



Comparison of Muscle Activity During Weight-bearing Exercises on Stable & Unstable Surfaces



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PURPOSE

To compare lower extremity muscle activity during forward lunge, single leg stance, and double limb squat using the STEPRIGHT™ Stability System, BOSU training system, and standard shoe.



Figure 1. STEPRIGHT™ Stability System

METHODS

- 18 recreationally active subjects, 9 males and 9 females, aged 18-25 years old
- Muscle activity was measured using a SEMG system on 8 muscles of the dominant limb
- Subjects performed three functional tasks on three surface types
- Surface type and functional task order were randomized
- Metronome was used to standardize cadence



Figure 2. Performance of Functional Activities

HYPOTHESIS

- Unstable devices would cause greater muscle activation than a firm surface
- The most difficult combination of task and surface type would be:
 - STEPRIGHT™ single leg stance
 - BOSU forward lunge
 - STEPRIGHT™ forward lunge

RESULTS & ANALYSIS

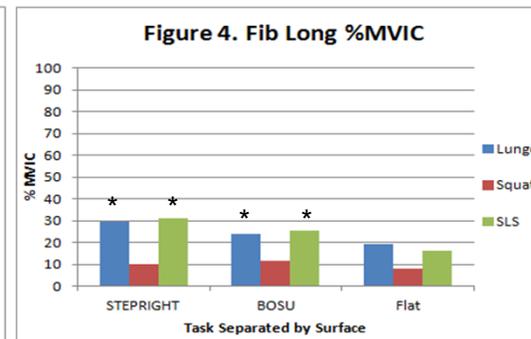
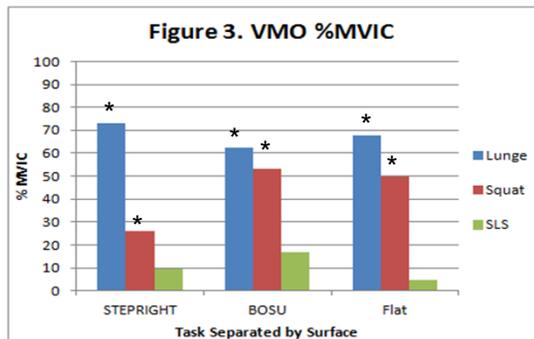
Table 1: Muscle Activation Levels During Forward Lunge Across Three Surfaces

Activation Level	STEPRIGHT™ Lunge	BOSU Lunge	Flat Lunge
"High" (>40% MVIC)	VMO Rectus Fem Tib Ant	VMO Tib Ant	VMO
"Moderate" (20-40% MVIC)	Bicep Fem Fib Long Add Long	Rectus Fem Bicep Fem Fib Long Add Long	Rectus Fem Bicep Fem Add Long
"Low" (0-20% MVIC)	Glute Med Lat Gastroc	Glute Med Lat Gastroc	Tib Ant Fib Long Glute Med Lat Gastroc

- Forward lunge STEPRIGHT™ and BOSU devices resulted in the highest values (40-78%MVIC) which are within the muscle strengthening range. The other tasks and flat surface resulted in moderate to low %MVIC values.
- Subjects self-reported that the BOSU lunge was the most difficult to perform despite similar %MVIC between BOSU and STEPRIGHT™ devices
- %MVIC of the FL and LG were greater when using the STEPRIGHT™ for SLS compared to the flat surface, $p < .05$
- %MVIC of the FL was greater when using the BOSU for forward lunge compared to the flat surface, $p < .05$

Table 2: Comparison of %MVIC Across Tasks with $p < .05$

MUSCLES	BOSU & STEPRIGHT™	STEPRIGHT™ ONLY	BOSU ONLY
Rectus Fem	Lunge > SLS	Lunge > Squat	Squat > SLS
VMO	Squat & Lunge > SLS		
Glute Med, Bicep Fem		Lunge > Squat	
Bicep Fem, Tib Ant	Lunge > SLS		
Add Long		Lunge > Squat & SLS	
Fib Long	Lunge & SLS > Squat		
Lat Gastroc		Lunge & SLS > Squat	



CLINICAL IMPLICATIONS

- Healthy collegiate-aged participants had similar %MVIC responses on the STEPRIGHT™ and BOSU devices on dominant lower limb
- When comparing across surfaces during SLS the STEPRIGHT™ elicited higher %MVIC at the ankle than a flat surface.
- The STEPRIGHT™ lunge elicited higher %MVIC than STEPRIGHT™ squat at the hip and ankle muscles
- Since the BOSU and STEPRIGHT™ devices are similar in cost, physical therapists may opt to choose the STEPRIGHT™ since it can be worn over the shoe for more mobile tasks compared to other unstable devices.

LIMITATIONS

- Population chosen was healthy, recreationally active, collegiate-aged individuals
- Neuromuscular balance factors not measured
- Electrode placement, manual muscle testing, and task performance were subject to variability
- Metronome and standardized task procedures may have altered body mechanics typically used during functional tasks

FUTURE RESEARCH

- Assess whether fatigue or endurance training affects %MVIC across unstable surfaces
- Same procedures performed on clinically relevant populations (i.e. patients with chronic ankle instability, patients with balance deficits)
- Comparison of balance training program using STEPRIGHT™ compared to other unstable surfaces