

Unilateral vs Bilateral Physica KR total knee arthroplasty: Does unilateral or bilateral lead to improved outcomes in the kinematics of walking gait?

Keywords: Total Knee Arthroplasty, Unilateral, Bilateral, Gait Analysis, Kinematics, Gait Symmetry

Introduction:

Osteoarthritis is a leading cause of total knee arthroplasty (TKA), which can be used to improve the quality of a person's life, through reduced pain and improved function of the knee (Huang et al. 2017). As well as affecting a person unilaterally, osteoarthritis can affect them bilaterally, which can lead to the need for a bilateral TKA (Stanley et al. 1990). Huang et al. (2017) assessed the functional outcomes from simultaneous bilateral TKA, demonstrating that the satisfaction levels were improved in the second TKA. Symmetry is an important aspect of gait analysis, as unilateral conditions such as unilateral TKA can lead to gait asymmetry (Patterson et al. 2012). Perfect symmetry can be defined with a symmetry ratio (SR) value of 1.

Objectives:

This research aims to determine whether the symmetry ratio values for unilateral and bilateral Physica kinematic retaining (KR) TKA participants are significantly different to perfect symmetry.

Methods:

National Health Service (NHS) ethical approval (15/SC/0725) was gained. Two groups were developed from four of the participants tested. All TKR participants were implanted with the Physica KR TKR (LimaCorporate, Italy), a minimum of 12 months post-op. Bilateral group (1 male, 1 female) and unilateral group (1 male, 1 female).

Gait analysis was performed using a 3D 10 camera motion capture system (VICON, Oxford). Marker data was sampled at 250Hz. Six successful trials were recorded for each participant and three were selected for processing once reviewed. Three-trial averages were used for each parameter (V), and then SR was calculated. The kinematic parameters investigated include peak flexion, peak extension and range of motion for the hip, knee and ankle joints.

Unilateral symmetry ratio (USR) = V_{op}/V_{non-op}

Bilateral symmetry ratio (BSR) = V_{1stop}/V_{2ndop}

T-tests were used to determine the differences between the groups symmetry ratios.

Results:

No significant differences were found with any symmetry ratios for the kinematic variables at the hip or ankle. However, at the knee significant differences were reported between the USR and BSR for peak knee flexion $p = .009$, $\alpha = .05$ and for peak knee extension $p = .047$, $\alpha = .05$.

The results comparing the two groups to perfect symmetry show that the bilateral TKA participants only had one significant difference in the kinematics reported; Hip range of motion $p = .009$, $\alpha = .05$. Whereas the unilateral TKA participants found significant differences between the peak knee flexion $p = .007$, $\alpha = .05$, peak knee extension $p = .030$, $\alpha = .05$, peak hip extension $p = .004$, $\alpha = .05$ and hip range of motion $p < .001$, $\alpha = .05$.

Conclusion:

The results suggest that the bilateral TKA participants have a more symmetrical gait pattern than the unilateral TKA's. Although the unilateral TKA participants demonstrated greater significant differences than the bilateral TKA, the functional outcome from the TKA is still positive due to the ability of the participants to perform activities they could not prior to the operation and their ability to perform all activities pain free. However, the within the bilateral TKA participants with two Physica KR implants the results show that due to no significant differences in the knee kinematics gait symmetry, that gait symmetry at the knee is restored. This research will progress to investigating running gait within unilateral and bilateral Physica KR TKA participants, as well as further comparisons with controls.