Postactivation Potentiation in swimming

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Where this thesis comes from..

1. No Spanish sprint swimmers
2. Physical Warm-Up???

It application is assumed, but the studies don’t show an specific sucessfully pattern in sprint swimming. (Neiva y cols., 2013).

Few differences
Where this thesis comes from..

3. - Wrong Procedures

4. - The swimmer needs to be highly activated for a specific moment

5. - Research needs to give tools to the coach

Can I control this?
INTRODUCTION

In short races, high power and speed are key components in swimming sprint events.
Swimming Start performance (SS) is an important component of the swimming race, especially in short events. (Burkett et al., 2010)

The shorter is the distance of the race, the higher is the repercussion on the final result (Cossor & Mason, 2001).

Values between 0.8-26% in 50-100 meters distance
INTRODUCTION

Results found in the recent literature show that it is preferable to achieve a good impulse adopting a rear weighted position, which implies higher muscle implication (Barlow et al., 2014), than to try to get off the platform as quickly as possible (Ozeki et al., 2012).
Some studies have reported the relationship between strong lower limbs and a good performance in the swimming starts (Beretic et al., 2013; Slawson et al., 2013; West et al., 2011), and the results suggest:

- Absolute Force
- Relative Force
- RFD

Quicker in 15m
(Beretic et al., 2013; West et al., 2011)

Such relationship has lead the interest of some authors in optimizing the take-off parameters of the start providing Warm Up routines based on PAP
DEFINITION OF POSTACTIVATION POTENTIATION

Postactivation Potentiation (PAP)

IMPROVES MUSCLE CONTRACTILITY

STRENGTH

SPEED

-Muscle cells more sensitive to the Calcium released by the sarcoplasmatic reticulum

-Improvement of the neurosystem excitation

-Increment of the muscle fibers recruitment
DEFINITION OF POSTACTIVATION POTENTIATION

PAP benefits are more effective if an optimal recovery time is given after the conditioning activity.

(Sale, 2004; Tillin & Bishop, 2009)
The more similar, the more is the quality of the stimulation

Postactivation Potentiation (PAP)

Rest Period

Trained Subjects

Similar Movement

The bigger the specificity of the PAP stimulus, the more effective the PAP benefits are (Sale, 2004; Tillin & Bishop, 2009).

The more individualized, the better effects

Most effective in individuals with more percentage of fast fibers

The more similar, the more is the quality of the stimulation
CHARACTERISTICS OF OUR PAP

Proposed to find a conditioning exercise similar to the start gesture

Lunge

Asymmetric

Intense

YoYo

Eccentric

Postactivation Potentiation (PAP)

Rest Period

Trained Subjects

Similar Movement

PAP in swimming
WHY LUNGE?

-Is an asymmetric exercise

-It allows the application and/or control of high loads

-High implication of the front leg and according some authors it causes the biggest impulse in swimming start

Based on the study of Kilduff et al., (2011)
WHY YOYO ECCENTRIC?

YoYo eccentric:
- High Muscular Activation (Concentric & Eccentric)
- Wide variety of exercises (allow an asymmetric placement)
- Nobody did it before in swimming
PAP APPLICATIONS

(SWU)
- 400m varied swimming followed by dynamic lower limb stretching

(LWU)
- P1 + PAP through 3 repetitions of Lunge in multipower at 85% of RM

(YWU)
- P1 + PAP through 4 repetitions in YoYo Squat

Mean ± SD

<table>
<thead>
<tr>
<th></th>
<th>SWU</th>
<th>LWU</th>
<th>YWU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dive Distance (cm)</td>
<td>291.36 ± 29.67</td>
<td>298.62 ± 32.72</td>
<td>304.35 ± 36.11</td>
</tr>
<tr>
<td>Horizontal Hip Velocity (m/s)</td>
<td>3.53 ± 0.41</td>
<td>4.17 ± 0.46</td>
<td>4.76 ± 0.49</td>
</tr>
<tr>
<td>Time to 5m (s)</td>
<td>1.75 ± 0.05</td>
<td>1.71 ± 0.05</td>
<td>1.65 ± 0.04</td>
</tr>
</tbody>
</table>

8 Min later \(\rightarrow\) Swimming Start
Horizontal Hip Velocity (VxH) improved after YWU in comparison with LWU and SWU.

Also improved after LWU, which confirms previous outcomes:

- Breed and Young (2003)
- Kilduff et al., (2011)

An increment of the force during the impulse phase increase the horizontal hip velocity of the flight.

The improvement of the impulse phase is a consequence of the improved peak forces generated on the block.
After YWU, it took the subjects less time to cover a distance of five meters (T5m) (1.65 ± 0.052 sec) compared to SWU (1.75 ± 0.057 sec) (p ≤ 0.001) and LWU (1.71 ± 0.04) (p ≤ 0.005).

More velocity when swimmer enters into the water

More velocity on the flight phase

Empowerment of the “Take-off”

Time in 15m neither deteriorated, nor improved. Other factors implicated (Tor, 2014)

Subacuatic phase was not effective (Elipot, 2010)
PAP APPLICATIONS

How can I identify the state of training?

Relative Force ($F_{rel}$)

\[
F_{rel} = \frac{\text{Force (N)}}{\text{Body Mass (Kg)}}
\]

Postactivation Potentiation (PAP)

- Rest Period
- Trained Subjects
- Similar Movement
- Subject A
  - Weight 55kg
  - RM Lunge Test: 45kg
  - Relative Force: 0.81

- Subject B
  - Weight 55 kg
  - RM Lunge Test: 65kg
  - Relative Force: 1.21
- Individuals better trained perform the swim start better.

- The higher is the level of training, the bigger is the reaction after PAP.
PAP APPLICATIONS and PARTIAL RESULTS

“The gaining obtained in performance comes from the improved force on the block phase.

Does actually PAP improve the forces produced on the block?
PAP APPLICATIONS and PARTIAL RESULTS

N=13
Performed three swimming track start

Later, they received PAP stimulation through YoYo Eccentric repetitions

6 minutes later they were tested again on a swimming track start

DATA ARE STILL IN PROCESS OF ANALYSIS!
# PAP APPLICATIONS and PARTIAL RESULTS

<table>
<thead>
<tr>
<th>SWU</th>
<th>Velocity Take-Off (m/s)</th>
<th>Time on the block</th>
<th>Force Horizontal (N)</th>
<th>Peak Horizontal Force (N)</th>
<th>Impulse (N*s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S 1</td>
<td>4.01</td>
<td>0.748</td>
<td>302.09</td>
<td>656.82</td>
<td>217.3</td>
</tr>
<tr>
<td>S 2</td>
<td>4.27</td>
<td>0.954</td>
<td>279.73</td>
<td>635.56</td>
<td>264.9</td>
</tr>
<tr>
<td>S 3</td>
<td>4.17</td>
<td>0.917</td>
<td>339.66</td>
<td>892.13</td>
<td>305.91</td>
</tr>
<tr>
<td>S 4</td>
<td>4.91</td>
<td>0.682</td>
<td>409.78</td>
<td>767.10</td>
<td>268.22</td>
</tr>
<tr>
<td>S 5</td>
<td>4.21</td>
<td>0.611</td>
<td>392.58</td>
<td>570.90</td>
<td>240.19</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PAP</th>
<th>Velocity Take-Off</th>
<th>Time on the block (sec)</th>
<th>Force Horizontal (N)</th>
<th>Peak Horizontal Force (N)</th>
<th>Impulse (N*S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S 1</td>
<td>3.96</td>
<td>0.878</td>
<td>244.41</td>
<td>633.66</td>
<td>214.7</td>
</tr>
<tr>
<td>S 2</td>
<td>4.21</td>
<td>1.03</td>
<td>252.01</td>
<td>650.01</td>
<td>261.08</td>
</tr>
<tr>
<td>S 3</td>
<td>5.08</td>
<td>0.901</td>
<td>384.13</td>
<td>974.61</td>
<td>345.71</td>
</tr>
<tr>
<td>S 4</td>
<td>5.68</td>
<td>0.792</td>
<td>380.20</td>
<td>786.97</td>
<td>301.49</td>
</tr>
<tr>
<td>S 5</td>
<td>4.41</td>
<td>0.819</td>
<td>306.89</td>
<td>586.15</td>
<td>251.49</td>
</tr>
</tbody>
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PAP in swimming

PAP CONTROL

By using YoYo eccentric, load is strong enough

Was the rest period appropriate?

It depends on the Load applied

It depends on the state of training

Postactivation Potentiation (PAP)

Rest Period

Trained Subjects

Similar Movement
The Rest administration to each swimmer can be applied by test/error, but it is necessary to be accuracy in keeping a control of the load.
WHY LUNGE IN MULTIPOWER? MORE PAP CONTROL

Allow the use of T-Force

1º • FORCE/VELOCITY/POWER curve and it’s relationship depending the LOAD

2º • Allow the identification of the most effective area (Peak performance)

3º • Easy way of controlling the state of training or fatigue.
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WHY LUNGE IN MULTIPower? MORE PAP CONTROL

1º • FORCE/VELOCITY/POWER curve and it’s relationship depending the LOAD

2º • Allow the identification of the most effective area (Peak performance)

3º • Easy way of controlling the state of training or fatigue. Instantaneous FB

PAP in swimming
1º • The subject perform his best, regardless the day of the test. This is not sure with the RM method.

2º • The decelerating phase provokes eccentric overload which provokes a very high muscular activation. Maximal Force workout.

3º • The more velocity, the more difficult to brake the wheel spinning. With multi-power, the maximal force is developed at the moment of less velocity.

4º • Exercise almost identical to the real action. Focus on the total stiffness of the muscular and joint kinetic system.

WHY YOYO ECCENTRIC? MORE PAP SPECIFITY

There are a lot of daily activities that we can not control.
1° • The subject perform his best, regardless the day of the test. This is not sure with the RM method.

2° • The decelerating phase provokes eccentric overload which provokes a very high muscular activation. Maximal Force workout.

3° • Maximal speed implies maximal force. The more velocity, the more difficult to brake the wheel spinning. With multi-power, the maximal force is developed at the moment of less velocity.

4° • Exercise almost identical to the real action. Focus on the total stiffness of the muscular and joint kinetic system.
CURRENT STUDIES; FUTURE PERSPECTIVES

PAP induction for UPPER LIMBS
CURRENT STUDIES; FUTURE PERSPECTIVES

PAP induction by using the LOAD of the MAXIMAL POWER

“PAP needs to be protocolized”
The hypothesis is that if swimmers are accustomed to develop an intense effort with fatigue, then they will be better prepared to perform when a time of rest is given.
CONCLUSIONS

1. • PAP improve the ballistic movement and its a practical tool for coaches.

2. • PAP could be relevant, specially in short events, where the differences are small.

3. • PAP is still a young method which needs much more researching.

4. • PAP should be applied as individualized as possible
PRACTICAL APPLICATIONS

The identification of the best way of inducing potentiation can give us the key for finding easier exercises in order of replicating in competition.
Thank you for your attention

Dankeschön!