

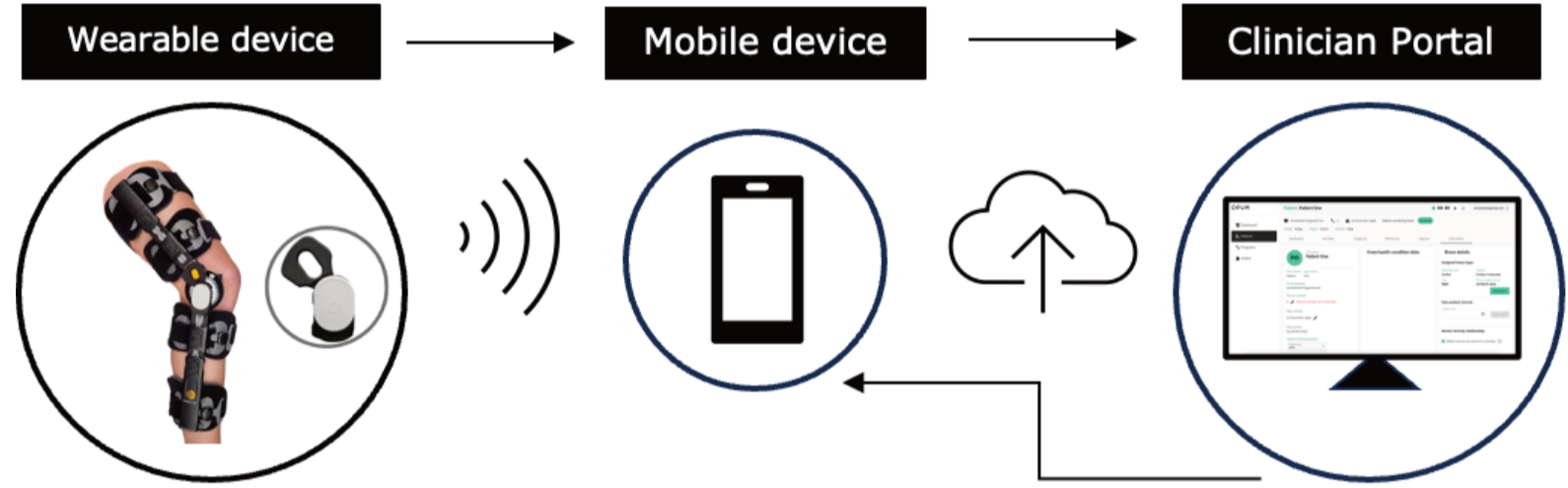
Towards Personalised Orthopaedic Care: Validation of the Digital Knee

Annah McPherson

Department of Exercise Sciences, The University of Auckland
Supervisors: Sarah Ward, Andrew McDaid

The Digital Knee®

- Recent advancements in wearable technology has enabled the digitisation of parts of the rehabilitation care pathway.^{1,2}
- OPUM Technologies have developed the Digital Knee® wearable sensor (an integrated accelerometer and goniometer) embedded into a commercially available knee brace which is paired with the OPUM Lab mobile application.
- Validation of gait metrics from the Digital Knee® against a gold standard system GAITRite® is required.^{3,4}

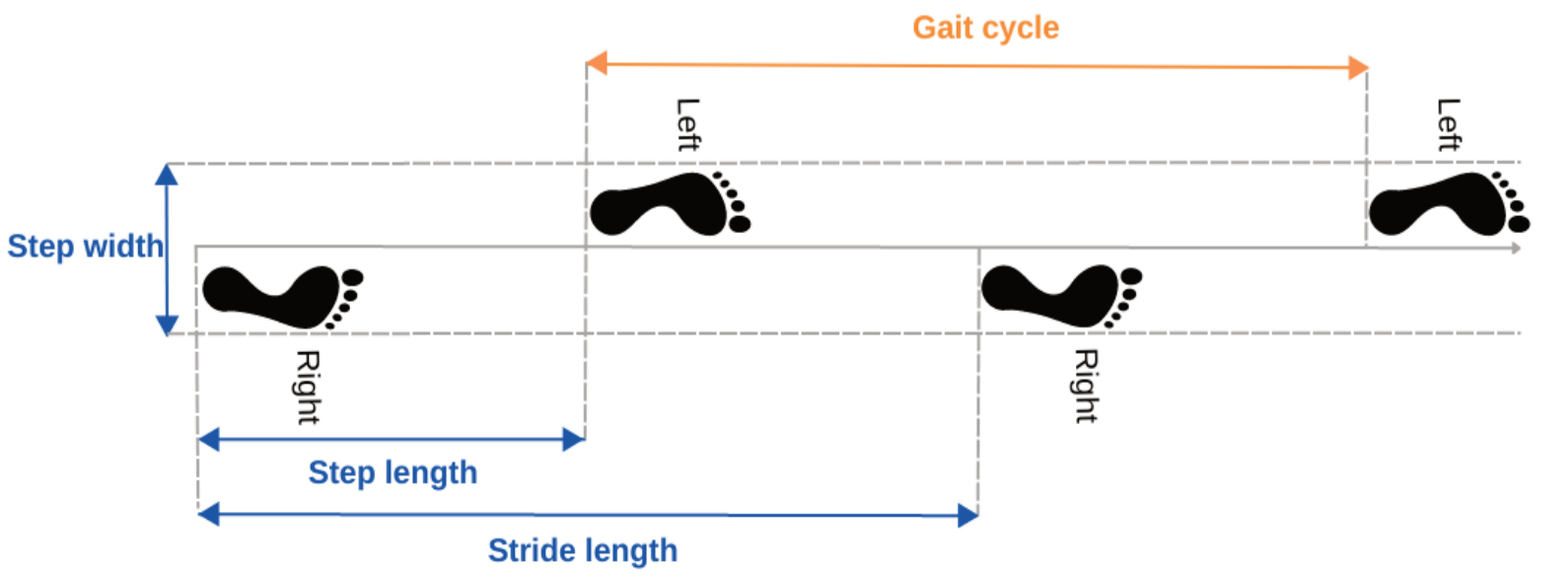


Aim

- To determine the level of agreement of the OPUM Digital Knee® wearable with the gold standard measurement system GAITRite®, for assessing lower limb gait metrics.

Methods

- 34 healthy participants were fitted with the OPUM Digital Knee® on their dominant limb.
- Walk over the GAITRite®, twice at normal walking speed, twice at fast walking speed.
- Outcomes: Stride length, stride time, gait speed.
- Parameters from Digital Knee® compared to that of GAITRite® using Bland Altman plots (mean bias, LOA, PE) and ICC_{2,1} to determine agreement and concurrent validity of the two measurement systems.



The Digital Knee® is a valid tool for assessing lower limb gait metrics.



OPUM clip-on Digital Knee® which connects via Bluetooth to a mobile device and stores data in the **Digital Knee Lab**

Corflex Contender Post-op Knee Brace®

Hinge with adjustable ROM to support the knee post-operatively ROM -10° to 100°

Quick-release buckles and adjustable straps to optimise fit and comfort

Adjustable brace length

OPUM

amcp632@aucklanduni.ac.nz

Results

Table 1. Test-retest agreement and concurrent validity between the OPUM Digital Knee® and GAITRite® for measuring spatiotemporal gait parameters.

Spatiotemporal Gait Parameter	OPUM Digital Knee® Mean (±SD)	GAITRite® Mean (±SD)	Agreement			Validity	
			Bias* Mean Difference (±SD)	95% LOA	PE (%)	ICC _(2,1)	95% CI
Comfortable Gait Speed							
Gait velocity (m/s)	1.36 [±0.17]	1.38 [±0.21]	0.02 [±0.21]	-0.39 to 0.42	30	0.41	[0.20, 0.59]
Stride length (m)	1.53 [±0.13]	1.48 [±0.15]	-0.04 [±0.17]	-0.38 to 0.29	22.1	0.29	[0.00, 0.44]
Stride time (s)	1.13 [±0.09]	1.10 [±0.09]	-0.04 [±0.08]	-0.17 to 0.10	14.1	0.66	[0.41, 0.80]
Fast Gait Speed							
Gait velocity (m/s)	1.65 [±0.26]	1.94 [±0.25]	0.28 [±0.39]	-0.49 to 1.05	42.6	-0.16	[-0.36, 0.08]
Stride length (m)	1.63 [±0.13]	1.79 [±0.18]	0.15 [±0.23]	-0.31 to 0.61	26.4	-0.04	[-0.21, 0.15]
Stride time (s)	1.01 [±0.14]	0.92 [±0.06]	-0.08 [±0.16]	-0.38 to 0.22	32.5	-0.01	[-0.20, 0.2]

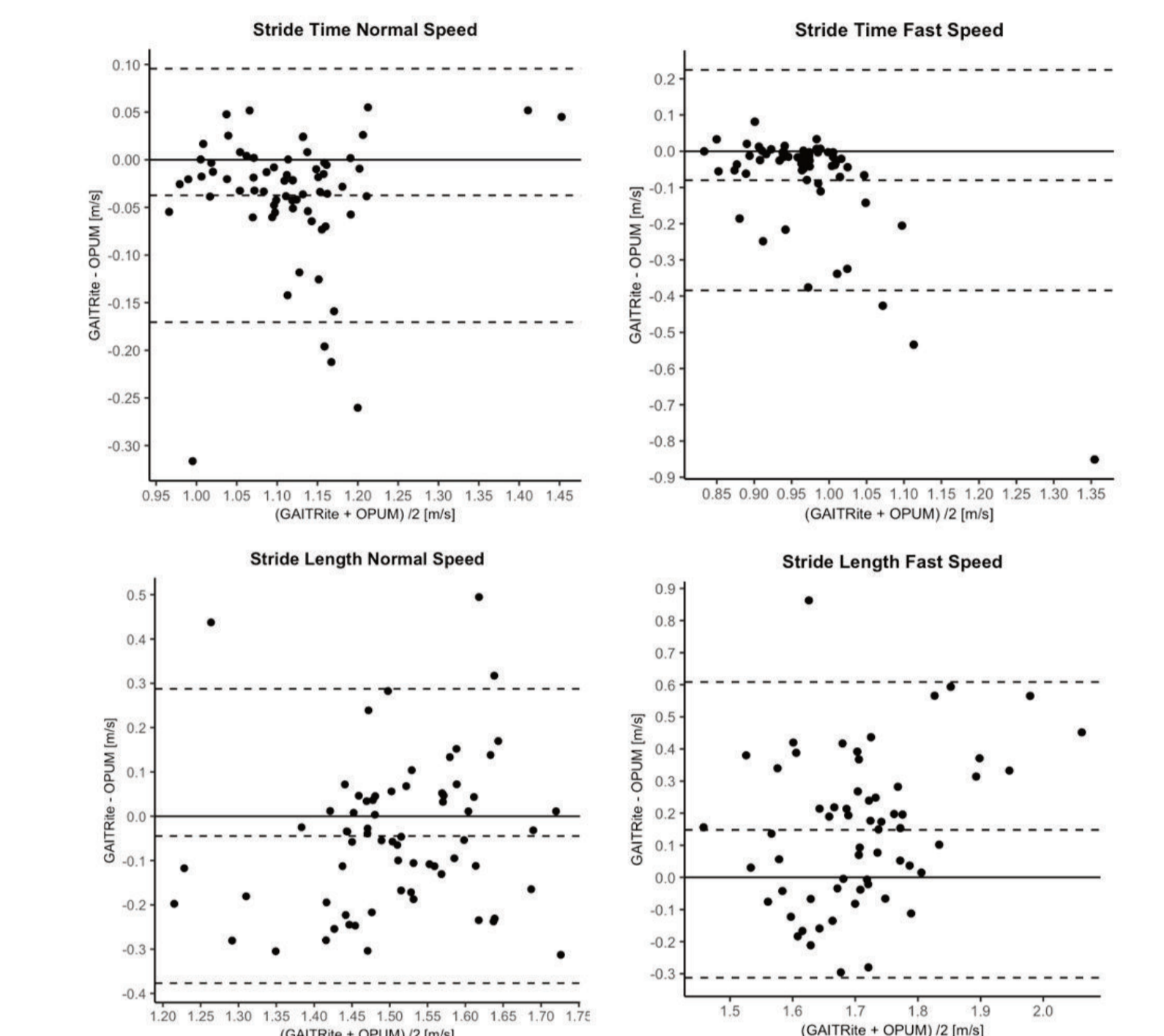


Figure 1. Bland-Altman plots representing the comparison of agreement between the OPUM Digital Knee® and the GAITRite® gait analysis measurements. Dotted lines indicate bias and dashed lines indicate the upper and lower 95% limits of agreement.

Conclusions

- Stride time was moderately valid (ICC_{2,1} = 0.66s), stride length and gait velocity demonstrated poor validity at a comfortable walking speed (ICC_{2,1} = 0.29m; 0.41m/s).
- All gait parameters demonstrated poor validity at a fast-walking speed (ICC_{2,1} = -0.16 to -0.01).
- The wearable sensor can be used to measure spatiotemporal gait parameters at comfortable walking speeds.

Future Directions

- This was a laboratory-based study, thus, assessing the device in a real-world environment is warranted.
- Validate the Digital Knee® in patients with knee pathologies.
- A different algorithm is required for fast walking speed in the OPUM Digital Knee®.

References

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