Gait symmetry and neuro-myofasical activity

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INTRODUCTION

Acute effects on gait symmetry despite knee pain

Knee pain often results in asymmetric gait pattern and limping. In these cases, single-legged exercises on unstable surfaces have shown positive outcomes as therapy intervention. Therefore, we assumed that walking in soft-elastic footwear may induce the same positive effects on gait symmetry. Our everyday experience has so far supported our assumption, scientific evidence, however, is insufficient.

The goal of this first pilot study was therefore to evaluate the acute effect of walking in shoes with a soft-elastic sole construction on gait symmetry in patients recovering from various knee injuries.

METHODS

- Eight middle-aged patients (5 ♀, 3 ♂), recruited at group therapy for knee patients
- Asymmetrical gait patterns due to various orthopedic pathologies
  - Knee osteoarthritis
  - Knee arthroplasty
  - ACL reconstruction
  - Unhappy triade
- Two shoe conditions in randomized order
  - Own shoes (Control shoe)
  - kybun, Slimfit sole (soft-elastic shoe)

- 40m walking trials with self-selected walking speed
- 3d-accelerometer (ADXL365) connected to a mobile data logger (MSR 160), fixed to L5/S1 at the lower back
- 3D-acceleration data recorded at 1024Hz (figure 1)
- Autocorrelation calculated on cranio-caudal and anterior-posterior acceleration signals
- Gait symmetry index calculated by division of peak 3 (ipsilateral overlap) and peak 4 (contralateral overlap) (figure 2)
- Gait symmetry index of 1.0 represents perfect gait symmetry, an index of 0 represents no symmetry

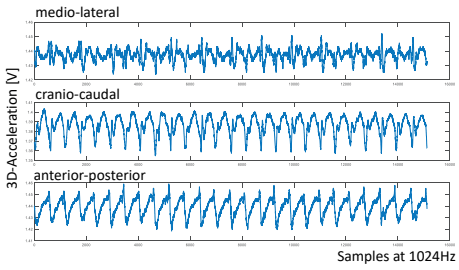

Fig. 1. Exemplary signals of 3D-accelerometer measurements. Gait cycles are easily detectable in cranio-caudal and anterior-posterior acceleration signals. Medio-lateral acceleration shows a less cyclic pattern.

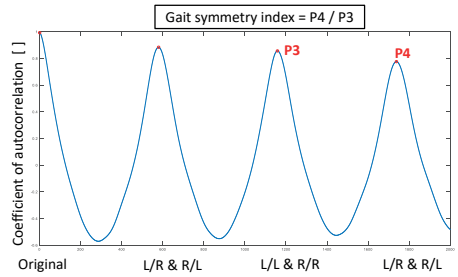

Fig 2. Coefficients of autocorrelation over time showing peaks for ispilateral (P3) and contralateral (P4) step-overlapping which were used to calculate the gait symmetry indices.

RESULTS

- All patients showed moderate to high gait asymmetries with low symmetry indices between 0.650 and 0.952.
- In 7 of 8 comparisons, anterior-posterior gait symmetry indices were higher in soft-elastic shoes than in participants own shoes (fig. 3, left)
- In 6 of 8 comparisons, cranio-caudal gait symmetry indices were higher in soft-elastic shoes than in participants own shoes (fig. 3 right)

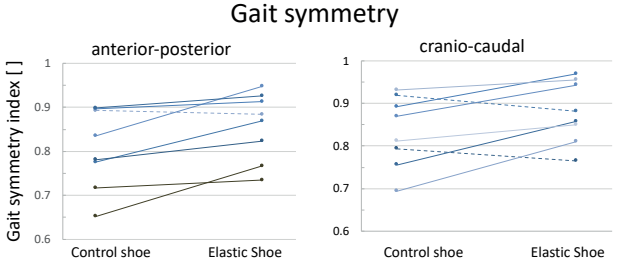

Fig. 3. Acute effect of soft-elastic shoes on gait symmetry index for all tested subjects. Solid lines: more symmetrical gait in elastic shoes, dashed lines: less symmetrical in elastic shoes.

CONCLUSION

Walking in soft-elastic shoes resulted in higher gait symmetry in 81% of all inner subject comparisons than walking in regular shoes. An explanation for this finding might be found in the physical properties of the soft-elastic material. In contrast to the heel strike with rather stiff shoes, the heel deforms the 2 cm thick soft-elastic material under the heel and, thus, the time to maximum impact is delayed. Consequently, the myofascial structure has considerably more time (up to 4 times more) to generate the necessary stiffness to support the impact. Instead of being "shocked" into a passive gait pattern response, the activated myofascial control mechanisms may help to disturb manifested asymmetric gait pattern. Additionally, the elastic characteristic of the sole material keeps the sensomotoric input steady during midstance and push-off forcing the myofascial system to be active constantly and, consequently, generating a new gait pattern. This new gait pattern may overwrite the existing asymmetric gait pattern and thereby reduce the patients' limping.

This pilot study indicates a positive effect of soft-elastics shoes on asymmetric and limping gait patterns due to knee injuries and knee pain. Various assumptions are needed to explain the observed effects, thus, systematic follow-up studies are planned to bring further insight into this effect.

References

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