**Introduction:** Compared to the design of a traditional multi-radius (M_RAD) total knee arthroplasty (TKA), a single-radius (S_RAD) TKA has a longer quadriceps moment arm and a fixed center of rotation in the femoral component. It is not known if the S_RAD TKA could enhance the knee extensor mechanism and provide adequate tension to the collateral ligament during daily activities. As the stand-to-sit is an important daily movement that requires adequate quadriceps eccentric force and knee stability in order to avoid falling, it is crucial to know if the design differences between the S_RAD and M_RAD TKA systems could affect the functional performance of the stand-to-sit movement. The purpose of this study was to investigate the effect of differences of TKA designs on knee kinematic and muscular activation for the stand-to-sit movement.

**Methods:** 16 unilateral, posterior-stabilized TKA participants (8 S_RAD and 8 M_RAD) with excellent knee society scores performed 4 trials of the stand-to-sit test. Three dimensional kinematics and knee flexor and extensor electromyography (EMG) were collected during each trial. Knee abduction/adduction (ABD/ADD) kinematics and root mean squared (RMS) EMG were calculated. MANOVA was used to determine the kinematic and EMG differences between the M_RAD and S_RAD groups (α = 0.05).

**Essential results:** The M_RAD group exhibited greater TKA vastus medialis (VM) RMS EMG in 31°-45° and 61°-75° knee flexion angular intervals (Figure 1) and biceps femoris (BF) co-contraction RMS EMG from 15° to 75° of knee flexion (Figure 2). The M_RAD TKA limb demonstrated 5° more ABD displacement and tended to have 3° less ADD displacement than the S_RAD TKA limb (Figure 3). In addition, the M_RAD TKA limb reached the ABD peak at 52% of the total stand-to-sit time, which was significantly later (p = 0.028) than the S_RAD TKA limb (33%). However, no kinematical differences were seen between the non_TKA limbs of the two TKA groups.

**Discussion:** The biomechanical differences were evident between these two TKA designs. The M_RAD TKA group demonstrated greater TKA quadriceps eccentric actions than the S_RAD group. One explanation was that with a shorter quadriceps moment arm for an M_RAD TKA than an equivalent S_RAD TKA, in order to produce the desired level of knee extension muscle torque needed to counteract the proximal joint reaction moment, the M_RAD group needed to increase the quadriceps eccentric activity.

Evidences of decreased medio-lateral stability and efforts to stabilize the TKA knee were demonstrated by the M_RAD group also during the stand-to-sit. For the TKA limb, the M_RAD group exhibited a greater ABD displacement than the S_RAD group. In addition, the ABD peak displayed by the TKA limb occurred significantly later for the M_RAD group compared to the S_RAD group. These suggested that the M_RAD TKA limb might not be able to effectively restrict its frontal plane motion due to the slack collateral ligaments. Also, the tendency of having less ADD displacement after the ABD peak suggested that the collateral ligaments of the M_RAD TKA limb were not able to pull the TKA limb back to its normal position. Furthermore, the M_RAD TKA limb displayed greater hamstrings co-activation EMG than the S_RAD TKA limb, possibly in anticipation of and during the shift to one knee flexion/extension axis from the other.

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**Figure 1.** VM RMS EMG for 4 angle intervals from 15 degrees to 75 degrees of knee flexion during knee flexion phase of stand-to-sit movement. For comparisons between TKA groups: * indicates p < 0.05.

**Figure 2.** BF RMS EMG for 4 angle intervals from 15 degrees to 75 degrees of knee flexion during knee flexion phase of stand-to-sit movement. For comparisons between TKA groups: * indicates p < 0.05, ** indicates p < 0.01.

**Figure 3.** ABD and ADD displacement of S_RAD and M_RAD TKA limbs.