

# The Relationship Between Hip Abduction Force and Gluteus Medius Activity Before and After Total Hip Arthroplasty

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## Summary

Altered hip abductor muscle activity in individuals with hip osteoarthritis (HOA) has been attributed to decreased hip abductor muscle strength. Our study demonstrates that while abductor strength normalizes one year after total hip arthroplasty (THA), Gluteus medius (GMed) activity during early midstance and terminal stance of gait remains elevated.

## Introduction

Individuals with HOA exhibit reduced hip abductor muscle strength compared to their contralateral limb and healthy controls [1]. Additionally, increased hip abductor muscle activation during gait has been observed, which is thought to result from reduced hip abductor muscle force [2,3]. However, the relationship between hip abductor muscle strength and activation during walking in HOA remains unclear. This study aimed to examine the interplay between hip abductor muscle strength and activity during gait in individuals with end-stage HOA and how this relationship evolves following THA.

## Methods

Isometric peak abduction force and GMed activity during both force measurement and level walking at a self-selected speed were assessed in 12 individuals with end-stage HOA (7 females, age:  $58.3 \pm 11.2$  years) before (PRE) and one year after THA (POST). A control group (CON) of nine individuals without HOA (6 females, age:  $71.2 \pm 5.6$  years) was also included. Maximal voluntary isometric hip abduction force, measured in an upright standing position, was normalized to body weight. GMed activity was recorded using surface electromyography (sEMG) at 1000Hz (miniWave, menios GmbH). The sEMG signals were band-pass filtered (30–300 Hz), rectified, low-pass filtered (10 Hz), and normalized to peak activity during gait or force measurement. Statistical analysis included Wilcoxon/Mann-Whitney-U tests, Spearman's rank correlation coefficient, and statistical parametric mapping (SPM) to compare hip abductor force and GMed activity before and after THA and in relation to CON.

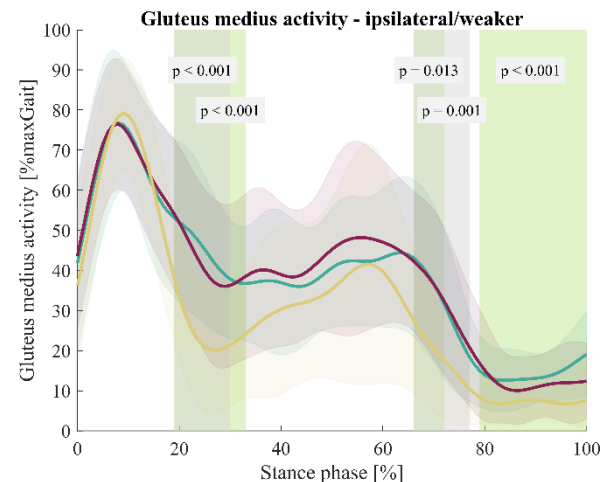
## Results and Discussion

The force ratio (ipsilateral/contralateral limb) increased from 90% PRE to 105% POST ( $p = 0.012$ ;  $|d| = 0.48$ ) caused by an increase in ipsilateral hip abduction strength ( $p = 0.016$ ;  $|d| = 0.42$ ) (Table 1). However, the correlation between changes in ipsilateral hip abductor force and ipsilateral GMed activity during walking from PRE to POST was weak ( $p = -0.29$ ). SPM analysis identified a supra-threshold cluster in ipsilateral GMed activity during walking between PRE/POST and the weaker limb of the CON at early midstance and terminal stance (Figure 1). Additionally, a significant difference was

observed between PRE and CON during pre-swing, a pattern previously described in individuals with severe HOA [3].

**Table 1:** Mean  $\pm$  SD of peak hip abduction force of individuals PRE THA, POST THA, and CON.

	PRE	POST	CON
Ipsilateral / weaker limb [N/kg]	$3.0 \pm 1.4$	$3.6 \pm 1.4$	$3.4 \pm 1.5$
Contralateral / stronger limb [N/kg]	$3.5 \pm 1.6$	$3.6 \pm 1.70$	$3.9 \pm 1.5$
Force ratio [% contralateral / stronger limb]	$90.6 \pm 30.7$	$105.3 \pm 30.9$	$85.7 \pm 12.5$



**Figure 1:** GMed activity during gait. PRE = green; POST = purple; CON = yellow; green area = SPM PRE-CON; grey area = SPM POST-CON.

## Conclusions

Although hip abduction force normalizes one year after THA, GMed activity during the stance phase of walking remains elevated, suggesting persistent neuromuscular adaptations beyond strength recovery.

## Acknowledgments

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## References

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