The effects of proprioceptive insoles on postural stability in the elderly population : a narrative review

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Introduction

Instability in elderly

Falls are a common cause of injury in the elderly population. Every year, one third of individuals aged 65 and above fall and 30% suffer moderate to severe injuries such as hip fractures[1]. These injuries often lead to diminished function and quality of life[2].

- Age is strongly associated with decreased peripheral somatosensory function[2,3,4,5].
- Plantar mechanoreceptors of the foot are essential in providing information about the body's position to the brain[2].
- Therefore, sensory impairments can lead to lack of adaptive postural response, imbalance and ultimately increase risk of falling[2,3,4,5].

Proprioceptive foot insoles, particularly textured and vibratory, could improve postural stability by increasing mechanoreceptor stimulation[2,3,4,5,6,7].

Old age → Sensory loss of the foot → ↓ Postural control → ↑ Risk of falling

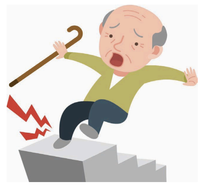


Fig. 1: Decreased foot sensation leads to risk of falling in elderly.

Objective

Determine the effects of proprioceptive insoles on postural stability in the elderly population.

Methodology

A literature review was performed using Pubmed.
Keywords: elderly, foot insoles, textured, vibratory, postural stability, center of pressure (CoP).
Inclusion criteria: healthy elderly, >65 years old.
Exclusion criteria: neurological disorders, foot ulcers, injuries that could interfere with standing.
Outcome measures: CoP displacement in anteroposterior (AP) and mediolateral (ML) directions, CoP sway area and velocity.

Fig. 2: Article selection process based on inclusion and exclusion criteria.

After reading titles: 15 retained → After reading abstracts: 10 retained → After reading articles: 6 retained

Interventions

Textured insoles

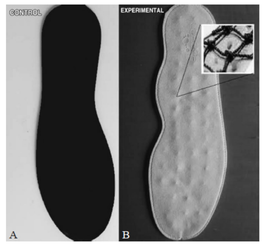


Fig. 3: A. Smooth insole. B. Textured insole embedded with small granulations stimulate plantar mechanoreceptors[2].

Vibratory insoles

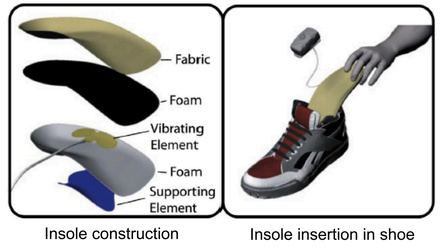
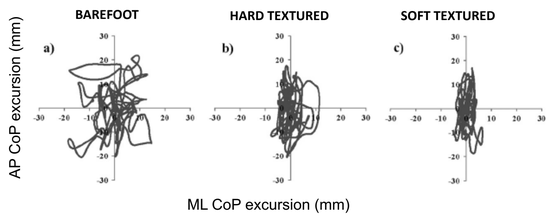


Fig. 4: Subthreshold mechanical vibration applied plantar to the foot amplifies and increases the detection of weak pressure signals[3].

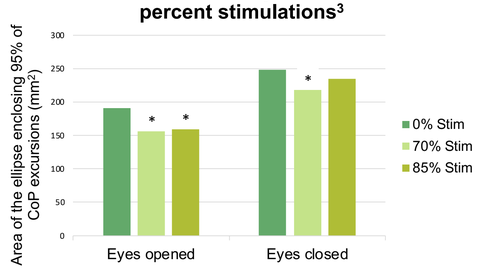
Results

Fig. 5: The effect of textured insoles on CoP displacement with eyes closed on a foam surface[5]



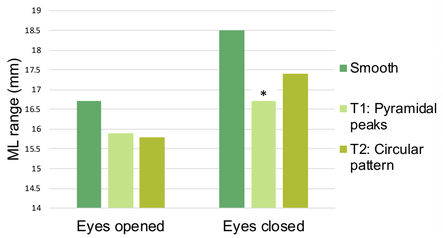
Significant decrease in area of CoP sway and ML sway from barefoot to the hard to the soft insole surface (Qiu et al., 2012).

Fig. 6: The effect of vibratory insoles on area of CoP sway with different percent stimulations[3]



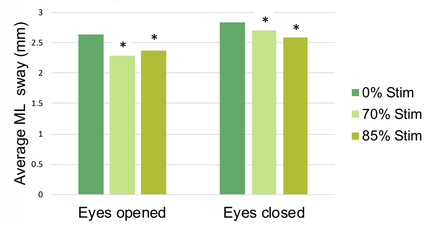
* Vibratory insoles decrease area of CoP sway in both visual conditions. Significance was observed only with 70% stimulation for eyes closed condition (Lipsitz et al., 2015).

Fig. 7: The effect of textured insoles on ML range[6]



* Textured insoles with pyramidal patterns decrease ML range in eyes closed condition (Hatton et al., 2011).

Fig. 8: The effect of vibratory insoles on ML sway with different percent stimulations[3]



* Vibratory insoles in both levels of stimulation decrease ML sway in both visual conditions (Lipsitz et al., 2015).

In addition, Annino et al. (2018) found that textured insoles significantly decrease net CoP velocity and velocity in the ML direction in eyes closed condition compared to baseline value with no insoles.

Discussion

Textured and vibratory insoles can improve standing postural stability in the elderly population. This is represented by the reduced CoP displacement mainly in the ML direction, decreased area of CoP sway and velocity during standing especially when stability is challenged (eyes closed).

Limitations

- Small sample sizes (N=12-50);
- Use of different vibratory insole devices and stimulation levels;
- Inconsistent methodology;
- Inconsistent experimental and control conditions.

Fig. 9: Enhancing somatosensory information perceived by the foot increases sensory feedback and stability[2,5].

Proprioceptive insoles → ↑ Sensory information from the foot → ↑ Sensory feedback → ↑ Postural stability

Conclusion

The studies have shown an improvement in multiple postural stability parameters in standing position during challenging conditions. This includes a decreased CoP displacement in the ML direction which is a strong predictor for falls[2,3,6].

Clinical implication

Proprioceptive insoles could potentially be an inexpensive, accessible and convenient mean to enhance stability in an elderly population at high risk of falling. Further quality research is required to confirm the findings and evaluate long term efficacy in fall prevention.

References

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