A low-cost, versatile, open-source, DIY partial body-weight support device

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Introduction

Body-weight supported therapy is a common practice [1]

Robotic systems are expensive (>$250K) [2]

Passive systems promising

- Constant force spring design
  - Device requires 3D printing/machined parts for estimated $4K cost [3]

Objective

- Develop an affordable dynamic body-weight support system that is easily adjustable with off–the-shelf parts

The Device

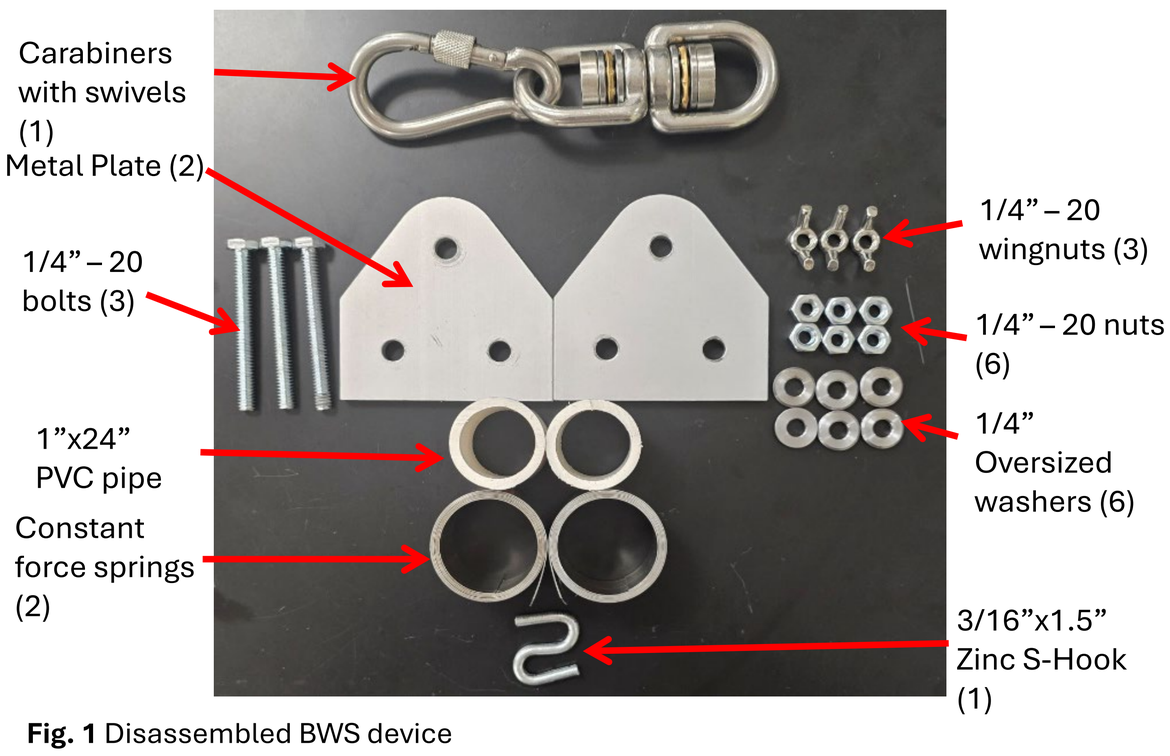


Fig. 1 Disassembled BWS device

All materials can be purchased off-the-shelf or delivered within 24 hours for ~$62 - $72 [4]

Can be assembled in < 10 minutes by a non-expert

- Only need to cut PVC pipe

Adjustable level of support

- Provide 28” – 32” length variation for ~ 3000 cycles

Can be used with existing body-weight support systems

Limitations

- Requires fall arrest infrastructure
- Hysteresis

Link to device GitHub [4]



Fig. 2 Assembled BWS device (left) being used in two different conditions, a single point of contact (center) and two points of contact (right).

Testing

Hysteresis Testing

- 2 spring configurations
  - Low - 61.2 N and High - 131 N
- Used motion capture to measure output motion and force sensor to track force
- Passive weight applied over a distance, repeated 10x

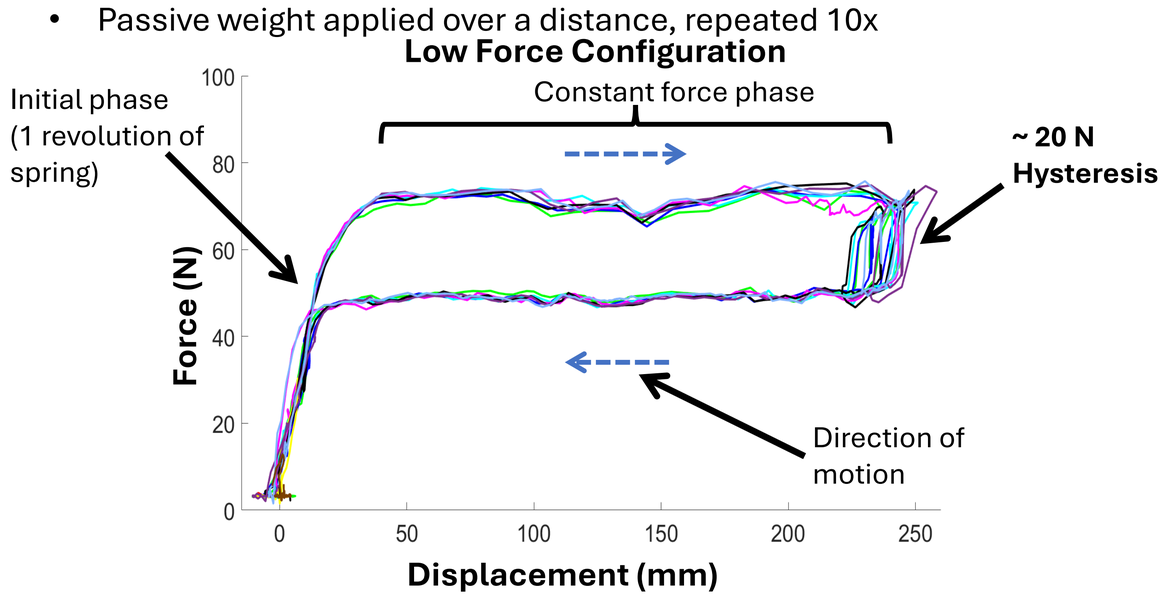


Fig 3 Hysteresis plots dashed arrows indicate direction of motion

Participant walking at 1 m/s

- BWS device attached to safety harness with fall arrest lanyards in parallel

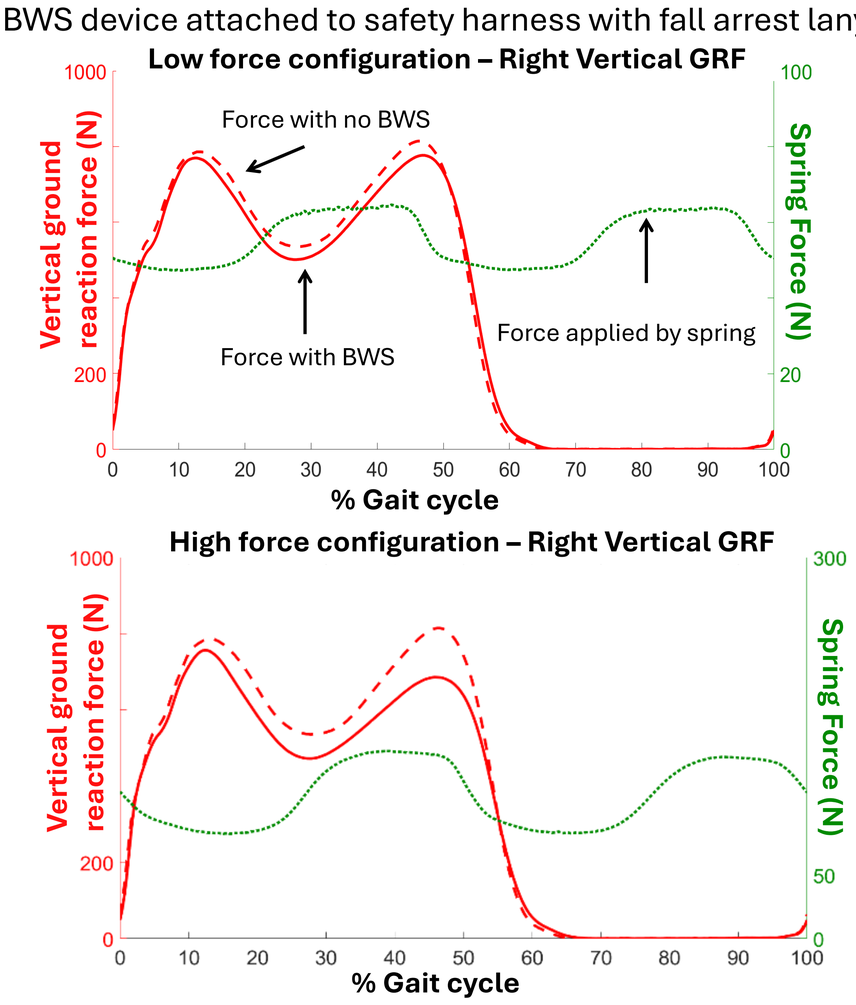


Fig 4 Average vertical ground reaction forces during gait

Conclusion

A low-cost, open-source, accessible constant force device is feasible

- Cost is orders of magnitude lower than devices with comparable function [3]

Hysteresis could possibly be reduced by altering the design

- Relationship between hysteresis and friction $e = f * F_r 2R_d$ [5]
- Increased complexity and cost of the design

References

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Acknowledgments
MSK T32 Training Grant AR007505