Weightlifting for Improved Swimming Performance

University of Michigan Strength and Conditioning - Olympic Sports

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Outline

- Purpose
- Kinetics and Kinematics
- Movements Investigated
  - The Clean
  - The Snatch
  - The Track Start from the Blocks
  - The Flip Turn
  - The Dolphin Kick
- How Will Weightlifting Help?
- Areas for Further Research
- References
Purpose

• To examine the benefits of incorporating weightlifting movements and their derivatives into a training program designed for swimmers.

  ▪ Specifically, this review analyzed biomechanical characteristics of the track-style start from the blocks, the flip turn and the dolphin kick, along with the biomechanical characteristics of the two weightlifting movements, to determine whether adaptations made through training of the weightlifting movements would theoretically satisfy the physical requirements and potentially improve performance of the listed swimming elements.
Kinetics and Kinematics

- **Kinetics** - the study of the forces associated with motion, including forces causing motion and forces resulting from motion (Encyclopædia Britannica, 2013).

- **Kinematics** - the study of the motion of bodies with respect to time, displacement, velocity, and speed of movement either in a straight line or rotary direction (Encyclopædia Britannica, 2013).
## Kinetics and Kinematics

<table>
<thead>
<tr>
<th>Kinetics</th>
<th>Kinematics</th>
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<tbody>
<tr>
<td>• Vertical Ground Reaction Force (Fz)</td>
<td>• Displacement (flight, glide)</td>
</tr>
<tr>
<td>• Power (P) = F x V</td>
<td>• Velocity (angular)</td>
</tr>
<tr>
<td>• Rate of Force Development (RFD)</td>
<td>• Time (block, flight, glide)</td>
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<tr>
<td>• Impulse (J) = FΔT</td>
<td>• Amplitude</td>
</tr>
<tr>
<td></td>
<td>• Frequency</td>
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</table>
The Clean

Kinetics & Kinematics

• Power
• Impulse
• Rate of Force Development
• Ground Reaction Force

Derivatives

• Floor, Hang (knee, mid-thigh, power)
• Clean Pull (floor, hang)
The Clean

### Physical Requirements

- Rapid generation of force (Power), strength
- Contraction of latissimus dorsi and teres major (Garhammer, 1984).
  - Joint kinetics - proper organization of power production and absorption (Kipp, Redden, Sabick & Harris, 2012).
  - 1 horse power = 746 W
  - Second pull is most explosive, generates greatest force (Comfort, Udall & Jones, 2012).
    - Up to 3,700 W (almost 5HP)
The Snatch

Kinetics and Kinematics
- Work
- Power
- Impulse
- Ground Reaction Force
- Peak Force
- Peak Velocity

Derivatives
- Floor, Hang (knee, mid-thigh, power)
- Snatch Pull (floor, hang)
The Snatch

Physical Requirements

• Great generation of muscular power (Gourgoulis, Aggelousis, Mavromatis & Garas, 2000).
• Quick turnover following second pull (Hadi, Akkuş & Harbili, 2012).
• Mobility

• Propulsion of BB ~ 1s
• Female World Champion Lifters (Akkuş, 2012)
  ▫ $P_{(1^{st} \text{ Pull})} = 643 \text{ W}$
  ▫ $P_{(2^{nd} \text{ Pull})} = 1,848 \text{ W (almost 2.5HP)}$
(Track) Start from the Blocks

Kinetics and Kinematics

• Block Time
• Flight Time
• Flight Distance
• Glide Time
• Glide Distance
• Velocity
• Impulse

• Contributes up to 30% of total time in 50m sprint (Lyttle & Benjanuvatra, 2004).

• Maximize take-off velocity and minimize block time (Lyttle & Benjanuvatra, 2004).
(Track) Start from the Blocks

Physical Requirements

- Arms (strength) aid pre-tensing leg extensors and increasing loading of leg muscles (Breed & Young, 2002).
- Muscular leg power for quick generation of force at push-off (Miller, Hay & Wilson, 2007).
Men’s 50m Freestyle

(2012 Olympic Trials - Nathan Adrian & Anthony Ervin)
The Flip Turn

Kinetics and Kinematics

• Time Into the Wall
• Time Out of the Wall
• Contact Time
• Rotation Time
• Streamline Time
• Speed In
• Speed Out

• Importance of walls in swimming, especially in the collegiate setting with the 25-yd SC
The Flip Turn

Physical Requirements

• Great force production when pushing off the wall (Bahadon, Mosavi, Hasannejad & Moradlo, 2012).

• Rapid extension of lower limbs with short wall contact time (Puel, Morlier, Avalos, Mesnard, Cid & Hellard, 2012).
Men’s 200 Freestyle
(2012 Olympic Trials - Michael Phelps & Ryan Lochte)
The Dolphin Kick

Kinetics and Kinematics

- Average Velocity
- Kick Frequency
- Kick Amplitude
- Strouhal Number
The Dolphin Kick

Physical Requirements

- Produce great propulsion and reverse directions quickly (Cohen, Cleary & Mason, 2012).
- Accelerate large mass of water with leg extension to generate thrust (von Loebbecke, Mittal, Fish & Mark, 2009).
- Focus on creating maximum thrust, which will de-prioritize efficiency (Hochstein & Blickhan, 2011).
Men’s 100m Butterfly
(2012 Olympic Trials- Davis Tarwater & Michael Phelps)
How Will Weightlifting Help?

- Improve RFD- starts, walls (Kipp, Harris & Sabick, 2011)
- Increase ability to generate power- starts, walls (Comfort, Allen & Graham-Smith, 2011) (Garhammer, 1985)
- Increase ability to generate a greater impulse- starts, walls (Seifert, Vantorre, Lemaitre, Chollet, Toussaint & Vilas-Boas, 2010)
- Increase explosive strength- starts, walls, dolphin kick (Akkuş, 2012)
- Increase overall strength to be more propulsive- dolphin kick (Miller, Hay & Wilson, 2007)
- Coordinated, organized power production- starts, dolphin kick (Kipp, Redden, Sabick & Harris, 2012)
Areas for Further Research

• Relationship between knee extension seen in weightlifting and the knee extension in dolphin kick (absence of ground force in water)?
• Studies that have training programs incorporating the lifts and tracking improvements in starts, wall times or underwater kicking times
References

- The CLEAN
References

- The SNATCH
- The START
References

• The DOLPHIN KICK


• The FLIP TURN


• MISCELLANEOUS

