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SYDNEY



NeuRA

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Involuntary muscle activity reduces passive joint range of motion at known torque

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Passive joint range of motion is commonly assessed in neurological conditions to diagnose and treat contracture

It is usually assumed that any involuntary muscle activity can be ignored

This assumption has not been tested



Aim

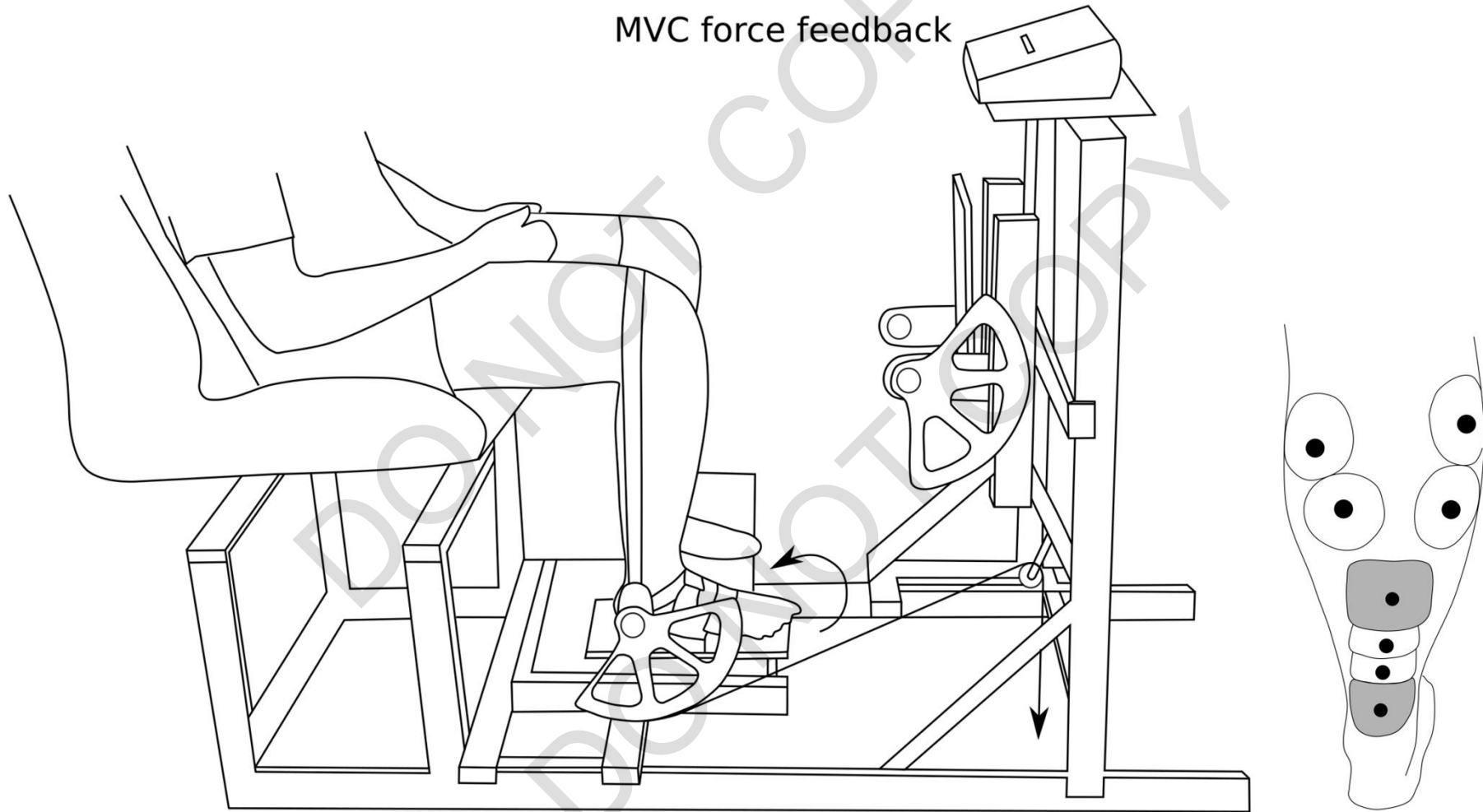
To determine whether, and to what extent, small amounts of involuntary muscle activity limit the range of passive joint motion

Methods

- Design: cross-sectional, repeated measures study
- Subjects: 30 able-bodied adults
- Protocol pre-registered on the Open Science Framework:
<https://osf.io/dbfe3/>

Experimental set-up

MVC force feedback



Stimulation protocol

With knee flexed 90°:

- Twitch interpolation was used to assess maximal plantarflexion torque
- We determined the tetanic stimulation intensity (50 Hz) required to generate the percentages of predicted maximal plantarflexion torque: 1, 2.5, 5, 7.5, and 10% MVC

Experimental protocol

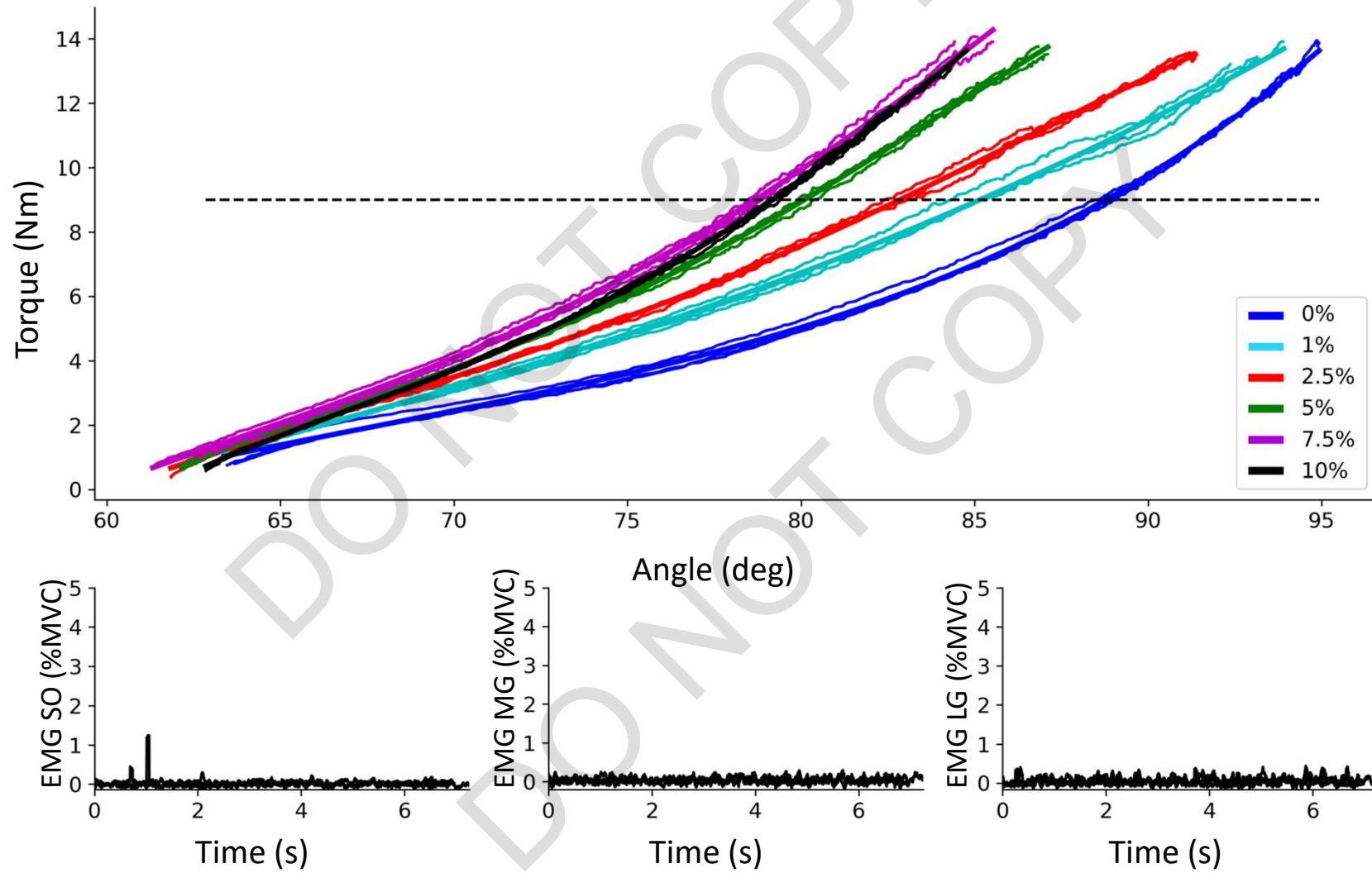
With knee flexed 90° and fully extended:

- Passive ankle torque and angle were measured
- Soleus was tetanically stimulated to generate plantarflexion torques ranging from 0 to 10% of predicted maximal torque
- The ankle was dorsiflexed to 15 Nm by a blinded assessor
- During the trial without stimulation, EMG signals from the plantarflexors were monitored

Analysis

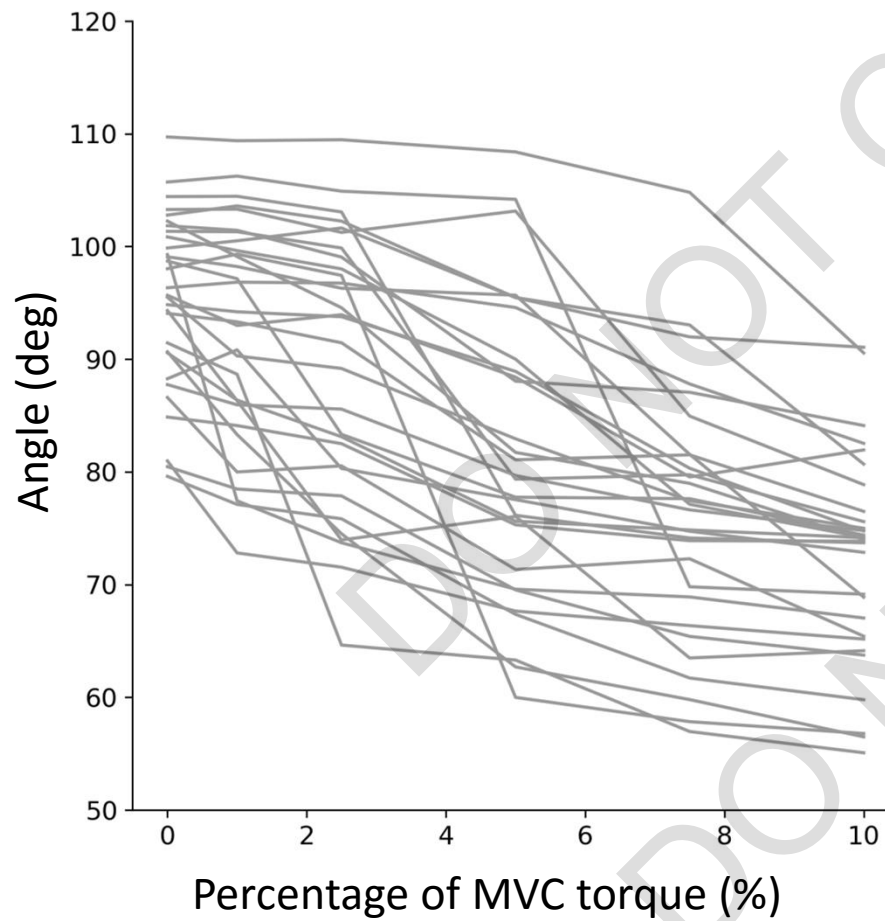
- A polynomial function was fitted to the torque-angle curve for each stimulation intensity
- Ankle angles at 9 Nm were derived
- Linear mixed models were used to estimate how ankle angle changed with increasing involuntary muscle activity

Results

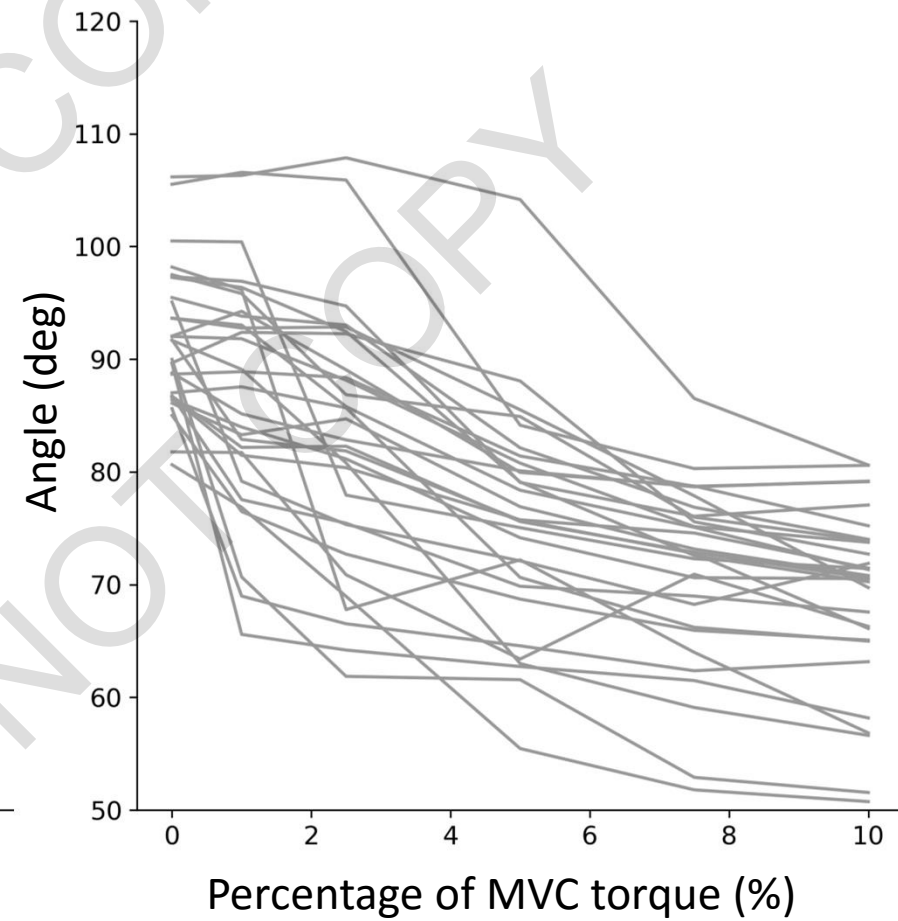


Ankle angle at 9 Nm

Knee flexed 90°

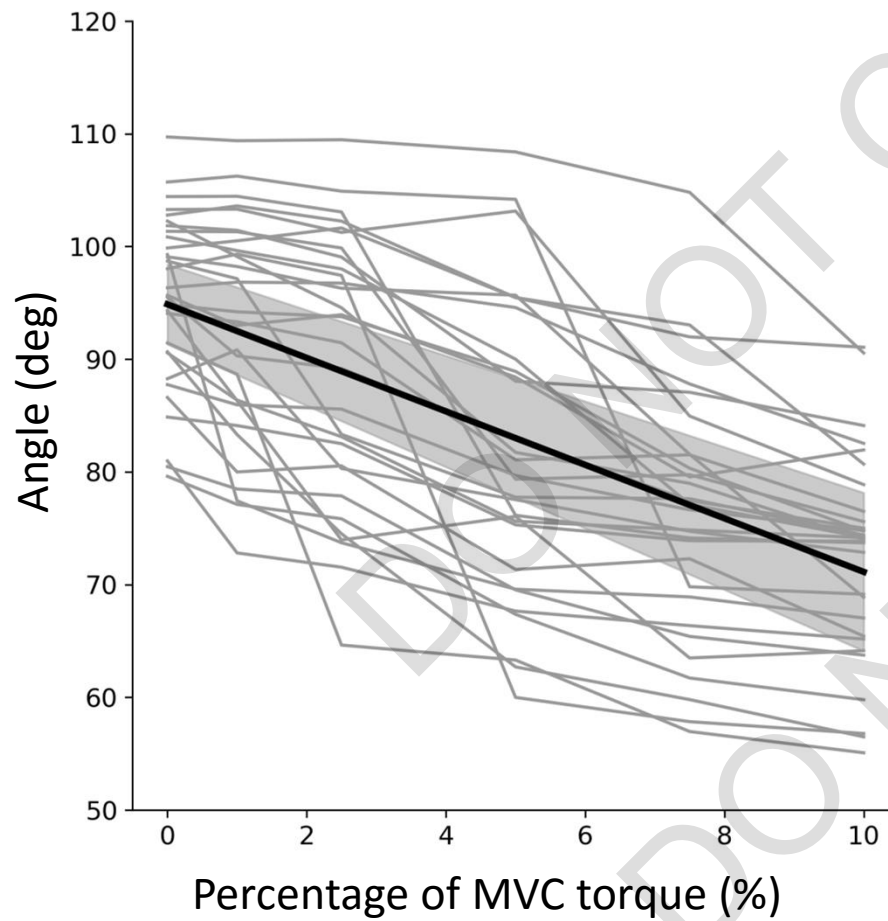


Knee fully extended

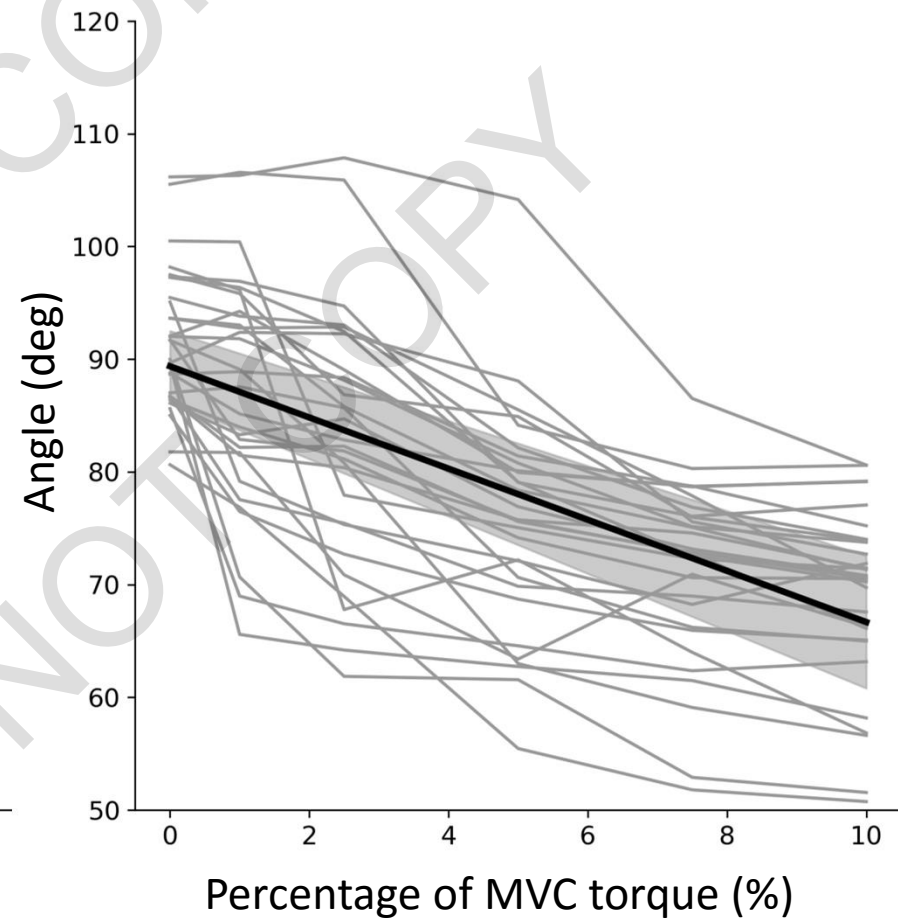


Ankle angle at 9 Nm

Knee flexed 90°



Knee fully extended



Conclusions

- Small amounts of involuntary muscle activity substantially limit measures of passive joint range of motion
- On average, for every 1% increase in plantarflexion torque, dorsiflexion range of motion decreases by more than 2°
- Therefore, when measuring the range of passive motion at a joint, small amounts of muscle activity should not be ignored