Hip Osteoarthritis Pain Has Specific Deleterious Effects on Postural Sway Control

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Introduction

Hip osteoarthritis (hOA) is a major joint disorder with implications to mobility and general health, and a high prevalence in individuals over the age of 60.[1-3] The structural degradation that leads to hOA pain may result in decreased postural sway control and increased falls risk.[4-5] More than 3,200,000 non-fatal and 24,000 fatal falls were documented in individuals above the age of 65 in 2012, amounting to over $30 billion in damages.[4-5]

A history of hOA and decreased postural sway control have been determined to be risk factors for falls. However, the relationship between hOA pain, postural sway control, and falls risk is not completely understood.[6-7]

Additionally, in order to better understand this relationship, especially in the era of COVID-19, it is imperative to broaden our knowledge of the methodologies and techniques that can be utilized to study such individuals throughout the future.

The goal of our efforts has been to better explain postural sway in a hOA population. This includes a set of four individual studies. The first three studies sought to better explain dynamic postural sway. Including a study to determine the normative data pertaining to Limits of Stability (LOS) in a general population, one to validate markerless techniques for LOS data acquisition and an evaluation of the relationship between a person's LOS and their disposition towards vigorous effort and interpersonality. We also investigated potential connections between physician's exercise disposition and their expectations of patient's functional health to better understand the empathy gap. These all culminate in a better understanding of the opportunities and needs for physical medicine in osteoarthritis care.

Aims and Objectives

This line of inquiry leverages methods and results from multiple studies that all speak to physical medicine, balance, and individuals with hip osteoarthritis. These studies provide methodological information for use in future research.

Study 1: Determine normative values pertaining to Limits of Stability (LOS) in a general population.
Aim: LOS normative data will allow patient classification.

Study 2: Validate markerless tracking and identify movement patterns expressed by an individual during LOS testing.
H1: Markerless tracking will correlate with markered tracking.

Study 3: Evaluate the relationship between a person's LOS and their disposition towards vigorous effort and interpersonality.
H1: LOS will correlate with the measured traits.

Study 4: Evaluate possible relationship between provider exercise disposition and expectations of patient reports of mobility limitations due to hOA.
H1: Vigorous exercise disposition will relate to different expectations of patients' reported functional mobility.

Methods

Study 1: 800 persons completed the BTrackS LOS protocol, wherein they were asked to lean maximally in all directions while standing on the force plate (see figure below). The averages of all participant data were graphed for use as normative data.

Study 2: Fifteen participants were fitted with LED movement capture markers and completed BTrackS LOS testing to simultaneously collect markered and markerless data using SIMI motion capture system with high-speed cameras. Joint center positions and segment angles were defined. Pearson Correlation was calculated to confirm relative reliability.

Study 3: Fifteen participants filled out the PRETIE-Q and Grit-8 to assess motivation, the TKI to assess personality, and completed BTrackS LOS testing to assess postural sway. Pearson Correlation was used to evaluate the relationships between surveys and LOS.

Study 4: 34 participants completed a self-report of exercise frequency and the PRETIE-Q in order to evaluate exercise disposition. Participants also completed the mWOMAC to provide their expectations of how an hOA patient would report their pain, stiffness, and physical function. Responses were compared to normative data,[8] and Pearson Correlation Coefficient was calculated between PRETIE-Q and mWOMAC.

Conclusions

Due to the research-related restrictions that were in place over the last several years as a result of the COVID-19 pandemic, as well as the vulnerability of our hOA patient population, the original research question regarding the relationship between hOA pain, postural sway control, and falls risk was unable to be studied as anticipated. However, in spite of these restrictions, we were able to successfully complete four related studies that have helped to broaden our understanding and knowledge of the methods and techniques that will be used throughout future studies to complete the above-mentioned research question.

Study 1: We determined normative values pertaining to LOS that will be used in future studies with individuals with hOA, which will allow us to further increase our understanding of such data in that patient population.

Study 2: We found that markerless tracking produces similar results to markered tracking, with all correlations being between moderate and very high, especially in the lower extremities. These findings open an avenue for virtual data collection through live video calls or telemedicine, which has been proven to be beneficial in a time such as the COVID-19 pandemic, especially considering our patient population.

Study 3: We saw that a disposition to exercise tolerance and a compromising personality are traits that play a role when assessing maximal dynamic postural sway. Knowing which questionnaires are best correlated with LOS findings will help us to tailor future studies in order to maximize the clinical utility.

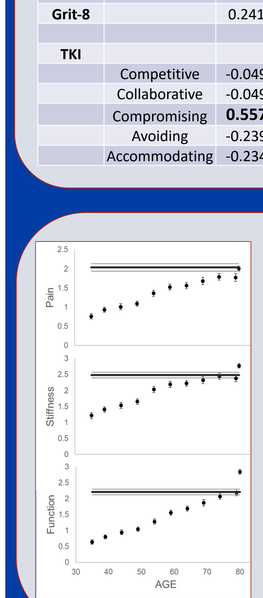
Study 4: We observed that there is a mismatch between the perceived pain, stiffness, and function from the provider using the mWOMAC, compared to the actual value reported by patients. While our study population tended toward lower exercise frequency, preference, and tolerance, they were found to expect more from the patients, thus creating this mismatch. Understanding this bias will allow us to focus on improving empathy, thus helping us to better care for those individuals with hOA, both in the research lab and the clinic.

These studies provide us with an increased understanding of the building blocks that we will utilize in continued research, thus allowing us to continue toward answering our original research question. We believe that a better understanding of postural sway control in individuals with hOA could help to recognize the risk of falls in such individuals, and reduce their occurrence through education, rehabilitation, surgery, or other treatments.

Results

TEST		Max LOS
PRETIE-Q		
	Overall	-0.41
	Preference	-0.191
	Tolerance	**-0.515**
Grit-8		0.241
TKI		
	Competitive	-0.049
	Collaborative	-0.049
	Compromising	**0.557**
	Avoiding	-0.239
	Accommodating	-0.234

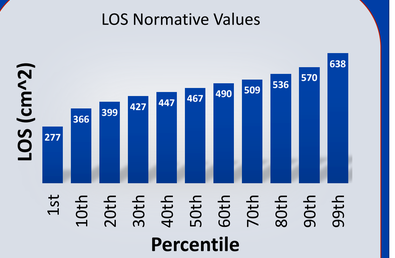
Study 3: Correlation of surveys to max LOS using Pearson Correlation (r). Bold values indicate significance, $p<0.05$. PRETIE-Q = The Preference for and Tolerance of the Intensity of Exercise Questionnaire. TKI = Thomas-Kilmann Conflict Mode Instrument.



Study 4: Provider expectations of patient pain, stiffness, and function. No correlation (r) was found between any variables in mWOMAC and PRETIE-Q. mWOMAC = Modified Western Ontario and McMaster Universtities Arthritis Index.

Joint Angle	Trunk	R. Knee	L. Knee
Avg. (r)	0.941	0.749	0.829
Interpretation	Very Strong	Moderate	Very Strong

Study 2: Pearson Correlation values (r) between marker and markerless tracking show that knee and hip angles were moderate to very strongly correlated.



Study 1: BTrackS LOS Normative Values of area of sway (cm^2), n=800

Take Home

Clinical assessment of dynamic postural sway appears to be available, objective, and highly meaningful to patient-centered physical medicine.

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Acknowledgements

Oakland University Biomechanics, Ergonomics, and Abilities Research (BEAR) Lab
Oakland University William Beaumont EMBARK

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