

The effects of attentional focus and cognitive tasks on postural control in healthy older adults

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Introduction

Posture is controlled by both higher “controlled” and lower “automatic” levels of processing¹. Studies demonstrate that an external focus of attention and the performance of a cognitive task while standing could potentially improve postural control. An internal focus urges an individual to focus on the production of their movement. Meanwhile, an external focus urges an individual to focus on the effect their movement has on an external device. Studies demonstrate that directing attention internally to control movement can disrupt postural control. However, an external focus and dual tasks remove the attention toward the movement, which allows automatic processes to take place, which seems to be more efficient in controlling posture².

The goals of this study were to evaluate the effect of internal and external focus and cognitive tasks on postural control and to observe the muscle activity of the lower leg in all conditions, which would determine whether changes in sway are due to an automatic process or co-contraction of the muscles of the ankle, known as stiffening. These findings could improve stability in an older population, who are at higher risk of falls.

Methodology

Twenty healthy older adults between the ages of 65 to 75 years performed 5 tasks while standing on a force platform:

1. Quietly standing (QS):

Standing on a force platform with feet together, while focusing on a target ahead.

2. Attentional tasks:

o Internal focus (IF):

Internally focusing on reducing the movements of the ankles.

o External focus (EF):

Externally focusing on reducing the movements of markers attached to the ankles. Two L-shaped devices were placed on the participants’ ankles; on each ankle, one metal strip was placed vertically on the leg and another one horizontally on the foot; both were linked at the ankle joint. Each metal strip was attached with Velcro straps and contained 3 markers.

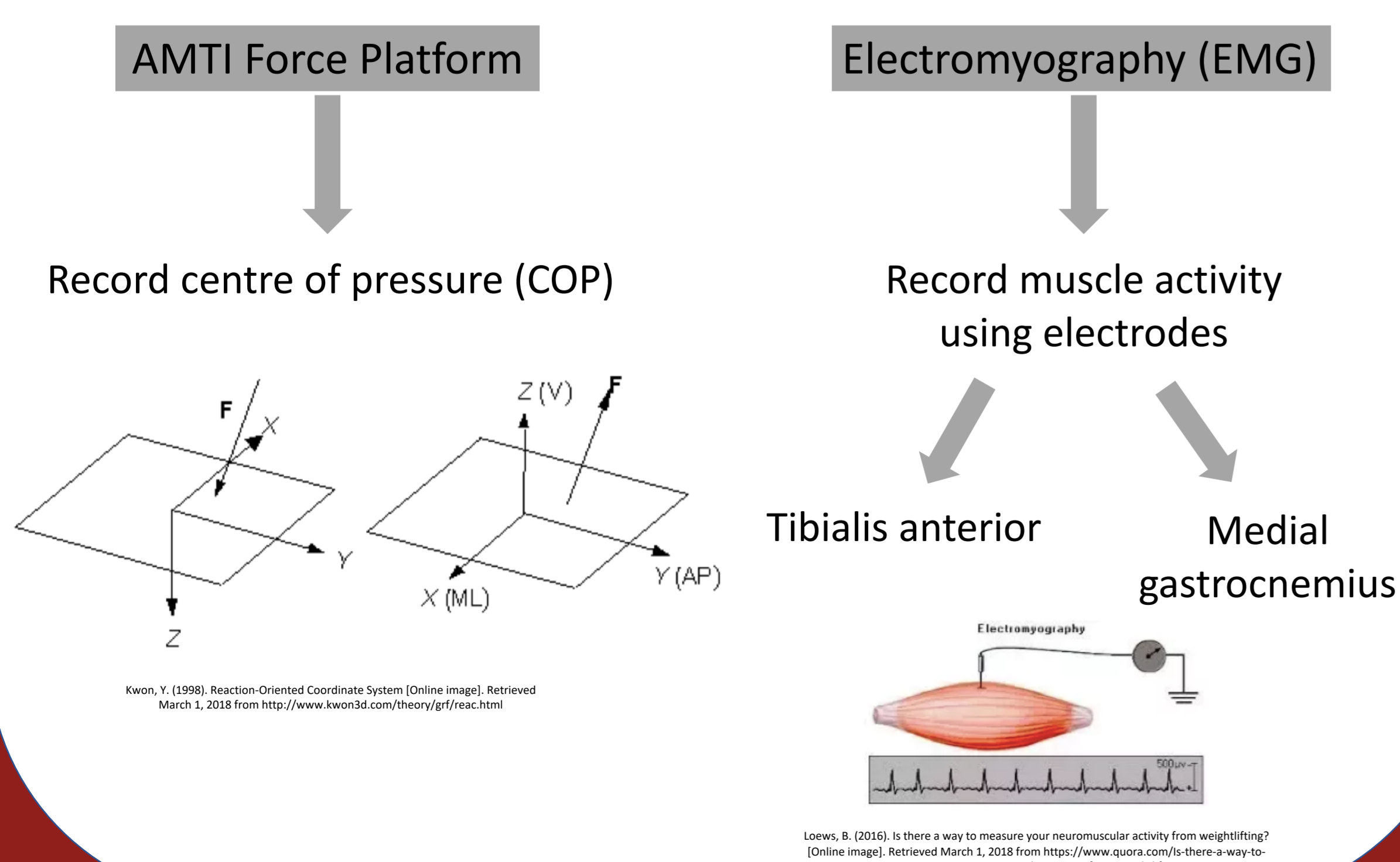
3. Cognitive tasks:

o Single Number Sequence (SNS):

Mentally counting the incidence of a digit in a number sequence.

o Double number sequence (DNS):

Mentally counting the incidence of 2 digits in a number sequence.



Results

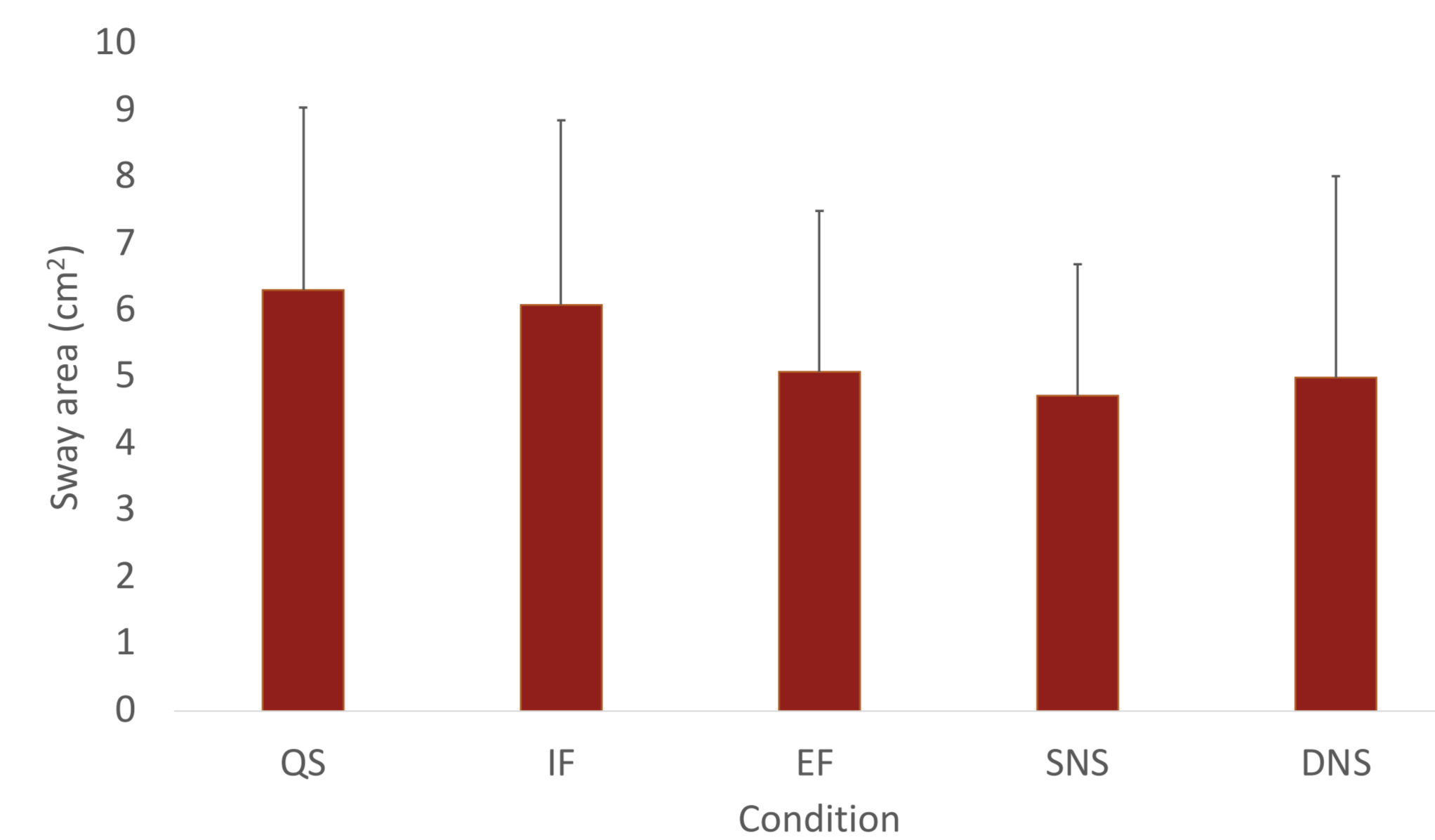


Figure 1. Sway area (cm²) of 5 conditions, in terms of the medio-lateral (ML) and anterior-posterior (AP) axis.

The sway area was significantly smaller in EF, SNS and DNS conditions. Larger sway size is characterized as a sign of postural instability³.

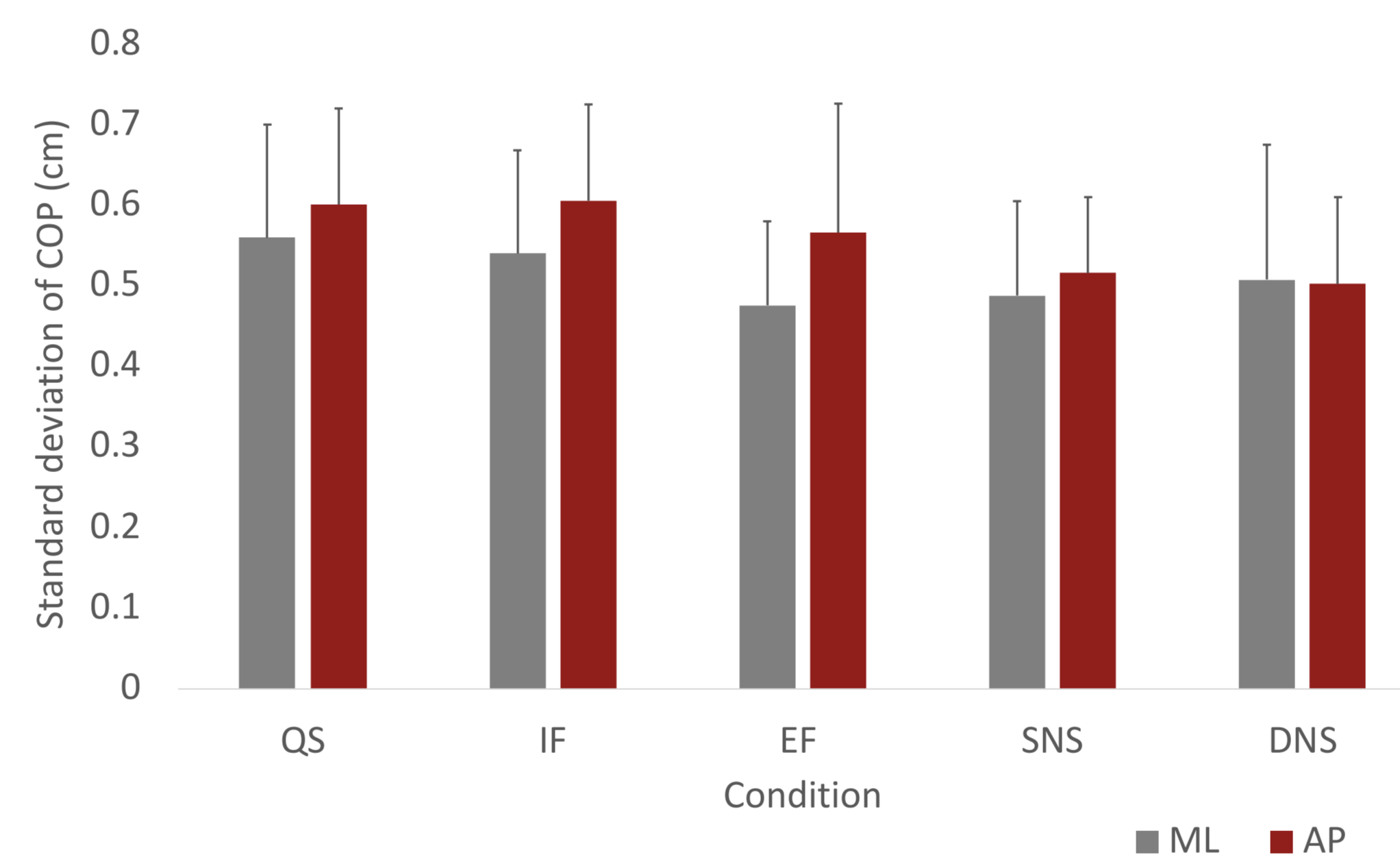


Figure 2. Standard deviation of the center of pressure (cm), indicating variability of postural sway, of 5 conditions in terms of the medio-lateral (ML) and anterior-posterior (AP) axis.

1. ML axis had a significant main effect of the SD of COP:

- o Standard deviation of COP was significantly smaller in EF, SNS and DNS conditions than in QS.
- o Standard deviation of COP was also significantly smaller in EF and SNS conditions compared to IF.

2. AP axis had a significant main effect of the SD of COP:

- o Standard deviation of COP was significantly smaller in SNS and DNS conditions than in QS and IF.

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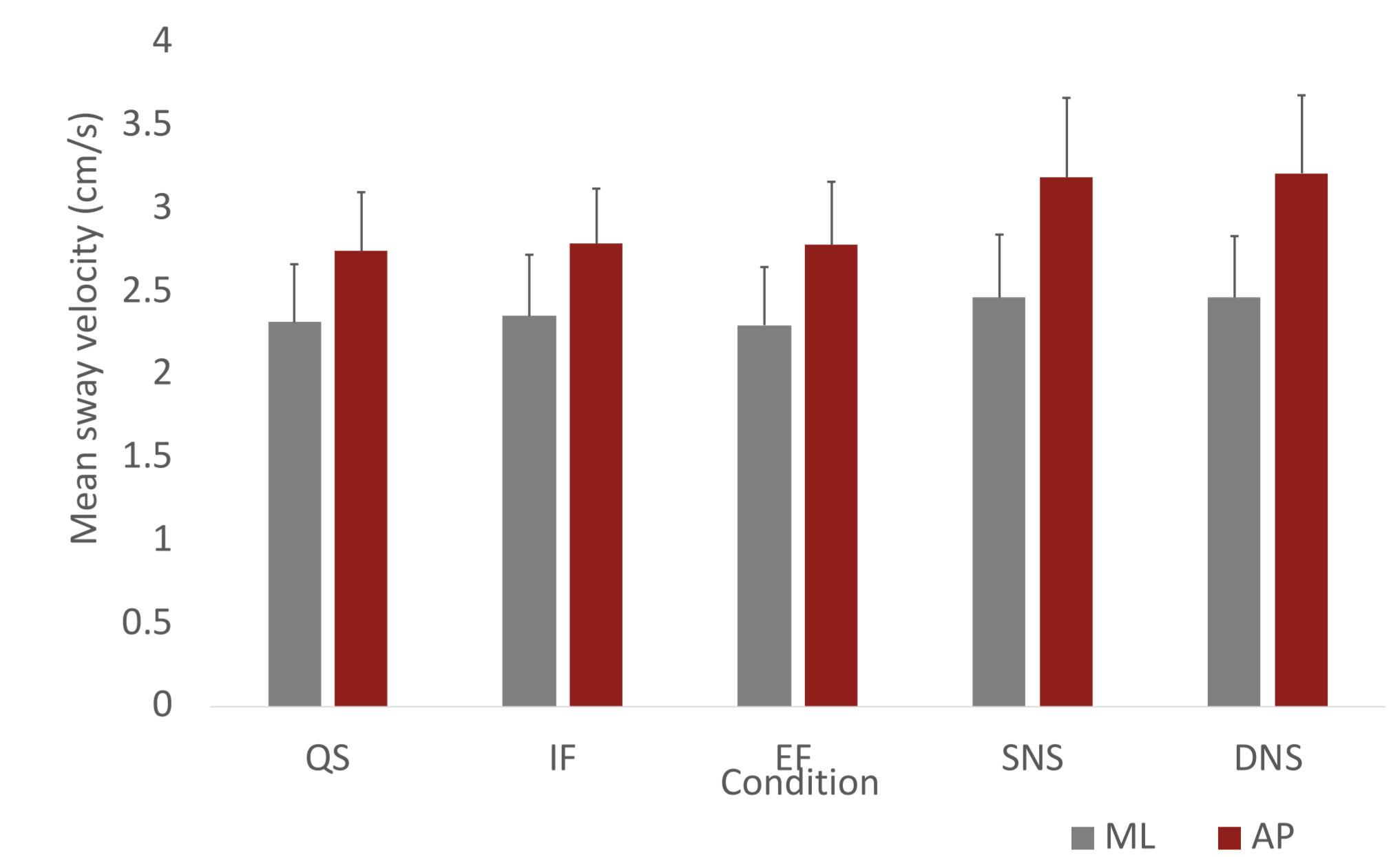


Figure 3. Mean sway velocity (cm/s) of 5 conditions, in terms of the medio-lateral (ML) and anterior-posterior (AP) axis.

1. ML axis had a significant main effect on mean velocity:

- o Mean velocity was significantly higher in SNS and DNS conditions than in QS, IF and EF.
- o Mean velocity was significantly lower in EF than in the IF condition.

2. AP axis had a significant main effect on mean velocity:

- o Mean velocity was significantly higher in SNS and DNS conditions than in QS, IF and EF.

The AP axis contains more sway since the ankle has more degrees of freedom in that direction.

Discussion

Postural stability was improved in external focus and cognitive tasks conditions compared to quiet standing and internal focus conditions. Since muscle activity in the tibialis anterior and medial gastrocnemius muscles did not change significantly for all conditions, improvements in postural control are likely due to an automatic process and not due to stiffening.

The sway area indicates no difference between the external focus and cognitive tasks conditions but the external focus did not have the same standard deviation of the center of pressure nor the same mean sway velocity than the cognitive task conditions. This indicates that the cognitive tasks use a more automatic strategy than the external focus condition, since no attention is placed on maintaining a certain posture. However, with an external focus, a small amount of attention is still placed on maintaining a certain posture, which is likely to interfere with the automatic process².

It would be interesting to study the effects of a long term cognitive task training program on postural stability on elderly participants.

References

1. Ghai, S., Ghai, I. & Effenberg, A. (2017). Effects of dual tasks and dual-task training on postural stability: a systematic review and meta-analysis. *Clinical interventions in aging*, 12, 557-577. doi: 10.2147/CIA.S125201
2. Bergamin, M., Gobbo, S., Zanotto, T., Sieverdes, J., Alberton, C., Zaccaria, M. & Ermolao, A. (2014). Influence of age on postural sway during different dual-task conditions. *Frontiers in aging neuroscience*, 6, 271. doi: 10.3389/fnagi.2014.00271
3. Yamamoto, T. (2015). Universal and individual characteristics of postural sway during quiet standing in healthy young adults. *Physiological reports*, 3(3). doi: 10.14814/phy2.12329