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Can Gait Studies be Used to Predict Risk of Hip Osteoarthritis?

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Summary:
This study provides additional evidence to support the idea that the reversal gait profile is associated with hip osteoarthritis risk.

Abstract:
Introduction:
Osteoarthritis (OA) of the hip is a common condition, affecting 1 in 4 individuals by the age of 85. Treatment options for addressing hip OA are generally focused on symptom management and many cases end with surgically replacing the joint with mechanical components. If hip OA could be detected earlier, treatment may be more effective in preventing or slowing the progression of the disease. A reversal gait pattern, defined as a second order change in the slope of the walking hip flexion angle, has been identified in individuals with hip OA at a significantly higher rate than asymptomatic controls and has been found to increase in prevalence with increasing severity of OA. This same reversal pattern has also been identified in patients with femoroacetabular impingement (FAI), a condition characterized by abnormal bone growth on the femoral head/neck and/or acetabular rim that leads to physical abutment and soft tissue damage. Many consider FAI to be a risk factor for idiopathic hip OA. Therefore, other groups thought to be at risk for hip OA should be analyzed for reversal gait prevalence to better understand its association to OA risk. One of the highest risk factors for hip OA is advanced age. Longitudinal research would be needed to substantiate the use of this marker as a predictor for hip OA development, but if the reversal gait prevalence does increase with age and is found to be significantly greater in an asymptomatic advanced age group, then additional evidence would exist to suggest a link between this marker and hip OA risk. And, if this link exists, then this marker could be a good, clinical marker for assessing functional surgical outcome since it is binary, it either exists in an individual or it doesn't, and it is easily tested, requiring only a limited marker set to collect. Therefore, the purpose of this study was to test the hypothesis that reversal gait prevalence would be significantly greater in an older asymptomatic group as compared to a younger asymptomatic group.

Methods:
In total, 208 subjects (96 Males, 112 Females) ranging in age from 20-80 participated in this study. At least 30 subjects per decade were enrolled. All participants were self-described "healthy" based on self-reported lack of back, hip, knee, or ankle pain; they were not specifically screened for hip OA or FAI. Each subject signed a Stanford University Institutional Review Board approved informed consent form. Sagittal plane hip kinematics were collected using a nine camera opteoelectronic system by Qualisys Inc according to an approach previously described by Prodromos (Prodromos, 1985). Each participant performed three walking trials at a self-selected normal walking speed. Walking speed as well as the hip flexion–extension profile for each trial was recorded while the right leg was in stance phase. Each walking trial was analyzed for the presence of reversals using an automated program written in Matlab. The reversal profile was first described by Hurwitz (Hurwitz, 1997) and was defined as a second order change in the slope of the hip flexion-extension profile. A subject was considered to have a reversal gait if this profile existed in at least one of the three normal walking trials. Subjects were classified by age according to decade and the percentage of patients in each age group with reversals was plotted. A fisher's exact test was used to compare the percentage of older subjects with reversals (50-80 y.o.) to the percentage of younger subjects with reversals (20-49 y.o.) (alpha=0.05).

Results:
When subjects were divided into a younger and older group, the older group had a significantly higher percentage of reversals as compared to the younger group (29.2% vs 12.6%, p=0.004). Additionally, reversal prevalence was found to increase with age in a similar manner as compared to the prevalence of new hip OA cases with age. This pattern along with the fact that the peak in reversal prevalence precedes the peak in new hip OA diagnoses by a decade, suggests that the reversal gait could be a marker for early onset hip OA, although longitudinal data would be needed to substantiate the idea of the reversal gait marker being a predictor of hip OA development. The older asymptomatic group has a higher incidence of reversal gait as compared to the younger group. Because the older group is known to be at a higher risk for hip OA development, this result further supports reversal gait as associated with hip OA risk.

Discussion:
The reversal gait metric was identified in an advanced age group of asymptomatic individuals, a group known to be at risk for hip OA. Additionally, previous research has identified the reversal gait in FAI patients, another group at a higher risk for hip OA development. Therefore, the reversal gait appears to be associated with hip OA risk and should be studied further as a potential marker for hip OA development. The reversal gait trend and peak along with the association with the at-risk groups suggests that the reversal gait could be a metric to use for predicting hip OA development and for assessing surgical outcome, but long term data would be needed to substantiate this speculation. The participants in this study were asymptomatic for back and lower limb pain; they were not specifically screened for hip OA or FAI. Therefore, there are likely a number of subjects in this study with early onset, asymptomatic hip OA, especially in the older group. The results are promising and suggest that reversal gait is associated with hip OA risk. Future studies should be conducted to further understand the cause of the reversal gait and its association with hip OA development over time.