



Increases in Free-Living Cadence Differ Between Transfemoral and Transtibial Osseointegrated Bone-Anchored Limbs Based on Pain

Eric J. Earley^{1,2}, Peter B. Thomsen-Freitas^{1,3}, Dan W. Milius^{1,2,4}, Mohamed E. Awad^{1,2}, Hannah B. Archer^{1,3}, Danielle H. Melton^{1,3,4}, Brecca M. M. Gaffney^{1,5,6,7}, Cory L. Christiansen^{1,3,5}, Jason W. Stoneback^{1,2}

University of Colorado Anschutz Medical Campus ¹Bone-Anchored Limb Research Group, ²Department of Orthopedics, ³Department of Physical Medicine & Rehabilitation, ⁴CU Medicine Center for Prosthetics, ⁶Department of Bioengineering; ⁵ VA Eastern Colorado Healthcare System; University of Colorado Denver ⁷Department of Mechanical Engineering

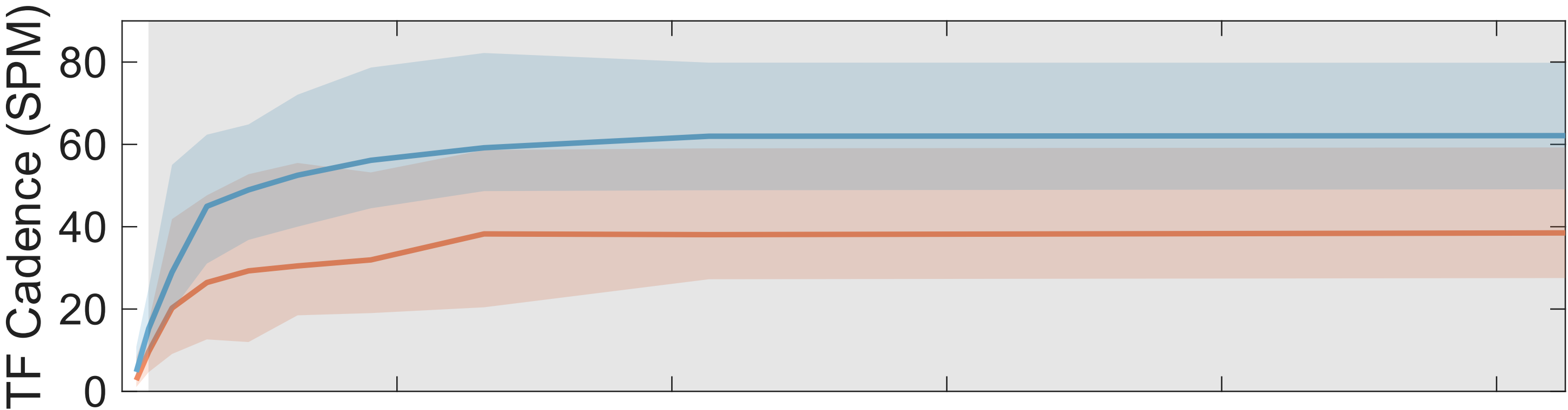


Summary

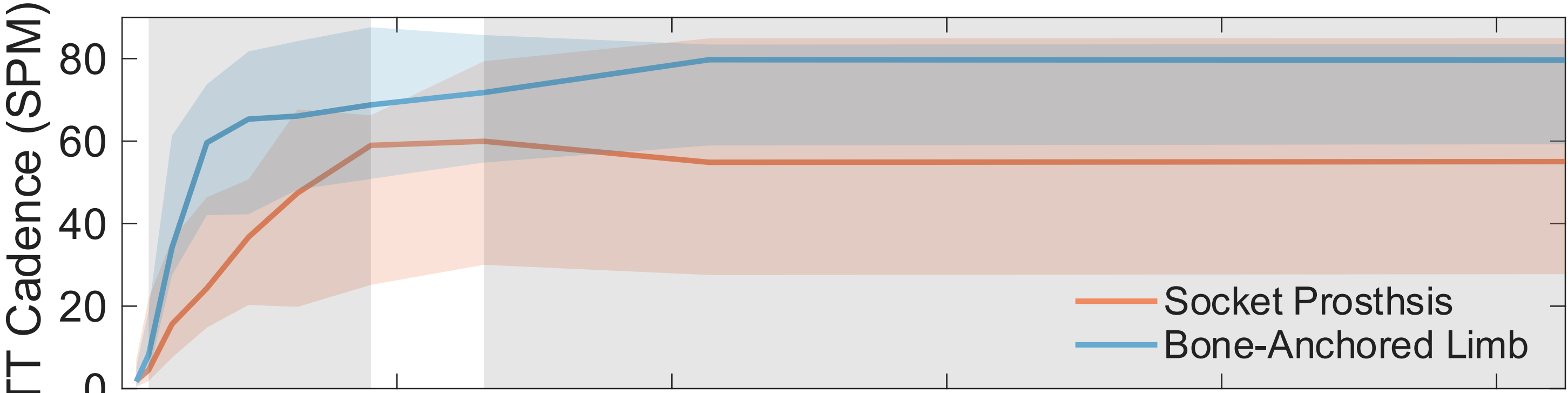
- We measured **free-living walking cadence** in individuals receiving **osseointegrated bone-anchored limbs (BAL)**, and compared improvements across **amputation levels, bout durations, and impact of pre-operative pain on quality of life (QoL)**
- **High-impact pre-operative pain** had a **greater influence** on the **post-operative improvements in walking cadence** for individuals with **TT amputation**, whereas improvements in walking cadence with **TF amputation** were **more similar regardless of pain**
- Our findings suggest **that some benefits of BAL**, especially for individuals with **TT amputation**, may be related **to improvements in activity-related pain interference**

Results

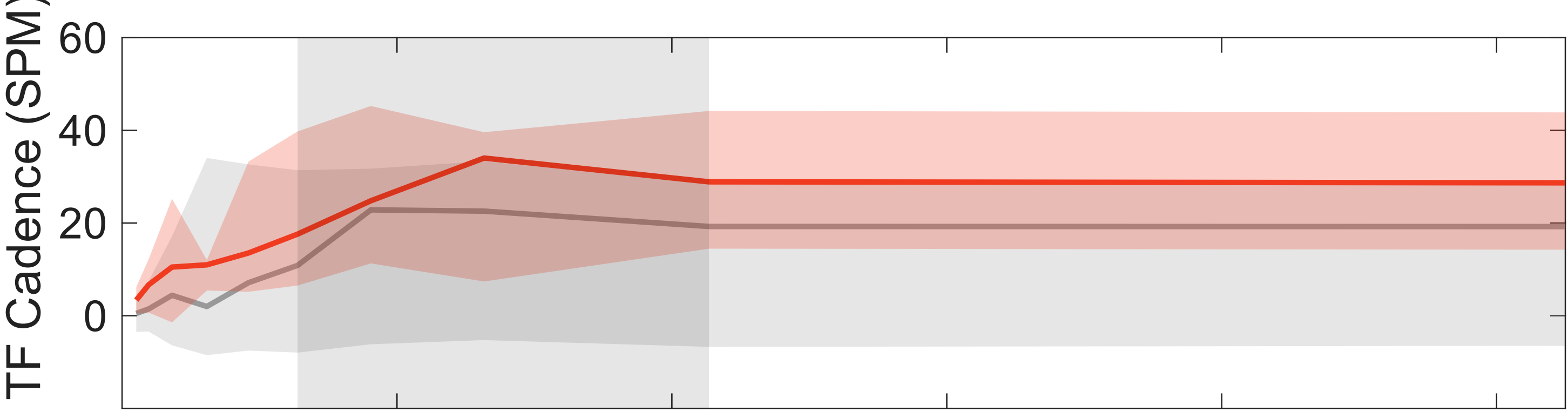
Plots show medians and quartiles.
Grey regions indicate statistically significant differences ($p < 0.05$)



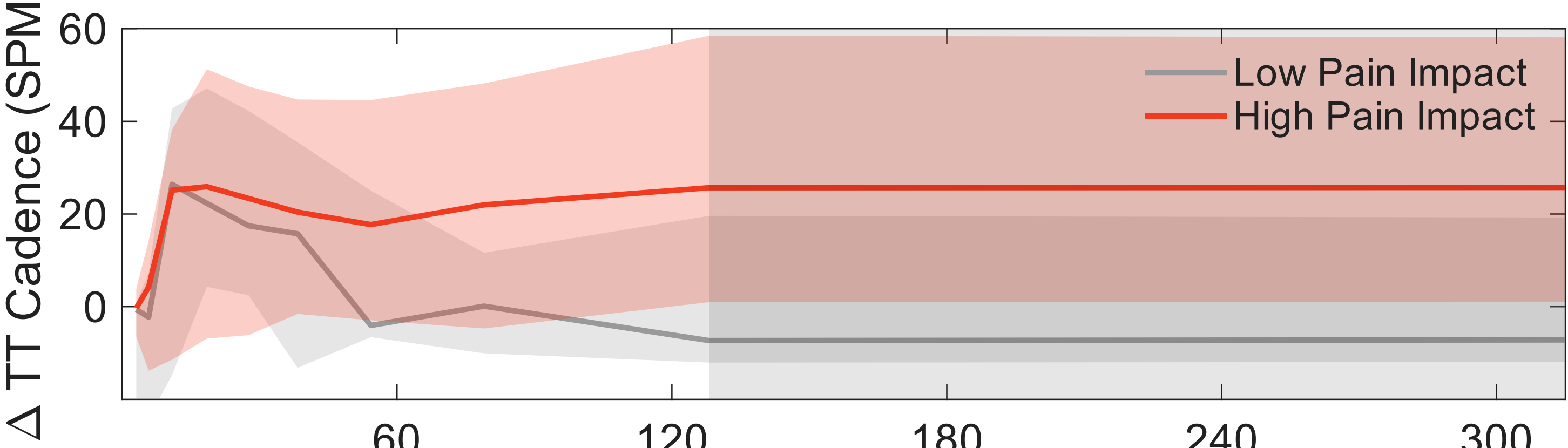
➤ Walking cadence **increased by 5-25 steps per minute** with BAL for 80% of bouts



➤ Walking cadence **increased by 11-25 steps per minute** with BAL for 70% of bouts



➤ Improvements in cadence with BAL were **2-11 steps per minute greater** for individuals with **high-impact pre-operative pain** for bouts between 40 seconds and 2 minutes



➤ Improvements in cadence with BAL were **30 steps per minute greater** for individuals with **high-impact pre-operative pain** for bouts longer than 2 minutes

Background

- Previous studies have demonstrated **improvements in daily steps, walking cadence, and bout durations for individuals with BAL**, compared to socket prostheses (SP)
- Studies have also demonstrated that **activity level** had **less impact on prosthesis-related pains** with **BAL** than SP
- **The purpose of this study was to evaluate how free-living cadence improvements with BAL differ based on three factors:**
 1. **Amputation level (TF vs TT)**
 2. **Walking bout durations (binned into deciles)**
 3. **Pre-operative pain impact ("considerable" or greater impact of amputation-related pain on QoL)**

Methods

- 26 participants with TF amputation(15M/11F) and 16 participants with TT amputation (11 M/5F) wore thigh-mounted activity monitors for 4+ days, both prior to and 1 year after BAL implantation
- Impact of pain on QoL was evaluated using the Questionnaire for Transfemoral Amputation (Q-TFA)
- Walking bouts defined as stepping activity interrupted by non-stepping activities < 30 seconds
- Bout duration deciles were calculated across all participants, resulting in equal numbers of walking events

Discussion

- Individuals with lower-limb amputation demonstrated **greater walking cadence with BAL** compared to SP, especially for longer walking bouts
- Pre-operative pain interference on QoL appears to play different roles on the benefits of BAL for individuals with TF and TT amputation
 - Improvements for individuals with **TF amputation** were **generally consistent regardless of pain**
 - Improvements for individuals with **TT amputation** tended to **only arise for those with high pain impact**
- Our findings **underscore the value of BAL in enhancing real-world mobility**, particularly for individuals experiencing socket-related challenges, and highlight the need for further research to identify underlying mechanisms of free-living activity improvements

Funding: This research was funded by the University of Colorado Bone-Anchored Limb Research Group.