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## IS GAIT VELOCITY AND GAIT QUALITY ASSOCIATED WITH HIP MUSCLE STRENGTH IN HIP OSTEOARTHRITIS PATIENTS SCHEDULED FOR TOTAL HIP ARTHROPLASTY?

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### *Abstract:*

**Purpose:** Association between lower extremity muscle strength and gait velocity has been documented in healthy elderly individuals but not in patients with hip osteoarthritis (OA), scheduled for total hip arthroplasty (THA). There has been an increasing interest in three-dimensional (3D) gait analysis to help identify gait pathology/quality, also in the group of hip OA patients. However, the complexity and amount of data collected during gait analysis lead to challenges when interpreting these. Gait Deviation Index (GDI) summarizes the lower limb kinematic data and describes 98% of the variation in gait and may be used to express the degree of gait pathology in patients compared to an age-matched healthy group. Thus, GDI as a measure of gait quality might help the clinicians interpreting data from the gait analysis. Knowledge about associations between hip muscle strength, gait velocity and gait quality would improve the understanding of rehabilitation aiming at improving hip muscle function. The aim of this study was to investigate associations between hip muscle strength, gait velocity, and GDI in patients with end-stage hip OA.

**Methods:** A cohort of 20 consecutive patients all with unilateral end-stage hip OA scheduled for THA (5 women and 15 men; age  $61 \pm 5.8$  years; BMI  $28.1 \pm 3.4$  (mean  $\pm$  SD)). All completed 3D gait analysis using Vicon, Oxford, UK movement analysis system (100 Hz) with the Plug-in-Gait marker set. Five gait trials were used to calculate the median GDI score and self-selected velocity for each patient. A GDI of 100 indicates no gait pathology and a 10 point change represents 1 standard deviation from the reference group. In our study, kinematic data from 20 age-matched healthy controls were used as reference. All patients performed isometric maximal voluntary hip muscle strength (iMVC) tests (hip-flexion, -abduction and -extension) in standing position. For each muscle group, three test contractions were performed. The contraction with maximal iMVC was selected for analysis. Multiple and simple linear regression analysis were used to determine coefficient of determination ( $R^2$ ) using GDI or gait velocity as dependent variables and hip iMVC (flexion, abduction, and extension) as the independent variables. Paired T-test was used when testing GDI for the affected versus the unaffected limb.

**Results:** A moderate significant association ( $R^2 = 0.43$ ;  $p=0.03$ ) between gait velocity and hip iMVC was observed when using multiple linear regression (Table 1). Furthermore, simple regression analysis revealed a moderate association ( $R^2 = 0.23$ ;  $p=0.03$ ) between hip abduction and gait velocity (Table 1). A significant difference ( $p= 0.03$ ) in GDI between the affected and unaffected limb was observed ( $85 \pm 9$  versus  $91 \pm 10$  for the affected and unaffected limb, respectively). However, no association between GDI and hip iMVC was found in the multiple or simple regression analysis (Table 1).

**Conclusions:** The present study confirms an association between hip iMVC and gait velocity on the affected limb for patients scheduled for THA. The present data indicate that rehabilitation aimed at improving hip muscle strength (especially abduction) would be effective. However, no association between hip iMVC and gait quality was shown. A significant deviation in GDI scores on the affected limb was present, confirming that the leg scheduled for THA demonstrates reduced gait quality. The relative small sample size, hip pain and self-selected velocity are factors to be considered, when interpreting these associations. Further research is needed to investigate how the surgical approach and rehabilitation affects the patient's gait

Table 1. Multiple and simple regressions for maximal voluntary contraction (iMVC) of hip extension, flexion and abduction versus gait velocity or Gait deviation index (GDI) (n=20).

Independent variable	Mean $\pm$ SD	R <sup>2</sup>	p-value
Gait velocity (m/s)	1.15 $\pm$ 0.14		
Multiple regression		0.43	0.03
Simple regression			
Hip extension (Nm/kg)	2.26 $\pm$ 0.59	0.03	0.45
Hip flexion (Nm/kg)	1.37 $\pm$ 0.41	0.16	0.08
Hip abduction (Nm/kg)	1.57 $\pm$ 0.39	0.23	0.03
GDI	85.3 $\pm$ 8.6		
Multiple regression		0.16	0.42
Simple regression			
Hip extension (Nm/kg)	2.26 $\pm$ 0.59	0.00	0.98
Hip flexion (Nm/kg)	1.37 $\pm$ 0.41	0.02	0.52
Hip abduction (Nm/kg)	1.57 $\pm$ 0.39	0.07	0.25

velocity and quality.

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