

Relationship between dynamic postural control ability with voluntary and passive sway and lower limb muscle activity

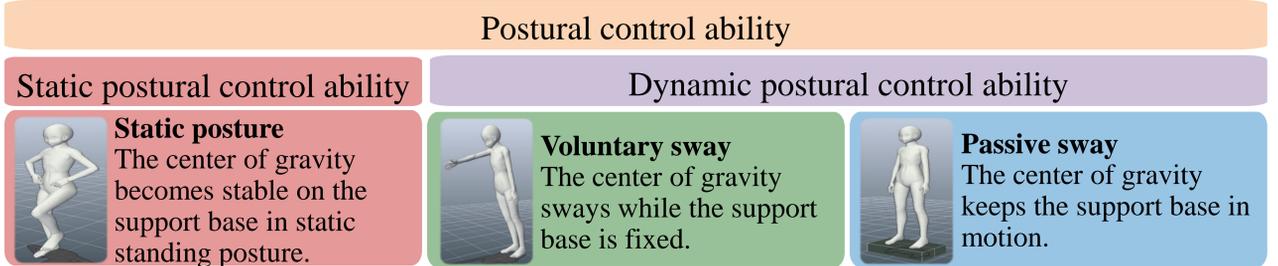
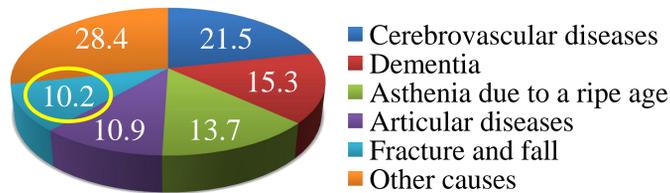
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Background

- Proportion of elderly individuals in Japan: 26% (2015)
- Bedridden period → 8.9 years (men), 10.2 years (women)

Percent distribution of main causes for requiring care



Dynamic postural control ability is necessary for fall prevention and preventive care in daily life.

PURPOSE We assessed the relationship between dynamic postural control ability and lower limb muscle activity by comparing younger and older adults.

Methods

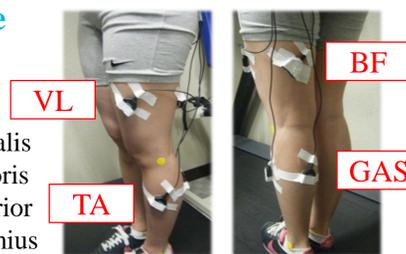
Subjects

	Old men (n = 5)	Young men (n = 5)
Age (years)	74.2 ± 8.2	22.2 ± 0.7
Height (cm)	164.3 ± 3.9	173.8 ± 5.2
Weight (kg)	63.3 ± 5.4	72.8 ± 12.4
Foot length (cm)	23.7 ± 0.4	25.5 ± 1.0

Surface EMG: EMG is expressed in % RMS when setting RMS of the maximum voluntary contraction to 100%.

Target muscle

VL: vastus lateralis
BF: biceps femoris
TA: tibialis anterior
GAS: gastrocnemius



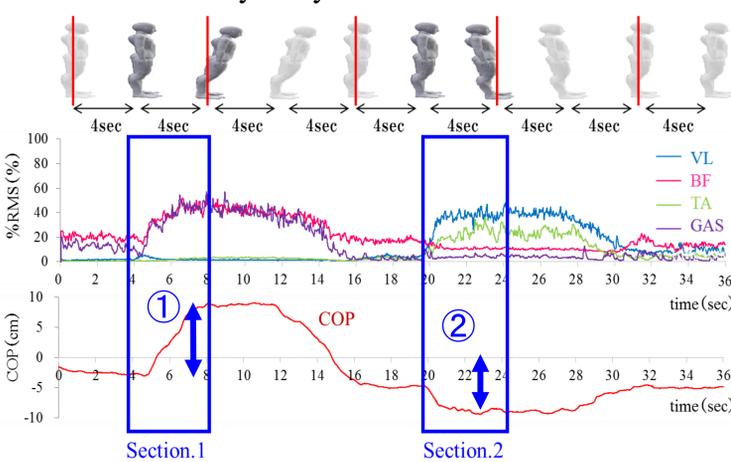
Measure of dynamic postural control ability

- We measure dynamic postural control ability with the center of pressure on the stabilometer or unstable tilt board.
- The unstable tilt board inclines front and back. It has a built-in sensor to measure direction and degree.

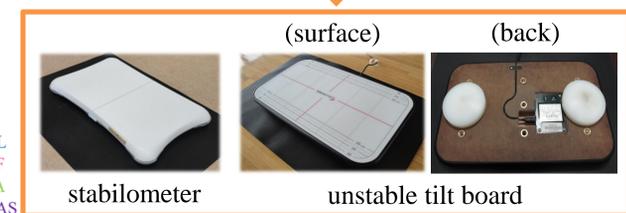
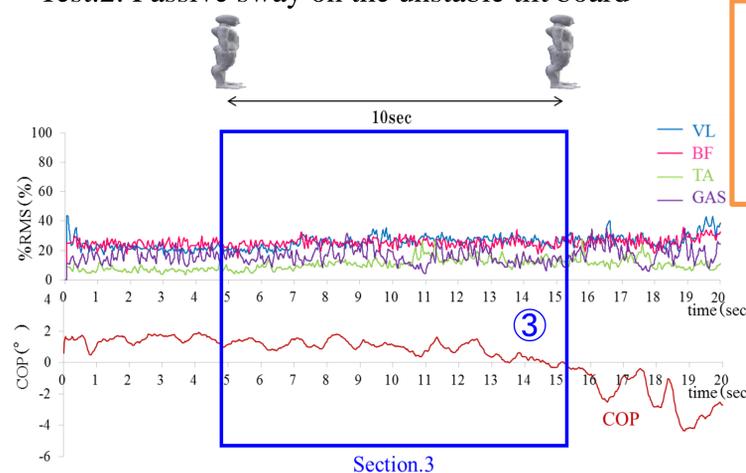


Protocol and Assessment

Test.1: Voluntary sway on the stabilometer

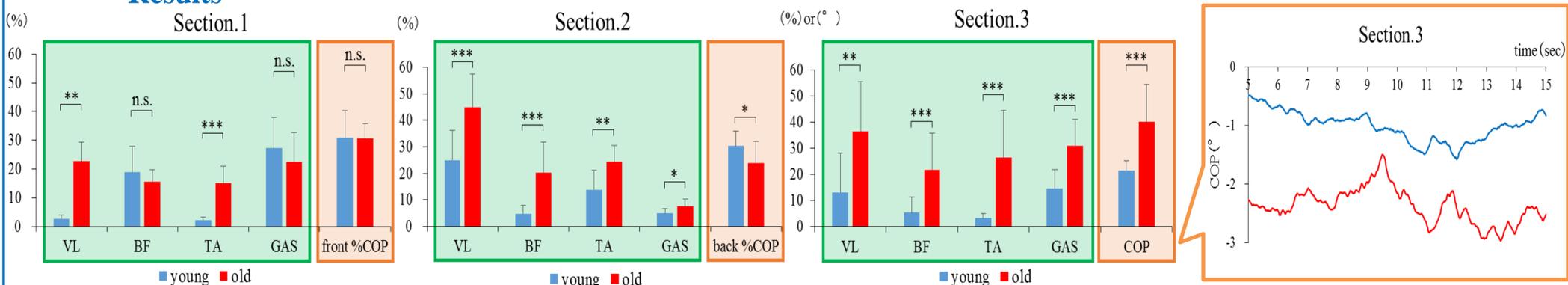


Test.2: Passive sway on the unstable tilt board



- ①: front % COP (%)
(= front COP sway/foot length)
- ②: back % COP (%)
(= back COP sway/foot length)
- ③: COP (°)

Results



Discussion

Section.1: Agonist (BF•GAS) • Antagonist (VL•TA)

- Front % COP is not different between younger and older adults, but muscle activity patterns are different.
- Younger: Reciprocal inhibition (Agonist ↑ • Antagonist ↓) ⇒ increase the degree of freedom of joint (mobility)
- Older: Co-contraction (Agonist ↑ • Antagonist ↑) ⇒ increase the stiffness of joint (stability)

Section.2: Agonist (VL•TA) • Antagonist (BF•GAS) / Section.3: Agonist (BF•GAS) • Antagonist (VL•TA)

- Back % COP and COP are better in younger adults than in older adults; older adults sway back with large amplitude.
- ⇒ The typical standing posture of older adults has a center of gravity in the back.
- Older adults increased lower limb muscle activity more than younger adults and used a hip strategy. ⇒ Older adults got worked up.

Conclusion

- Older adults compensate for the decline in dynamic postural control ability by increased lower limb muscle activity and a hip strategy.
- Voluntary sway to the front showed a trend of co-contraction. ⇒ increase of energy cost.
- Older adults used a hip strategy in unfamiliar conditions such as voluntary sway to the back and passive sway on an unstable surface. ⇒ increase of fall risk.
- Exercise training should involve not only increasing muscle mass but also conditioning to relax the muscles for fall prevention; they should possibly shift from a hip strategy to an ankle strategy.