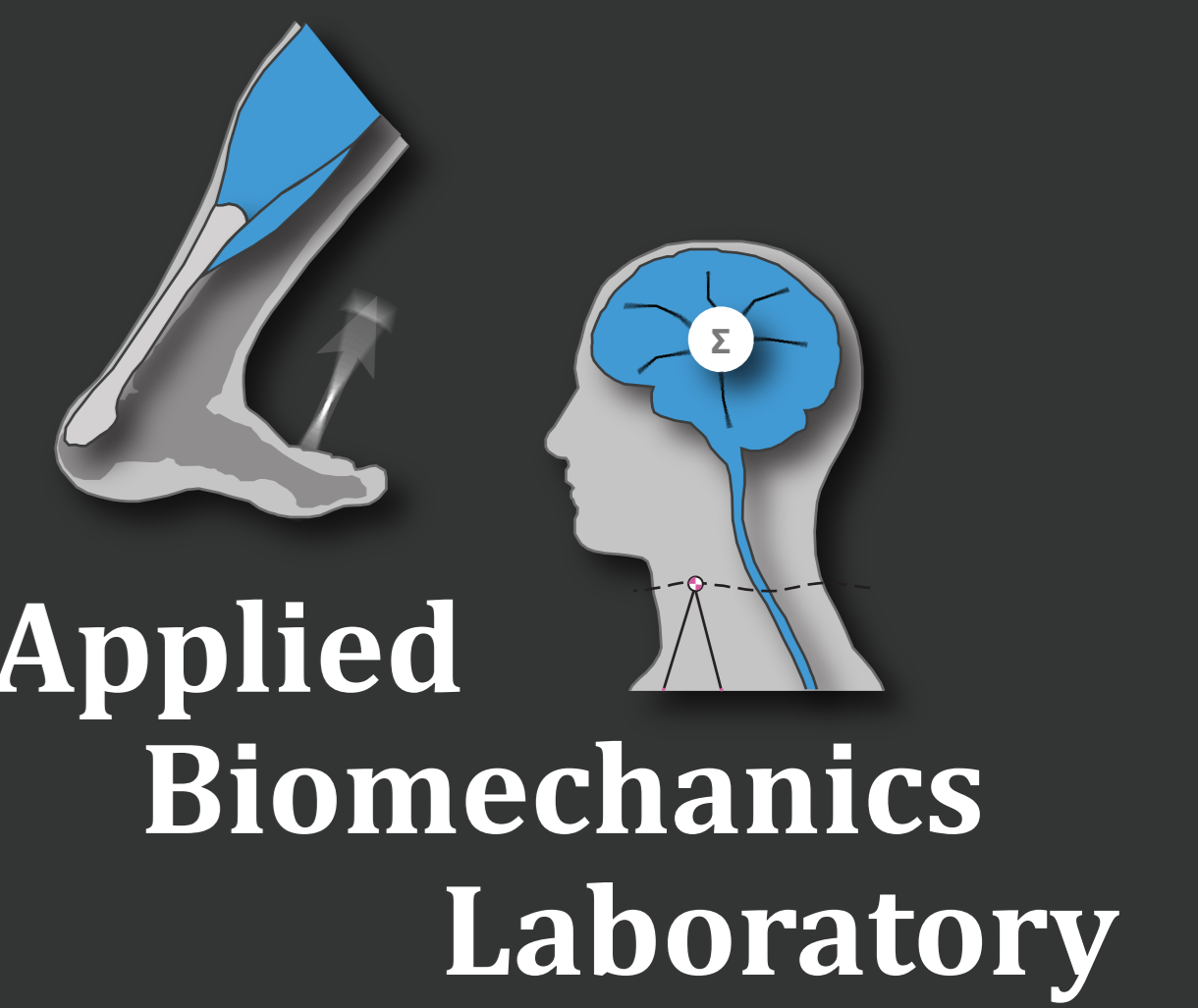


# The Effect of Anticipation on Calf Muscle Response to Standing Perturbations

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## 1. Introduction

Falls pose a tremendous risk to older adults; understanding the mechanisms of muscle response to balance challenges is an imperative contribution to the development of training paradigms, assistive technologies, and clinical interventions that mitigate fall risk for vulnerable individuals.

There is evidence that anticipation of a balance challenge is likely to augment force responsiveness of distal leg muscles based on voluntary proactive adjustments [1,2]. However, there is a gap in studies analyzing ultrasound data that would provide vital context for the robustness of these responses. This study seeks to use metrics extracted from in vivo ultrasound data (i.e., fascicle length and velocity) to investigate the influence of anticipation on the proactive and reactive responses of the medial gastrocnemius to rapid surface translations.

### Hypotheses

Compared to unanticipated perturbations, anticipated perturbations will result in:

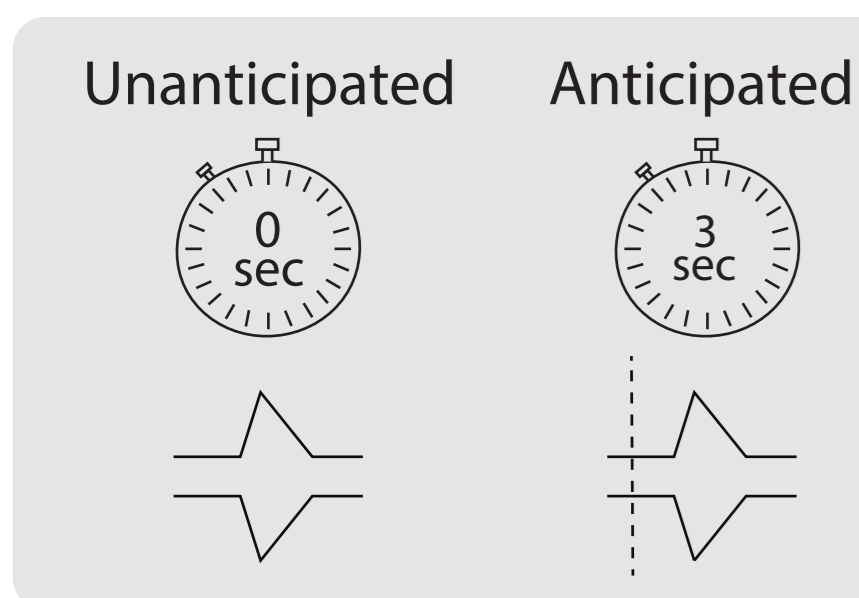
#### 1. Proactive Response

- Greater Length Change
- Faster shortening velocities for posterior perturbations
- Faster lengthening velocities for anterior perturbations

#### 2. Reactive Response

- Lower Length Change
- Slower shortening velocities for posterior perturbations
- Slower lengthening velocities for anterior perturbations

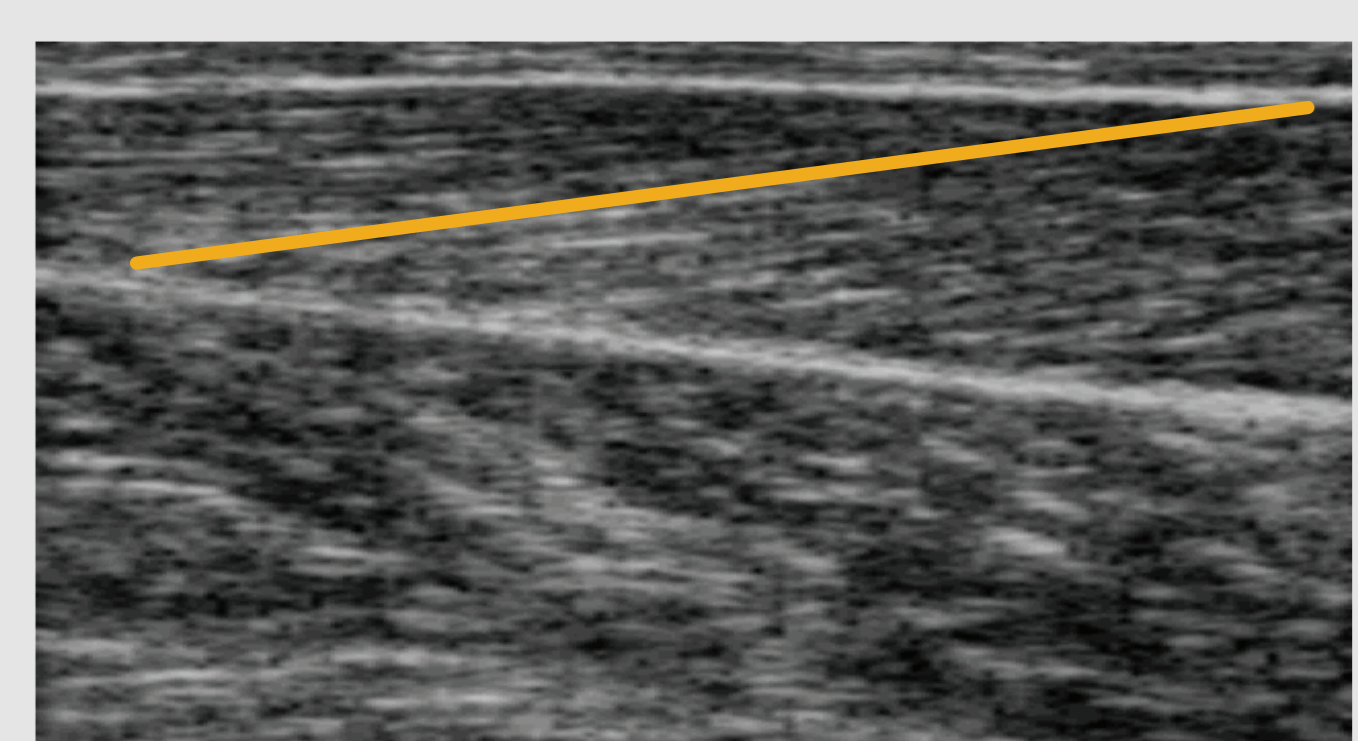
## 2. Methods



**Subject Demographics**  
Age: 22.3 ± 3.4 yrs  
Mass: 65.8 ± 12.3 kg  
Height: 1.72 ± 0.5 m  
9F/5M



Ultrasound Analysis [3] of Medial Gastrocnemius

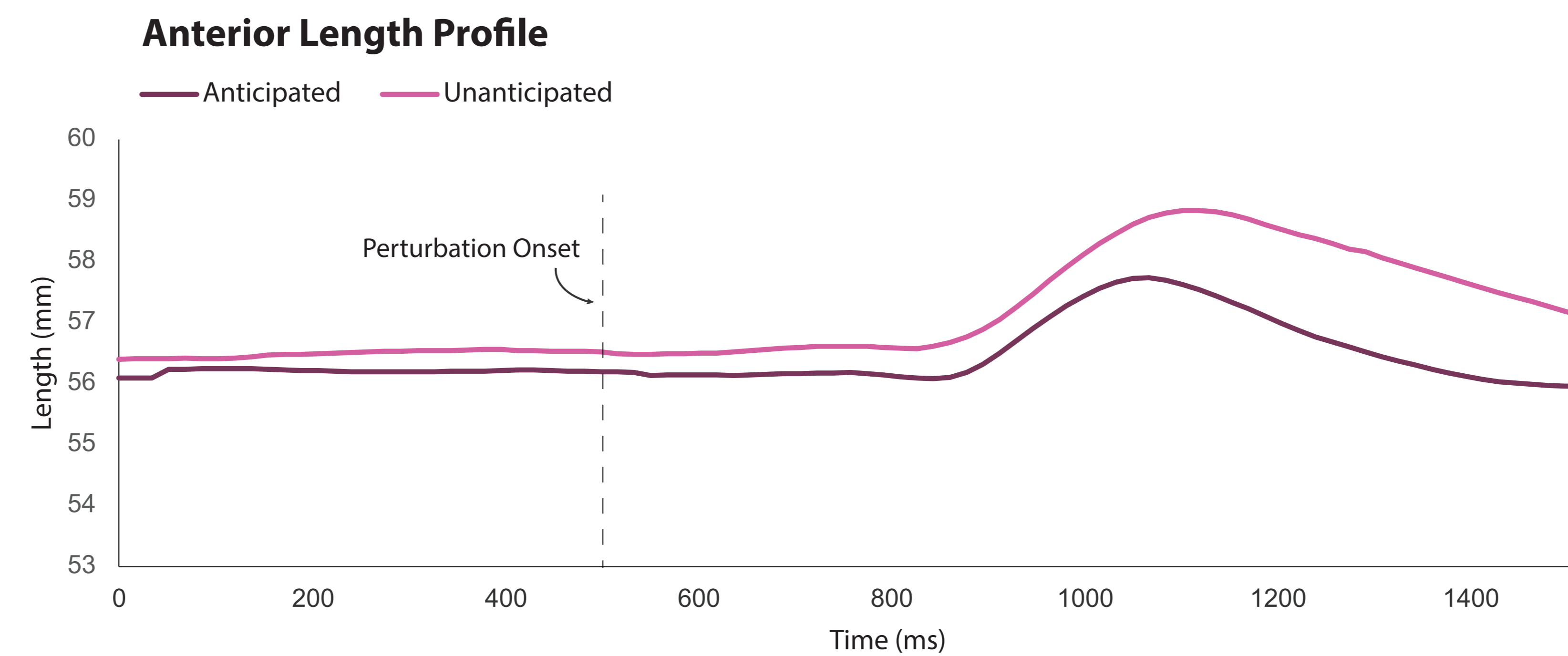
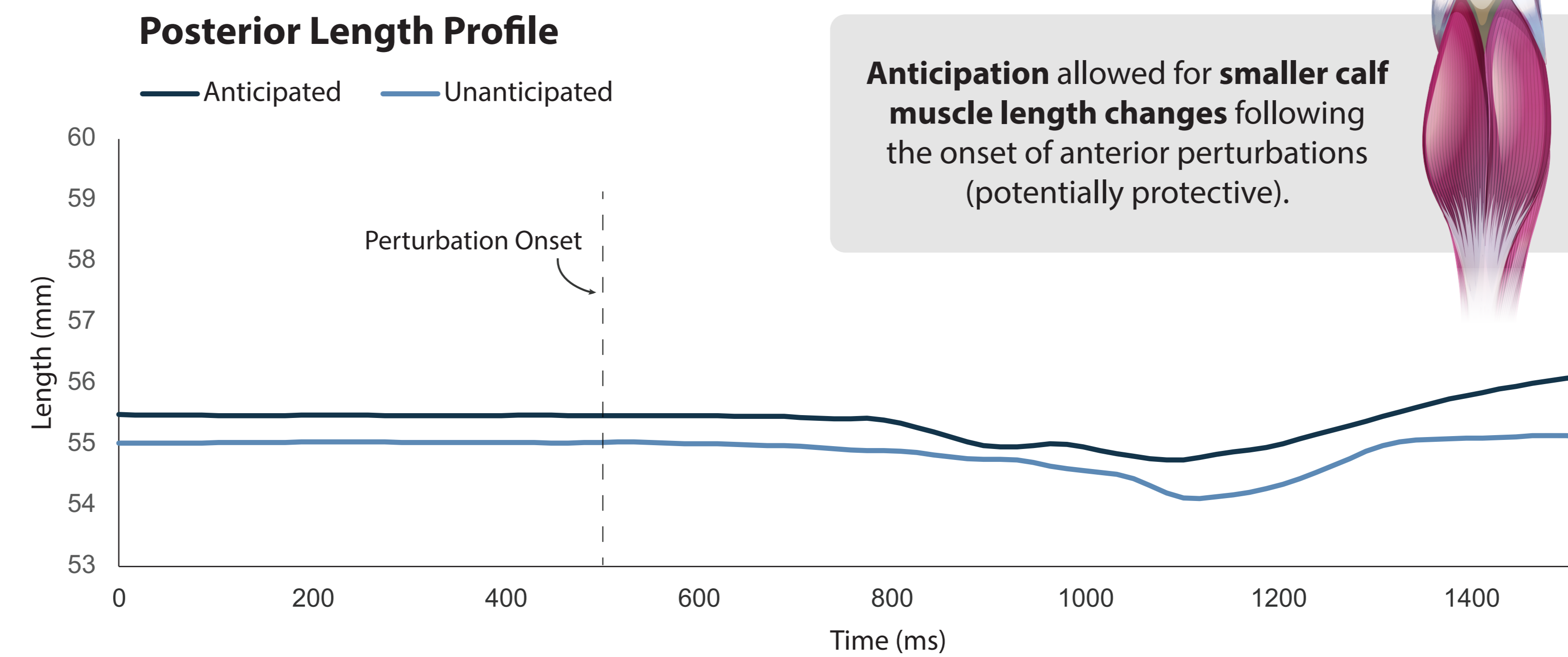


**Extractable Features**  
1. Length 2. Velocity

**Outcome Measures**

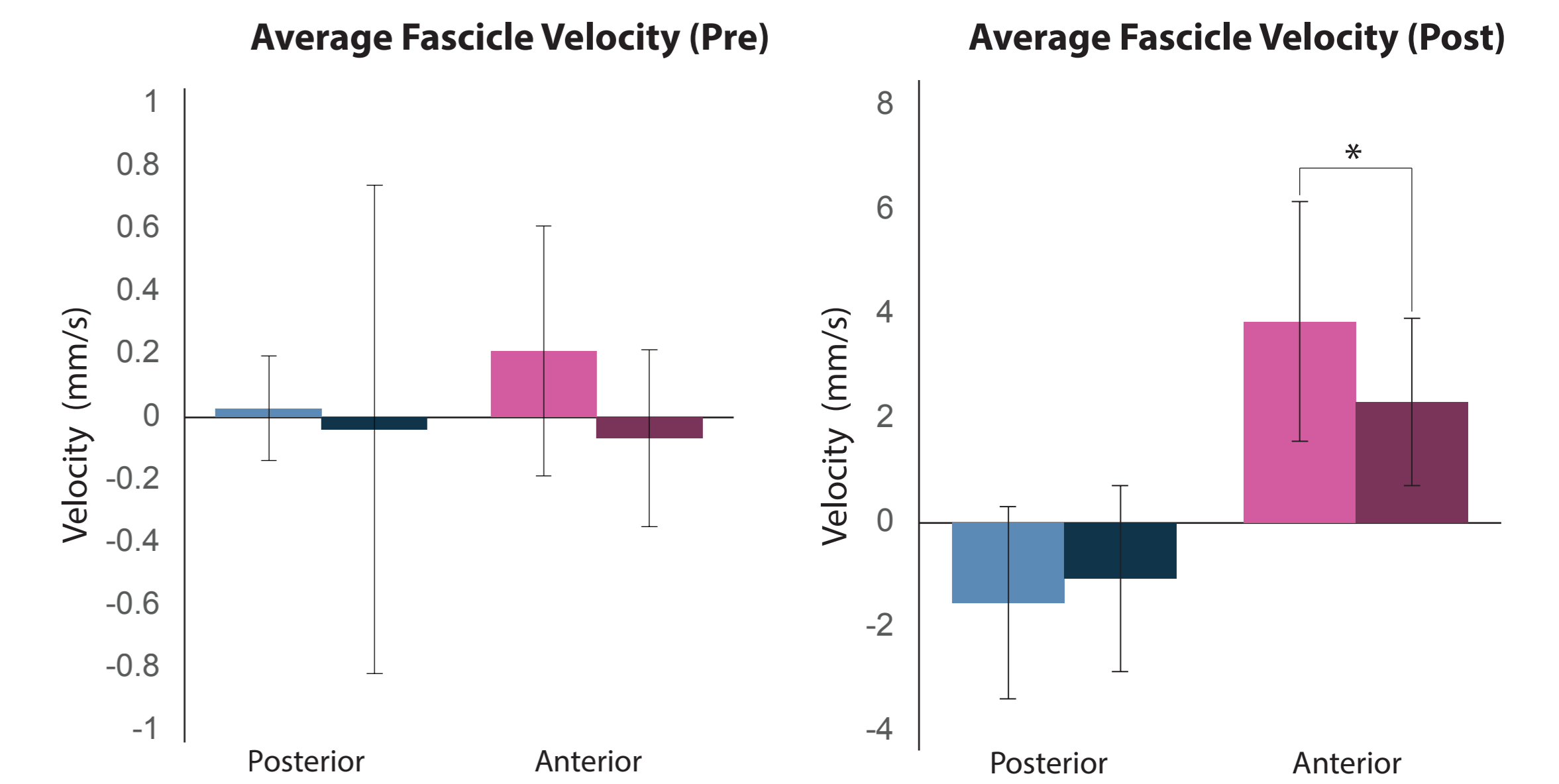
- 1. Avg. Length  $\Delta$
  - 2. Avg. Velocity
- Indicators of force generation capabilities

## 3. Length Profiles



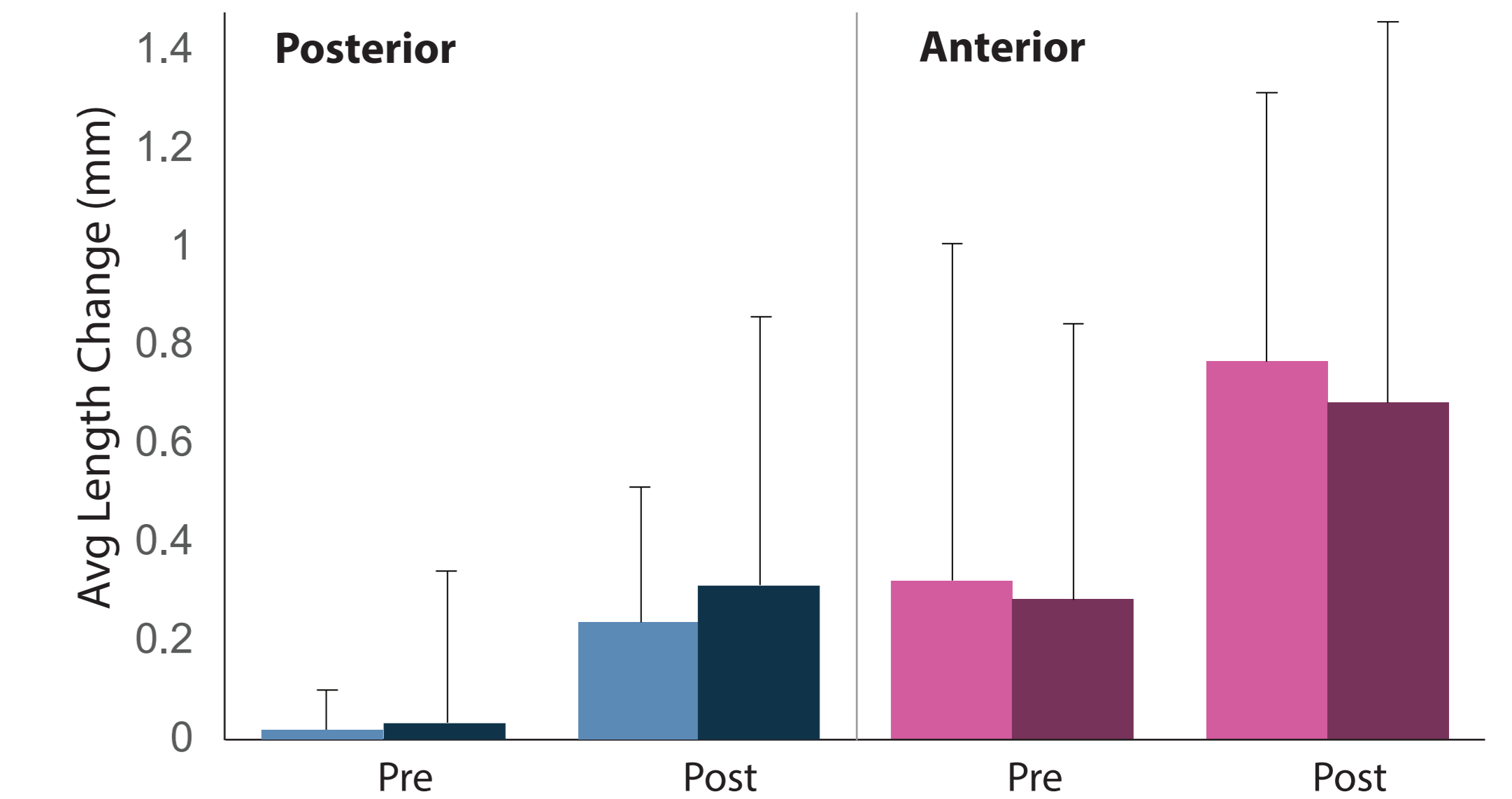
## 4. Averages

■ Unanticipated, Posterior ■ Anticipated, Posterior ■ Unanticipated Anterior ■ Anticipated, Anterior



Independent of direction, **anticipation** tended to elicit calf muscle **shortening velocities** prior to the onset of perturbations (non significant)

**Anticipation** resulted in **slower lengthening velocities in the anterior direction** (i.e. those that would precipitate backwards falls, which are more dangerous and result in more injury).



## 5. Conclusions

**Take-Home:** Anticipation appears to be protective against perturbations that would elicit a backwards fall.

### Future Directions

- Investigating the fascicle response of the Tibialis Anterior (TA) may provide more insight into the agonist-antagonist relationship between the TA and MG in the context of standing perturbations.
- Understanding the muscle fascicle response to anticipated perturbations in young adults will provide a comparative foundation for the response in populations who are vulnerable to falls (i.e. old age/cognitive decline)



## Acknowledgements

We thank the volunteers of this study for their participation.

### References

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