# People with unilateral transtibial amputations reorganize muscle coordination patterns when walking with visual feedback targeting increased peak propulsive horizontal force

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**Introduction:** People with unilateral transtibial amputation (UTTA) walk using a passive-elastic prosthesis and apply less peak propulsive force (PPF) from their affected leg (AL) than their unaffected leg (UL). We previously found that when given visual feedback (VF) to increase AL-PPF by 20%, 3 out of 12 participants with UTTA met the target (≥20% increase), and 6 participants increased AL-PPF <15% compared to baseline. In this study, we used muscle synergy analysis to characterize how groups of muscles were coordinated during walking between high responders (≥20% increase) versus low responders (<15% increase), and hypothesized that high responders would reorganize UL muscle coordination when presented with VF. **Methods:** Twelve people with UTTA walked with a passive-elastic prosthesis on a treadmill for 5 minutes at 1.25 m/s in two conditions, without VF as a baseline, and with VF of AL-PPF 20% (20VF) higher than baseline. We recorded EMG from lower-limb muscles on both legs, and applied non-negative matrix factorization on the UL EMG signals to extract synergy weightings to describe muscle coordination patterns during the baseline and 20VF trials. We used k-means clustering to identify muscle synergy clusters across participants, which automatically sorts the synergy weightings into a chosen number of clusters so that muscle coordination patterns within the same cluster are as similar as possible. **Results:** Participants presented 3 clusters of UL synergies in baseline and 5 clusters during 20VF trial. During baseline, we observed a cluster characterized as a co-activation of the two measured ankle dorsiflexors (Lateral Gastrocnemius and Soleus),

and this cluster was regrouped into a co-activation between one of the two measured ankle dorsiflexors and one of the measured hip extensors (Bicep Femoris or Gluteus Maxiums). Such reorganization in muscle synergies was observed in all high responders, but not in low responders. Low responders continued to present a synergy cluster with co-activation of both ankle dorsiflexors. **Discussion:** We found that people with UTTA using a passive-elastic prosthesis who increased AL-PPF when given VF reorganized their UL muscle synergies to achieve the VF target. A VF-based training program targeting specific synergy profiles may be useful for post-amputation rehabilitation.