Assessment and Training of Dynamic Stabilization of the Lumbopelvic-Hip Complex

Kyle R. Morey, MS, ATC; Rachael E. McGrail, MS, ATC; Elisa C. Tanksley, MS, ATC; Gary B. Wilkerson, EdD, ATC; Marisa A. Colston, PhD, ATC; Joe LaCaze, DC

THE UNIVERSITY of TENNESSEE CHATTANOOGA

BACKGROUND AND PURPOSE

- Antagonist imbalances in strength and flexibility alter joint alignment and can increase susceptibility to injury[1]
  - Neuromuscular control (NMC) of the lumbopelvic-hip complex (LPHC) has been linked to injury risk[2]
- Current assessment methods for postural alignment focus on muscular factors and ignore the neural component[3]
  - Improved NMC of the LPHC can be expected to improve dynamic stability of the lower extremity joints[4]
- Isometric contractions have been shown to alter muscle activation patterns without concomitant strength training[5]
  - Adaptations within the central nervous system appear to modulate reflexive antagonist activation levels[5]
- The purposes of this study were to evaluate the effectiveness of the ROTEX™ device for identification of suboptimal antagonist balance and its potential value for improvement of LPHC function

PARTICIPANTS AND PROCEDURES

- 37 NCAA Division I athletes: 19.6 ±1.2 years; volleyball, women's soccer, wrestling, men's golf, women's golf
  - 22 male, 73.46 ±12.20 kg, 173.64 ±8.82 cm and 15 female, 63.70 ±5.65 kg, 172.38 ±7.43 cm
- Measurements acquired before and after an exercise intervention designed to enhance dynamic pelvic stability
  - Hip internal rotation (IR) and external rotation (ER) measured
    - Passive and active range of motion; Baseline® digital inclinometer (DJO Global, Vista, CA)
  - Pelvic displacements measured by Level Belt Pro application (Perfect Practice Inc., Columbus, OH)
    - iPod positioned at level of PSIS to record Anterior/Posterior (AP) and Right/Left (RL) pelvic tilt
  - Intervention protocol involved serial hip IR isometric contractions with pelvis maintained in posterior tilt
    - ROTEX™ device (ROTEXMotion, Opelousas, LA) protocol involved progressive increases in hip IR
      - Back and shoulders against wall with feet positioned at center of rotating discs (Figures 1-3)
      - Posterior pelvic tilt in ~5-10° knee flexion and maximum hip IR during 10-s isometric contraction
        - Posterior pelvic tilt maintained with further increase of active hip IR for 10-s; repeated twice
          - Total of 3 isometric contractions for 30-s duration of intervention
  - Repeated measures ANOVA; $\alpha \leq .05$; ($> .05$ to $\leq .10$ interpreted as borderline statistical significance)
    - No Bonferroni correction for multiple comparisons (exploratory analysis)
      - Hip ROM (IR and ER); passive and active (average of 3 measurements)
      - Mean pelvic position during 10-m walk; sagittal plane AP and frontal plane RL

RESULTS

- Mean ± standard deviation for pre- and post-intervention measurements presented in Table 1
  - AROM IR, PROM IR, and PROM ER increased significantly after the intervention (Figures 4 & 5)
    - Change in AROM IR from pre- to post-intervention: +2.17°; $p<.001$; ES=.373; $\eta^2=.360$
    - No significant change in AROM ER from pre- to post-intervention: $p=.968$
    - Change in PROM IR from pre- to post-intervention: +1.68°; $p=.029$; ES=.248; $\eta^2=.126$
    - Change in PROM ER from pre- to post-intervention: +1.69°; $p=.028$; ES=.242; $\eta^2=.126$
  - Average pelvic displacement decreased in sagittal plane (AP) during walk after intervention (Figure 6)
    - Change in AP displacement from pre- to post-intervention: -1.44°; $p=.059$; ES=.478; $\eta^2=.114$
    - No significant change in RL displacement from pre- to post-intervention: $p=.906$

Figure 1: ROTEX™ device

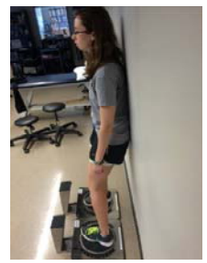

Figure 2: Side-view of protocol

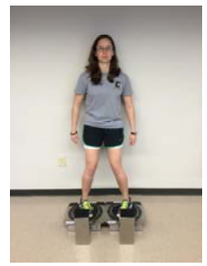

Figure 3: Front-view of protocol

Table 1	Pre-Intervention	Post-Intervention	F	p
AROM IR	29.48 ±5.82	31.65 ±4.80	20.23	<.001
AROM ER	38.70 ±7.81	38.75 ±7.71	<0.01	.968
PROM IR	39.37 ±6.78	41.05 ±7.57	5.20	.029
PROM ER	49.06 ±6.99	50.75 ±7.08	5.21	.028
Mean AP Walk	-5.22 ±3.01	-3.78 ±3.45	3.86	.059
Mean RL Walk	-8.30 ±1.53	-7.90 ±1.58	0.01	.906

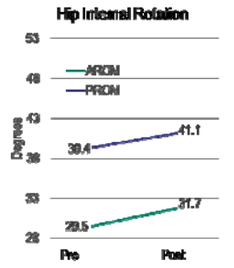

Figure 4

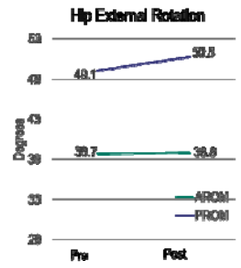

Figure 5

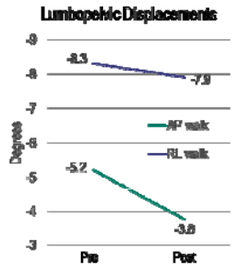

Figure 6

CLINICAL RELEVANCE

- Bilateral isometric contractions of the hip internal rotators with posterior pelvic tilt appear to have beneficial effects
  - Our results support the existence of an association between hip ROM and dynamic pelvic stability
  - An optimal range of hip IR and ER may reduce the magnitude of AP pelvic displacements during gait
- A plausible explanation for our findings is alteration of relative activation levels of antagonist hip muscle groups
  - Decreased muscle tension resistance may explain the post-intervention increase in hip motion
  - Alternatively, the hip motion increase may have been due to improved flexibility of static restraints
- More research is needed to clarify neuromechanical aspects of optimal LPHC function:
  - The possible effect of isometric contractions on muscle activation levels
  - Interdependencies among displacements of the lumbar spine, pelvis, and hip joints
  - The possible influence of suboptimal LPHC function on core and lower extremity injury risk

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