

Obstacle Crossing Following Stroke

Dr. Cathy Said

Senior Physiotherapist, Austin Health
NHMRC Research Fellow,
Rehabilitation Sciences Research Centre
University of Melbourne



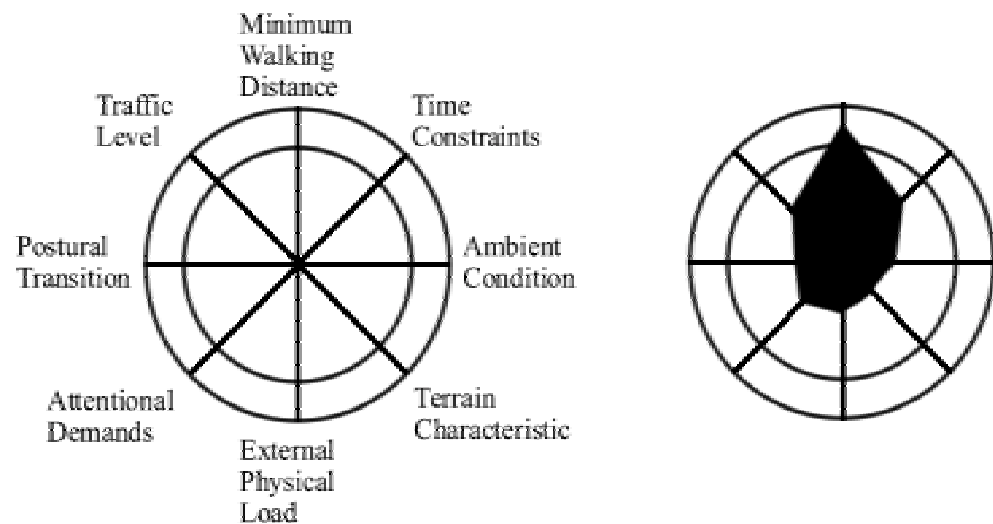
- Adjunct A/Professor Patricia Goldie
- Professor Aftab Patla
- Professor Meg Morris
- Dr. William Sparrow
- Associate Professor Elsie Culham
- Professor Mary Galea

Background

- Walking pattern needs to adapt to various environmental features, including obstacle.
- Obstacles implicated in falls following stroke (Forster 1995)
- How is this ability compromised following stroke?

Dimensions of Mobility

Dimensions of Mobility



(a) Normal Operating Range for Independent Community Ambulator

(b) Individual Operating Range

Deficits in Obstacle Crossing Following Stroke: Study 1

- 24 stroke subjects,
24 controls
- two testing sessions
- 8 trials in a session
 - » 2 no obstacle
 - » 3 high obstacle
 - » 3 wide obstacle
- pass/ fail
- videotaped



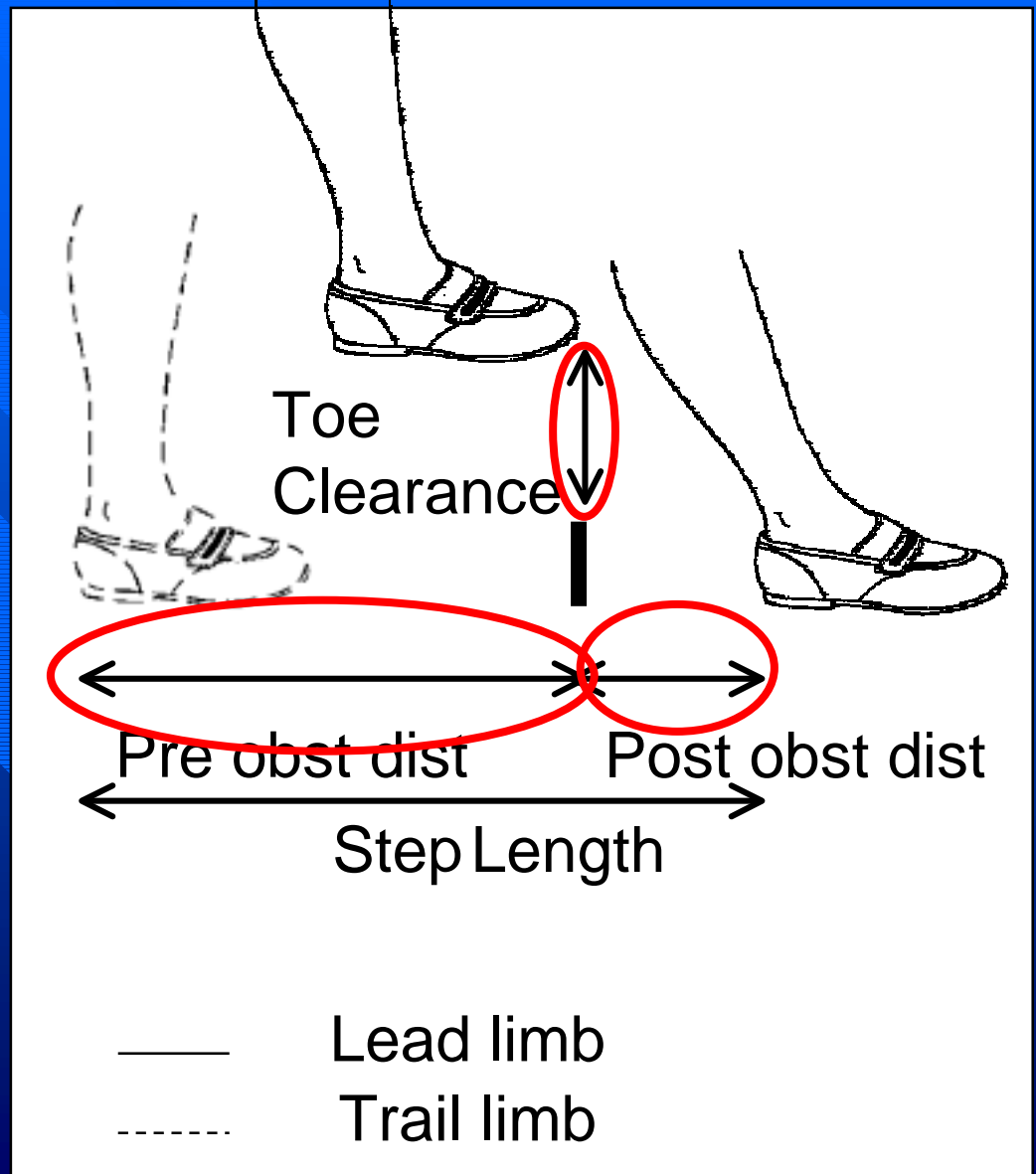
- 13/24 subjects with stroke failed to negotiate at least one small (1 cm – 8 cm) obstacle
- No preference to lead with either limb.

(Said et al 1999)

Results

- Stroke subjects generally had increased lead toe clearance.
- SS maintained pre-obstacle distance, but reduced post-obstacle distance

(Said et al 2001)



Study 2

- To quantify how lead and trail limb control during obstacle clearance was altered on the affected and unaffected limb following stroke.
- To examine the balance control mechanisms during obstacle crossing.

Method

- 12 subjects with cortical/ subcortical stroke and 12 healthy subjects matched for age, gender and height.
 - Mean age 65.1 years ($SD = 16.6$)
 - Median 62 days post stroke

- Reflective markers
- VICON 512 6 camera motion analysis system
- 4 unobstructed trials
- 4 cm x 1.5 mm obstacle
- 8 trials
 - 4 cm high obstacle
 - 4 cm wide obstacle
- Healthy subjects repeated at matched speed
- Matched pairs *t* test



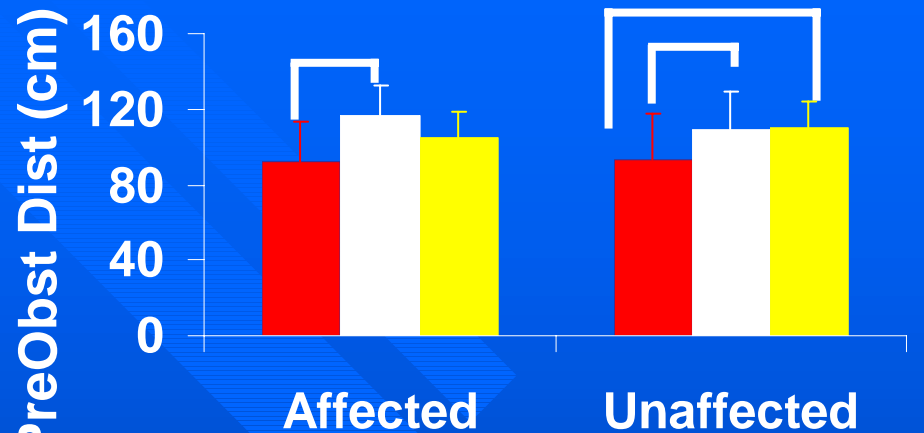
Results

- Only results from High Obstacle will be discussed.
- Stroke subjects significantly slower than healthy subjects at self-selected speed ($p < .05$), but no different from matched speed ($p > .05$).

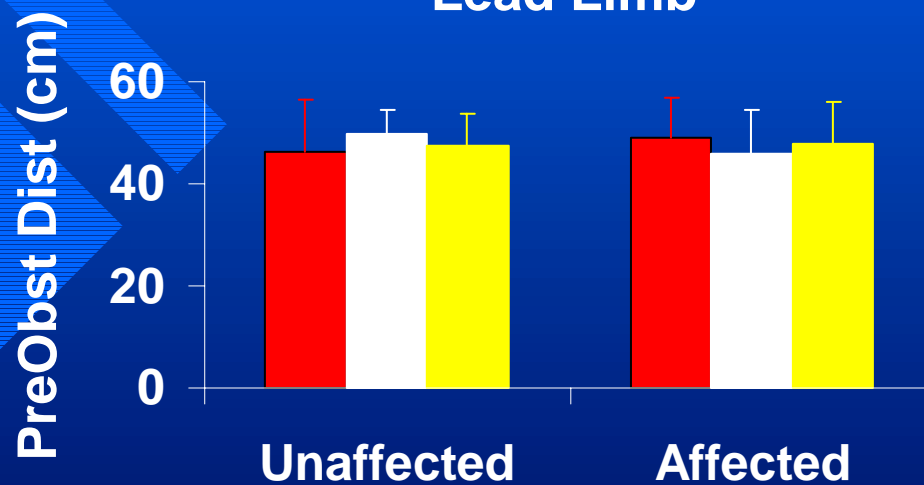
Obstacle Approach



- Stroke
- Healthy, self select speed
- Healthy, matched speed

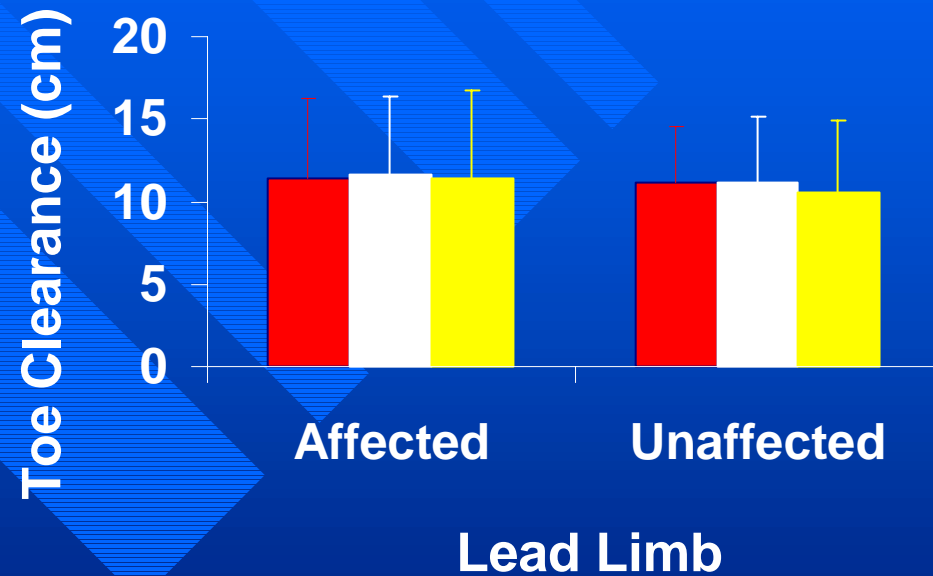
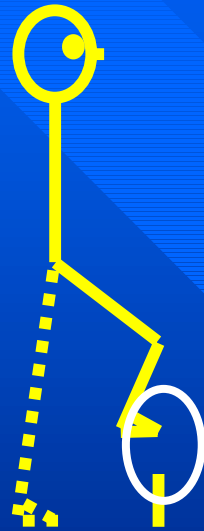


Lead Limb



Trail Limb

Lead Clearance

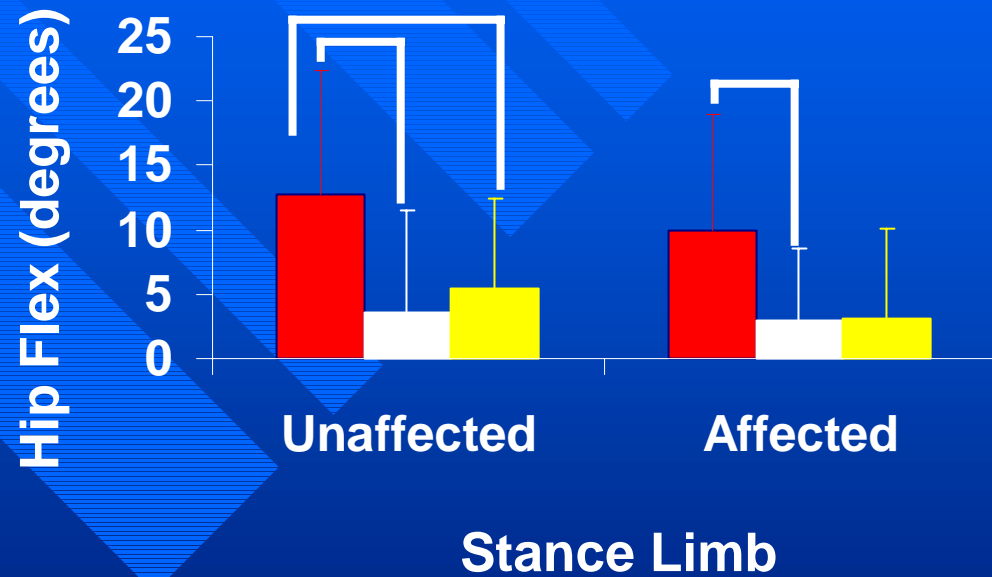


- Stroke
- Healthy, self select speed
- Healthy, matched speed

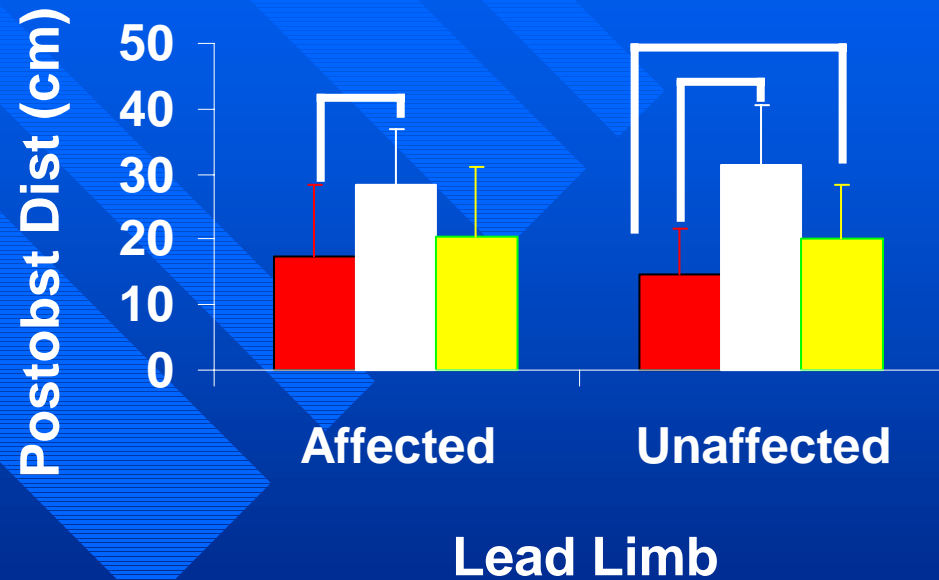
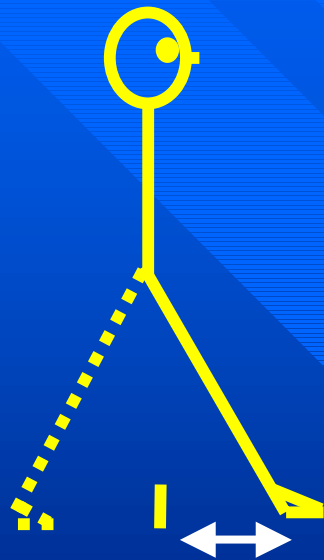
Trail (Stance) Limb



- Stroke
- Healthy, self select speed
- Healthy, matched speed



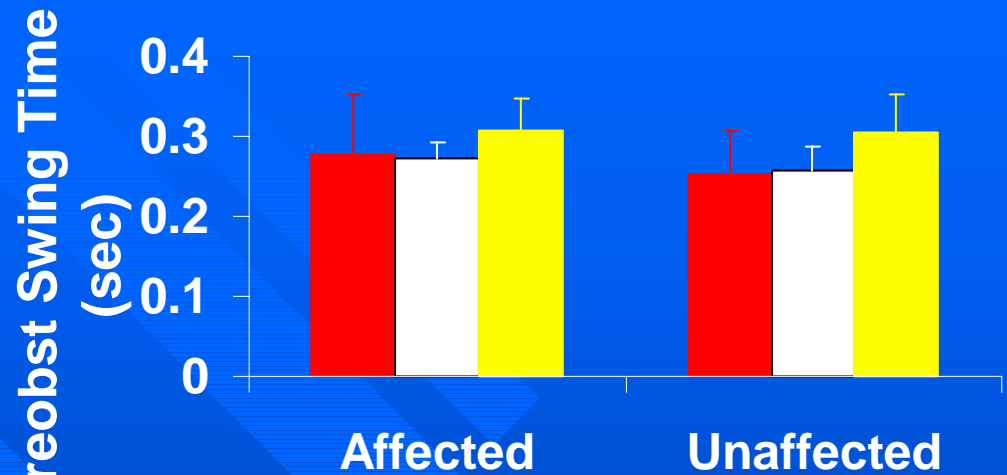
After Crossing



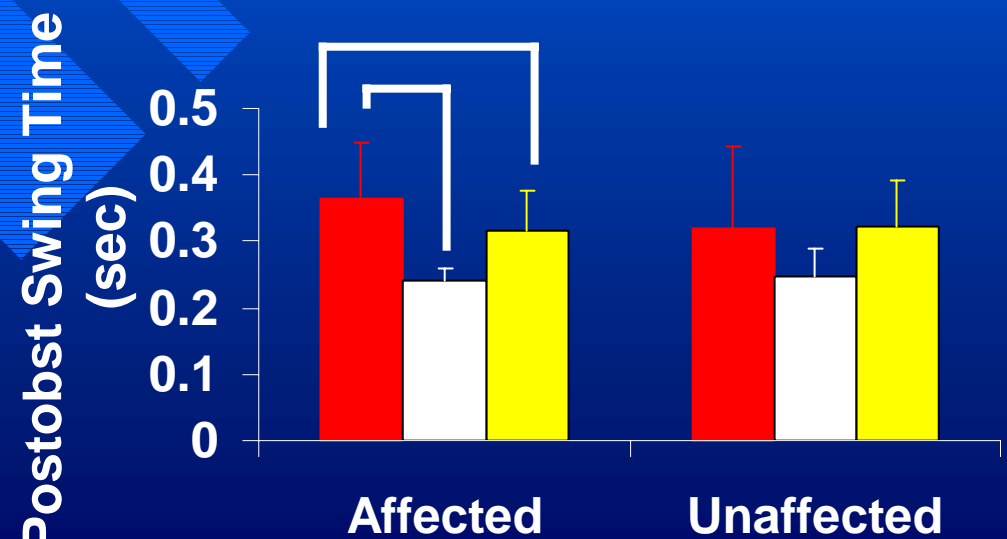
- Stroke
- Healthy, self select speed
- Healthy, matched speed

Lead Swing Time

- Stroke
- Healthy, self select speed
- Healthy, matched speed

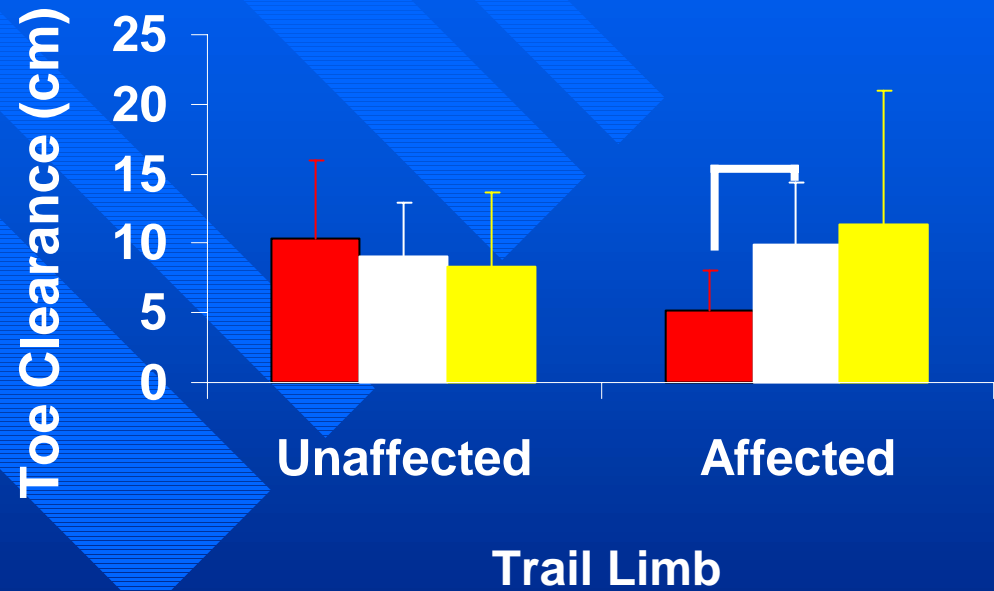


Lead Limb



Lead Limb

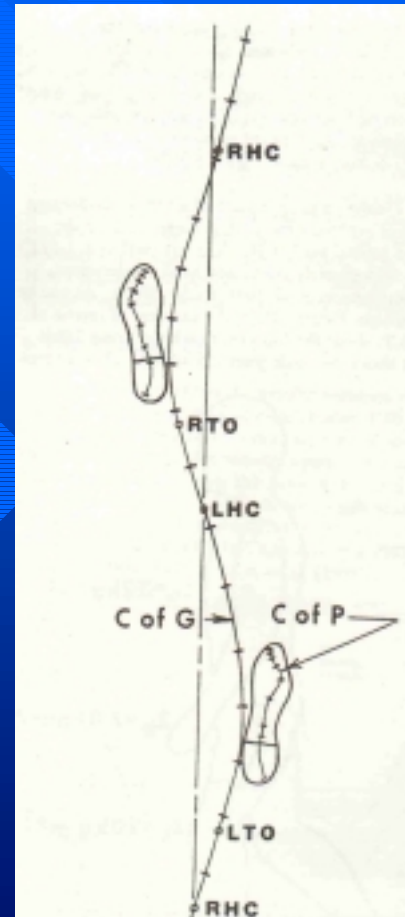
Trail Limb Clearance



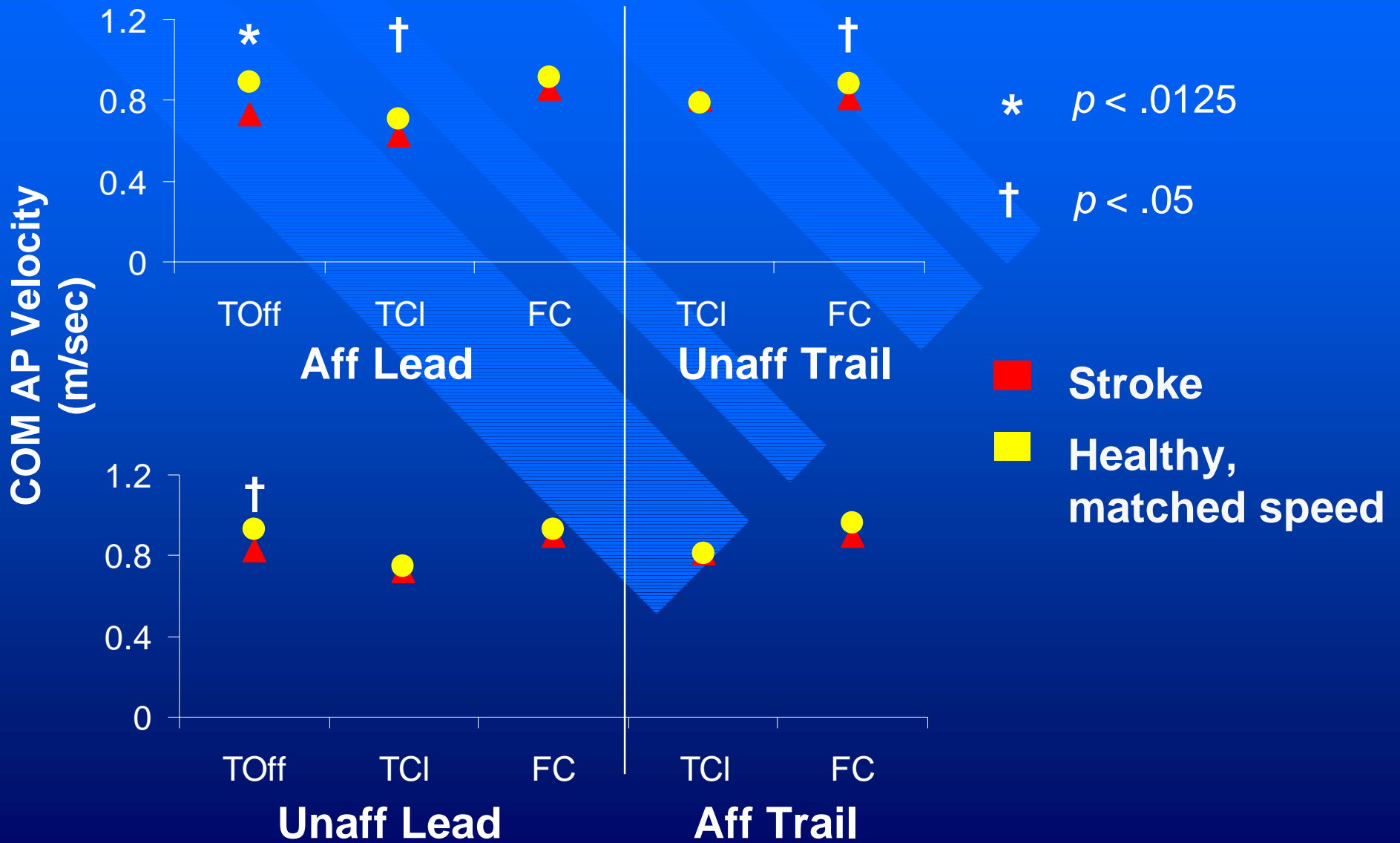
- Stroke
- Healthy, self select speed
- Healthy, matched speed

Balance Control During Obstacle Crossing

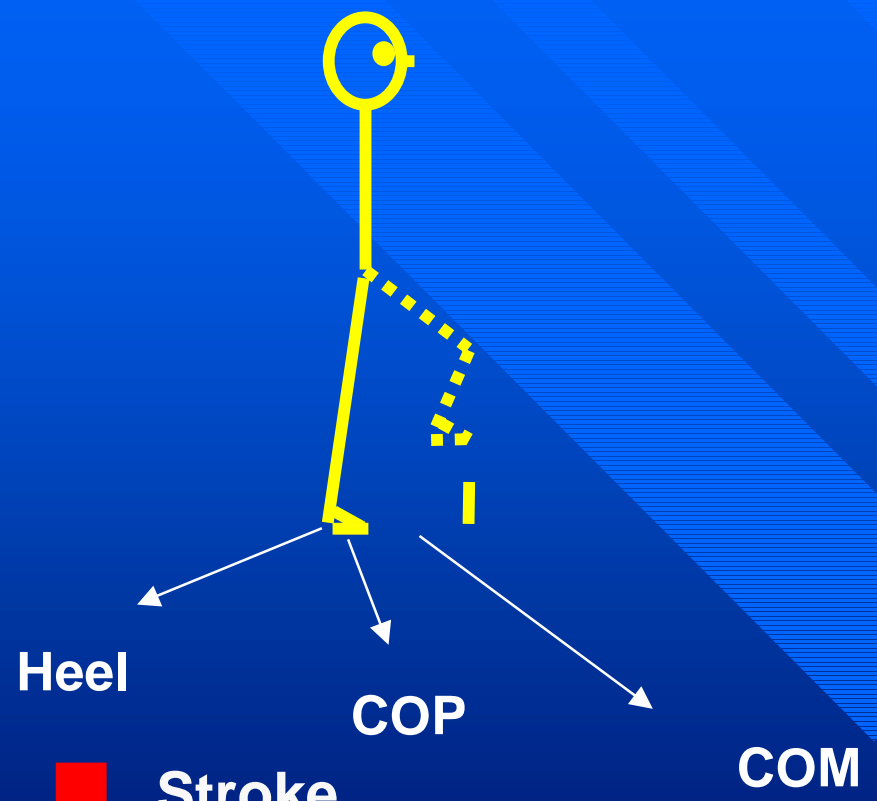
- How DO you measure balance control during walking??????
 - Walking is inherently unstable.
 - Gait speed may be a confounding factor.



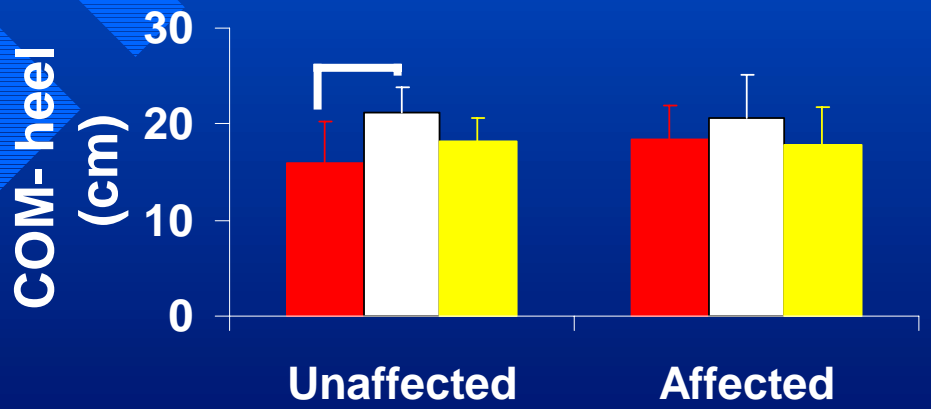
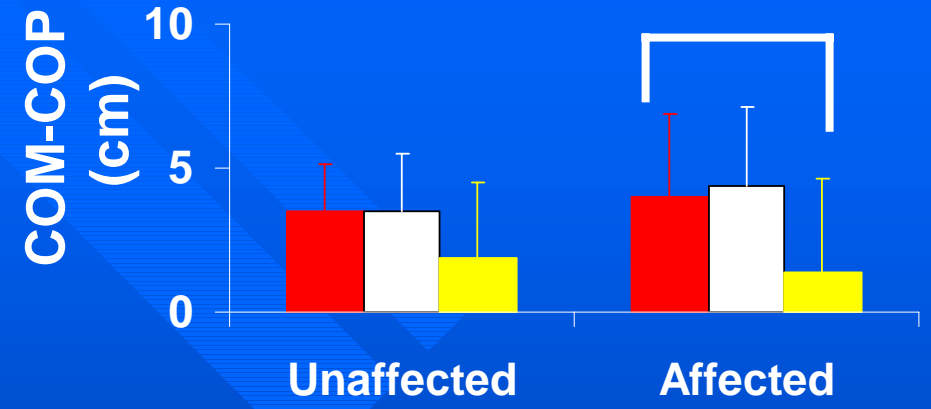
COM AP Velocity



COM, COP and BOS



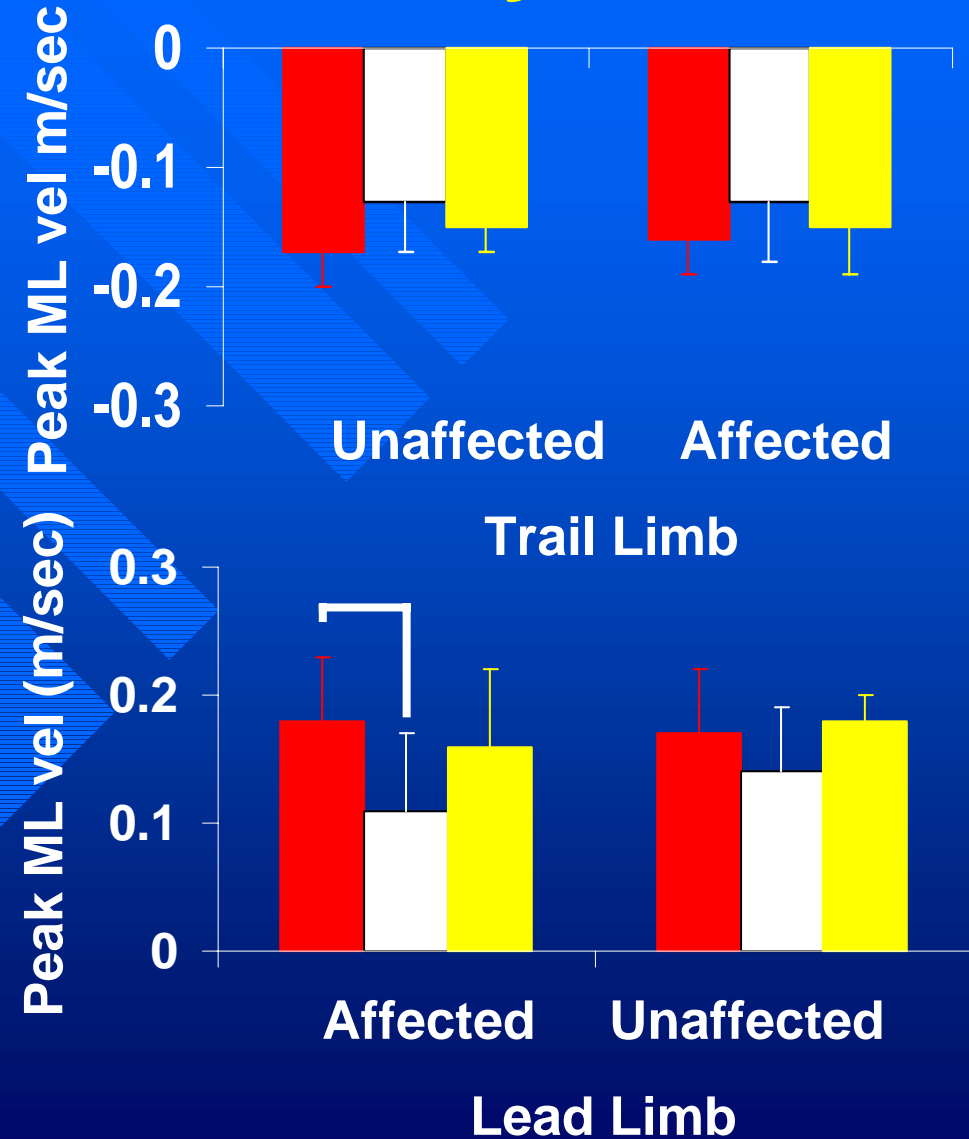
- Stroke
- Healthy, self select speed
- Healthy, matched speed



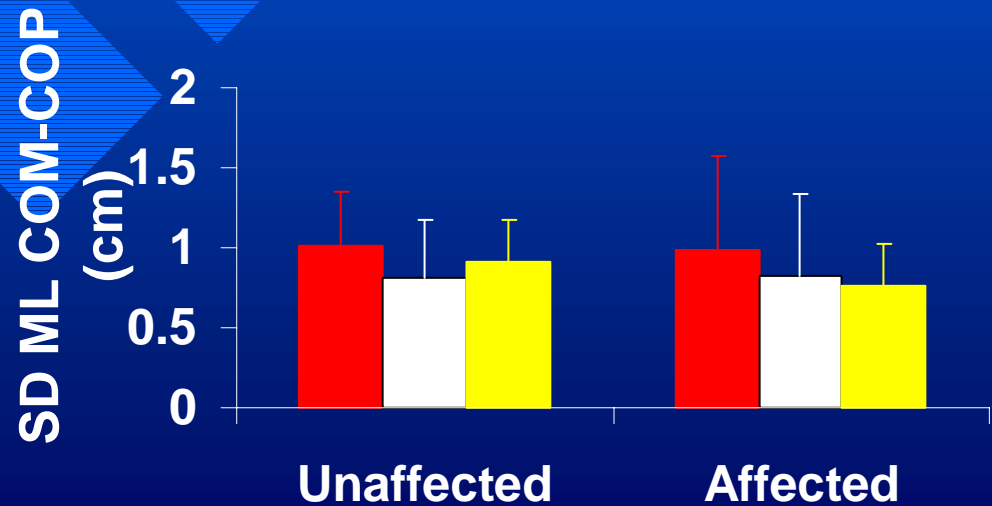
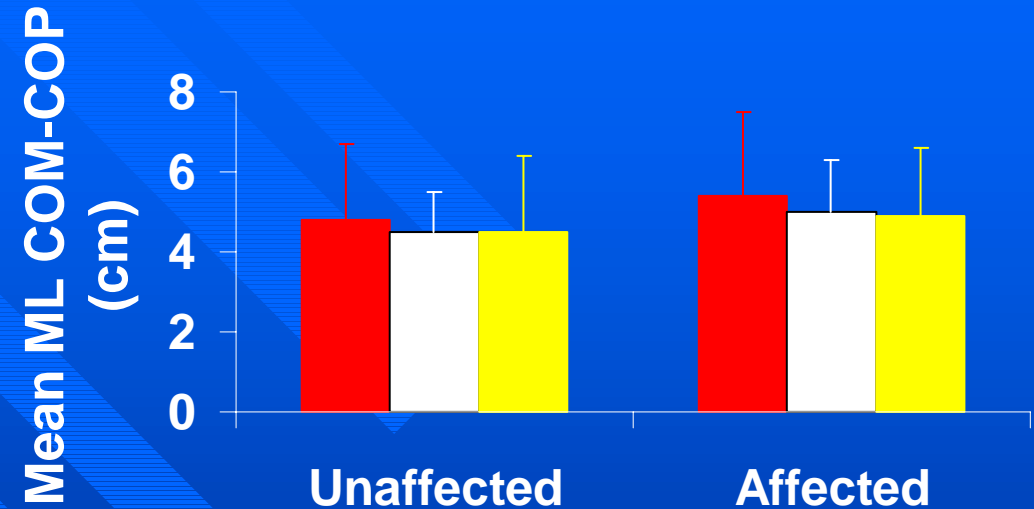
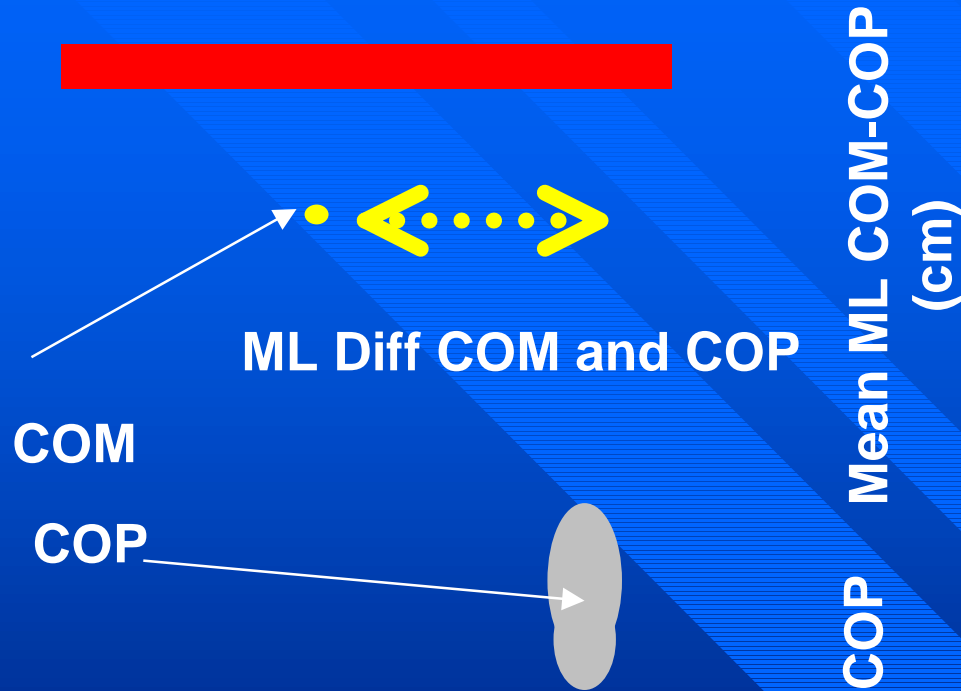
Stance Limb

Peak ML COM Velocity

- Stroke
- Healthy, self select speed
- Healthy, matched speed

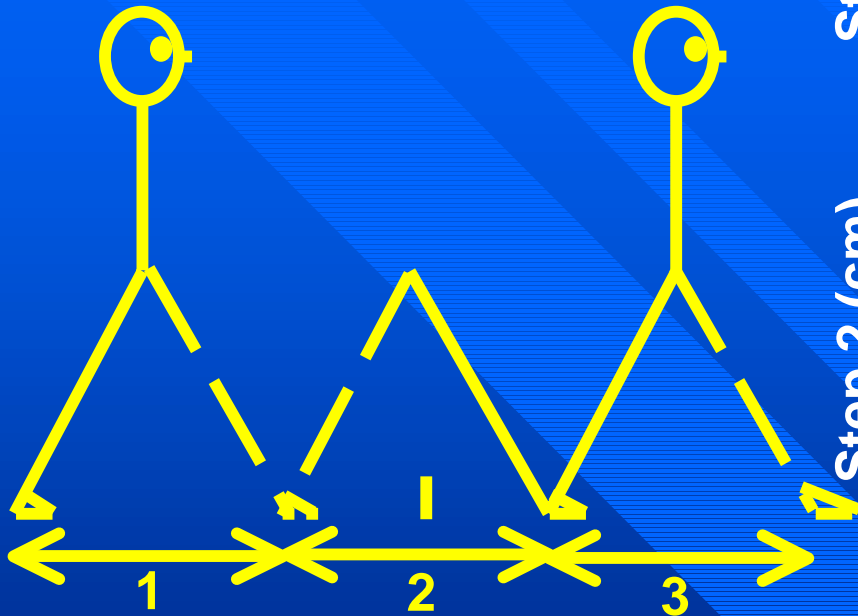


ML COM & COP

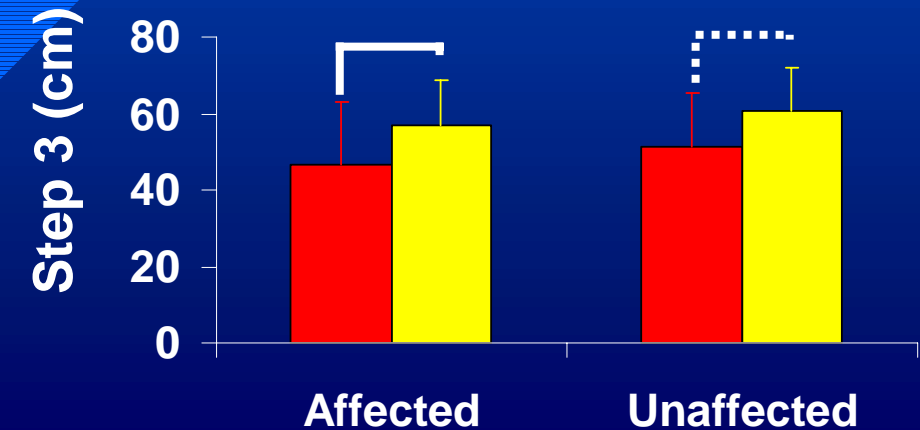
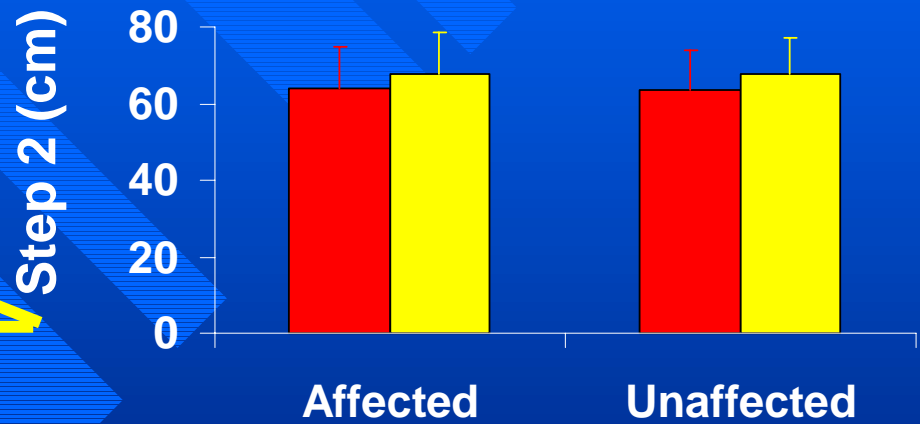
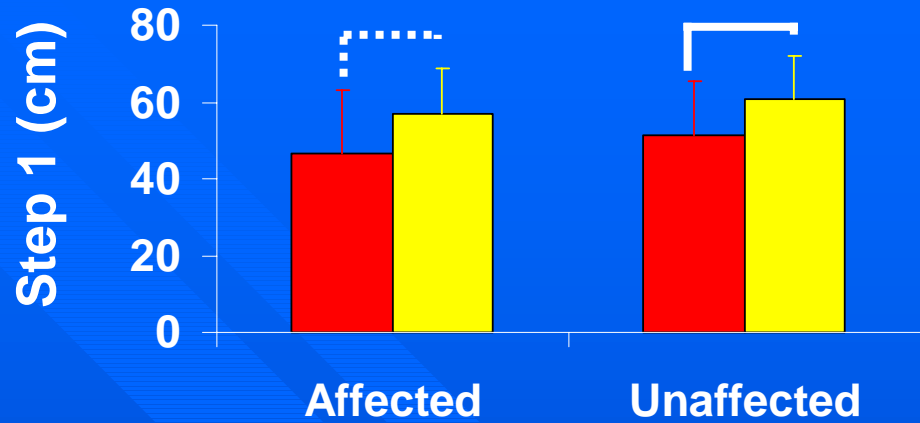


- Stroke
- Healthy, self select speed
- Healthy, matched speed

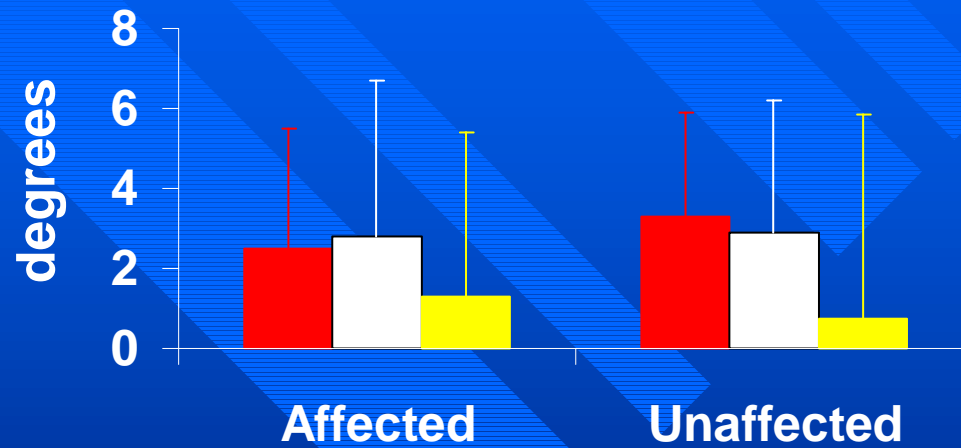
Step Length



- Stroke
- Healthy, matched speed

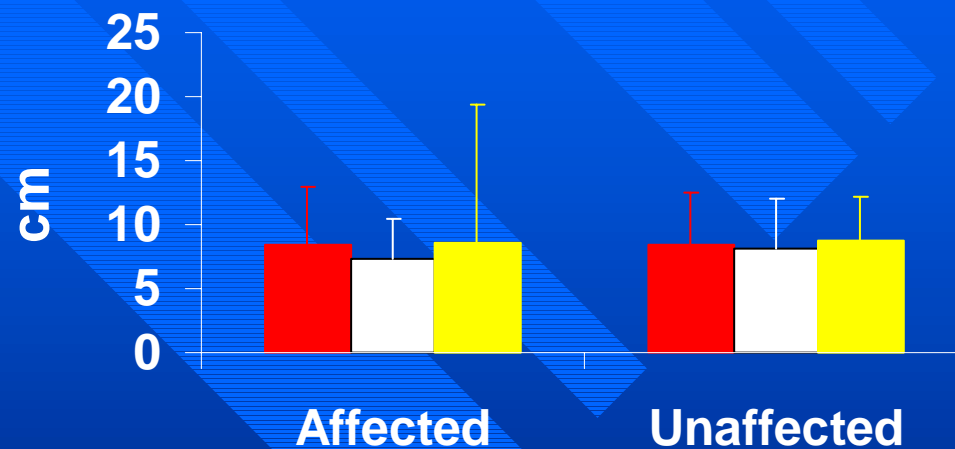


Trunk Angle



- Stroke
- Healthy, self select speed
- Healthy, matched speed

Step Width



- Stroke
- Healthy, self select speed
- Healthy, matched speed

Questions still to be answered.....

- Does difficulty with obstacle crossing correlate with falls?
- Does obstacle crossing improve with standard rehabilitation?
- Do laboratory measures of balance correlate with physiotherapists ratings of stability?

Current Research... in progress

- 20 stroke subjects tested twice performing obstacle crossing, 1 month apart.
- Physiotherapists rating subjects' balance during walking.
- Prospective collection of falls data for 6 months following testing.

Results.....



Conclusion

- Obstacle crossing is impaired following stroke
- Placement of the lead limb too close to the obstacle after crossing and poor balance control during and after obstacle crossing may contribute to falls risk.
- Obstacle crossing should be considered when assessing walking following stroke.

Acknowledgements

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