Use of the Kinematic Chain in the Fencing Attacking Lunge

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The Attacking Lunge in Fencing
Determinants of Fencing Lunge Performance

COORDINATION

• ‘Experts’ vs novice isolated arm vs full lunge movement (Yiou and Do., 2000)

<table>
<thead>
<tr>
<th></th>
<th>Isolated touche condition</th>
<th>Sequential touche + lunge condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experts</td>
<td>2.66 ± 0.29</td>
<td>2.90 ± 0.30*</td>
</tr>
<tr>
<td>Novices</td>
<td>2.47 ± 0.36</td>
<td>2.52 ± 0.29</td>
</tr>
</tbody>
</table>

ARM MOVEMENT

• Kinematics and EMG showed no difference with sword arm (Frere et al., 2011)

LOWER EXTREMITIES

• Elite lunge further - 1.17 ± 0.17m vs 1.02 ±0.01m (Gholipour et al., 2008)

• Statistical model - Rear knee, hip and lead hip (Bottoms et al., 2013)

• Kinematic and EMG – rear hip extensors, rear knee, and plantarflexors strongly correlated with forward velocity (Guilhem et al., 2014)
The Kinematic Chain

- Proximal to distal sequencing  
  Bobbert and Soest (2000)
- Increasing angular velocity
- Capitalizes on neuromuscular design  
  Kurokawa et al. (2001)
**Aim:** To investigate whether skilled fencers utilise a sequential kinematic chain in the rear leg of the fencing attacking lunge.
Method

Participants

- **6 novice** (age 22y ±10, height 177.7cm ± 8, mass 74.6kg ± 16.1)
- **4 skilled** (age 24y ±14, height 181cm ± 5, mass 71.9kg ±15.2)

Procedure

- 8 maximal explosive lunges at target following auditory cue
- Maintained ecological validity
- Whole body kinematics (200Hz)
- 2 integrated force plates (1000Hz)

Post Process

- Custom written Matlab code
Method

• Temporal patterning
• Sword velocity
• Lead leg displacement
• 3D joint kinematics
• GRF / Impulse
### Results: Performance Parameters

<table>
<thead>
<tr>
<th>Variable</th>
<th>Novice</th>
<th>Skilled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reaction Time (s)</td>
<td>0.21</td>
<td>0.21</td>
</tr>
<tr>
<td>Movement Time (s)</td>
<td>0.69</td>
<td>0.70</td>
</tr>
<tr>
<td>Lunge Distance (leg lengths)</td>
<td>0.83</td>
<td>1.12*</td>
</tr>
<tr>
<td>Max Sword Velocity (m.s⁻¹)</td>
<td>2.63</td>
<td>3.21*</td>
</tr>
</tbody>
</table>

- Both elbow extension and lead leg ‘kick out’ show no differences...
- Rear leg must be propulsive driver
Results: Kinematic Chain

![Graph showing angular velocity versus percentage of movement for skilled movement. The graph compares angular velocity at the hip, knee, and ankle.](image)

- **SKILLED**
  - Angular Velocity (deg/s)
  - Percentage of Movement (%)
  - Hip
  - Knee
  - Ank

Images showing different movement phases:
1. [Image 1]
2. [Image 2]
3. [Image 3]
4. [Image 4]
Results: External Kinetics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Novice</th>
<th>Skilled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Vertical Force (BW)</td>
<td>0.84</td>
<td>0.90</td>
</tr>
<tr>
<td>Peak Horizontal Force (BW)</td>
<td>0.61</td>
<td>0.89*</td>
</tr>
<tr>
<td>Normalised Vertical Impulse</td>
<td>0.11</td>
<td>0.13</td>
</tr>
<tr>
<td>Normalised Horizontal Impulse</td>
<td>0.08</td>
<td>0.13*</td>
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</table>

- More EFFECTIVE FORCE
Conclusion

• More skilled athletes demonstrate greater sword velocity

• Greater sword velocity is developed sequentially through a rear leg kinematic chain

• The ankle contribution was significantly greater in skilled performers

• This resulted in greater horizontal impulse. Therefore EFFECTIVE propulsive force
Future Direction / Application
Thank you for listening.
References


