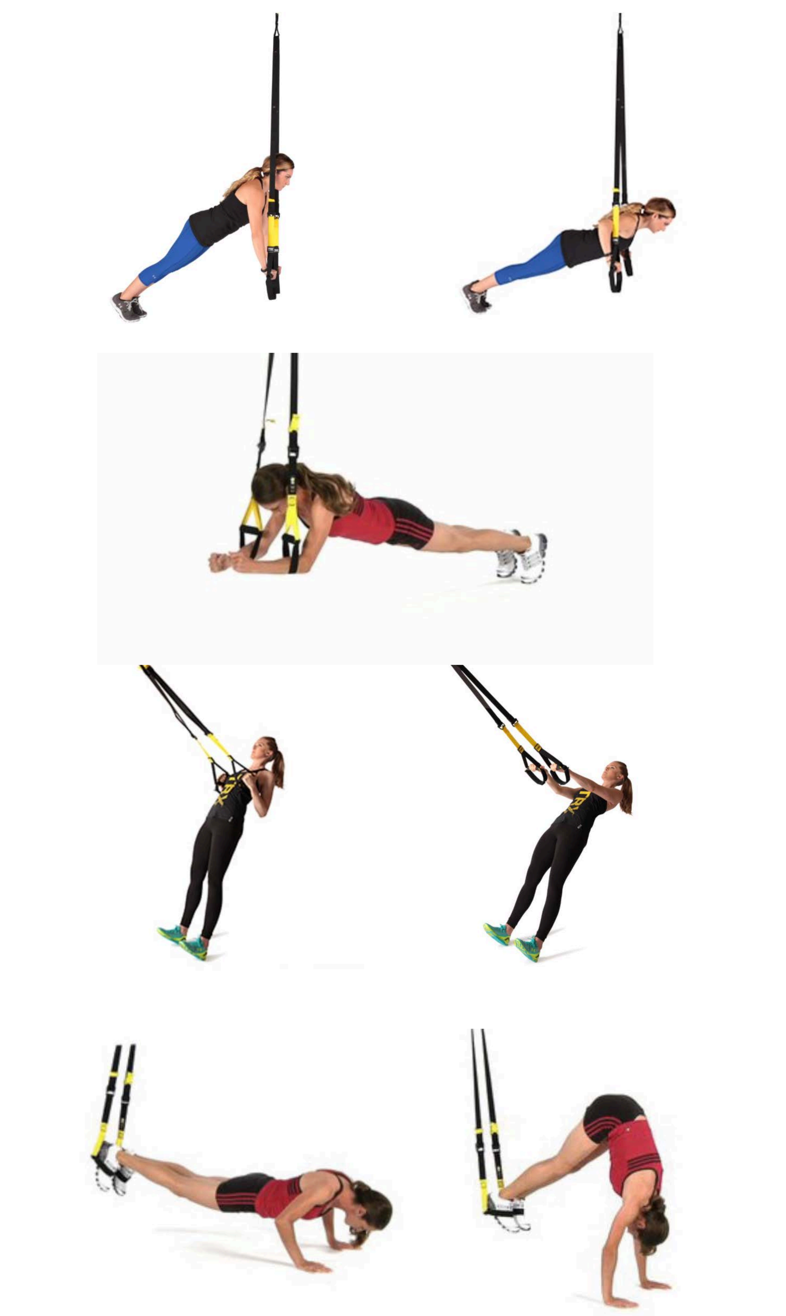
- Systematic Review
  - o PubMed, CINAHL, Embase, SportDiscus
  - o Search Terms: suspension training®, suspension device(s), unstable base, instability device(s), TRX®, electromyography, EMG, exercise, sports, physical fitness, fitness, therapeutic exercise, kinesiotherapy, muscle, and skeletal muscle
  - o Included only trunk and upper extremity (UE) muscles
  - o All participants were healthy and active

Results

- Analyzed exercises included: push-ups, planks, pikes, and inverted rows in stable and suspended conditions
- EMG values were measured for 12 muscle groups of the upper extremity and the core
- Consistently shown that the rectus abdominis (RA) was recruited at higher levels with suspension training across all exercises
- Values for the other 11 muscle groups differed across studies

Results

+	Suspension device use increased muscle activation
≈	No significant difference in activation between suspension and stable exercise
–	Suspension device use decreased muscle activation



Photos courtesy of trxtraining.com and coreperformance.com

	Anterior Deltoid	Biceps Brachii	External Oblique	Erector Spinae	Internal Oblique	Latissimus Dorsi	Middle Trapezius	Posterior Deltoid	Pectoralis Major	Rectus Abdominis	Triceps Brachii	Upper Trapezius
Push-Up												
Beach et al.[2]			+	≈	+	+				+		
Borreani et al.[3]	–								–		+	+
Calatayud et al.[4]	–			+					≈	+	+	+
Snarr et al.[6]	+								+		+	
Plank												
Atkins et al.[1]			–	≈						+		
Snarr et al.[7]			+	+						+		
Inverted Row												
Snarr et al.[5]		–				≈	≈	≈				
Pike												
Snarr et al.[8]			+	+						+		

Conclusions

- **The use of a suspension device may be suitable for exercise progression of the push-up, plank, and pike positions, but not for the inverted row**
- Based on EMG values:
  - o Rectus Abdominis Muscle - suspension devices are an appropriate progression of all of these exercises for those wanting to challenge their anterior core
  - o Remaining Core Musculature - suspension devices are an appropriate progression overall for the pike and push-up; plank is inconclusive; inverted row not analyzed
  - o Upper Extremity Musculature - suspension devices are appropriate for exercise progression of push-up when targeting the posterior UE; not appropriate for push-up or inverted row when targeting the anterior UE; plank and pike were not analyzed
- Studies were not performed in a rehabilitation setting, making these conclusions inapplicable to an injured population

Clinical Relevance

Standardization

- Studies lack procedural consistency in data processing which limits the ability to compare data between them

Recommendations

- Muscle activation alone may not fully explain why suspension training can be more difficult for individuals than traditional, stable training; clinicians should consider all patient factors before prescribing suspension training
- Further research should look to diversify the subject pool and look at other exercises to enhance the understanding of suspension devices and their effects

Acknowledgements / References

We thank Leila Ledbetter, MLIS and Emily Mazure, MLIS for their assistance with the initial search. **1. Atkins et al.** J Strength Cond Res. 2015; 29(6): 1609-15. **2. Beach et al.** Hum Mov Sci. 2008; 27(3): 457-72. **3. Borreani et al.** Phys Ther in Sport. 2015; 16(3): 248-54. **4. Calatayud et al.** J Sports Sci Med. 2014; 13(3): 502-10. **5. Snarr et al.** J Ex Phys Online. 2013; 16(6): 51-58. **6. Snarr et al.** J Human Kinet. 2013; 39: 75-83. **7. Snarr et al.** J Strength Cond Res. 2014; 28(11): 3298-305. **8. Snarr et al.** J Strength Cond Res. 2016; 30(12): 3436-42.