

Assessment of knee muscle performance in para-athletes with unilateral transtibial amputation

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INTRODUCTION & AIM

Unilateral transtibial amputation can (TTA) lead to persistent knee muscle deficits and inter-limb asymmetry, which may vary with contraction velocity and differ between flexors and extensors. Quantifying velocity-specific torque deficits, ILA patterns, and H/Q balance in para-athletes is essential for targeted strength profiling and interpretation against intact-limb reference values.

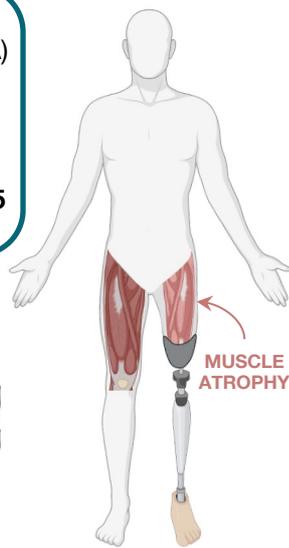
AIM

- 1 Quantifying prosthetic-limb peak torque deficits across 60–300°·s⁻¹
- 2 Mapping velocity-dependent inter-limb asymmetry (ILA) for flexion and extension
- 3 Assessing H/Q ratio as an index of relative flexor vs extensor preservation
- 4 Reporting intact-limb PT reference values (n=8)

METHOD

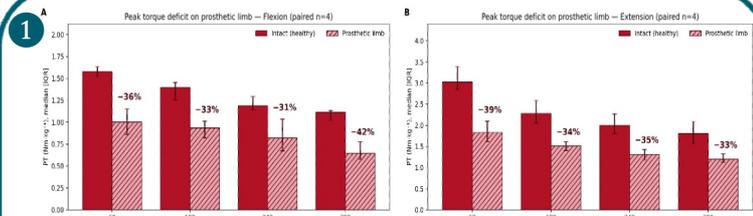
Cohort snapshot

Eight male para-athletes (unilateral TTA)
 Weight (no prosthesis): **68.9 ± 7.9 kg**
 BMI: **22.9 ± 1.9**
 Height: **172.9 ± 7.2**
 Amputation → prosthetic gait: **4.4 ± 1.5 months**

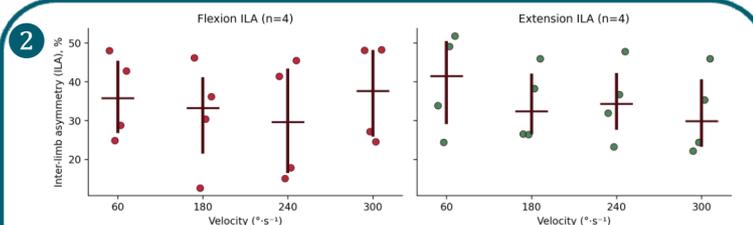


Concentric knee flexion/extension was assessed by **Isomed 2000** dynamometer at **60, 180, 240, and 300°·s⁻¹**.

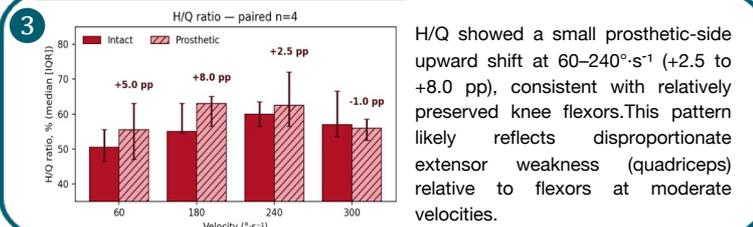
RESULTS & DISCUSSION



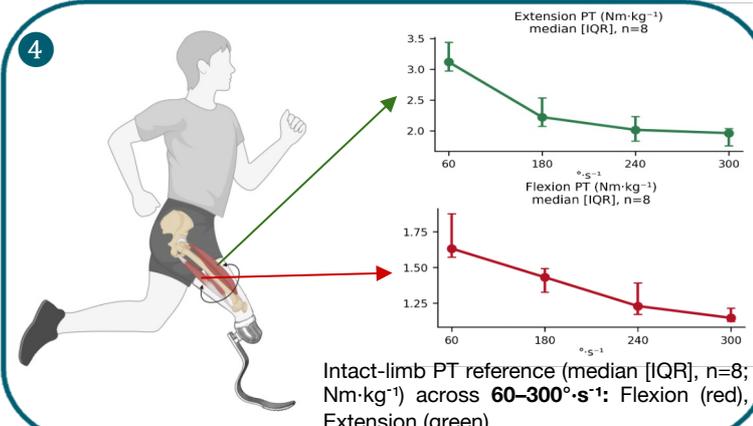
Prosthetic-limb peak torque (Nm·kg⁻¹) was substantially reduced across 60–300°·s⁻¹, with deficits of –31 to –42% in flexion and –33 to –39% in extension (median [IQR]). Deficits persisted at all velocities, indicating a pronounced residual-limb strength limitation despite athletic training.



Inter-limb asymmetry (ILA) was velocity-dependent, reaching minima at 240°·s⁻¹ in flexion and 300°·s⁻¹ in extension. Individual data revealed pronounced between-athlete variability, including clear outliers at several velocities.



H/Q showed a small prosthetic-side upward shift at 60–240°·s⁻¹ (+2.5 to +8.0 pp), consistent with relatively preserved knee flexors. This pattern likely reflects disproportionate extensor weakness (quadriceps) relative to flexors at moderate velocities.



Intact-limb PT reference (median [IQR], n=8; Nm·kg⁻¹) across 60–300°·s⁻¹: Flexion (red), Extension (green)

CONCLUSION

The profile suggests a predominant extensor deficit with clear velocity specificity, supporting the rationale for targeted, velocity-specific extensor strengthening on the prosthetic side.