TEMPOROSPATIAL PARAMETERS IN PEDIATRIC HIP PATHOLOGY PATIENTS: PRE AND POST-SURGICAL INTERVENTION

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INTRODUCTION

Temporospatial parameters are consistently used in clinical settings through quantitative observations in order to evaluate gait deviations, recommend clinical interventions, and monitor patient progress over time. Self-selected gait speed, when compared to an aged-matched control group, can help determine overall gait function. Symmetry is an important evaluation tool used to assess gait efficiency, balance, and can provide insight on an impaired limb compared to the non-impaired leg during rehabilitation progression. Lower limb gait symmetry may provide clinicians a snapshot in overall function, particularly in hip pathology patients. The purpose of this study was to compare the temporospatial parameters of a large hip pathology cohort to an aged-matched control group as well as determine the impact of post-surgical intervention.

CLINICAL SIGNIFICANCE

Investigating temporospatial parameters in a large cohort of adolescent patients undergoing hip preservation surgery may assist in rehabilitation.

METHODS

A retrospective analysis of data collected through an IRB-approved prospective surgical hip preservation registry (HPS) was conducted on adolescent and young adult patients with non-neurological, non-syndromic hip pathology (data pulled from 1996-2020). An over-ground, self-selected gait analysis was conducted on all patients prior to surgery.

Three hundred and twelve (N=312) pre-operative patients (aged 16±3yrs, BMI 25±6kg/m^2) were included with the following diagnoses: Acetabular Dysplasia (AD) (n=133), Femoroacetabular Impingement (FAI) (n=90), Legg-Calve-Perthes disease (LCP) (n=58), and Slipped Capital Femoral Epiphysis (SCFE) (n=31). Ninety patients (n=90) were diagnosed with a bilateral hip deformity and 124 patients had previous hip surgery. A healthy aged-matched control sample (control) of 91 individuals (aged 17±5yrs, BMI 22±6kg/m^2) were utilized for comparison. In addition to cadence, normalized speed, stride time, and stride length, a limb comparison symmetry index was calculated for step time, step length, single and double limb support [3]. A higher symmetry index value indicates greater asymmetry. Non-parametric (Mann-Whitney and Kruskal Wallis) tests were used (alpha=0.05).

RESULTS

Overall: In the patient group (Patient), there were significant differences in cadence (Patient: 112±9, Control: 117±9 steps/min, $p<0.001$), normalized speed (Patient: 0.29±0.04, Control: 0.33±0.04, $p<0.001$), stride time (Patient: 1.08±0.09, Control: 1.03±0.08s, $p<0.001$, and stride length (Patient: 1.25±0.12, Control: 1.33±0.13m, $p<0.001$). A sub-analysis of 210 patients were used to compare post-operative changes in function. The latter time point was used in the analysis if a patient had both 1-year and 2-year post-op gait data. There was a statistical

difference between the pre-operative (PRE) and post-operative (POST) groups across normalized speed (pre: 0.29±0.04, post: 0.30±0.04, p<0.001) and stride length (pre:1.25±0.12, post:1.30±0.12m, p<0.001).

Previous Surgery Group: There were no significant differences across cadence, normalized speed, stride time, and stride length in the previous surgery group (PS) compared to the no previous surgery group (No PS) (p>0.05), however, the PS group had significantly greater asymmetry across step length (No PS:3.75±3.87, PS:4.77±4.38, p=0.031), single limb support (No PS:3.95±4.01, PS:5.80±5.86, p=0.002), double limb support (No PS:4.06±3.76, PS:4.58±3.52, p=0.047), and step time (No PS:3.64±3.80, PS:4.82±4.51, p=0.021).

Comparison Across Diagnoses: AD patients (0.30±0.04) ambulated at a faster speed compared to FAI patients (0.29±0.03, p=0.020)**,** LCP patients (0.28±0.03, p=0.013), and SCFE patients (0.28±0.04, p=0.004). Pre- to post-operative analysis across diagnoses revealed a significant, yet marginal, difference in normalized speed in AD (pre: 0.30±0.04, post: 0.31±0.03), FAI (pre:0.29±0.03, post:0.31±0.04), and LCP (pre:0.28±0.03 post:0.30±0.04) as well as stride length in AD (pre:1.25±0.12, post: 1.29±0.12m), FAI (pre:1.28±0.11, post: 1.32±0.12m), LCP (pre:1.22±0.11, post:1.27±0.12m).

DISCUSSION

Pre-operatively, adolescents undergoing hip preservation surgery have significantly impaired temporospatial parameters when compared to age-matched controls, but show significant improvement post-operatively. Patients with previous surgery tend to have a greater temporospatial gait asymmetry pre-operatively. Furthermore, hip preservation surgery may improve or optimize walking efficiency with an increase in walking speed and stride length post-operatively. Kinematic and kinetic changes in adolescents and young adults with hip disorders have varied in the literature, dependent on age, diagnosis and treatment. However, this is the first to report relatively consistent changes in ambulatory function across a variety of young active patient populations following hip preservation surgery.

Table 1. Temporospatial parameters in hip pathology patients at the pre-operative (Pre-Op) and post-operative (Post-Op) visits compared to a healthy control group (Control); SI – Symmetry Index; Mean (SD)

Variable		Mean SD	Variable		Mean SD
Cadence (Steps per min)	Control	116.82±8.90	SI Step Length	Control	3.35±2.81
	Pre-Op	112.38±9.44		Pre-Op	4.15±4.10
	Post-Op	113.42±8.24		Post-Op	3.67±3.20
Normalized Speed	Control	0.33±0.04	SI Single Limb Support	Control	2.54±2.01
	Pre-Op	0.29±0.04		Pre-Op	4.68±4.91
	Post-Op	0.30±0.04		Post-Op	5.08±6.99
Stride Time (s)	Control	1.03±0.08	SI Double Limb Support	Control	4.65±5.13
	Pre-Op	1.08±0.09		Pre-Op	4.27±3.67
	Post-Op	1.06±0.08		Post-Op	5.12±7.44
Stride Length (m)	Control	1.33±0.13	SI Step Time	Control	2.86±2.44
	Pre-Op	1.25±0.12		Pre-Op	4.11±4.13
	Post-Op	1.30±0.12		Post-Op	3.87±3.68

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