Pelvic Obliquity During Walking in Clinic and Home Environments

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BACKGROUND

- Altered mediolateral pelvic displacement or obliquity during walking is common among older adults.[1]
- It is associated with dysfunctional gait, impaired balance, and elevated fall risk.[2, 3]
- Traditional assessment of pelvic obliquity relies on clinical observations. Now, novel pose estimation algorithms allow precise 3D kinematics, **both in and out of clinical settings**.[4]

OBJECTIVES

1) Compare pelvic obliquity during walking in clinical and home environments.
2) Investigate the relationship between pelvic obliquity with fall risk for community-dwelling ambulatory older adults.

DEMOGRAPHICS

Inclusion criteria

- Age 21-90 years; stroke >6 months prior; independent ambulator with or without assistive device; normal or corrected-to-normal vision.

Exclusion criteria

- Neurological condition except stroke; aphasia limiting comprehension of task instructions; pregnancy; uncontrolled hypertension (>150/90mmHg at rest); dementia, cognitive impairments, or psychiatric disorders limiting the ability to provide informed consent; epilepsy; orthopedic or pain conditions limiting walking.

Characteristics	Neurologically Intact (n=21)	Stroke (n=5)
Age (years)	72 ± 9.77	77 ± 5.48
Gender (F/M)	15/6	2/3
Height (m)	1.66 ± 0.09	1.74 ± 0.11
Leg Length Discrepancy (cm)	0.61 ± 0.56	1.87 ± 2.10
Mini Mental Status Exam	29 ± 1.43	28.6 ± 1.95
Berg Balance Scale	52.29 ± 5.47	43.4 ± 15.81
Lower Extremity Fugel Myer	N/a	24.8 ± 5.02

Table 1. Participant characteristics per group, mean ± SD

STUDY DESIGN

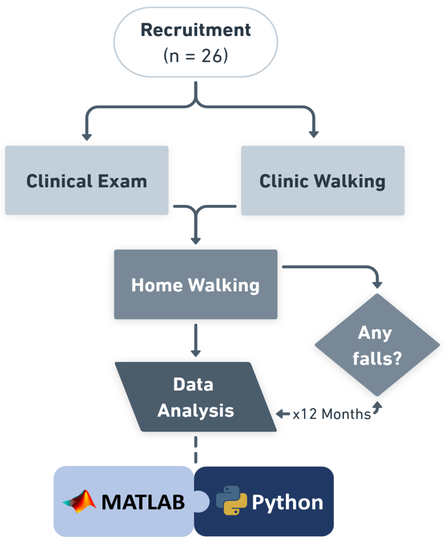

Fig 1. Study design visualized.

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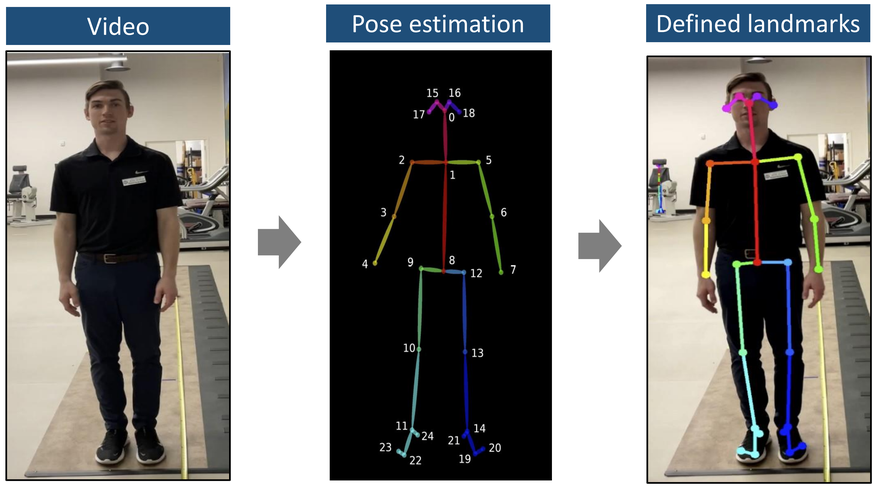
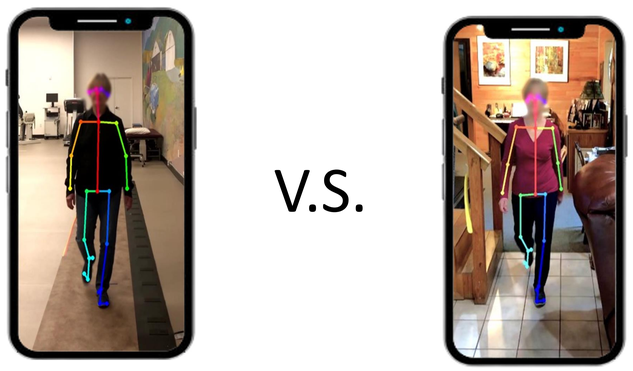
VIDEO PROCESSING WORKFLOW

1. Apply body landmarks[5, 6, 7]

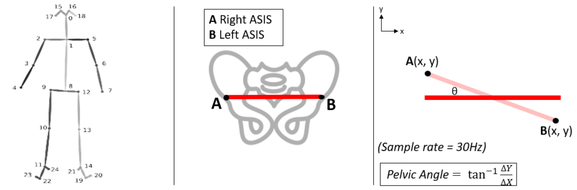


2. Calculate kinematic measures

3. Make environmental comparisons[8]



MEASURING PELVIC OBLIQUITY



Position of pelvis during quiet stance[9]

- Establish when the pelvis is 'neutral' by subtracting the mean of the pelvic angles during quiet stance from the pelvic angles during walking segments.

$$Neutral\ angle = \tan^{-1}\frac{\Delta Y}{\Delta X} - avg(\tan^{-1}\frac{\Delta Y\_qs}{\Delta X\_qs})$$

Mediolateral pelvic motion during walking[10, 11]

- Calculate the mean, standard deviation, and maximum distance (MAXD) of the pelvic angular displacement during walking segments.

$$MAXD = \max(Pelvic\ Angle) - \min(Pelvic\ Angle)$$

Mediolateral pelvic angular velocity during walking

- Calculate the mean and standard deviation of the pelvic angular velocity.

$$Velocity = \frac{\Delta Pelvic\ Angle}{\Delta time}, \text{where } \Delta\text{time} = \frac{1}{Sample\ rate}$$

CORRELATING FALL RISK

Track the frequency of self-reported falls each month after the initial visit, for 12 months

Fig 2. The number of people vs frequency of reported falls at 1, 2, 3, and 4 months after the subject's initial visit. *Data collection is ongoing.

Record the details surrounding a fall episode

Time	Location	Situation	Consequence
7:00 AM	Bathroom	Slipped reaching for grab bar	L Shoulder pain, L knee scrapes
9:00 AM	Front yard	Getting the mail	Bruised ribs
10:00 AM	Bathroom	L leg gave out in bathroom	No injuries
12:00 PM	Yard	Walking in the mud and slipped	Minor bruises on hip
3:00 PM	Farm field	Walking, knees and hips gave out	No injuries
1:00 PM	Living room	Picking up object, fell on blankets	No injuries

Table 2. Fall journal outlining the date, time, location, situation, and consequence of a self-reported falls for each subject.

Establish a relationship between pelvic obliquity and fall frequency[12]

CLINICAL RELEVANCE

- Identifying changes in pelvic obliquity during home walking may prompt physical therapists to modify their gait assessment methods.
- Understanding the relationship between pelvic obliquity and fall risk can inform targeted interventions for pelvic stability and fall risk reduction.

Take a picture for a list of references!