WPI Assists Multiple Sclerosis - A New TECHnique

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Project Goal

The project aims to **create** and **test** a device to help people with Multiple Sclerosis (MS) move more easily. Working with Dr. John Marmarou from the 810 MS Specialty Center, we're **developing a clip-on frictionless toe guard and a complementary grabber to prevent 'foot drop' when moving between different surfaces**. This will improve **mobility** and **reduce** the risk of falls for those with MS.

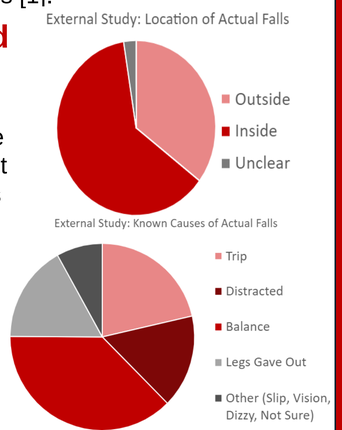
Foot Drop

Foot drop is characterized by the impaired ability to lift the front part of the foot, leading to dragging or slapping against the ground during walking. This condition arises from nerve damage impacting the muscles responsible for foot elevation. Consequently, weakened dorsiflexor muscles fail to lift the foot properly, manifesting as foot drop. Such impairment poses challenges to mobility and escalates the likelihood of tripping and falling, particularly when encountering raised surfaces [1].

Clinical Need

Common Causes for Foot Drop:

- Nerve injury: serious knee injury or knee replacement
- Muscle or nerve disorders
- Brain & spinal cord disorders: such as stroke, MS or amyotrophic lateral sclerosis (ALS) [2]
- Estimated that over 1.8 million people have MS worldwide [3].



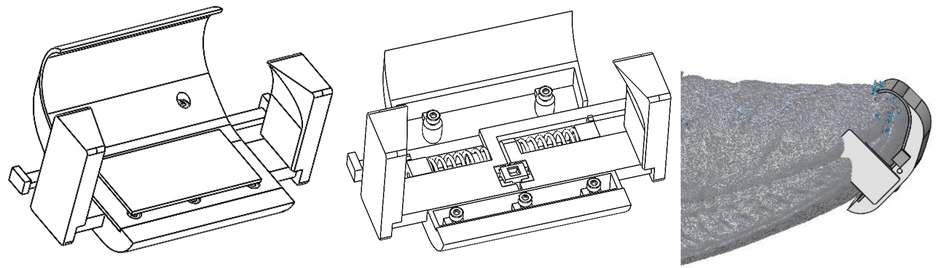
*Both Charts Ref. [4]

Project Timeline

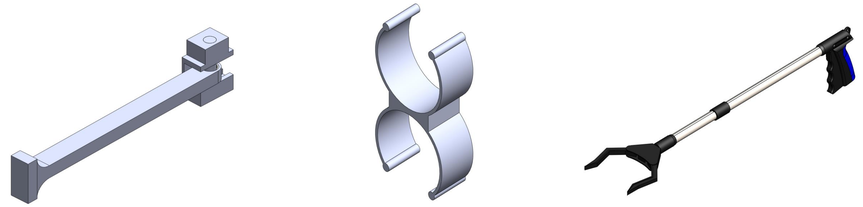
- **September 2023:** Choose the Device
- **October 2023:** Complete Critical Design
- **November & December 2023:** Build the Device
- **January & February 2024:** Test, Repair, & Refine Design
- **March & April 2024:** Complete MQP Report, Prep Competition Presentation
- **May 2024:** CMSC Competition

Preliminary Research → Design → Full-Scale Testing → MQP Report → Conference

Our Assistive Device: The Frictionless Toe Guard



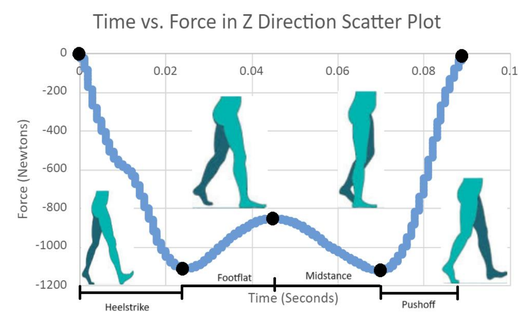
The Grabber



Consortium of Multiple Sclerosis Centers (CMSC) Meeting

Results & Analysis – Force Study

Walking Trials - Gait Cycle Analysis



Average Friction Coefficient Both Trials

Surface Condition	Without Toe Guard	With Toe Guard	Percentage Change
Hardwood	0.748	0.197	-73.66 %
Vinyl	0.668	0.175	-73.80 %
Mat	0.528	0.191	-63.82 %
Carpet	0.692	0.209	-69.80 %

Conclusions

- Successful design and testing of prototype toe guard assistive device
- Withstood the forces of walking and tripping
- Minimized friction during footdrop
- Uninterrupted walking gait maintained

Future Work

- Enhancing product durability through fabrication
- Even further improvement with decreasing friction
- Further developing the design to fit better on the shoe
- Acquisition of provisional patent

References

[1] - *Foot drop*. (n.d.). (2023, May 11). MS Trust. https://mstrust.org.uk/a-z/foot-drop
[2] - *Foot drop—Symptoms and causes*. (n.d.). Mayo Clinic. Retrieved April 9, 2024, from https://www.mayoclinic.org/diseases-conditions/foot-drop/symptoms-causes/syc-20372628
[3] - *Multiple sclerosis*. (n.d.). Retrieved April 9, 2024, from https://www.who.int/news-room/fact-sheets/detail/multiple-sclerosis
[4] - Gunn, H., Creanor, S., Haas, B., Marsden, J., & Freeman, J. (2014). Frequency, Characteristics, and Consequences of Falls in Multiple Sclerosis: Findings From a Cohort Study. *Archives of Physical Medicine and Rehabilitation*, *95*(3), 538–545. https://doi.org/10.1016/j.apmr.2013.08.244