

# A novel approach to improve mobility measures by using multidirectional reactive stepping in individuals with multiple sclerosis- a pilot study

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## INTRODUCTION

- Individuals with multiple sclerosis (MS) commonly experience mobility limitations that pose a serious challenge to achieve independent living (Cooté et al 2014).
- Though impaired mobility have been documented in MS (Kanekar et al 2013), rehabilitation approaches to improve mobility in individuals with MS are limited.

## OBJECTIVES

- To evaluate a novel approach to improve the mobility measures by using reactive stepping training in individuals with MS

## METHODOLOGY

Participants: Three individuals with MS (relapsing and remitting type)

### Inclusion Criteria

### Exclusion Criteria

Normal and corrected vision	Remission within last 3 months
Able to stand and walk at least for one minute without any walking aid or an orthotics	Subjects with mini-mental state examination score < 25

**Training:** Subjects stood in the central position & required to step into the 8 targets as quickly as possible following a randomly appearing visual cue (Fig 1 & 2) indicating the specific direction to step. The eight targets were color marked on the floor with distance of 18" in forward, right, left, forward-right, forward-left directions and 9" in backward, backward-right and backward-left directions (Fig 1).

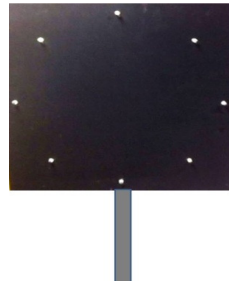
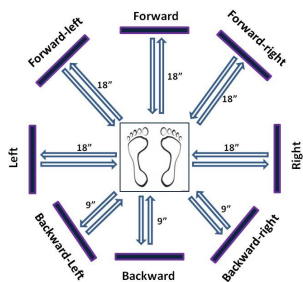


Fig 1: Representation of the pattern of stepping marks (Arrows indicates the direction of stepping and returning to the initial position).

Fig 2: Schematic representation of the display that produces visual cues

**Set-up and progress:** Initially visual cue setting was set at 2:4 (ON: OFF) ratio. During the ON period, the light signal (cue) was displayed in front of the subjects and during 'OFF' period, the light was off. The progression was made by decreasing the OFF period by 1 sec per week till the subjects can reach 2:2 (ON:OFF) ratio.

**Duration:** Thirty minutes per session for 3 days per week for four weeks. Each session consisted of three 10 min training sets with 2 min rest between the sets

## Outcome variables

- LOS test
  - Reaction time (RT)
  - Movement velocity (MVL)
  - End point excursion (EPE)
  - Maximal excursion (MXE)
  - Directional control (DCL)
- Tinetti performance oriented mobility assessment (POMA)
- Functional reach test (FRT)
- Maximal step length (MSL)
- Four square step test (FSST)

Fig3: Dynamic posturography- Equitest (NeuroCom)

## DATA ANALYSIS

- Data were expressed as mean ± standard deviation
- Paired 't' test was performed to find any significant difference between the pre and post training values in the outcome measures.

## RESULTS

Demographics and Anthropometrics	
N=3 (2 females; 1 male)	Mean±SD
Age (yrs)	54.6±4.0
Height (cm)	163.40±8.1
Weight (Kg)	62.25±5.1
BMI(Kg/m <sup>2</sup> )	23.38±2.5
Duration (yrs)	18.33±4.0
EDSS score	3.0±0.5

## Results of LOS test

LOS test composite scores	Pre	Post	p value
	Mean ± SD	Mean ± SD	
RT	1.28 ± 0.05	0.75 ± 0.15	0.037
MVL	2.47 ± 0.82	4.28 ± 1.73	0.094
EPE	57.88 ± 7	76.92 ± 6.32	0.001
MXE	70.58 ± 6.24	82.5 ± 6.96	0.004
DCL	67.5 ± 9.92	75.67 ± 6.73	0.103

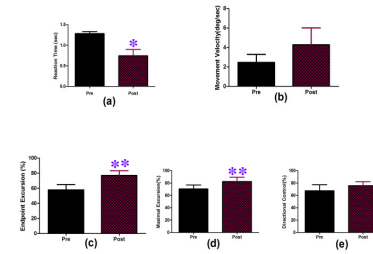


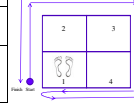
Fig4: Components of LOS test a) reaction time b) movement velocity c) endpoint excursion e) maximal excursion f) directional control, \*p<0.05; \*\*p<0.01

## Mobility measures

Mobility measures	Pre	Post	p value
	Mean ± SD	Mean ± SD	
POMA-Gait	8.67 ± 1.15	10.33 ± 0.58	0.037
POMA-balance	10.67 ± 2.52	14.33 ± 1.53	0.031
Stimes sit to stand (sec)	16.85 ± 2.38	15.26 ± 1.79	0.042
10 meter walk test (sec)	9.59 ± 0.81	8.01 ± 0.79	0.014



MSL(cm) mean±SD		
Pre	Post	p value
66.58±13.9	74.17±11.65	0.033



FSST (sec) mean±SD		
Pre	Post	p value
9.74±1.09	8.26±0.69	0.027



FRT (cm) mean±SD		
Pre	Post	p value
14.67±4.54	20.08±4.29	0.011

## DISCUSSION

- All subjects completed the study. Neither adverse effects were observed by the therapist nor reported by any of the patients who completed the study. This suggests that the study is feasible
- Improvement of limits of stability, gait, balance, functional reach, sit to stand, maximal step length and four square step test all suggest the comprehensive benefits obtained by training
- Improvement in reaction time will help the patients to regain stability quickly if their balance is disturbed- might be beneficial for fall prevention
- Improvement in maximal and endpoint excursion reflects improvement in ability to reach safer limits in addition to perception of their safety limits (balance confidence)

### Limitations

Limited sample size. Require further follow-up.

**Conclusion:** Four weeks multi directional reactive step training improves gait, balance, limits of stability and mobility measures in individuals with MS.

### References

- Cooté S, Finlayson M, Sosnoff JJ, "Level of mobility limitations and falls status in persons with multiple sclerosis. Arch Phys Med Rehabil. 2014 May;95(5):862-6.
- Neeta Kanekar and Alexander S. Aruin, "The role of clinical and instrumented outcome measures in balance control of individuals with multiple sclerosis," Multiple Sclerosis International, vol. 2013, Article ID 190162, 10 pages, 2013. doi:10.1155/2013/190162

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