GAIT BIOMECHANICS IN AN OBESE GASTRIC BYPASS SURGERY POPULATION: PRELIMINARY RESULTS

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INTRODUCTION

Obesity is a major risk factor for knee, but not hip or ankle osteoarthritis (OA). Knee varus malalignment and an increased knee adduction (varus) moment are key variables linked to OA progression. We are studying gastric bypass surgery (GBS) patients with and without knee pain to evaluate gait biomechanics in obese subjects before and after a 100-pound weight loss.

METHODS

Twenty-one subjects were studied, including 18 females and 3 males. The pre-surgery age of the subjects was 49.86 ± 6.81 years and the pre-surgery body mass index (BMI) was 47.15 ± 7.01 kg/m^2. Weight-bearing, semi flexed anterior-posterior radiographs were taken to access radiographic knee OA (rOA). Eighteen (85%) subjects reported knee pain, and of those 18, 14 (78%) had rOA and 4 (22%) had no rOA. Normalized Western Ontario McMaster Arthritis Questionnaire (WOMAC) pain scores were less than 13 for the 3 subjects without pain and ranged from 16 to 73.2 for those with pain. Subjects were able to walk without the use of assistive devices.

Spatial-temporal, kinematic, and kinetic data were collected during natural cadence gait with a 7-camera Vicon 370E system. Peak knee flexion during swing, peak ankle plantarflexion for push-off, peak knee varus moment, and peak ankle plantarflexion power for push-off were determined to be the parameters of interest. Twenty-one subjects completed pre-surgical gait analysis sessions and 6 subjects completed post-surgical sessions. Weight loss for the 6 subjects was 48.41 ± 12.78 kg, for a post-surgical BMI of 29.40 ± 5.78 kg/m^2. Four of the subjects with pre-surgery knee pain reported no knee pain after weight loss. Subjects were compared to published normal control populations, using two-sample t-tests. For pre- and post-surgical assessments, subjects served as their own controls and paired t-tests were used to access significance.

RESULTS AND DISCUSSION

Five sets of comparisons were made for the 4 key parameters: 1) all obese subjects (n=21) versus control, 2) the no pain group (n=3) versus control, 3) the pain group (n=18) versus control, 4) the pain group versus the no pain group, and 5) the 6 post-surgical subjects versus their pre data, as shown in **Table 1**. Control values for peak knee flexion during swing, peak ankle plantarflexion for push-off, and peak ankle plantarflexion power for push-off were taken from Winter [1]. Peak knee varus moment was taken from Gok [2] since Winter only reported on sagittal plane kinematics and kinetics.

	Obese		Control		Significance
	Mean	StDev	Mean	StDev	
Peak Knee Flexion During Swing (deg)	47.01	9.12	64.86	5.41	p < 0.001
Peak Ankle Plantarflexion for Push-Off (deg)	-12.07	6.06	-19.77	5.81	p < 0.001
Peak Knee Varus Moment (Nm/kg)	0.48	0.21	0.33	0.05	p < 0.001
Peak Ankle Plantarflexion Power Before Push-Off (W/kg)	1.74	0.73	3.33	1.02	p < 0.001

	No Pain		Control		Significance
	Mean	StDev	Mean	StDev	
Peak Knee Flexion During Swing (deg)	43.81	9.81	64.86	5.41	p < 0.001
Peak Ankle Plantarflexion for Push-Off (deg)	-17.45	4.14	-19.77	5.81	None
Peak Knee Varus Moment (Nm/kg)	0.46	0.10	0.33	0.05	p < 0.05
Peak Ankle Plantarflexion Power Before Push-Off (W/kg)	2.36	0.52	3.33	1.02	p < 0.01

	Pain		Control		Significance
	Mean	StDev	Mean	StDev	
Peak Knee Flexion During Swing (deg)	47.55	9.03	64.86	5.41	p < 0.001
Peak Ankle Plantarflexion for Push-Off (deg)	-11.15	5.89	-19.77	5.81	p < 0.001
Peak Knee Varus Moment (Nm/kg)	0.49	0.23	0.33	0.05	p < 0.001
Peak Ankle Plantarflexion Power Before Push-Off (W/kg)	1.64	0.72	3.33	1.02	p < 0.001

	Pain		No Pain		Significance
	Mean	StDev	Mean	StDev	
Peak Knee Flexion During Swing (deg)	47.55	9.03	43.81	9.81	None
Peak Ankle Plantarflexion for Push-Off (deg)	-11.15	5.89	-17.45	4.14	p < 0.01
Peak Knee Varus Moment (Nm/kg)	0.49	0.23	0.46	0.10	None
Peak Ankle Plantarflexion Power Before Push-Off (W/kg)	1.64	0.72	2.36	0.52	p < 0.01

	Pre		Post		Significance
	Mean	StDev	Mean	StDev	
Peak Knee Flexion During Swing (deg)	43.91	8.49	52.73	3.64	p < 0.01
Peak Ankle Plantarflexion for Push-Off (deg)	-9.02	5.42	-10.21	5.86	None
Peak Knee Varus Moment (Nm/kg)	0.45	0.13	0.49	0.19	None
Peak Ankle Plantarflexion Power Before Push-Off (W/kg)	1.83	0.61	1.98	0.70	None

Table 1: Means, standard deviations, and p values for each of the 4 key parameters for the 5 sets of comparisons.

CONCLUSIONS

There were significant differences between the normal controls and the pre-surgical obese group for all 4 of the key parameters. Pain-free subjects demonstrated fewer differences in comparison with normal controls than did subjects with pain. Differences in ankle plantarflexion and ankle power between the pain and pain-free groups were statistically significant. Weight loss is associated with knee pain relief, which can account for improvement in gait biomechanics. The 6 subjects who completed pre- and post-operative evaluations exhibited a significant improvement in peak knee flexion during swing and 4 of these individuals became pain-free post-GBS. We plan to further investigate changes in gait biomechanics due to obesity, OA, or pain by completing post-operative tests after weight loss in all subjects.

REFERENCES

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