

Spatiotemporal Gait Asymmetry Distinguishes Fallers and Non-Fallers in Below Knee Amputees

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Below Knee Amputees (BKA)

Population

- Average age of 50
- Causes include trauma, disease, and birth defects (Ephraim, 2017)

Expected Growth

- Double to 3.6 million by 2050
- Risk increases with age (Wong, 2016)



Falls

Higher fall risk

- Decreased balance and balance confidence
 - Diminished strength and lack of surrounding musculature
 - Limitations of the lower limb prosthetic's fabrication and alignment
- (Wong, 2016).

Associated with

- In 2015, \$50 billion in medical costs (Florence, 2018)

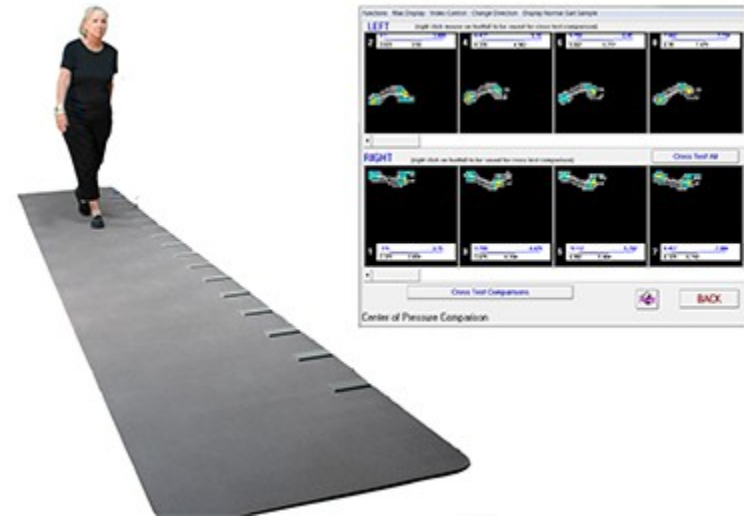
Spatiotemporal Gait Asymmetry

Symmetry ratios

- Step length
- Swing time
- Stance time

GAITRite system

- 4.3 m pressure sensitive walkway



(Lutz, 2017)

Research Objective

The study was performed to investigate differences between spatiotemporal gait patterns, functional mobility, and balance confidence among unilateral BKA fallers and non-fallers.

Methodology

Equipment and Procedure

- Participants completed 5 walking trials, at a self-selected speed, on a 4.3 m GAITRite system.
- Step length, swing time, and stance time for each limb were collected. Symmetry ratios between limbs were calculated between the prosthetic and non-prosthetic limbs.
- Self-reported falls within the past 12 months.

Physical tasks

- Timed Up and Go (TUG) test measuring mobility and fall risk.

Methodology

Questionnaire

- Activity-Specific Balance Confidence (ABC) questionnaire measuring balance confidence in daily activity.

Statistical analysis

- Independent t-tests were performed to compare means of the BKA fallers and the non-fallers.
 - TUG test
 - ABC questionnaire
 - Symmetry ratios

Results

Table 1. Below-knee-amputee patient characteristics between fallers and non-fallers.

Characteristics of Patients			
Participants	n = 26	mean \pm SD	
	Faller (≥ 2 falls), Nonfaller (≤ 1)	Fallers (14)	Non-fallers (12)
Demographics	Age (years)	43.75 \pm 9.31	45.5 \pm 8.79
	Height (cm)	177.76 \pm 9.20	177.73 \pm 6.37
	Weight (kg)	92.78 \pm 15.99	94.05 \pm 18.34
	BMI (kg/m ²)	29.20 \pm 3.35	30.95 \pm 5.11
Physical Task	TUG Test (s)	12.14 \pm 2.65	8.463 \pm 1.09
Questionnaires	ABC (/100)	77.36 \pm 10.97	87.77 \pm 13.71

Results

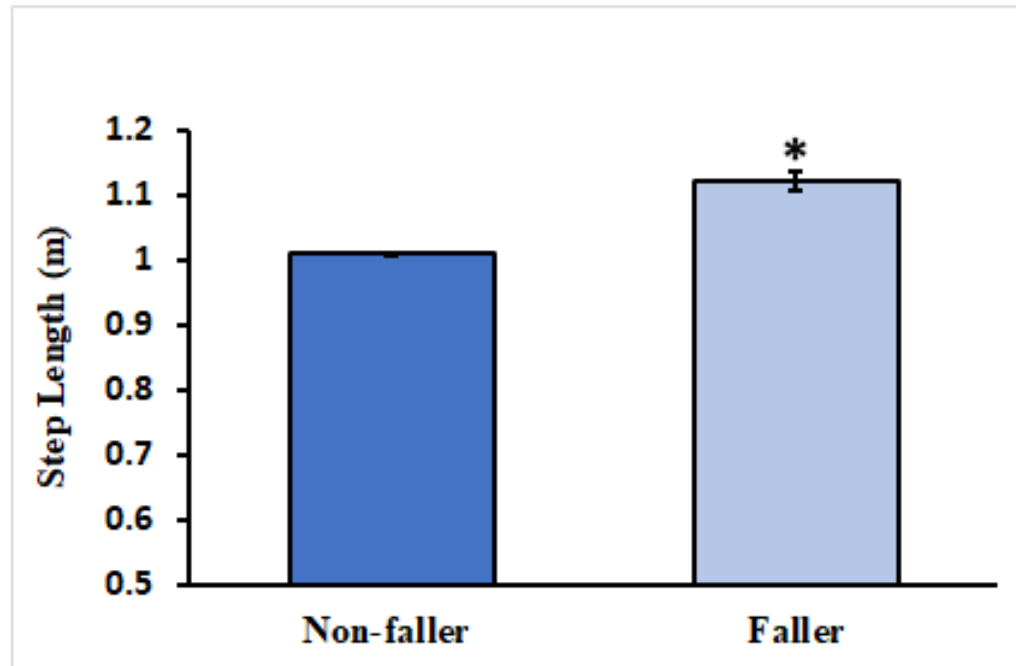


Figure 1. Mean step length asymmetry values between non-faller and faller BKA ($t_{24} = -6.592$, $p = .000^*$). Error bars represent the standard error of the mean. An asterisk (*) represents a significant difference between groups ($p < .05$).

Results

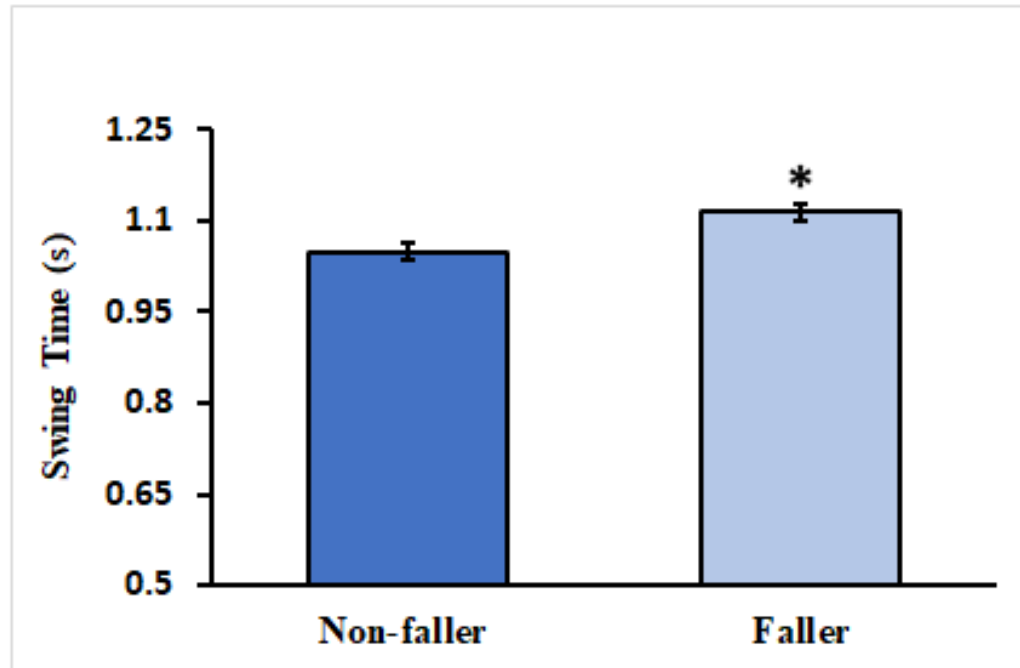


Figure 2. Mean swing time asymmetry values between non-faller and faller BKA ($t_{24} = -3.188$, $p = .004^*$). Error bars represent the standard error of the mean. An asterisk (*) represents a significant difference between groups ($p < .05$).

Results

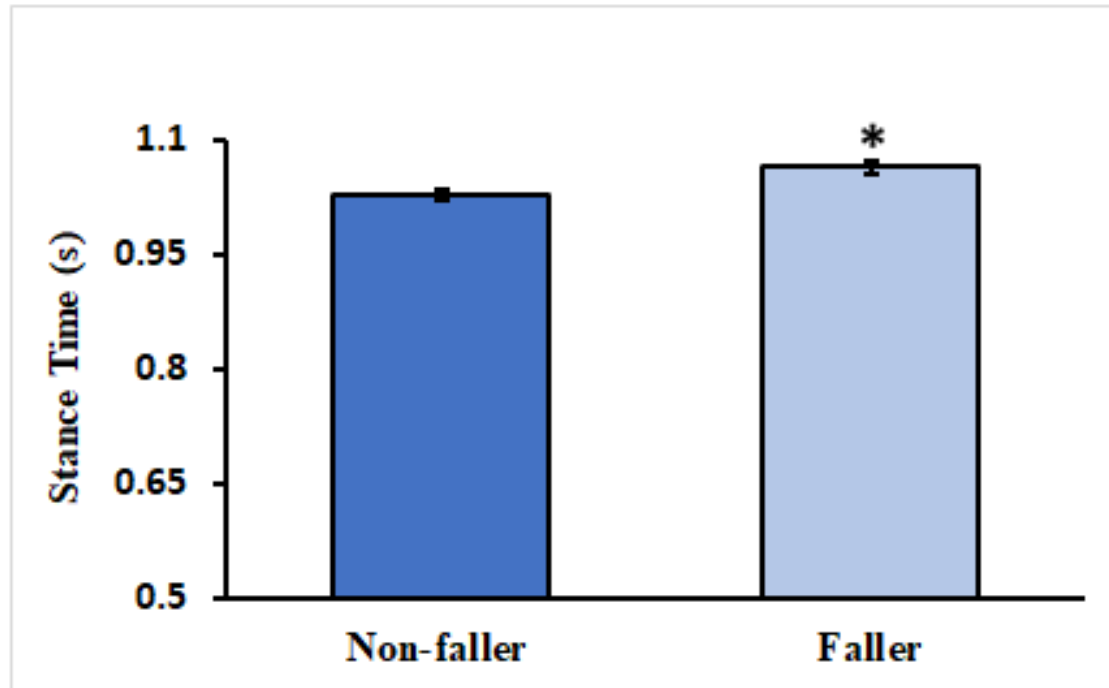


Figure 3. Mean stance time asymmetry values between non-faller and faller BKA ($t_{24} = -3.131$, $p = .005^*$). Error bars represent the standard error of the mean. An asterisk (*) represents a significant difference between groups ($p < .05$).

Results

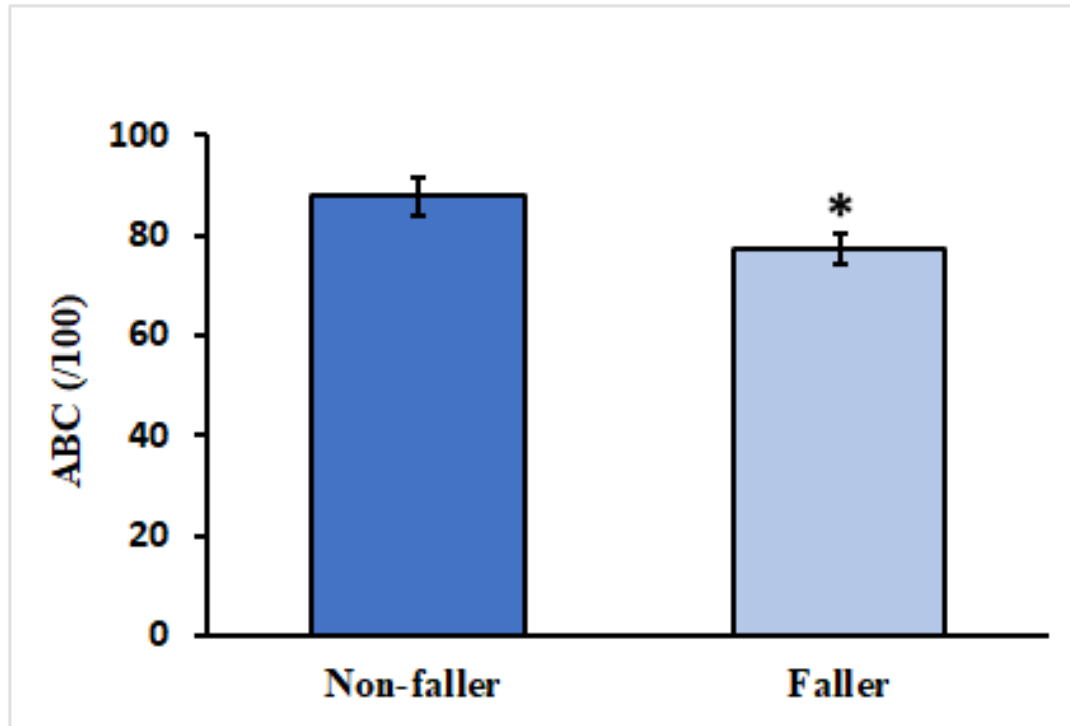


Figure 4. Mean balance confidence (ABC) values between non-faller and faller BKA ($t_{24} = 2.152$, $p = .042^*$). Error bars represent the standard error of the mean. An asterisk (*) represents a significant difference between groups ($p < .05$).

Results

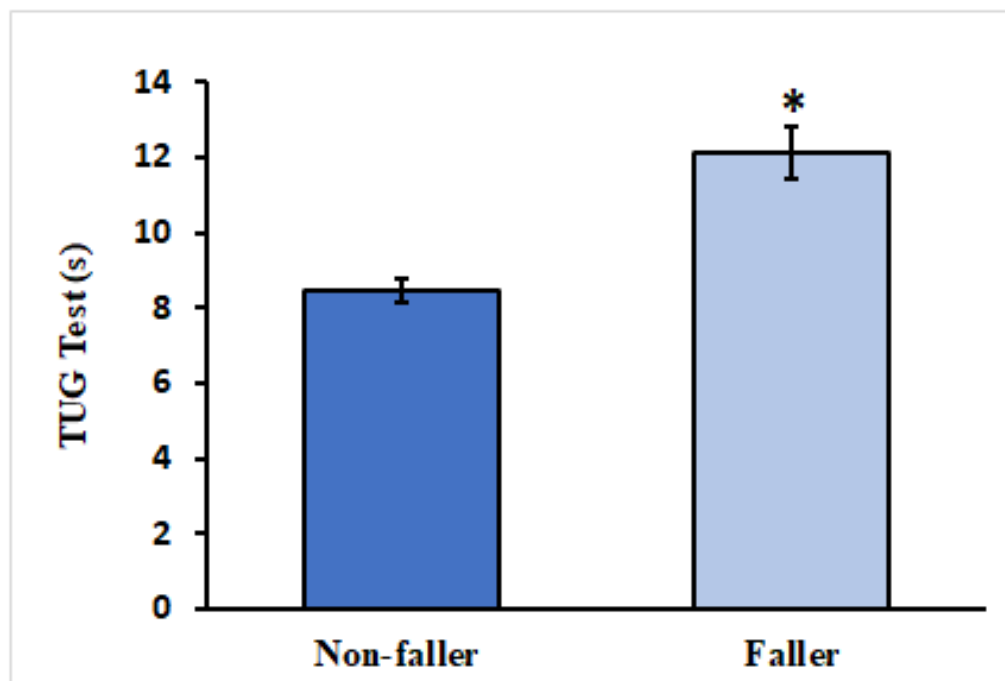


Figure 5. Mean Time Up and Go (TUG) Test between non-faller and faller BKA ($t_{24} = -4.472$, $p = .000^*$). Error bars represent the standard error of the mean. An asterisk (*) represents a significant difference between groups ($p < .05$).

Discussion

- BKA fallers had increased gait asymmetry compared to the non-fallers, which may be attributed to prosthetic alignment, as well as acquired gait changes because of diminished strength, and range of motion.
- These results suggest that spatiotemporal asymmetry could be useful in distinguishing prospective fallers from non-fallers among BKA.

Conclusion

- These findings should be used by clinicians to identify BKA at a greater risk of falling, and specific functional and psychological interventions should be considered for these individuals to improve gait asymmetry, functional mobility, and balance confidence (Pirker, 2017).

Limitations

- Lack of potentially pertinent medical information obtained at initial assessment.
- Manufacture and fabrication of the prosthesis used.
- Similar statistical analysis should be repeated with a larger sample size.

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Questions?