Measuring Upper Extremity Loading in Passive Exoskeleton-Assisted Gait: A Case Study

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INTRODUCTION

- Individuals with spinal cord injury (SCI) commonly rely on assistive devices such as walkers and exoskeletons to regain mobility. However, these devices often place considerable strain on the upper extremities, especially the shoulders. Excessive loading can lead to injuries such as rotator cuff damage and impingement syndrome, affecting users' long-term quality of life.

- This study evaluates whether the UNILEXA passive exoskeleton, when used with a platform walker, maintains upper extremity loading within safe limits.

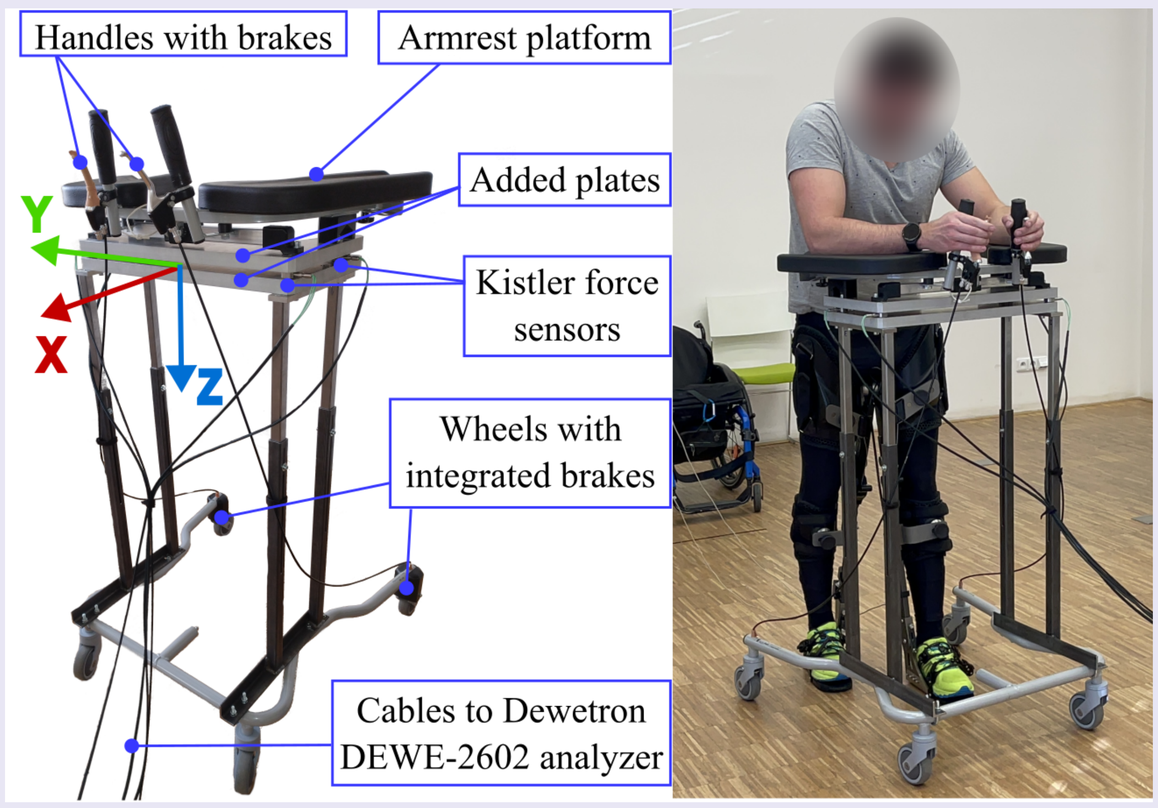
METHODS

- Participants: Two individuals with SCI (ASIA A, lesion T7): one experienced UNILEXA user and one beginner.

- Device: Instrumented platform walker equipped with four three-axis piezoelectric force sensors.

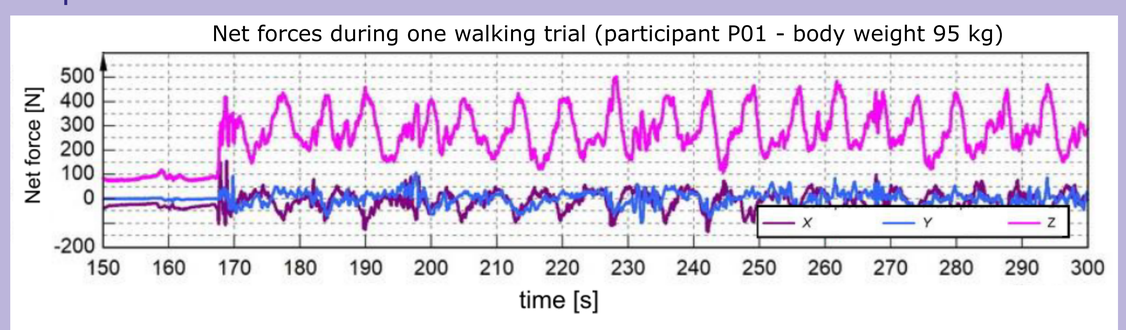
- Tasks: Participants performed repeated 6-meter walking trials, standing maneuvers, and turning exercises.

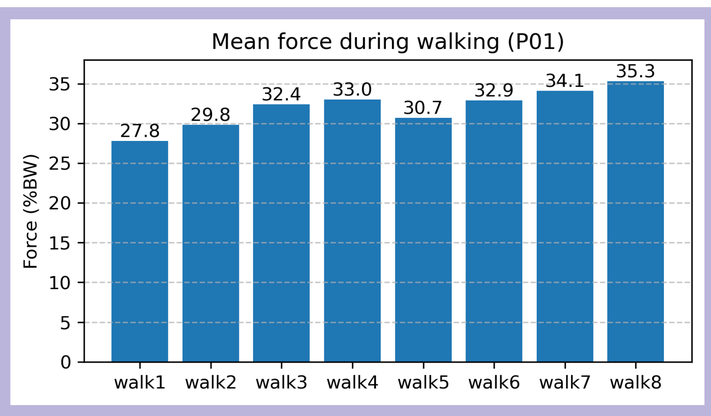
- Measurements: Forces were recorded at 1 kHz and analyzed using FlexPro software.



RESULTS

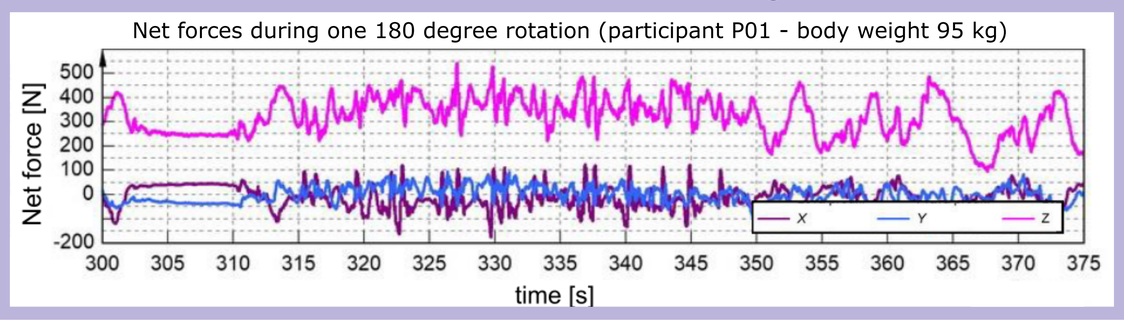
- Walking: Average upper extremity loading was ~30% body weight during steady walking. Participant fatigue gradually increased loading from 27.8% to 35.3% body weight over repeated trials.





- Standing: Brief peaks reached approximately 90% body weight during sit-to-stand maneuvers. Load quickly decreased to ~40% once users engaged the exoskeleton's knee-lock mechanism.

- Turning: Lateral forces increased during turns, though remained stable without excessive loading.



DISCUSSION

- Upper extremity loading (~30%) was comparable to or lower than other walker-assisted gait studies (25-35%).

- Peak loads during standing (~90%) were brief, minimizing long-term risk.

- Gradual load increases indicated user fatigue; however, values remained within safe limits.

- The UNILEXA passive exoskeleton combined with a platform walker ensures upper extremity loads remain within acceptable, safe limits for rehabilitation. This reduces potential shoulder overuse injuries common in SCI rehabilitation, supporting the suitability of the UNILEXA exoskeleton for safe long-term use.



UNILEXA 2.0

KEY REFERENCES

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