Research Interests:
Exercise Interventions in Special Populations

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Objectives

- PhD Review
  - The Journey
  - The Conclusions
  - The Future

- Other research themes
  - Re Walk
  - PhD students
PhD Review: The Journey

RQ: Why are there so many hamstring injuries in professional football? And how might they be prevented?

Hawkins et al. (2004)  
Woods et al. (2004)
The Population

11.0 years = initiation of adolescent growth spurt in English males by height (Malina, Bouchard, and Bar-Or, 2004 pg. 308)

14.0 years = Peak of adolescent growth spurt in English males by height (14.1 years by weight) (Malina, Bouchard, and Bar-Or, 2004. Pg 308)

Adolescence: 10 - 22, biologically defined period of maturation, rapid growth and development (Malina, Bouchard, and Bar-Or, 2004)

11.6 years = initiation of sexual maturation in English males (Malina, Bouchard, and Bar-Or, 2004 pg. 312)

15.3 years = peak gain in strength for US males (upper limb) (Malina, Bouchard, and Bar-Or, 2004 pg. 328)

Childhood | Youth | Adulthood

01/01/1990 = Date of Birth

01/01/2013 = Age 23 years

“My existence is a continuum so I’ve been what I am at each point in the implied time period”
Cross-Sectional Studies

- 157 elite male youth footballers from two centres of excellence in the north (u12 – u18)
- 134 completed biological age questionnaire (PDS: Petersen et al., 1988) as well.
- Bilateral Isokinetic evaluation of Con Q and H, Ecc H
- Calculated PT, PTBW, AoPT, CHQ, FHQ, Asymmetry Index according to footedness
- Mixed model stats design and Pearson’s correlations between position and strength based data
Findings => New Questions

1: Correlation between PTBW and AoPT EH.
   Weak (10% explained) but significant (p<0.001).
   More outer range = greater strength.

2: - Snap shot
   - Longitudinal view point needed
   - U18 age group profile for injury risk

3: U18 less equality than U13 (p=0.001) and U12 (p=0.012)
Longitudinal Study

- 69 elite male youth footballers (u12 – u15)
- Same isokinetic variables but over 3 time points in season
- Mixed model stats design
Findings => New Questions

- Mid season performance drop (similar in adult football (Carling and Orhant, 2010; Magal et al., 2009; Caldwell and Peters, 2009; Thomas and Reilly, 1979), RL (Gabbett, 2005a and b), but only RL youths (Gabbett 2005b)
- Increased injury risk after break? (Price et al. 2004)

# MS lower than SS value (p=0.014) *MS lower than SS and ES value (CH: p=0.026, 0.011 respectively EH: p=0.003, 0.004 respectively).
Introduction and Background
Hamstring muscle strains are common in young footballers (Price et al., 2004) and due to a high recurrence rate (Hawkins et al., 2001) may present significant training or match losses and need to be addressed.

Purpose
Our purpose was to evaluate muscular performance outcomes of an exercise intervention targeting the hamstring muscles in a cohort of elite male youth footballers (Under 18, U18). It was hypothesised that: 1) the strength of the hamstrings, measured by peak torqu-body weight (PTBW), would increase; 2) the functional and conventional hamstrings-quadraiceps ratios (FYQ, CHQ) would improve by moving towards equality (1:1) and 3) that the AoPT would move towards outer range (i.e. a more extended knee position) following the exercise intervention.

Methods
Our study used a convenient sample of 1 team of U18 elite youth footballers (n = 16). Half of the participants were assigned to a control group (n=8) and eight completed the exercise intervention which took place early in the 2009/10 season. The U18 age group was targeted because previous research has suggested that this may represent an appropriate time to introduce preventative strategies targeting the hamstring musculature (Forges et al., 2009).

Isokinetic Dynamometry
Participants completed a standardised 5min cycle warm up. Following this, five maximal repetitions of concentric quadriceps (CQ), concentric hamstrings (CH), and eccentric hamstrings (EH) were completed. PTBW, CQ, CHQ and AoPT were calculated for repetitions two to four in an attempt to minimise the effects of fatigue and inexperience. Finally, participants were ranked 1-10 in order of their performance and assigned to groups via odd and even number placing.

Exercise Intervention
The exercise intervention was undertaken twice weekly (16 sessions total) after normal training and is outlined in Table 1.

Statistical Analysis
Data were analysed using SPSS version 16 (Chicago, IL, USA). A mixed model repeated measures ANOVA was used to investigate group x condition x time for PTBW and AoPT (CQ, CH, EH), FYQ and CHQ. Post hoc analysis was completed using a LSD comparison.

Results

Table 2: Participant Demographics

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Height (cm)</th>
<th>Weight (kg)</th>
<th>Waist (cm)</th>
<th>Hip (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.2 ± 0.5</td>
<td>179.2 ± 4.7</td>
<td>76.9 ± 5.8</td>
<td>81.0 ± 7.4</td>
<td>101.3 ± 7.2</td>
</tr>
</tbody>
</table>

There were no significant (p>0.05) between group effects for CQ or EH. For CQ there was a significant interaction between time and leg dominance (F1,11)= 8.7; p=0.05. Post hoc analysis revealed that n/dom CHQ was significantly higher to 1 (p<0.01). Figure 1. There were significant main effects for time for EHQ (F1,11)= 12.6; p<0.01 (Figure 2) and CHQ (F1,11)= 8.4; p=0.05, respectively. In both cases, the ratio moved closer to 1 post intervention.

Discussion
Both hypotheses were rejected because there were no significant differences between the control and intervention groups after the exercise intervention. This may suggest that early-season football training in conjunction with the exercise intervention significantly improved hamstrings muscle performance for all participants. A further possibility may be the presence of some contamination from experimental to control groups which resulted due to the participants belonging to the same competitive team.

Interestingly, the magnitude of PTBW EH improvement for all participants was only significant on the n/dom leg. This may be partially explained by the improvements in the intervention group which outperformed in post test by approximately 0.25 N.m/kg (13%). Both groups improved their FYQ ratio, however the intervention group improved three times more than the control on the n/dom leg (30%) and twice as much on the dom leg (24%). This may be explained by the observed decreases in PTBW CQ which increased overall CHQ.

We also recorded a decreased AoPT EH angle post intervention for all participants. This finding may be explained by a change in the length-tension relationship of the hamstring musculature, specifically the addition of sarcomeres in series allowing the muscle to operate more effectively in outer range (Brocket et al., 2001). There was also an unexpected pattern of different training adaptations to the dom and n/dom legs. There was greater variation of change on the dom leg, possibly suggesting an altered leg-limb training status.

Conclusions
Our findings may be of interest to those who prescribe preventative and restorative hamstring exercises for young footballers. The intervention programme was effective to modulate perceived ‘risk’ factors for hamstring injury such as increased leg dominance, and to improve leg muscle symmetry.

Clinical Applications
The dose-response relationship of exercise to adaptation appeared to be specific to the population at hand, meaning that further intervention programmes should be of 10 weeks or longer. In addition before implementation of an exercise intervention, training status, and leg dominance of the participants as well as the type and overall regimen of exercise prescribed should be considered.

References

Table 2: Pre and post intervention PTBW and AoPT (CQ, CH, EH) for dom and n/dom legs

<table>
<thead>
<tr>
<th>Group</th>
<th>Pre Intervention</th>
<th>Post Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTBW</td>
<td>Dom</td>
<td>CQ</td>
</tr>
<tr>
<td></td>
<td>3.1 ± 0.3</td>
<td>3.0 ± 0.5</td>
</tr>
<tr>
<td></td>
<td>CQ</td>
<td>2.9 ± 0.3</td>
</tr>
<tr>
<td></td>
<td>EH</td>
<td>2.9 ± 0.3</td>
</tr>
<tr>
<td></td>
<td>AoPT</td>
<td>2.9 ± 0.3</td>
</tr>
</tbody>
</table>

Prevention? Exercise Intervention

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PhD Review: The Conclusions

• Chapter using logistic regression analysis
• Intervention better for REF
• Treat youth training as continuum.. Sport specificity in strength starts early
• Ecc Hams focus also needed early
• Intervention where at risk (age and temporal) may be more effective than general strategies
PhD Review: The Future

- Exercise Intervention
  - Rehabilitation/Prevention
  - Sport/Health
- ReWalk
- PhD students
Thank you for listening
References


