USING ELASTIC ANKLE EXOSKELETONS TO COUNTERACT AGE-RELATED STRUCTURE-FUNCTION DEFICITS

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INTRODUCTION

Aging is associated with a decline in gait performance.

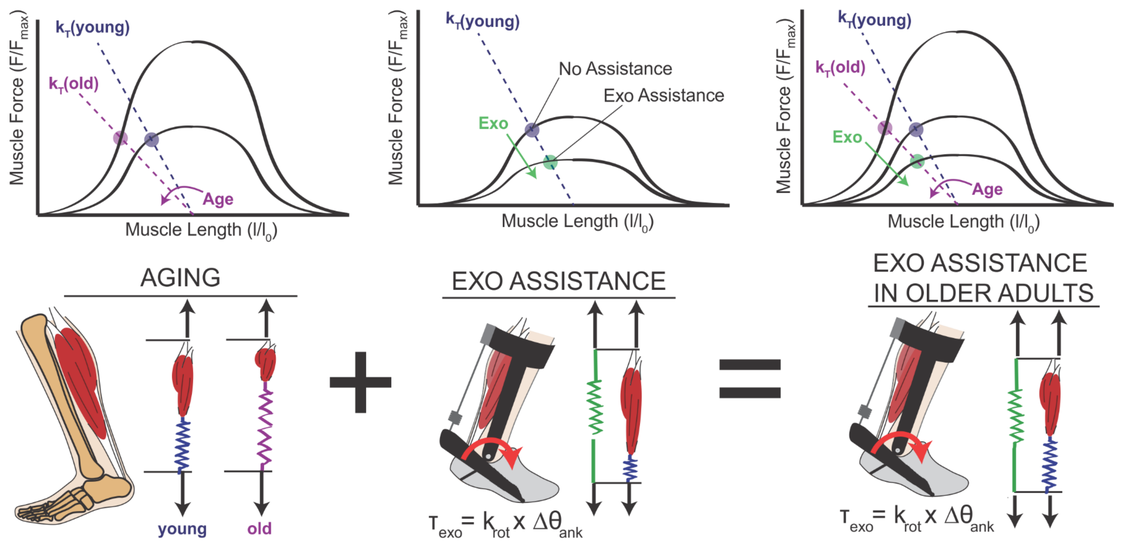
We suspect that ankle pushoff in older adults is disrupted due to structural changes in the plantarflexor muscle-tenon unit [1].

1. Decreased tendon stiffness
2. Decreased muscle strength

Muscle in older adults (A) on a less favorable point on muscle length-tension curve:

1. Increased normalized force generation
2. Shorter muscle fascicle average length
3. Increased muscle activation

In young adults (B), elastic exoskeleton assistance results in decreased biological moment[2], increased fascicle length[3], and decreased muscle activation[2].



<u>Hypothesis:</u> Adding parallel elastic assistance during walking in older adults would lead to a:

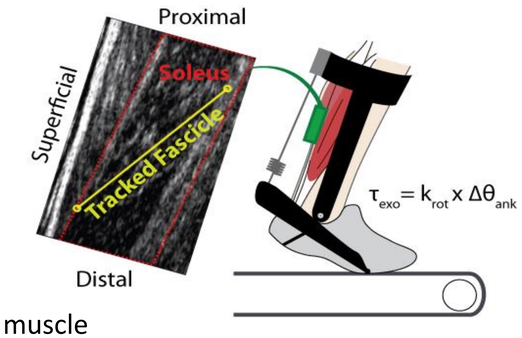
1. Decrease in the biological ankle moment
2. Increase in soleus muscle fascicle operating lengths
3. Decrease in plantarflexor muscle activation

METHODS

Evaluated Elastic Exoskeleton Assistance on One Older Adult (68 years old)

Walked at 1.25 m/s for 5 minute trials with two stiffness conditions

- No Assistance (0 Nm/rad)
- Exo Assistance (150 Nm/rad)



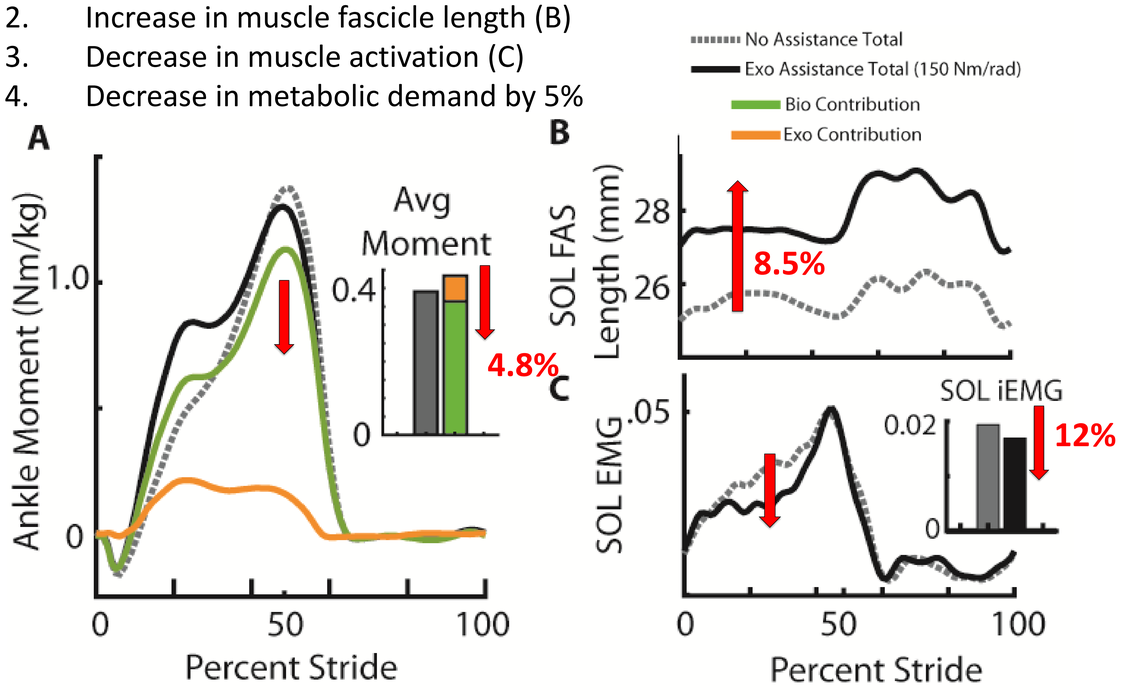
Measured Physiologic Response to Exoskeleton Assistance

1. Whole Body – Metabolic Demand
2. Joint Mechanics – Inverse Dynamics
3. Neuromuscular Activation – EMG
4. Muscle Dynamics – B-mode ultrasound of soleus muscle

RESULTS

Elastic ankle exoskeleton assistance on an older adult resulted in

1. Decrease in biological moment (Peak and Average) (A)
2. Increase in muscle fascicle length (B)
3. Decrease in muscle activation (C)
4. Decrease in metabolic demand by 5%



REFERENCES

1. Franz, J. R. Exerc Sport Sci Rev, 2016 44(4): 129-136
2. Collins SH, Wiggin MB, Sawicki GS. Nature, 2015
3. Sawicki G., et al. IEEE Trans Biomed Eng. 2015 Oct 15.

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CONCLUSION

- Exoskeleton potentially offsets muscle level changes associated with aging
- Potential to prescribe device properties to the individuals morphology