Gait biomechanics after total hip arthroplasty: using statistical parametric mapping to identify differences between various surgical approaches

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Background

The effect of surgical approach used for total hip arthroplasty (THA) is still not conclusive on the evidence of functional joint performance. Biomechanical studies have tried to assess the impact of the surgical approach on gait characteristics and recovery. Some studies which used discrete analyses have shown that some surgical approaches provide better hip joint function after one year post-surgery, but several studies did not find any differences.

Objectives

The goal of this study was to compare hip biomechanics during gait using statistical parametric mapping (SPM) in patients who underwent THA with either a lateral (LAT), anterior (ANT), or posterior (POS) approach.

Design and Methods

Forty-five patients underwent unilateral THA with either a LAT (male=8, female=7; age=66.4±6.3 years; BMI=27.1±4.5), ANT (m=6, f=9; age=62.9±4.9 years; BMI=29.8±4.8), or POS (m=8, f=7; age=62.9±4.9 years; BMI=29.8±4.8), or POS (m=8, f=7; age=67.4±5.8 years; BMI=27.4 ± 4.9) approach, and were compared with 15 healthy controls (CTRL) (m=8, f=7; age=64.9±3.9 years; BMI=24.5±3.2). All patients underwent biomechanical gait analysis approximately 9 months following surgery. Nine infrared cameras and two embedded force platforms were used to record the participants joint movements and ground reaction forces as they walked down a 10m walkway at a self-selected pace. Participants completed a minimum of three trials which were processed and time-normalized to the gait cycle (heel strike to heel strike) of each limb. Hip joint biomechanics were calculated, and included sagittal and frontal joint angles and moments, as well as joint powers. The side of interest was the operated limb for the THA groups and the dominant limb in the CTRL group. Hip biomechanics were compared between groups throughout the entire gait cycle using a One-Way ANOVA SPM. Alpha was set to 0.05 and Bonferroni *post hoc* comparisons were completed.

Results

SPM comparisons indicated that the LAT group had significantly less hip extension just prior to toe-off (55-59% of gait cycle) compared with the CTRL group. No significant differences were observed in frontal hip angles. The POS group had a significantly lower hip flexion moment just prior to toe-off compared to the ANT (50-57% of gait cycle) and CTRL (50-56% of gait cycle)

groups. The ANT group had significantly lower hip abduction moment for most of the stance phase compared to the LAT (5-50% of gait cycle) and CTRL (5-53% of gait cycle) groups. The POS group had a significantly lower hip abduction moment compared to the LAT (3-13% of gait cycle) and CTRL (3-27% of gait cycle) groups. No significant differences were observed in hip power.

Conclusion

The SPM comparison allowed for hip biomechanical comparisons throughout the entire gait cycle. The LAT approach portrayed better frontal kinetics and reduced sagittal kinematics after 9 months post-surgery whereas the ANT group had better sagittal kinematics and reduced frontal kinetics as compared to the healthy CTRL. This tends to contradict existing literature. This study had several limitations which must be addressed. Each surgeon performed the approach they were most comfortable with and two different types of implants were used with a range of head sizes from 28-50. Future studies should complete both pre- and post-operative assessments with larger cohort in each group, as well as standardize the implants as much as possible to determine if observed differences are due to the approach and no other factors.