EFFECTS OF BACKWARD WALKING AS A MODALITY FOR LOW BACK PAIN REDUCTION IN ATHLETES

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The therapeutic effectiveness of backward walking for treatment of low back pain (LBP) was examined among athletes experiencing LBP and healthy non-athletes. All participants were pre-tested walking backward, performed 10-15 mins of backward walking three days/week for three weeks and were post-tested. Low back sagittal and coronal plane range of motion, shock attenuation (SA), stride length (SL), stride rate (SR), velocity and LBP were evaluated ($\alpha=0.05$). All variables were significantly different between groups, excluding SA. Velocity, SL and SR were significantly different pre vs post. Owing to the clinical nature of this study, single-subject analyses were performed and identified unique individual responses to the intervention. Results suggest that backward walking may assist some athletes presenting with LBP.

KEYWORDS: athletic rehabilitation, retro walking, single-subject, spine, treatment modalities

INTRODUCTION: The number of collegiate athletes who experience LBP is thought to range between 1% to greater than 30% (Spencer & Jackson, 1983; Watkins & Dillin, 1999; Bono, 2004). Bountiful radiographic evidence exists documenting the fact that vertebral disc degeneration is higher in athletes than in non-athletes (Bono, 2004) yet no known cause-effect relationship has been advanced. Sports which consist of repetitive back hyperextension motion such as diving, gymnastics and wrestling have been reported to be associated with higher rates of spondylolysis (Wier & Smith, 1989; Hodges & Richardson, 1999; Bono, 2004), yet the occurrence of these vertebral stress fractures has not been documented to be higher in athletes versus non-athletes.

For many athletes, LBP can be highly debilitating, leading to reduced or total elimination of training and their focus shifts to rehabilitation. Varying degrees of intensity of LBP coupled with individual pain tolerance levels can allow some athletes to continue to train while managing LBP with non-surgical or non-physician directed therapy. Effective modalities to reduce the limited training and downtime associated with LBP are continuously being sought by athletic trainers. Backward walking (BW) and running have been promoted anecdotally and have shown potential kinematic benefits (Bates et al., 1986) but have not received thorough scientific scrutiny with respect to LBP. Masumoto et al. (2007, 2009) have shown that BW in a water environment increased core muscle activity and metabolic cost versus walking forward in the same environment. Whitley and Dufek (2009) documented increased flexibility of the hamstrings following a BW intervention. We sought to expand on these findings and questioned the effectiveness of BW as a modality for relief of LBP in athletes.

The primary purpose of this study was to investigate the effectiveness of a BW exercise program in alleviating LBP in athletes. A secondary purpose was to identify which aspects of BW performance may be beneficial (if any) in alleviating LBP. We hypothesized that the use of BW as an intervention would reduce athletes' self-reported LBP measures and modify impact attenuation charactistics and low back/pelvic movement displayed during BW.

METHOD: Five NCAA Division I athletes currently experiencing LBP (21.2±5.1yrs, 172.8±7.3cm, 68.5±7.7kg) and five active, healthy collegiates free from LBP (21.6±1.5yrs, 168.1±7.0cm, 63.0± 0.6kg) volunteered to participate in the study. Inclusion criteria for the LBP group was stipulated as having experienced LBP in the past 8 months and currently electing to allow the pain to resolve without physician involvement for the present time and the duration of the study. All granted written consent in accordance with policies established for the Protection of Human Subjects at the affiliated university.

Data were obtained from all study volunteers both pre- and post intervention. Pre and post-testing consisted of first subjectively reporting a LBP pain value (LBP group only). All volunteers practiced walking backward on a treadmill (Precor, Model C966) prior to data collection. When each participant reported that they felt comfortable walking backward without use of external support (grasping treadmill rails), BW velocity was established and encouraged to be as fast as comfortably possible. Participants were then instrumented with two lightweight uniaxial accelerometers (PCB Piezotronics Inc., Model 352C68), one secured to the distal anterior surface of the right tibia and the other to the midpoint of the forehead. A biaxial electrogoniometer (Biometrics, Model SG150) was secured externally to the low back, spanning T12-S2. Participants then walked backward on the treadmill for nine minutes with data obtained synchronously (1000 Hz) using Bioware data acquisition software (Kistler, version 3.21) during the sixth minute of the walk (Melcher et al., 2008). Following the pre-test, participants completed three weeks of supervised BW on a treadmill for 15 mins/day, three days/week. Following completion of the intervention, all participants were post-tested following the same procedures as the pre-test.

Ten strides per participant-condition were extracted from the continuous data sets using the tibial accelerometer time-history profiles to define each stride. Accelerometer and electrogoniometer data were filtered with a 4th order low pass Butterworth filter (20 Hz) using a custom laboratory program (MatLab version 6.1). Dependent variables (DVs) included walking velocity (Vel), subjective pain measure (P; LBP group only), shock attenuation (SA: [1-(peak head acceleration/peak leg acceleration)]*100), stride length (SL), stride rate (SR), sagittal plane range of motion (sROM) and coronal plane range of motion (cROM) of the low back. The mean values of ten footfalls per participant-condition-test session were utilized for two (group) x two (time) mixed model analysis of variance procedures for each DV ($\alpha=0.05$). P scores for the LBP group were evaluated using a correlated t-test. Owing to the clinical nature of the investigation, we also sought to explore results of the LBP participants on a single-subject statistical basis and did so using the Model Statistic technique (Bates et al., 2003) for SA, sROM and cROM to explore potential systemic kinetic or low back kinematic changes.

RESULTS: Group descriptive data are summarized in Table 1. There were no significant group x time interactions for any of the DVs. A significant decrease ($p=0.004$) in P for the LBP group was observed following BW. Significant group differences were observed for Vel ($p<0.0001$), sROM ($p=0.0067$), cROM ($p=0.0487$), SL ($p=0.0002$) and SR ($p=0.0012$) while significant time effects (i.e., pre vs. post) were observed for Vel ($p=0.0004$), SL ($p=0.0110$) and SR ($p=0.0213$). SA was not different nor were there any significant changes in low back kinematics across time. The Model Statistic single-subject analysis procedure identified a significant reduction in SA (7.8-24.0%) following the intervention for four of the five participants ($p<0.05$). There was a significant increase in sROM (4-6 deg) and cROM (3-12 deg) observed for three of the five participants following the intervention ($p<0.05$).

DISCUSSION: LBP is a complex clinical presentation for the athletic trainer and is thought to be best managed by categorizing or matching treatments to particular symptomology (Heck and Sparano, 2000). There was no attempt in the current work to categorize specific LBP etiology nor to control or suspend other forms of treatment modalities for participants. Despite these limitations, results identified significant gait-related changes for both groups following BW intervention. Both groups increased velocity, stride parameters, and low back ROM following three weeks of BW exercise. It appears that the presence of LBP did not interfere with the ability of participants to adapt to BW. Both groups achieved greater walking velocity with a greater percent increase in SL vs SR. In order to explore the possible relationship between SL and sROM, we examined the ratio of percent change in sROM:SL. This ratio was 0.89 for the healthy (control) group and 1.26 for the LBP group, possibly suggesting that increased SL was achieved with a greater change in sROM for the LBP group vs. the healthy group. Importantly, all LBP participants reduced self-reported P and over half significantly increased low back ROM, suggesting, as has been previously reported (Whitley and Dufek, 2009) that BW may improve low back and hamstrings flexibility.

During BW, hip extension and knee flexion is greater than in forward walking (Yang, et al., 2005). Greater hip extension and a concomitant extension of the lumbar spine increasingly load the facet joints opening up the disc space, causing a reduction in compressive loads to the intervertebral discs (Heck and Sparano, 2000). This unloading of the discs may be a mechanistic outcome of BW via increased hip extension as evidenced by the decreased P scores reported by the LBP group. As well, increased loading of the facet joints may explain the increased low back ROM observed for both groups.

Table 1. Descriptive results (mean ± standard deviation) by group-time and pre-post % change.

DV	Healthy (n=5)			LBP (n=5)		
(units)	Pre	Post	% change	Pre	Post	% change
Pain	na	na	na	3.2	2.0*	-37.5
(integer)				1.3	1.0	
Velocity	0.54†	0.87 *†	61.1	1.14†	1.38*†	21.1
(m/s)	0.04	0.21		0.13	0.11	
SL	0.79†	1.08 *†	36.7	1.22†	1.36*†	11.5
(m)	0.13	0.14		0.08	0.15	
SR	0.69†	0.81*†	17.4	0.94†	1.02*†	8.5
(hz)	0.07	0.10		0.05	0.13	
SA	67.3	69.8	3.7	64.5	52.0	-19.4
(%)	26.0	17.3		11.6	19.9	
sROM	4.6†	6.1†	32.6	11.0†	12.6†	14.5
(deg)	2.3	1.8		1.6	6.0	
cROM	14.3†	18.8†	31.5	9.7†	13.1†	35.0
(deg)	4.9	5.9		2.3	7.4	

Note: Mean followed by standard deviation; See text for abbreviations; % change=[(post-pre)/pre) * 100]; na=not applicable; *=significant difference ($p<0.05$) between conditions (Pre, Post); † = significant difference ($p<0.05$) between groups (Healthy, LBP).

Single-subject analysis results provided additional insight into the effects of the intervention. SA is a measure that captures a sense of how the body attenuates shock generated at impact due to foot contact with the ground (Mercer et al., 2002). In the current study, the increase in BW velocity resulted in a decrease in SA for 4 of the 5 participants. Peak leg acceleration (LgPk) did increase with increased BW velocity; however, it was coupled with a concomitant increase in peak head acceleration (HdPk). HdPk has been shown to remain relatively unchanged at 1.0-2.0 g's during forward running (Mercer et al., 2002, Dufek et al, 2008). In the current study, both LgPk and HdPk increased with an increase in BW speed during the post-test for most participants, while HdPk values remained well below 1.0 g (range=0.4-0.7 g's). Interestingly, one individual with an increase in SA for the post-test (6.4%) exhibited the smallest increase (0.14 m/s) in BW velocity of all study participants. This might suggest a different BW strategy for this subject in order to accommodate the LBP. Single-subject kinematic outcomes also provided insight into possible adaptation strategies. Three participants significantly increased sROM (average=4.8 deg) and cROM (average=6.6 deg) with one participant significantly reducing sROM (7.5 deg) and cROM (3.2 deg). BW appeared to significantly increase low back motion and reduce LBP for three individuals while one individual appeared to adopt a unique BW strategy.

Limitations of the study do not allow one to state definitively that BW only led to the observed outcomes of reduction in self-reported LBP, increased walking velocity, and increased low back ROM for most participants. No control was imposed upon individuals relative to supplementary forms of treatment, with the exception of physician intervention.

Symptomology was not screened and categorized (Heck and Sparano, 2000). Time itself may have contributed to the reduction in LBP. Despite these limitations and in light of the debilitating effects that LBP can produce for an athlete, we suggest further study into functional changes that may be elicited as a result of BW.

CONCLUSION: Study results present trending evidence in support of BW relative to pain reduction and increased low back ROM for athletes with LBP. Single-subject evaluation provided insight into possible mechanistic changes elicited by the BW for specific individuals with LBP, including an increase in SL accompanied by increased sROM. Clearly, additional research into the effects of BW is warranted for athletes presenting with unresolved LBP.

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