

Changes in gait patterns and muscle activity following total hip arthroplasty: A six-month follow-up

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A B S T R A C T

Background: Appropriate gait function is an important determinant of the outcome of total hip arthroplasty and relies on appropriate joint motion and muscle activity. The purpose of this study was to test the hypothesis that 6-month postoperative dynamic joint range of motion, time-distance measures and muscle activity in the operated limb in patients undergoing total hip arthroplasty differ from preoperative levels and are more similar to those observed postoperatively in the contralateral limb and in healthy subjects.

Methods: Basic time-distance gait measurements, knee and hip kinematics and electromyographic activity from eight hip muscles were obtained preoperatively and 6 months postoperatively in 52 patients undergoing total hip arthroplasty and in 24 age-matched healthy subjects during treadmill walking.

Findings: Postoperative dynamic hip range of motion for the operated limb (confidence interval differences [− 3.9°; − 2.3°]) and postoperative knee range of motion for both limbs (operated: [− 8.4°; − 5.6°]; contralateral: [− 8.1°; − 5.3°]) in patients with total hip arthroplasty were significantly lower than values for the control subjects ($P < 0.001$). Postoperative gait in patients with total hip arthroplasty was more symmetric than preoperative gait. Preoperative and postoperative electromyographic intensities were higher in patients with total hip arthroplasty than values for the control subjects ($P < 0.001$), and patients had different EMG patterns compared to the control group.

Interpretation: Pre- and postoperative differences not only in hip but also in knee kinematics emphasize the importance of evaluating the dynamic outcome of total hip arthroplasty by assessing joint motion of all lower extremity joints in both legs.

目的

- **THA後6ヶ月で歩行のパラメーターは改善し、健常者に近い歩行パターンとなっているという仮説を検証すること。**

デザイン

- **横断研究**
- **THA後患者55例、対照群24例（健常者）**
- **THA患者は術前と術後6ヶ月、対照群は1回の各種測定を実施。**

アウトカム

- 三次元歩行解析による歩行パラメーター
- 筋電図評価

Table 2

Results of the reliability test. The reliability of all test parameters was assessed by comparing data obtained in the two sessions of the control group according to the definition of the British Standards Institution (Bland and Altman, 1986). According to the definition, all study parameters were reliable.

Parameter	Mean of differences (test 1–test 2)	95% confidence interval mean of difference
Gait parameters		
Stance phase (% gait cycle)	–0.7	[– 3.0; 1.6]
Step length (m)	–1.0	[– 9.9; 7.9]
Knee flexion angle (°)	1.3	[– 3.0; 5.6]
Hip flexion angle (°)	1.5	[– 2.6; 5.7]
Muscle activity parameters		
Rectus femoris (%NC)	–0.2	[– 13.4; 13.0]
Sartorius (%NC)	2.7	[– 24.3; 29.7]
Adductor magnus (%NC)	3.9	[– 18.6; 26.4]
Tensor fasciae latae (%NC)	0.5	[– 8.4; 9.4]
Biceps femoris (%NC)	2.6	[– 14.0; 19.2]
Semitendinosus (%NC)	1.2	[– 19.2; 21.6]
Glutaeus maximus (%NC)	2.1	[– 23.0; 27.2]
Glutaeus medius (%NC)	–2.1	[– 27.3; 23.1]

%NC – % norm contraction.

統計解析

➤ 反復測定分散分析

結果

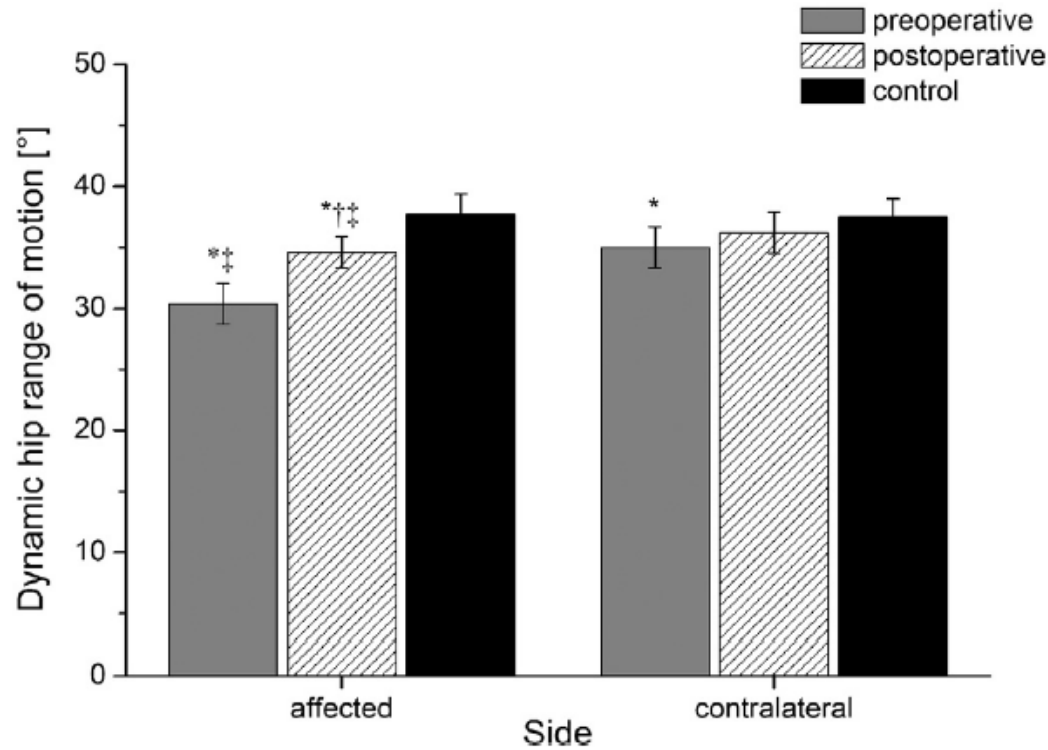


Fig. 1. Mean (95% confidence interval) dynamic hip range of motion for the operated and the contralateral limb during level walking pre- and postoperatively for THA patients and for control subjects. *—significantly different from control group; †—significantly different from preoperative levels; ‡—significantly different from contralateral side ($P < 0.001$).

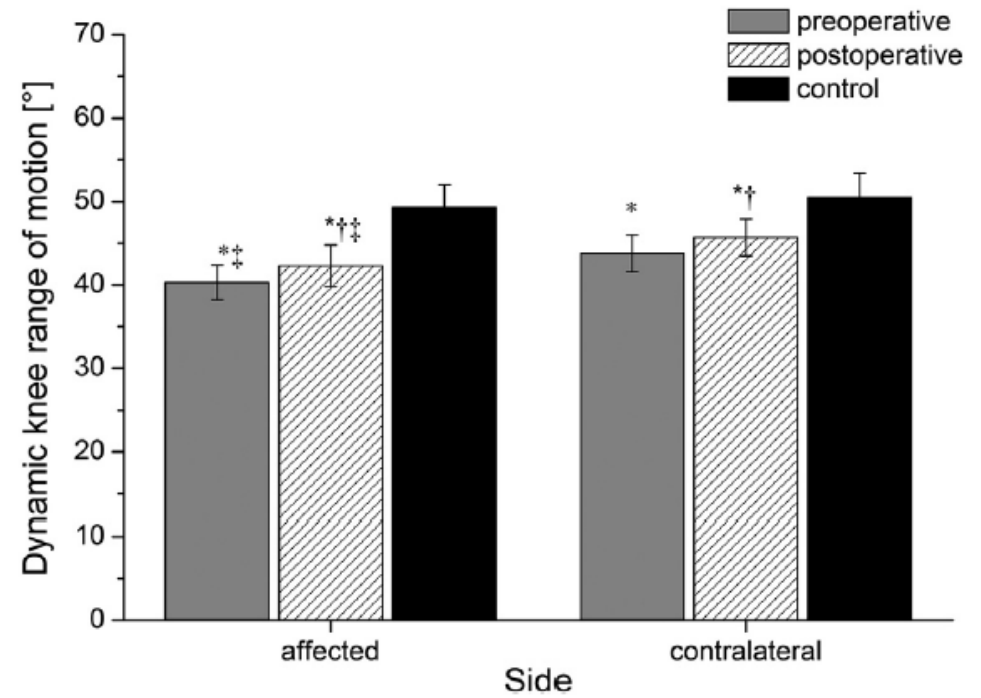


Fig. 2. Mean (95% confidence interval) dynamic knee range of motion for the operated and the contralateral limb during level walking pre- and postoperatively for THA patients and for control subjects. *—significantly different from control group; †—significantly different from preoperative levels; ‡—significantly different from contralateral side ($P < 0.001$).

結果

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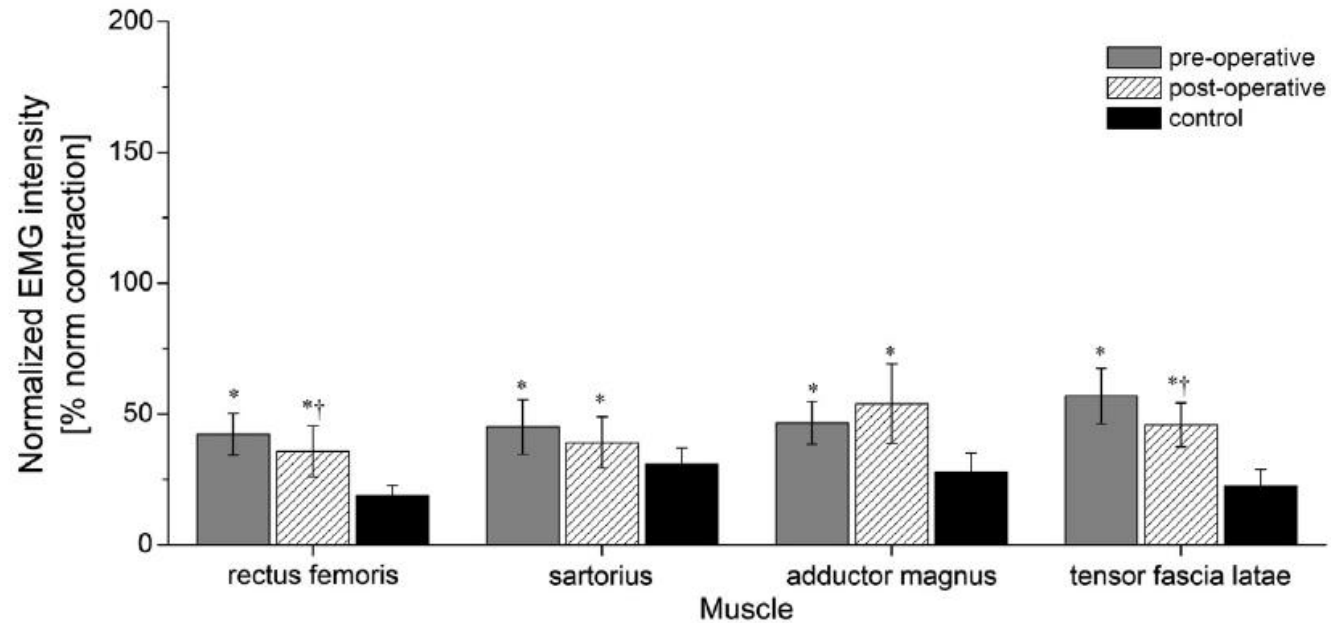


Fig. 3. Mean (95% confidence interval) normalized EMG intensity averaged over the entire gait cycle for the rectus femoris, sartorius, adductor magnus and tensor fascia latae muscles of the operated limb during level walking pre- and postoperatively for THA patients and for control subjects. *—significantly different from control group; †—significantly different from preoperative levels ($P < 0.001$).

% norm contractionとは男性5kg、女性3kgの等尺性収縮時を100%として算出

結果

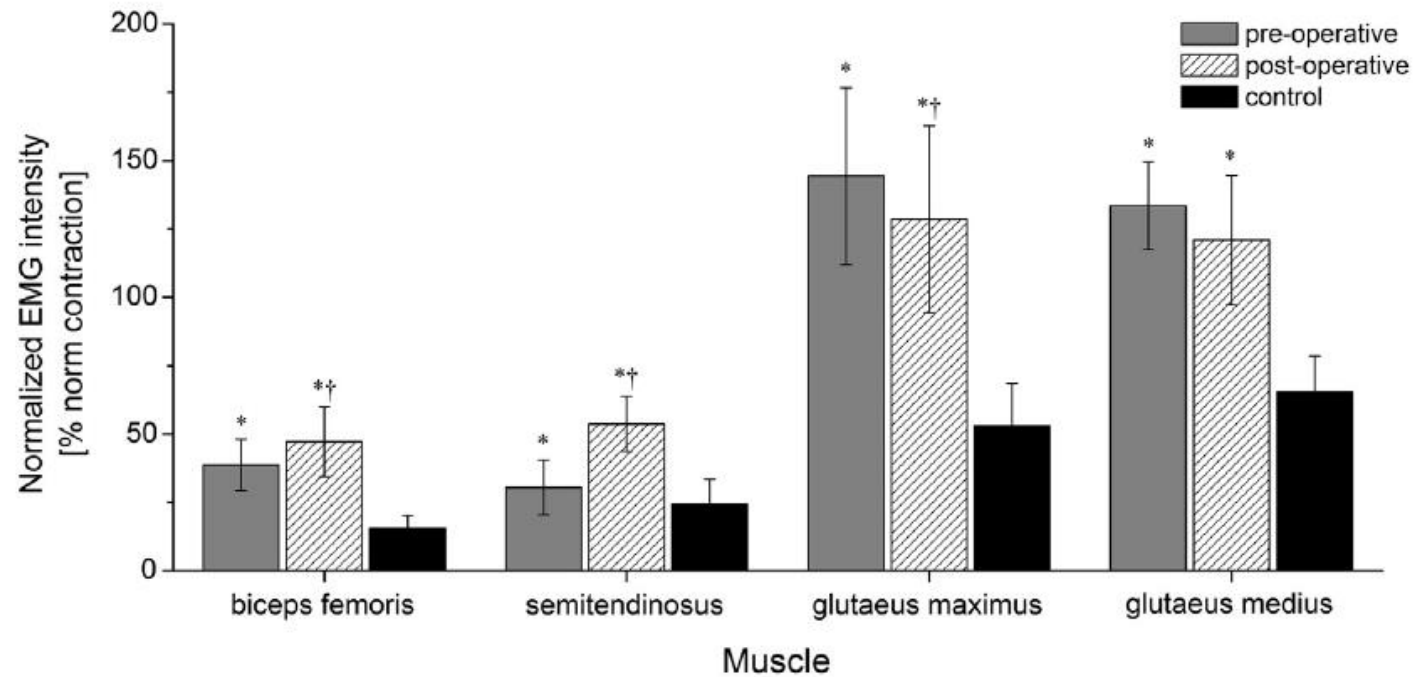
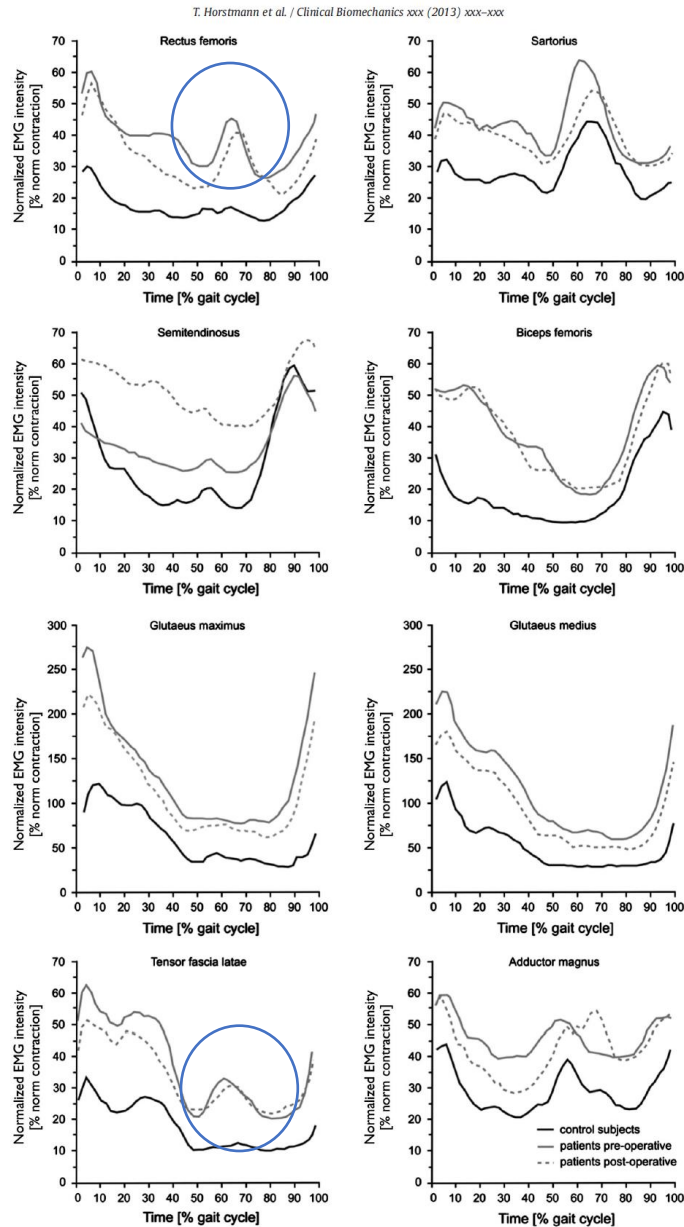


Fig. 4. Mean (95% confidence interval) normalized EMG intensity averaged over the entire gait cycle for the biceps femoris, semitendinosus, gluteus maximus and gluteus medius muscles of the operated limb during level walking pre- and postoperatively for THA patients and for control subjects. *—significantly different from control group; †—significantly different from preoperative levels ($P < 0.001$).



結果

- 半腱様筋と大腿二頭筋は立脚期で高い活動を認めた。
- 中臀筋と大臀筋について、健常者は立脚初期のみ活動が高まるが、それ以外は終止THA後患者の方が筋活動が高かった。
- 前遊脚期頃からRF、TFLの活動が高まりすぎている。

考察

- 術前よりは歩行のパラメーターは改善し、健常者のパターンに近くなっていた。
- 股関節のみではなく膝関節のパラメーターも考える必要がある。
- % norm contractionを改善するには、もととなる筋力（分母）の改善が必要。
- 歩行のパラメーターを改善し、非効率な動きを改善させる必要がある。