Biomechanics of Seated Shot Put

Alison O’Riordan¹, Dr Andy Greenhalgh², Dr Laurent Frossard³,⁴,⁵, Dr Stuart Miller¹

¹London Sports Institute, Middlesex University, UK
²University of Hertfordshire, UK
³Queensland University of Technology, Australia
⁴University of the Sunshine Coast, Australia
⁵YourResearchProject, Australia

Sports Consultancy
Overview

• Background to Seated Throwing
• Pilot Study 1 & 2
  – Methods
  – Results
• Overall Conclusions & Applications
What is Seated Throws?

- Throwing events for disabled athletes who throw from a **SEATED** position using a **THROWING FRAME**

- Athletes with
  - Spinal Cord Injury (F52 – 57)
  - Neurological conditions (F32 – 34)
Rationale


• A better understanding of the interaction between the seated athlete and their throwing frame is needed (Keogh & Burkett 2016).
Overall Research Project

- The interaction between throwing technique of seated shot putters and their throwing frame.
- Movement variability
- Throwing configuration
- Throwing frame design
Introduction to Pilot Study 1 and 2

• To inform and guide methodology for Main Testing
• Novel research & methodology

• Pilot Study 1
  – Does holding pole position influence performance?
• Pilot Study 2
  – Does throwing configuration influence performance?
Methodology

- 3D Data Collection via Qualisys system
- 12 cameras (Pilot 1) – 21 cameras (Pilot 2)
- Reflective markers on joint centres
Methodology
Pilot Study 1

- Does holding pole position influence performance?
- One elite athlete in Class F55 (paraplegia from T10) – 10+ yrs experience
- 6 trials from 2 different holding pole positions
- Distance thrown recorded after each trial

- 3D data collection via 12 camera
  Qualisys set-up
- Data Analysis via Visual 3D

- 2 different holding pole positions (Nearer & Further)
Pilot Study 1

• Does holding pole position influence performance?
• One elite athlete in Class F55 (paraplegia from T10) – 10+ yrs experience
• 6 trials from 2 different holding pole positions
• Distance thrown recorded after each trial
• 3D data collection via 12 camera Qualisys set-up
• Data Analysis via Visual 3D

• 2 different holding pole positions (Nearer & Further)
Results

• Trunk angular velocity greater for **NEARER** holding pole position.

• Athlete usually throws with a holding pole position **FURTHER** away from him

• Mean Performances –
  – Further Pole distance 8.84m ± 0.3576;
  – Nearer Pole distance - 8.86m ± 0.338

Poster at 2017 UK Paralympic Performance Conference
Results

• Trunk angular velocity greater for **NEARER** holding pole position.

• Athlete usually throws with a holding pole position **FURTHER** away from him.

• Mean Performances –
  – Further Pole distance 8.84m ± 0.3576;
  – Nearer Pole distance - 8.86m ± 0.338

Poster at 2017 UK Paralympic Performance Conference
Pilot Study 2

• Does seating configuration influence performance?
  • One elite athlete in Class F34 (a neurological class) – 2 yrs experience
  • 6 trials from 4 different throwing configurations
  • Distance thrown recorded

• 3D data collection via 21 camera Qualisys set-up
• Data Analysis via Visual 3D

• 4 different throwing configurations
Pilot Study 2

<table>
<thead>
<tr>
<th>Throwing Configuration 1</th>
<th>Throwing Configuration 2</th>
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</thead>
<tbody>
<tr>
<td>Front on without pole</td>
<td>Diagonal without pole</td>
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<table>
<thead>
<tr>
<th>Throwing Configuration 3</th>
<th>Throwing Configuration 4</th>
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<tbody>
<tr>
<td>Front on with pole</td>
<td>Diagonal with pole</td>
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4 Throwing Configurations
Pilot Study 2

- Does throwing configuration influence performance?
- Angular velocity – Trunk, R Shoulder, R Elbow, R Wrist
- Velocity of shot put
- Power to Release Position

![Power Position](image1.png) ![Release Position](image2.png)
Results

Trunk Angular Velocity

R Shoulder Angular Velocity

R Elbow Angular Velocity

R Wrist Angular Velocity

From Power to Release Positions

Time normalised

Front On No Pole

Front On-NO Pole

Diagonal-NO Pole

Diagonal-WITH Pole

Front on-WITH Pole
Results

Velocity of Shot Put from Power to Release Position (time normalised)

[Graph showing velocity changes from power to release position, with different conditions and positions marked.]
Results

Velocity of Shot Put from Power to Release Position (time normalised)

Front On
No Pole

Release

Power Position

Release Position
## Results

<table>
<thead>
<tr>
<th></th>
<th>Posn 1</th>
<th>Posn 2</th>
<th>Posn 3</th>
<th>Posn 4</th>
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<tbody>
<tr>
<td></td>
<td>Front On</td>
<td>Diagonal</td>
<td>Diagonal</td>
<td>Front On</td>
</tr>
<tr>
<td></td>
<td>No Pole</td>
<td>No Pole</td>
<td>With Pole</td>
<td>With Pole</td>
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<td><strong>Mean (m)</strong></td>
<td><strong>Mean (m)</strong></td>
<td><strong>Mean (m)</strong></td>
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<td>0.28241813</td>
<td>0.168927993</td>
</tr>
</tbody>
</table>

### Trunk Angular Velocity

[Graph of Trunk Angular Velocity]

### Shot Put Velocity

[Graph of Shot Put Velocity]
Preliminary Conclusions from Pilots

• Potential interaction between seating position and holding pole
  • With holding pole – similar movement patterns
  • Without holding pole – seating position appears to affect movement pattern
Informing Main Testing

• Methodological considerations
• Investigate potential interaction between seating position and inclusion of holding pole

Potential Practical Applications

• Provides rationale for optimising individual athlete’s throwing position
  – Seating position
  – With/without holding pole
  – Holding pole position.
What Next?

Main Testing
World Para Athletics Champs
July 2017

Invitation to Participate in
World Leading
Seated Throws Research

Who?
F55, F56 & F57 Seated Throwers

What?
Biomechanical analysis of seated shot putters

When?
Saturday 22 July 2017

Where?
Lee Valley Athletics Centre
(30 mins drive from Olympic Park)

Research Information
• This is world leading research, with ethics approval.
• This research is investigating the interaction between the athlete & their throwing frame to improve performance using 3D motion analysis. It will also measure sitting pressure.
• You will be asked to throw maximally from 4 different sitting positions using a generic throwing frame.
• In return you will receive a FREE biomechanical analysis of your own optimal throwing technique using your own throwing frame.

Expressions of Interest & Further Information
If you would like to take part or require further information, then please send an email by 01 JULY 2017 to Alison O’Riordan - oriordan.alison@gmail.com

Researcher Information
• Alison O’Riordan
• PhD Researcher – Middlesex University
• Elite Paralympic Throws Coach
• Director of AOR Sports Consultancy
• www.allisonoriordan.co.uk
• @Alli_Oriordan
Thank You
oriordan.alison@gmail.com
www.alisonoriordan.co.uk
@Ali_Oriordan