A BIOMECHANICAL MODEL OF SACRO-ILIAC JOINT DYSFUNCTION AS A CAUSE OF LOW BACK PAIN

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INTRODUCTION

A biomechanical model of sacro-iliac (SI) joint dysfunction is proposed. It was hypothesized that sacro-iliac joint dysfunction in the form of abnormal activation of gluteus maximus and biceps femoris gives rise to lumbopelvic pain by failing to stabilize the sacro-iliac joint during weight bearing. The model was tested on a pilot study of two volunteers.

METHODS

Two male volunteers participated in the study. One subject had no complaint of sacro-iliac joint pain. The other subject had sacral sulcus tenderness, pain over the sacroiliac joint on right side and standing asymmetry of the posterior superior iliac spine.

Electromyogram (EMG) was recorded using pairs of disposable bipolar surface Ag/AgCl electrodes on the symptomatic side for the lumbar multifidus, gluteus maximus and biceps femoris muscles in walking. The surface electrodes were positioned as advised by Snijders et al[1].Baseline activity was recorded at rest. Subjects were asked to walk in a straight line. Each test was taken three times for two full gait cycles. EMG data was taken on the patient before and after a session of physiotherapy. Two dimensional high speed video was used to capture data of walking motion. Surface EMG data were sampled at 1000 Hz and pre amplified at the source. The raw EMG data of the three muscles were full-wave rectified and base line corrected. Then the rectified data were smoothened by passing it through a second order low pass filter with a Butterworth response at 2- 27 Hertz .

RESULTS AND DISCUSSION

Table 1 compares the EMG values from the volunteers. Multifidus was activated throughout the gait sequence but increased activity in swing phases. There was little difference in activity.

Biceps femoris muscle activated in mid swing phase to peak and subsequently relax before initial contact to allow gluteus peak at loading response in the normal volunteer. Gluteus activation remained low in mid stance and terminal stance, but showed another peak activity in pre-swing event .In the patient biceps was activated at terminal swing and at the time of initial contact, it was still relatively active. Gluteus activation was generally poor in the symptomatic individual and failed to reach a peak in loading response. There was consistent activation of biceps on terminal swing event with another peak activation in ipsilateral pre-swing event. Unlike the normal volunteer, gluteus failed to show increased activity in terminal stance to pre swing events. After physiotherapy, there was general decrease in biceps femoris activity and increase in gluteus activity.

SI joint is the key linkage in transmission of weight from the upper limbs to the lower. The joint is vertically oriented and subject to a large shear force and forward momentum on weight bearing. Gluteus is strongly active during initial contact and loading response events when we experience an abrupt limb loading and as such need for SI joint stability is at a premium. Sub-optimal activity of gluteus could disrupt weight transference. Body would attempt to compensate by recruiting biceps femoris, which could exert its influence through its proximal attachment to sacrotuberous ligament [2]. This compensatory strategy might in itself also give rise to pain due to prolong biceps contraction or stretching of long dorsal ligament .

The study showed a difference in gluteus maximus and biceps femoris activity in key events of gait between the two volunteers. A larger study is planned to validate the model.

REFERENCES

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Table 1: Mean electromyogram value compared between normal volunteer (a), patient pre (b)and post-physiotherapy (c) in different events of gait cycle (in mV)

Event of gait cycle	Multifidus			Biceps femoris			Gluteus maximus		
	a	b	c	a	b	c	a	b	c
Initial contact	0.08	0.04	0.08	0.07	0.28	0.04	0.54	0.10	0.07
Loading response	0.04	0.04	0.06	0.05	0.06	0.04	0.92	0.03	0.09
Mid stance	0.04	0.05	0.05	0.06	0.08	0.05	0.10	0.03	0.05
Terminal stance	0.09	0.09	0.06	0.06	0.88	0.12	0.10	0.03	0.05
Pre swing	0.06	0.06	0.08	0.06	1.10	0.19	0.86	0.04	0.09
Mid swing	0.07	0.05	0.06	0.14	0.08	0.03	0.15	0.05	0.06
Terminal swing	0.25	0.22	0.05	0.46	0.44	0.06	0.60	0.14	0.09
Baseline value	0.04	0.04	0.07	0.05	0.06	0.04	0.10	0.03	0.05