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IS RECOVERY IN MUSCLE ACTIVATION AND JOINT MECHANICS DURING GAIT INFLUENCED BY TOTAL HIP ARTHROPLASTY SURGICAL APPROACH?

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Introduction

Background

- In 2016-2017, approximately 56,000 hip arthroplasties were performed in Canada.¹
- The lateral and posterior total hip arthroplasty (THA) approaches constitute more than 90% of the THAs performed.
- Gluteus medius, an important pelvis stabilizer, is disrupted during the lateral THA approach and gluteus maximus is disrupted during the posterior THA approach.²
- THA surgical approach may impact long term recovery of muscle strength, which may influence muscle activation and pelvis control during gait.

Knowledge Gap

- There is uncertainty if gluteus medius and gluteus maximus muscle dysfunction during gait persist long term following THA.
- THA surgical approach may also influence the long term recovery of pelvis control during functional activities following THA.
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Objectives

- To compare gluteus medius and gluteus maximus muscle activation and pelvis obliquity angles during gait between patients that underwent lateral and posterior THA approaches for hip osteoarthritis one year after surgery and healthy controls.

Methods

Participants

- Participants that had a primary THA for hip osteoarthritis using a lateral approach (n=19) or posterior approach (n=19), and healthy adults (n=21) were recruited.
- Surgeries were preformed at the Jewish General Hospital by three different surgeons.

Data Collection

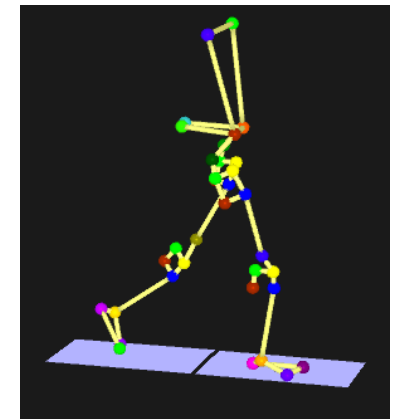
- Muscle activation of gluteus medius and gluteus maximus during gait were collected with surface electromyography (EMG). Motion and force data were gathered using an eight camera motion capture system (100 Hz) and two force plates (2000 Hz).
- Participants ambulated at self selected speeds for five trials.
- Maximum voluntary isometric contraction of gluteus medius and gluteus maximus were collected using an isokinetic dynamometer.

Outcomes

- Gluteus medius and gluteus maximus EMG during gait.
- Pelvis obliquity angles during gait.
- Maximum isometric hip abduction and hip extension muscle torques.

Statistical Analysis

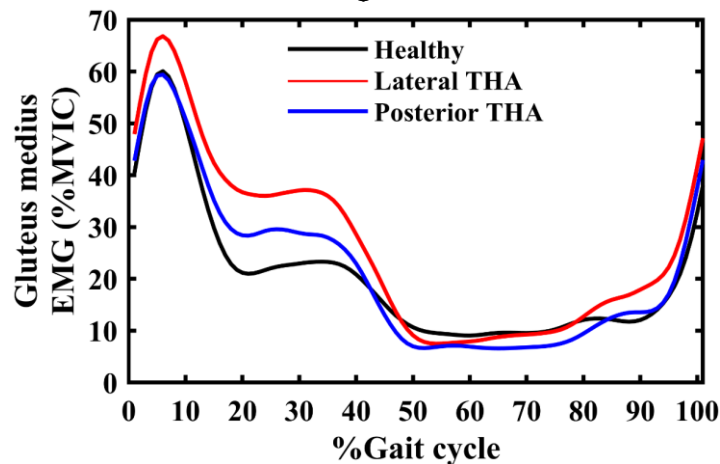
- Principal component analysis was used to identify key characteristics (principal components) of gait waveforms. Participant waveforms were then score against these characteristics to produce principal component scores.
- Analysis of variance and Cohen's d effect sizes compared principal component scores and muscle torques between groups. Bonferroni post hoc test adjusted for multiple comparison.



Results

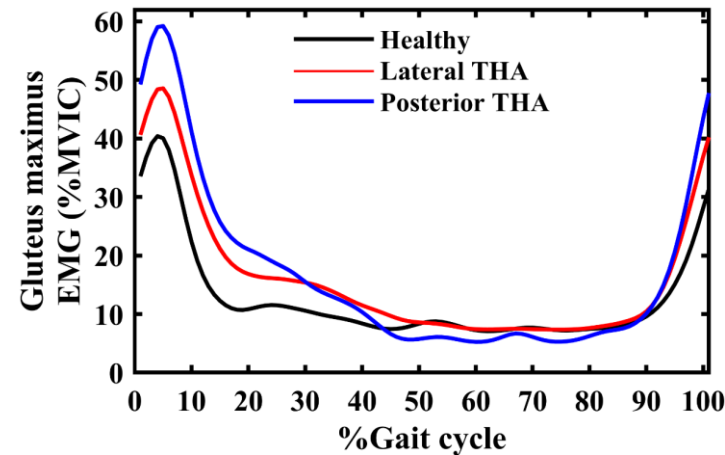
Gluteus medius EMG

- The lateral THA group had significantly higher gluteus medius muscle activation amplitudes compared to the healthy group with a large effect size ($p = 0.01$, $d = 1.04$).
- There were no significant differences between lateral and posterior THA groups.



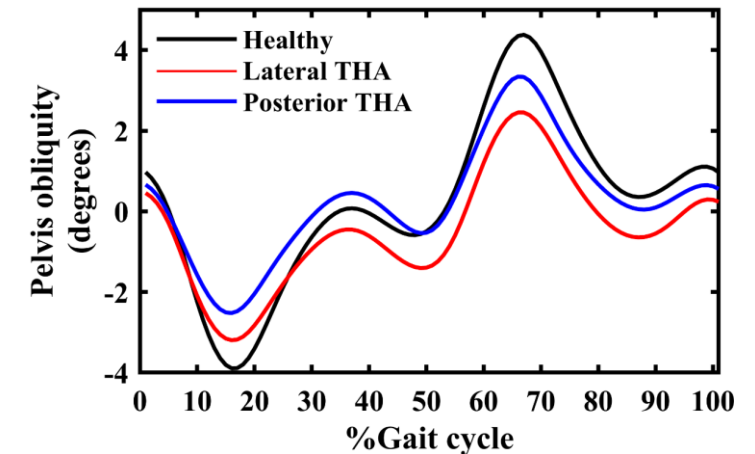
Gluteus maximus EMG

- The posterior THA group activated their gluteus maximus to a greater extent compared to the healthy group during the loading response ($p = 0.02$, $d = 0.98$).
- There were no significant differences between lateral and posterior THA groups.



Pelvis obliquity angle

- The lateral THA group had decreased pelvic obliquity angle excursions (i.e. less range of motion) with a medium effect size ($p = 0.03$, $d = 0.77$) compared to the healthy group.
- There were no significant differences between lateral and posterior THA groups.



MVIC: Group effects in maximum isometric hip abduction torque was approaching significance ($p=0.06$) with pairwise comparisons revealing that the healthy group had significantly higher torque values compared to the lateral THA group ($d = 0.70$; $p = 0.05$). Maximum isometric hip extension torque did not differ significantly between groups.

Discussion & Conclusion

- Gluteus medius and maximus muscle activation and pelvic obliquity angles during gait differed significantly between THA and healthy groups. However, there were no differences between lateral and posterior approach THA groups.
- Despite hip abductor weakness at one year following lateral THA, these participants were able to effectively control their pelvis during gait. The increased gluteus medius activation during gait might have compensated for this weakness.
- The higher gluteus maximus activation during gait among participants with posterior THA could be due to pre operative osteoarthritis related weakness or from the THA surgery. However, isometric hip extension torque did not differ between study groups.

Clinical impact

- Pre operative training of gluteus medius and maximus muscle could reduce the long term post-operative deficits in these muscles during functional activities.
- Rehabilitation protocols should emphasize adopting more functional training of these muscle (e.g. gait training) to promote carry over to functional activities.

References

1. Canadian Joint Replacement Registry Update. <https://www.cihi.ca>: The Canadian Joint Replacement Registry; 2018.
2. Petis S et al. Surgical approach in primary total hip arthroplasty: anatomy, technique and clinical outcomes. Can J Surg. 2015;58(2):128-139.