INTRODUCTION: Total knee arthroplasty (TKA) is an effective surgical intervention that reduces the pain and disability associated with end stage knee osteoarthritis (OA). Although the majority of patients who undergo TKA demonstrate a substantial improvement in function, not all patients experience positive outcomes and a large percentage require contralateral TKA within 10 years. Primary TKA is often performed when the pain and disability associated with the disease severely interferes with an individual’s ability to perform activities of daily living. By this time, the patients have developed long standing compensations to reduce knee pain and have a substantial weakening of the quadriiceps. This can lead to learned movement patterns that persist after surgery and place excessive loads in the uninvolved knee joint, which may expedite the disease process on the contralateral side. The purpose of this abstract is to critically interpret longitudinal functional and motion analysis data collected on persons prior to and following TKA for unilateral knee OA. This evaluation will help elucidate appropriate timing of TKA surgery and direct future post-operative rehabilitation protocols.

METHODS: We examined numerous pre- and post-operative functional and demographic variables from an initial cohort of 216 persons who underwent TKA for unilateral knee OA and a smaller control group of 64 healthy adults. OA subjects were excluded if they had neurological impairments or maximal knee pain (greater than 4 out of 10) on the contralateral side. While these data have been or will be published separately, we collectively evaluated the findings from these studies to: 1) explicate the most appropriate timing of TKA, 2) examine the learned abnormal patterns that need to be eradicated following TKA surgery and 3) suggest rehabilitation techniques to overcome persistent movement dysfunction.

RESULTS: Immediately prior to TKA, persons were significantly weaker, more disabled and had a higher body mass than control subjects (Table 1). Significant and clinically meaningful improvements in strength and function were seen after TKA, although mean values for the functional variables remained lower than healthy controls 2 years after TKA. Significant differences in strength were not seen at 2 years between TKA and control subjects. BMI significantly increased within 2 years after TKA and remained significantly higher than the controls. Sixty-three of 105 persons required a handrail prior to TKA and this was significantly more than the control group. 19 of 64. TKA did not decrease the incidence of handrail use post-operatively, as 57 of 105 persons still required a handrail 2 years after TKA.

Motion analysis data revealed that following unilateral TKA, persons still required a handrail 2 years after TKA. These factors should be methodologically evaluated. It is evident, however, that there is a current standard of care after TKA. Rehabilitation protocols that include an aggressive strengthening component should become the standard of care after TKA. In addition, all persons after TKA should have access to weight management or nutrition professionals to counter the increase in BMI seen in our sample. The effects of obesity and weight gain may affect the joint loads in the non-operated limb and lead to cardiovascular sequelae. Future research should evaluate the effect of rehabilitation protocols that include a biofeedback protocol to help restore symmetrical movement patterns. This may reduce the load of the non-operated limb and lower the need for subsequent contralateral TKA.

DISCUSSION: Several important conclusions can be extrapolated from the results of these studies. Consistent with typical clinical observations, persons with knee OA in this study waited until they experienced remarkable dysfunction before undergoing TKA. This was evidenced by the fact that patients with OA had significant quadriiceps weakness and the majority of these persons required a handrail during stair ascent or descent. Time to complete the stair climbing task was twice as long for persons with OA as compared to the controls. The advanced disease process at the time of surgery may be a barrier to exercise and could partially explain the higher body mass in these individuals. Additionally, the remarkable impairment at the time of surgery can have important consequence on long-term outcomes. Pre-operative quadriiceps strength predicts functional ability one year after surgery. Therefore, postponing surgery until the presence of substantial quadriiceps weakness may result in poor post-operative outcomes. Because restoring strength in a joint with substantial pain is not always feasible, persons may benefit from TKA earlier in the disease process.

The rehabilitation protocol in this study utilized an aggressive quadriiceps strengthening regimen. This regimen produced significant improvements that were greater than the normal post-operative standard of care. Despite this, some functional variables were still significantly lower than healthy controls 2 years after TKA. This suggests that current rehabilitation protocols, even with aggressive strengthening, do not completely restore function. Following TKA, the majority of persons still required the handrail during stair negotiation, took longer during stair ascent and descent and reported lower KOS-ADLS scores. More importantly, the majority of persons demonstrated an increase in body mass. Although functional ability improved, persons after TKA did utilize these improvements and reduce their body mass.

The rehabilitation protocol also did not address important biomechanical alterations that may increase joint loads on the contralateral limb, particularly during a challenging stair negotiation task. Aggressive strengthening may improve the joint kinematics and functional ability after TKA, but it does not reduce asymmetries during dynamic activities that may expedite the disease process on the non-operated limb. Three years after TKA, the status of the non-operated knee predicts functional ability3. Similarly, the early post-operative strength of the non-operated knee predicts long term outcomes. Persons with end-stage knee OA may benefit from TKA intervention earlier in the course of the disease process. Surgical intervention prior to severe functional disability and quadriiceps weakness may result in greater long term outcomes. This may also reduce the magnitude of learned abnormal biomechanical movement patterns that place greater load on the non-operated limb. The current standard of care after TKA needs to be changed. All rehabilitation protocols should incorporate aggressive strengthening and weight loss or cardiovascular components. Functional retraining to normalize joint forces should also be incorporated into post-operative treatment regimens.