

Assessment and Rehabilitation Of Gait Disorders In Multiple Sclerosis

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“*Functional Community Ambulation*”

What does that mean?

- What minimum speed of ambulation is needed?
- What is the minimum distance needed?

Mean Values: Distances, Curb Heights, Street Crossing Times:

Destination	Mean	Range
	<u>meters</u>	<u>meters</u>
Crosswalk Length (Residential)	13	8-16
Crosswalk Length (Commercial)	27	22-34
Post Office	64	33-102
Bank	98	50-179
Physician Office	98	43-159
Supermarket	267	233-338
Department Store	286	174-381
Drugstore	332	148-597
	<u>cm</u>	<u>cm</u>
Curb Height (Residential)	20	15-22
Curb Height (Commercial)	18	14-22
	<u>seconds</u>	<u>seconds</u>
Crosswalk Time	20.5	16-23

Correlation of walking tests to “functional speed”

Who should try an HFAO?



Prototype Design



- Flaws:
 - This design did not generate enough “lift”
 - Cumbersome to don/doff
 - Trunk and hip extensor fatigue

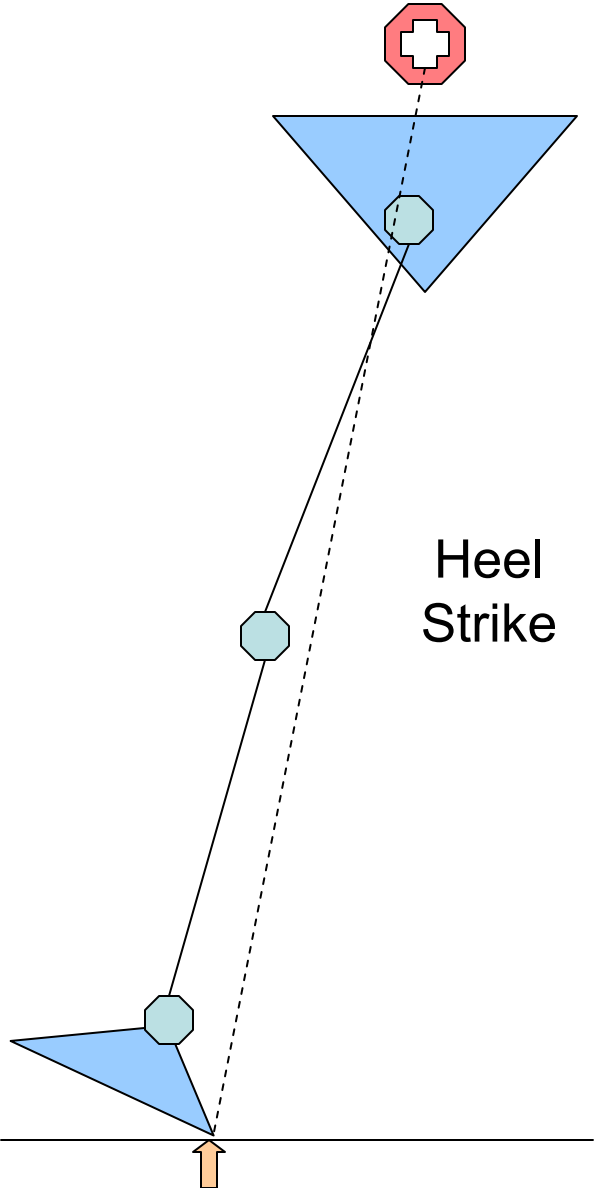
Final Design



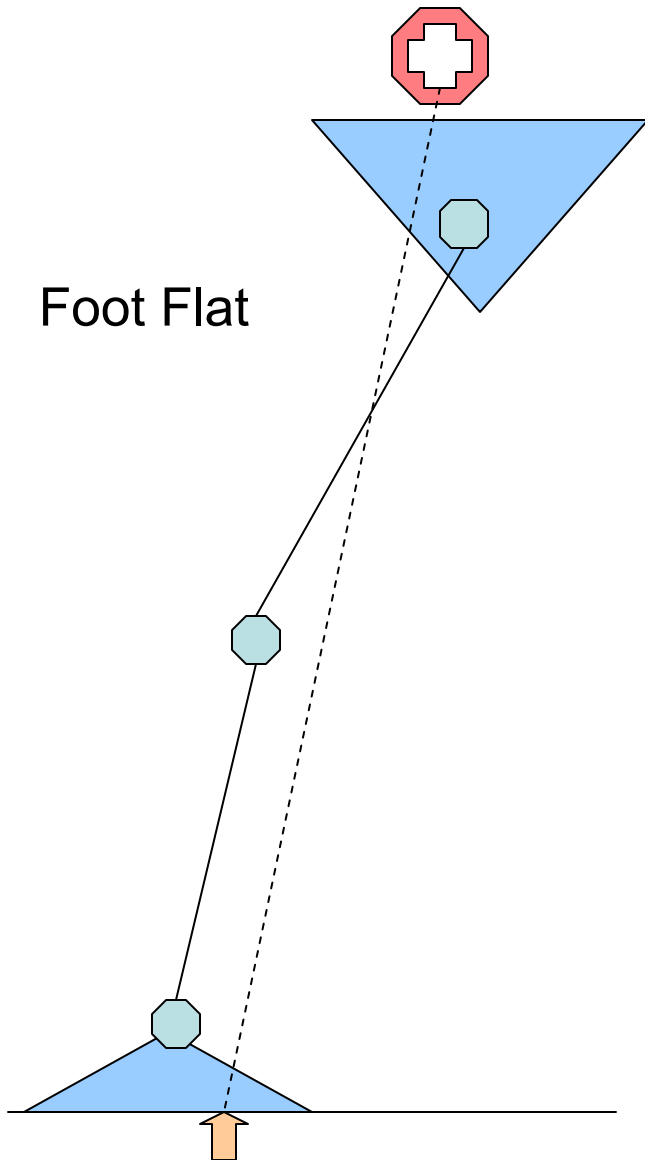
- Easy to don/doff
- Easily adjustable “lift” effect
- No medial or lateral “whip” effect with 2 elastic bands
- Lightweight
- Wear w/ any shoes

SAGGITAL ANALYSIS

Joint	Angular Attitude	Mechanical Force	Muscular Activity
Ankle	90 degrees Neutral Position	2 ft. lbs. Plantar Flexion Moment	Dorsiflexors
Knee	180 degrees Complete Extension	10 ft. lbs. Flexion Moment	Extensors
Hip	25 degrees Flexion	20 ft. lbs. Flexion Moment	Extensors



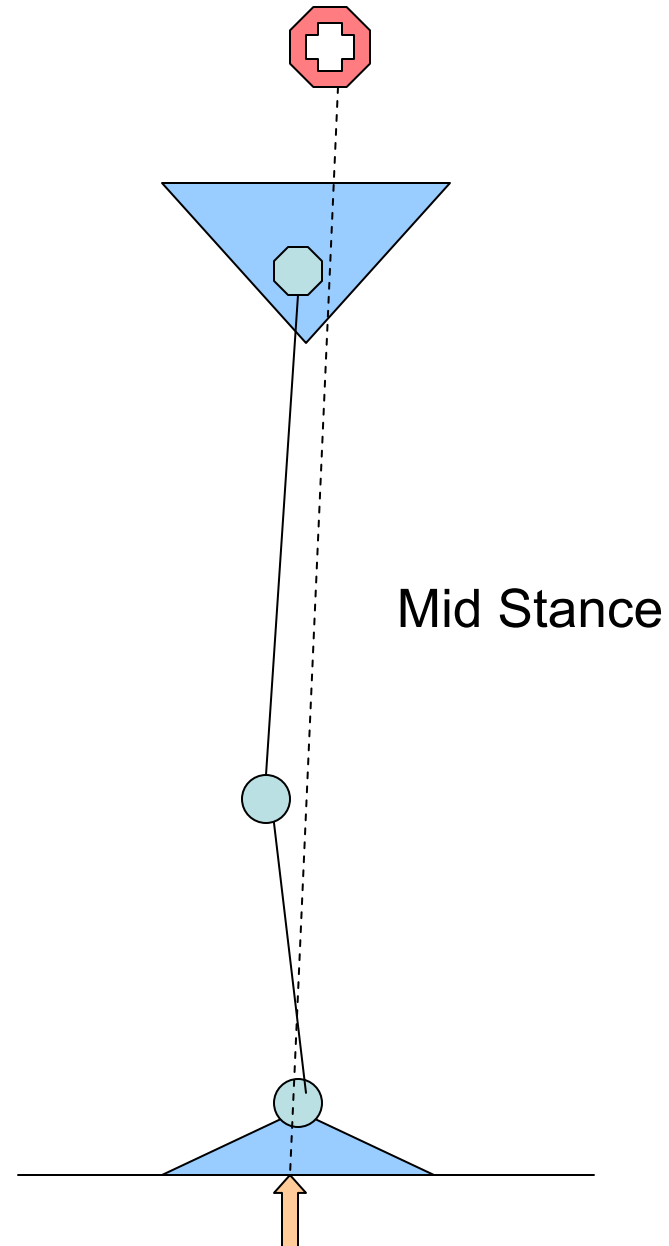
SAGGITAL ANALYSIS



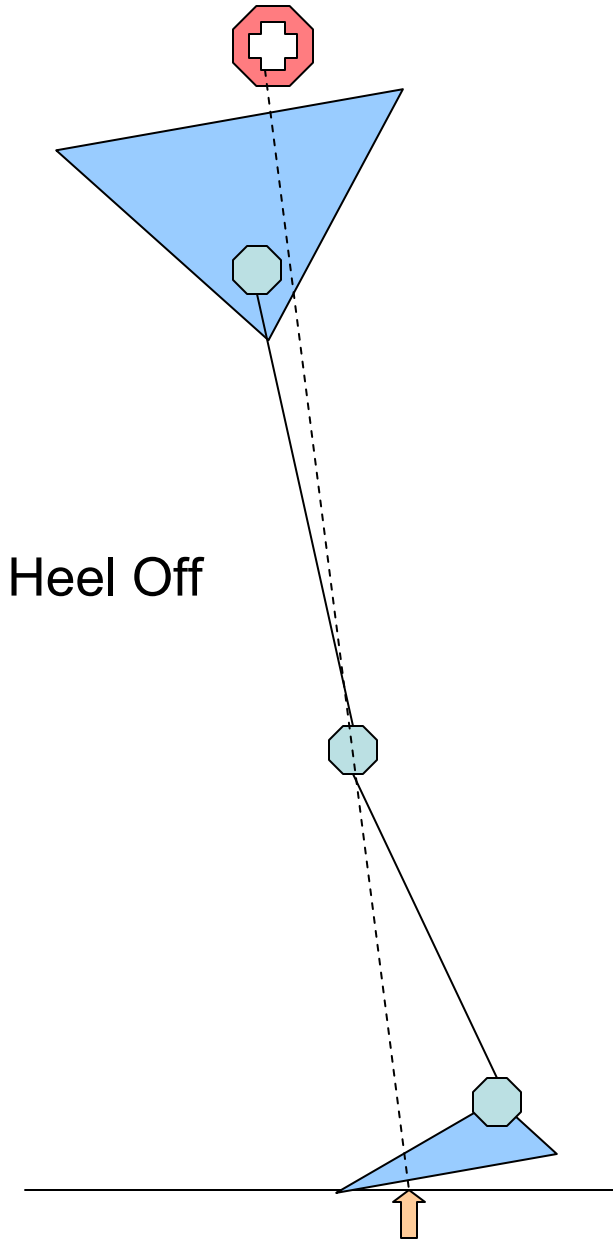
Joint	Angular Attitude	Mechanical Force	Muscular Activity
Ankle	15 degrees Plantar Flexion	10 ft. lbs. Plantar Flexion Moment	Dorsiflexors
Knee	20 degrees Flexion	50 ft. lbs. Flexion Moment	Extensors
Hip	23 degrees Flexion	30 ft. lbs. Flexion Moment	Extensors

SAGGITAL ANALYSIS

Joint	Angular Attitude	Mechanical Force	Muscular Activity
Ankle	2-3 degrees Dorsiflexion	25 ft. lbs. Dorsiflexion Moment	Plantar Flexors
Knee	10 degrees Flexion	20 ft. lbs. Flexion	Extensors
Hip	10 degrees Flexion	30 ft. lbs. Extention Moment	Flexors



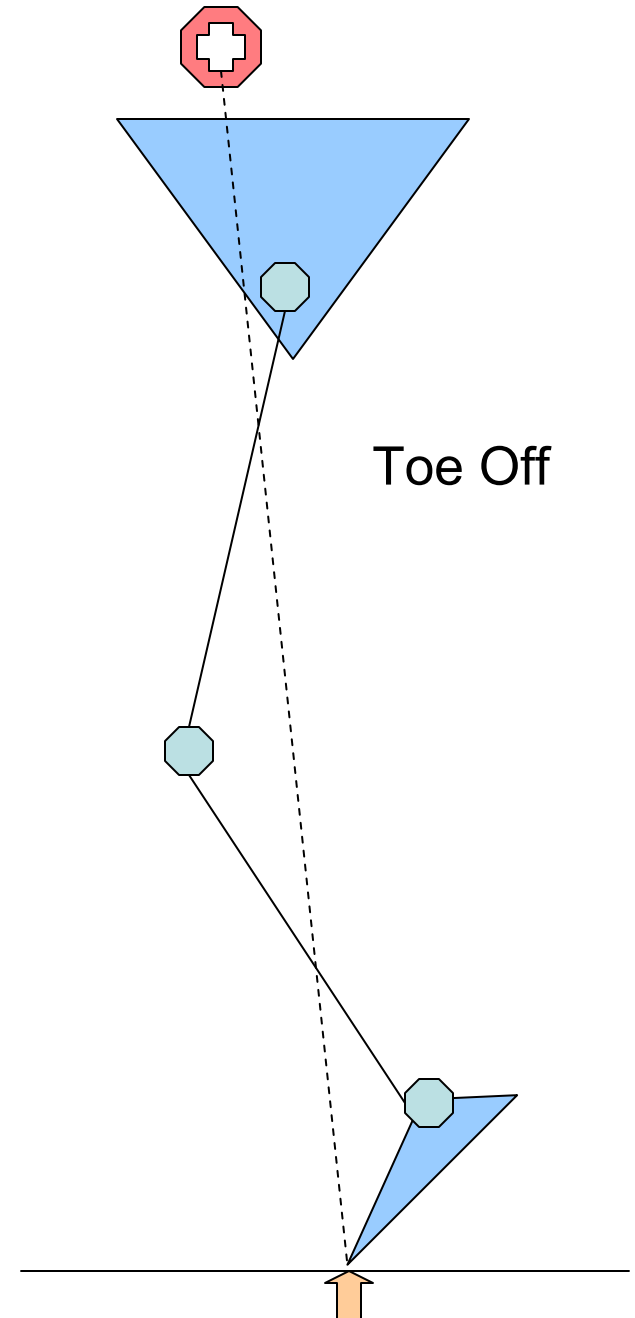
SAGGITAL ANALYSIS



Joint	Angular Attitude	Mechanical Force	Muscular Activity
Ankle	15 degrees Dorsiflexion	80 ft. lbs. Dorsiflexion Moment	Plantar Flexors
Knee	2 degrees Flexion	20 ft. lbs. Extension Moment	Flexors
Hip	-10 degrees Hyperextension	40 ft. lbs. Extension Moment	Flexors

SAGGITAL ANALYSIS

Joint	Angular Attitude	Mechanical Force	Muscular Activity
Ankle	20 degrees Plantar Flexion	5 ft. lbs. Dorsiflexion Moment	Plantar Flexion
Knee	40 degree Flexion	20 ft. lbs. Flexion Moment	Extensor s
Hip	10 degrees Flexion	10 ft. lbs. Flexion Moment	Flexors



Case #1: baseline gait



Case #1: gait with R HFAO



Case #2: baseline gait



Case #2: with bilateral HFAO



Case #3: weakness AND spasticity

- 58 year old female with c/o late day fatigue, L leg tripping, decreased endurance
 - Strength Right Left
 - hip flex 4+ 1
 - hip abd 4+ 3
 - hip ext 4 2+
 - knee flex 4+ 3-
 - knee ext 5 4
 - ankle df 4+ 1
 - ankle pf 5 2
-
- Wears L AFO, proceeded with L HFAO trial



Case#3: Outcomes

<u>Test</u>	<u>Baseline</u>	<u>With HFAO</u>	<u>% change</u>
• 25' walk:	9.41 sec	7.79 sec	20.87%
• 6 min walk:	1,211 ft	1,358 ft	12.19%
• Timed Up & Go	15.16 sec	11.56 sec	23.75%
• Mellen Gait Test	51.06 sec	45.46 sec	10.96%

Case #4:



Case #5: DV



Case #5: Subjective Comments

Efficacy of Hip Flexion Assist Orthosis in Ambulatory Multiple Sclerosis Patients – Outcomes

- 21 patients completed the study.
 - 3 dropped out (one MS relapse, 1 non-compliant, 1 b/c “brace too ugly to wear”)
- Age range 37-68, median 53
- 12 women, 9 men
- Inclusion criteria: unilateral hip flexor strength 3/5 or less, <3/10 low back pain, cognitively intact, able to walk 100’.

Efficacy of Hip Flexion Assist Orthosis in Ambulatory Multiple Sclerosis Patients – Outcomes

- | <u>Test</u> | <u>avg % change</u> |
|---|---|
| • 25' walk: | 22.82% (18/21 faster) |
| • 6 min walk: | 27.34% (19/20 longer distance, 1 person not able) |
| • Timed Up & Go | 12.44% (17/21 faster) |
| • Mellen Gait Test able) | 13.30% (16/20 faster, 1 not able) |
| • Satisfaction: | |
| – 0 patients “very dissatisfied” | |
| – 1 patient “somewhat dissatisfied” (dropped out) | |
| – 2 patients “neutral” | |
| – 3 patients “somewhat satisfied” | |
| – 16 patients “very satisfied” | |

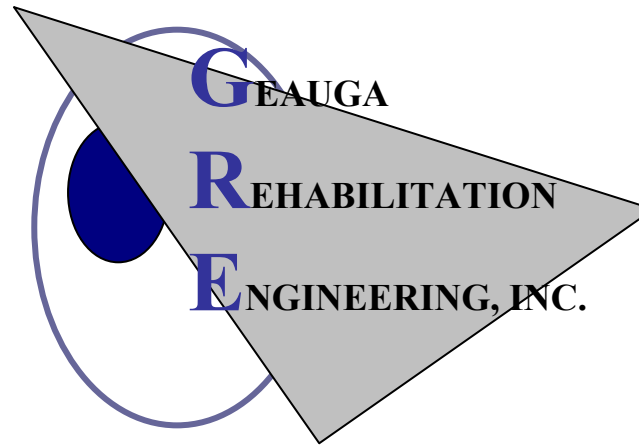
Subjective comments from participants...

- What's good...
 - “Less fatigue when walking”
 - “I walk without stumbling”
 - “Yeah! I can walk on grass!”
 - “Easier to go shopping”
 - “I can walk longer distances”
 - “I go to outdoor events that I used to avoid”
 - “It picks up my foot in the yard and on the golf course”
 - “I went fishing again at my favorite pond. I never thought I'd do that again”
 - “My abdomen pain is gone since I started wearing this”
- What needs work...
 - “It's ugly. I just can't wear this. People stare.”
 - “I had some foot soreness”
 - “I had some back pain the first 2 days”
 - “A 'spacer' is needed to avoid knee rubbing”
 - “It's hard to get under my jeans”
 - “I get skin irritation at ITBP site”
 - “Does it come in pink floral patterns?”

Costs

- \$290, out of pocket
- Not covered under insurance (yet). New L-code request has been submitted to CMS.
- Physical Therapy is required for fitting and gait training.
- Available at www.greop.com or by phone at 440-585-5785

'Thank You' to GRE for their time and effort to help develop the Hip Flexion Assist Orthosis



*A Center for Advanced Prosthetic
And Orthotic Technology*

**Jonathan M. Naft, C.P.O.
Prosthetist/Orthotist**

Chris Long, R.T.O.

www.GREOP.com

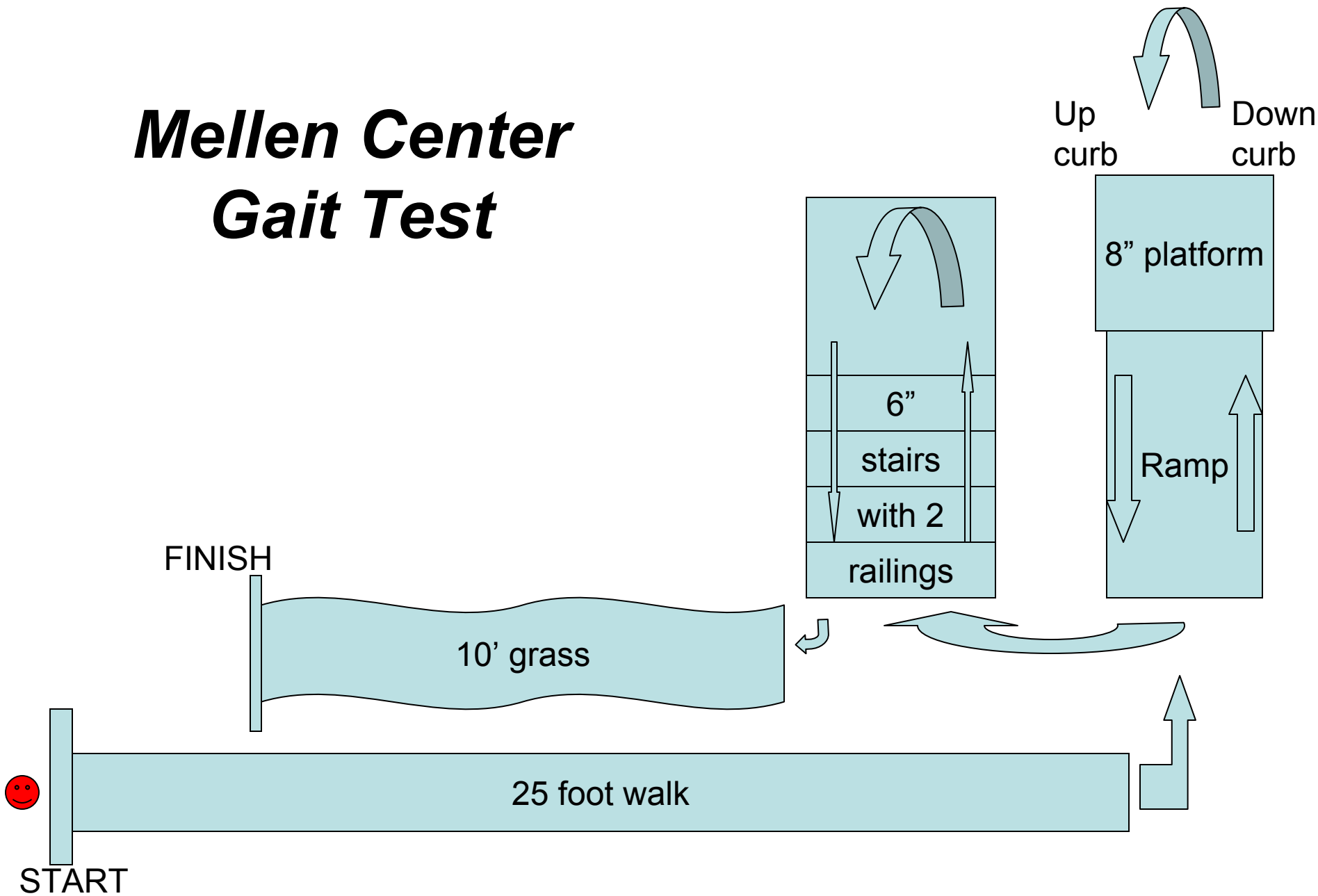
Outcome Measures for Gait in MS

- 25 foot walk
- Timed Up and Go (TUG)
- 6 Minute Walk Test (6MWT)
- Dynamic Gait Index (DGI)

Mellen Center Gait Test

- Scoring based on:
 - Speed
 - Completion of ‘real world obstacles’ contained in course (ramps, curbs, stairs, “grass”)
 - Safety & Quality: rewarded when using assistive devices for safety, rather than penalized for AD’s.

Mellen Center Gait Test





Scoring for Speed...

- Less than 25.0 seconds = 10
- 25.0 - 30.0 seconds = 9
- 30.1 - 35.0 seconds = 8
- 35.1 - 40.0 seconds = 7
- 40.1 - 45.0 seconds = 6
- 45.1 - 50.0 seconds = 5
- 50.1 - 60.0 seconds = 4
- 60.1 - 70.0 seconds = 3
- 70.1 - 90.0 seconds = 2
- 90.1 - 120.0 seconds = 1
- More than 120.1 seconds or non-ambulatory = 0
- Speed Score: ***/10

Scoring for Completion...

- 25 ft walk 1
- ramp up 1
- curb down 1
- turn 1
- curb up 1
- ramp down 1
- stairs up 1
- stairs down 1
- grass 2
- Completion score: ***/10

Scoring for Safety & Quality...

- No assistive device and is steady, safe = 10
- Uses cane or quad cane and is steady, safe = 9
- Uses walker, rolling walker, rollator, and is steady, safe = 8
- No assistive device, but stumbles during course = 7
- Uses assistive device, stumbles once = 6
- Uses assistive device, stumbles more than once = 5
- No assistive device, but stumbles and requires assistance to prevent a fall = 4
- Uses a cane or quad cane, but stumbles and requires assistance to prevent a fall = 3
- Uses a walker or rollator, but stumbles and requires assistance to prevent a fall = 2
- Clearly unstable with any assistive device, requires constant physical support to prevent repeated falls = 1
- Unable to perform = 0

- Notes: A stumble is defined as a mild loss of balance that does NOT require physical assistance to prevent a fall.

- Quality Score: ***/10

- Total Score: ***/30

Potential Changes to MCGT:

- More realistic grass
- Separate ramp from stair railing
- Analyze speed scoring intervals and change point system
 - Remove point system for speed in favor of timed score
 - Do not add all 3 scores as it adds to ceiling effect

- Set up a permanent course
- Data is currently being analyzed for reliability and validity

Thank you!