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

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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 (Rotex Motion, 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; η^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; η^2=.126
    - Change in PROM ER from pre- to post-intervention: +1.69°; p=.028; ES=.242; η^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; η^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

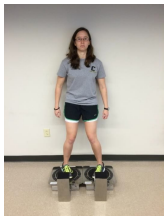

Figure 3: Front-view of protocol

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

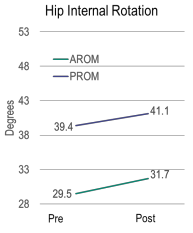

Figure 4

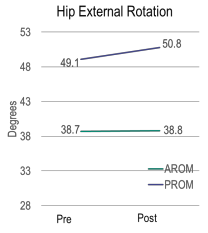

Figure 5

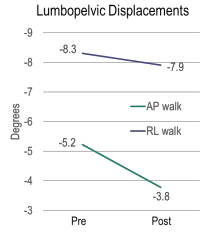

Figure 6

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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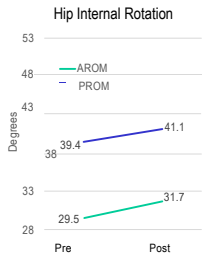
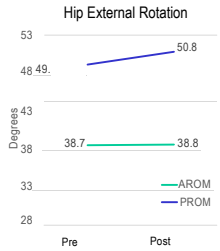
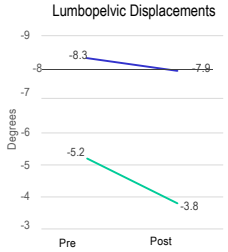
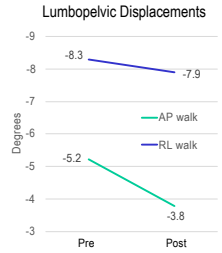

Hip Internal Rotation
53
48
43
38
33
28
Degrees
AROM
PROM
39.4
41.1
29.5
31.7
Pre
Post


Hip External Rotation
53
48
43
38
33
28
Degrees
49.
50.8
38.7
38.8
AROM
PROM
Pre
Post


Lumbopelvic Displacements
-9
-8
-7
-6
-5
-4
-3
Degrees
-8.3
-7.9
-5.2
-3.8
Pre
Post


Lumbopelvic Displacements
-9
-8
-7
-6
-5
-4
-3
Degrees
-8.3
-7.9
-5.2
-3.8
AP walk
RL walk
Pre
Post