XXIV CONGRESS OF THE INTERNATIONAL SOCIETY OF BIOMECHANICS
XV BRAZILIAN CONGRESS OF BIOMECHANICS

CORRELATION BETWEEN THREE-DIMENSIONAL GAIT ANALYSIS, PAIN PERCEPTION AND STENOSIS DEGREE VERIFIED ON IMAGING EXAM IN PATIENTS WITH LUMBAR SPINAL STENOSIS

[1]Garbelotti Jr. SA; [2,3]Lucareli, PRG; [3]Godoy W; [3]Bernal MB; [3]Ramalho Jr. A and [1]Greve JMD
[1]University of Sao Paulo - HCFMUSP - Department of Experimental Physiopathology, São Paulo, Brazil
[2]Nove de Julho University, Laboratory of Study of the Movement, São Paulo, Brazil
[3]Albert Einstein Hospital - Laboratory of Study of the Movement, São Paulo, Brazil
email: silviogarbelotti@hotmail.com

SUMMARY

This study contains information about the influence of physical effort in pain perception and overall function of gait in patients with lumbar spinal stenosis and correlations with dural sac area. We observed significant changes in the gait cycle as well as the GDI index of gait progression and a significant correlation among GDI and pain, probably as a defense strategy against the significant increase in pain.

INTRODUCTION

Back pain is a common complaint especially among older patients.The spinal stenosis term is based on the fact that a minimum space of the spinal canal is necessary for normal functioning of the nervous structures, and when this space becomes narrow, results in nerve compression symptoms such as pain, numbness, weakness and neurogenic claudication, which increase with stress and decreases with rest [1,2]. The aim of this study is Evaluate kinematics changes of gait before and after physical effort in treadmill test, and correlate with the perception of pain and the lumbar stenosis degree obtained by nuclear magnetic resonance.

METHODS

14 subjects were evaluated with diagnostic of lumbar stenosis with a mean age of 74,5 (9,8) years and average size of the spinal canal was 43.86 (28.76) mm2.

The Vicon® MX 40 system and the was used for the kinematic data acquisition during gait cicles. Vicon MX 40® system and 3D reconstruction images software Nexus® were used.

The exam consisted of three phases: 1) Capture of six gait cycles after a rest period; 2) Walk on treadmill for a maximum of 20 minutes; 3) New capture of other 6 gait cycles immediately after the effort. From these data, temporal-spatial variables and GDI [3] were extracted and analyzed individually and compared to the pain perception obtained by visual analog scale at the beginning and the end of the exam and the cross-sectional area of the spinal canal obtained from the nuclear magnetic resonance.

RESULTS AND DISCUSSION

Most of the correlations were weak and the most significant results are reported to GDI when we observed decrease in medians for both lower limbs to moderate negative correlation when compared to pain perception after effort for both left (r=-0.64, p=0.014) and right limb (r=-0.53, p=0.049) (table 1), which means that there is a significant reduction in the global function of the lower limbs according the symptom of pain increases (p=0.002) (table 2). This fact may be reflected in decreased cadence and gait speed and also the times of single support (significant for the left limb, p=0.019) and balance (significant for the right limb, p=0.013) (table 2) as a protection strategy against pain and imbalance. No correlation with dural sac area was observed.

The significant variations of pain and time of the gait cycle periods pre-and post-exercise. And correlation suggests an effective control strategy to ease the pain [5].

And the relationship between GDI with pain means there is significant reduction in lower limb involvement in the progression of gait as the symptom of pain increases. This may be a result of the decrease in cadence and speed along with the times of single support (p = 0.019 limb left) and balance (p = 0.013 right limb) as part of a strategy to protect against pain and imbalance [1,2,4,5]. Furthermore, aged naturally present increase static hip flexion combined with a decrease in the kinetic capacity of ankle plantar flexion [6], two variables that compose the GDI and that can have influenced the final result of the index.

CONCLUSIONS

There is changing the speed, cadence and time of single and double support for compensation of pain and decreased function of the lower limbs measured by GDI correlates with increased pain. No correlation of GDI or pain perception with dural sac area was observed.

REFERENCES

1. Bacchini M et al. Biomechanic risk factorsf or patients withlumbar stenosis shown through gait analysis. [Abstracts 2007 SIAMOC]. *Gait Post*. 2008 August;**28**(Suppl1):S1-S2.
2. Haig AJ et al. Predictors of pain and function in persons with spinal stenosis, low back pain, and no back pain. *Spine*. 2006 Dec 1;**31**(25):2950-7.

3. Schwartz MH; Rozumalski A. The gait deviation index: A new comprehensive index of gait pathology. *Gait Posture*. 2008;**28**:351–357.
4. Tong HC et al. Comparing pain severity and functional status of older adults without spinal symptoms, with lumbar spinal stenosis, and with axial low back pain. *Gerontology*. 2007;**53**(2):111-5.
5. Papadakis NC et al. Gait variability measurements in lumbar spinal stenosis patients: part A. Comparison with healthy subjects. *Physiol Meas.* 2009a;**30**:1171–1186.
6. Kerrigan DC et al. Effect of a Hip Flexor–Stretching Program on Gait in the Elderly. *Arch Phys Med Rehabil*. 2003 Jan;**84**:1-6.

Table 1 - Correlation between the kinematic variables of gait, pain perception and the dural sac area before and after walking on a treadmill without inclination and self-regulating speed.

		Pain Perception				Dural Sac Area			
		Pre-effort		Pos-effort		Pre-effort		Pos-effort	
		r	p-value	r	p-value	r	p-value	r	p-value
Left Side	Speed (m/s)	-0,15	0,62	0,04	0,9	0,23	0,42	0,16	0,59
	Cadence (steps/min)	-0,45	0,11	-0,39	0,17	0,05	0,88	0,03	0,91
	Stride lenght (cm)	-0,01	0,98	0,19	0,52	0,15	0,6	0,11	0,7
	Single support (% cicle)	-0,14	0,62	0,09	0,77	0,13	0,67	0,16	0,57
	Double support (% cicle)	0,09	0,76	-0,11	0,7	-0,27	0,36	-0,18	0,54
	Balance (% cicle)	-0,04	0,9	0,05	0,87	0,32	0,27	0,06	0,84
	Gait Deviation Index	-0,22	0,45	0,64*	<0,05*	-0,21	0,46	-0,08	0,78
Right Side	Speed (m/s)	-0,15	0,62	0,04	0,9	0,21	0,46	0,16	0,59
	Cadence (steps/min)	-0,42	0,13	-0,42	0,14	0,1	0,74	0,02	0,96
	Stride lenght (cm)	-0,01	0,98	0,2	0,49	0,15	0,6	0,12	0,69
	Single support (% cicle)	-0,04	0,9	0,12	0,69	0,3	0,3	0,01	0,98
	Double support (% cicle)	0,14	0,64	-0,09	0,75	-0,28	0,33	-0,24	0,4
	Balance (% cicle)	-0,2	0,49	0,04	0,9	0,04	0,9	0,24	0,42
	Gait Deviation Index	0,01	0,98	-0,53*	<0,05*	-0,31	0,29	-0,34	0,24

Spearman Correlation Test; P<0,05

Table 2 - Kinematic variables of gait before and after walking on a treadmill without inclination and self-regulating speed (median and interquartile range - IQ).

	Left Side					Right Side				
	Pré-esfoço		Pós-esforço			Pré-esfoço		Pós-esforço		
	Median	IQ	Median	IQ	p-valor	Median	IQ	Median	IQ	p-value
Speed (m/s)	0,77	0,45	0,76	0,5	0,69	0,78	0,45	0,77	0,49	0,84
Cadence (steps/min)	100,37	17,63	100,46	17,55	0,65	101,11	16,62	100,81	16,08	0,55
Stride length (cm)	95,85	48,73	93,3	43,4	0,83	97,05	48,65	93,12	45,17	0,92
Single support (% cicle)	33,25	5,59	31,46	4,69	<0,05*	32,99	4,74	33	6,63	0,78
Duble support (% cicle)	33,36	10,99	34,88	10,04	0,22	33,48	11,08	34,85	11,6	0,22
Balance (% cicle)	33,49	3,94	33,2	5,65	0,78	33,07	4,71	31,91	5,46	<0,05*
Gait Deviation Index	75	24,25	77,3	20,43	0,22	71,75	27,3	70,85	23,08	0,26
Pain perception**	0,0	2,25	3,0	5,25	<0,001*	--	--	--	--	--

Wilcoxon Signed Ranks Test; p<0,05; ** without differentiation by side.*