

THE EFFECT OF IMPLANT DESIGN ON SUPPORT MOMENT ASYMMETRY IN TOTAL KNEE ARTHROPLASTY PATIENTS DURING SIT/STAND TASKS

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Introduction

Side-to-side lower limb asymmetry is common among late-stage knee OA patients^[1]. It is typically reduced, but not resolved to the level of healthy controls following total knee arthroplasty (TKA)^[2]. Implant design can affect post-operative muscle activity during activities of daily living^[3], which may subsequently result in differences in loading asymmetry too. It is not yet known whether such differences exist in post-op TKA patients. This study aimed to examine whether patients receiving a Medial Pivot (MP) implant differed significantly in their lower-limb loading asymmetry, compared to patients receiving a Posterior Stabilized (PS) implant and a group of healthy controls.

Methods

Twenty-six knee OA patients underwent TKA with either an MP (M=8, F=6; age=63.7± 5.7yrs) or a PS implant (M=6, F=6; age=66.3±8.2yrs) and were compared pre-operatively (<1 month) and post-operatively (12±1 months) to a group of age/sex-matched controls (CTRL) (M=6, F=8; age=64.4±5.6yrs). Participants were required to perform sit-to-stand (StS-Up) and stand-to-sit (StS-Down) tasks, while motion capture cameras tracked reflective markers placed according to a custom, full-body marker set. Force plates measured ground reaction forces for each limb, and the moment contact was made and lost with the chair. Inverse dynamics was used to calculate the sagittal support moment (summation of hip and knee extension and ankle plantar flexion) for each limb, during the raising and lowering phases of StS-Up and StS-Down, respectively. Data were time-normalized to the start and end of each phase, and normalized to participants' body weight. Asymmetry was measured by calculating the difference (unaffected minus affected/non-dominant minus dominant for controls) in the area under the curve (ΔAUC) (0 = perfect symmetry)^[4]. Both raw and absolute differences were calculated to provide insight into side-specific and overall asymmetry, respectively. Mann-Whitney U and Wilcoxon Signed Rank non-parametric tests ($\alpha=0.05$) were used to compare between and within the groups.

Results

Pre-operatively, both patient groups favored their unaffected side significantly more than the CTRL group favored either side. The PS group was also significantly more asymmetric overall than the CTRL group for both tasks, whereas the MP group only differed significantly for StS-Up. The PS group favored their unaffected side significantly more than the MP group during both tasks and was significantly more asymmetric overall during

StS-Down, but not StS-Up. Following surgery, both patient groups continued to favor their unaffected side during both tasks. However, the PS group displayed significantly less asymmetry post-operatively, whereas the MP group showed no significant improvement. Although both patient groups also continued to favor their unaffected side, overall limb asymmetry was similar to the CTRL group.

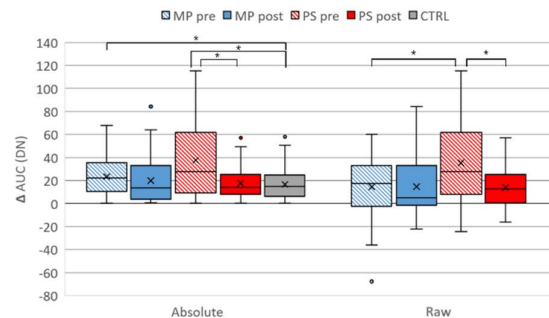


Figure 1: ΔAUC during StS-Up for the MP and PS groups pre- and post-operatively, and for the CTRL group (*=sig. at 0.05, +ve raw values = unaffected/non-dominant side, DN=dimensionless number)

Discussion

The results concur with previous studies indicating that lower-limb asymmetry among knee OA patients improves, but is not resolved after TKA^[2]. Although they displayed similar levels of asymmetry to healthy controls, the TKA groups favored their unaffected limb, whereas no pattern was detected in the CTRL group. Continuing to favor the unaffected side may be due to strength deficiencies or unresolved guarding strategies that persist after surgery. This may have implications for the development of OA in the contralateral limb. The PS group showed significantly greater improvements in joint loading asymmetry after TKA, compared to the MP group, but displayed significantly more asymmetry pre-operatively, making it difficult to determine the influence of implant design. Future studies must include groups with similar asymmetry pre-operatively, and will examine joint-specific contributions to asymmetry.

References

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