

Shoulder stress in different team handball throwing techniques

Herbert Wagner

Team handball



- Intense dynamic movements
- Numerous physical confrontations
- Optimize individual and team performance
- Prevent injuries

Wagner et al. (2015)

Team handball injuries



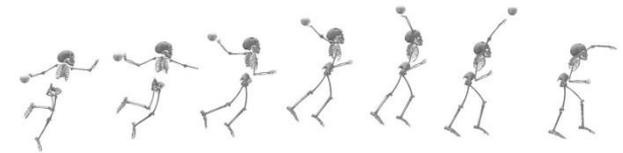
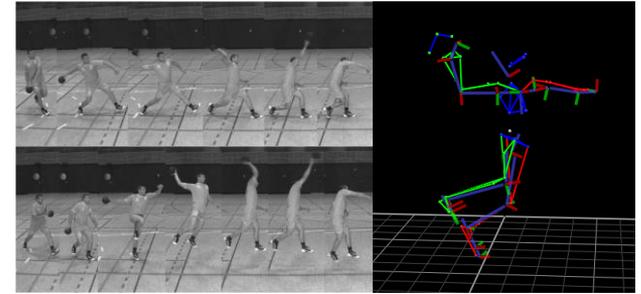
- 108 injuries per 1000 hours (Langvoort et al., 2007)
- Lower (42%), upper extremity (18%)
- Overuse symptoms in the shoulder
- 36% shoulder pain on the test day, 22% previously occurring pain (Myklebust et al., 2013)

Shoulder stress in team handball



- Physical contact in the game
- Numerous repetitions of high performance throws
- Awareness of stress in the shoulder
- Understand and prevent shoulder injuries

Aims of the study

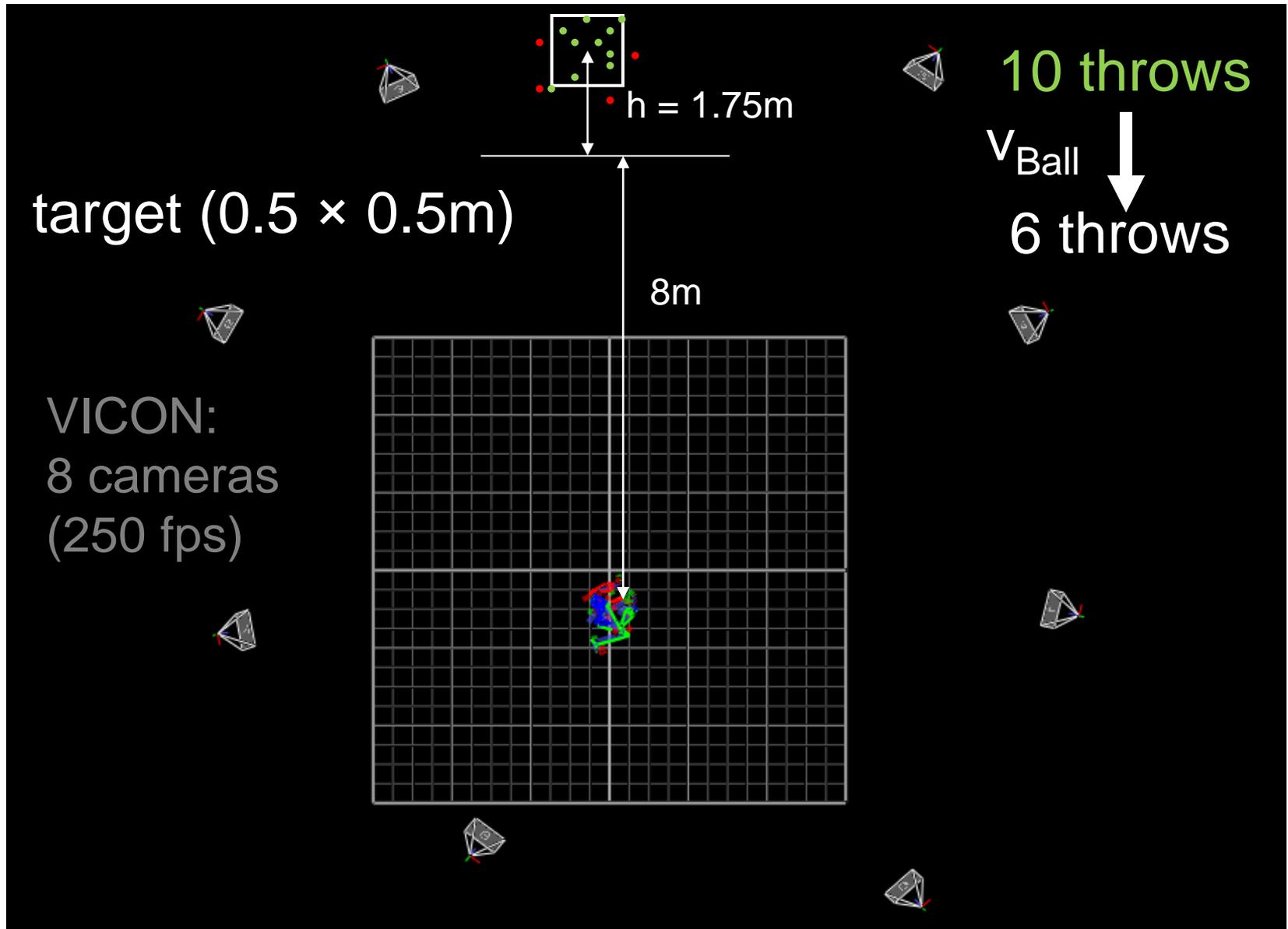


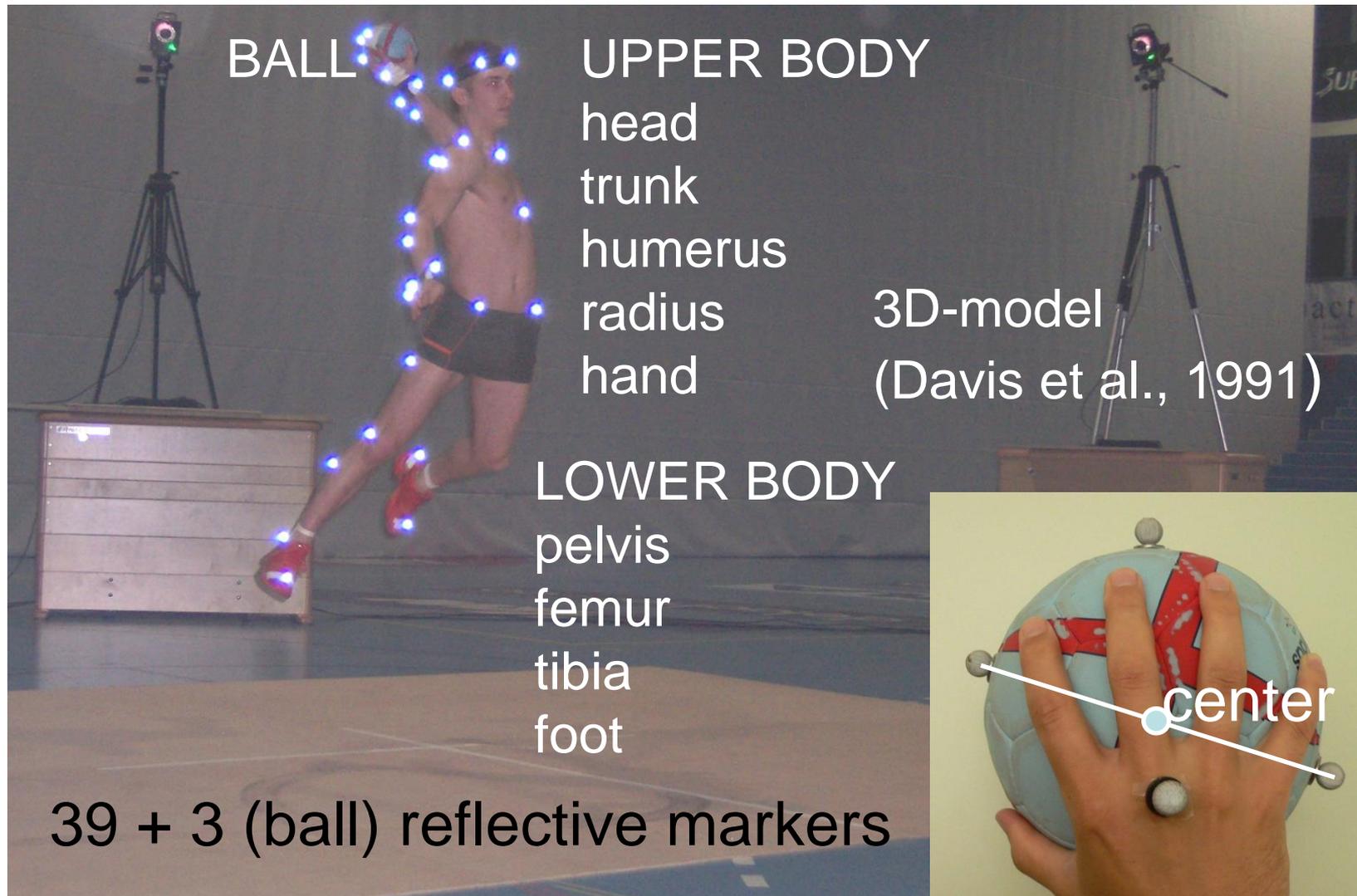
- Measure 3D-kinematics in different team handball throwing techniques
- Describe different throwing techniques via the upper body joints
- Compare stress in the shoulder with the stress in other upper body joints

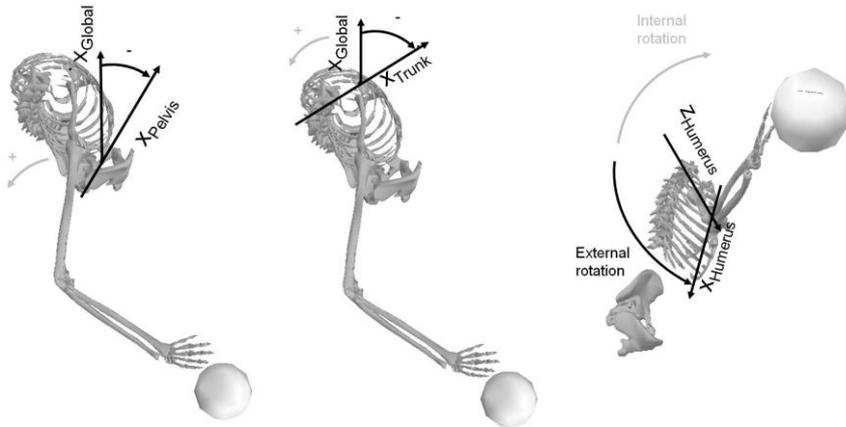
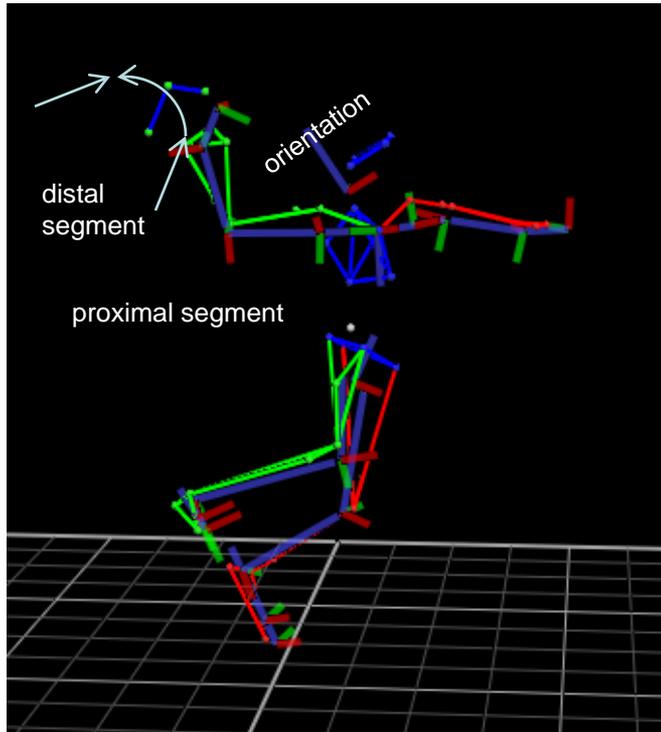
Elite team handball players (n=14)

- Age: 22.5 ± 3.7 yrs
- Body weight: 84.4 ± 10.5 kg
- Body height: 1.87 ± 0.06 m
- Training experience: 10.3 ± 3.6 yrs



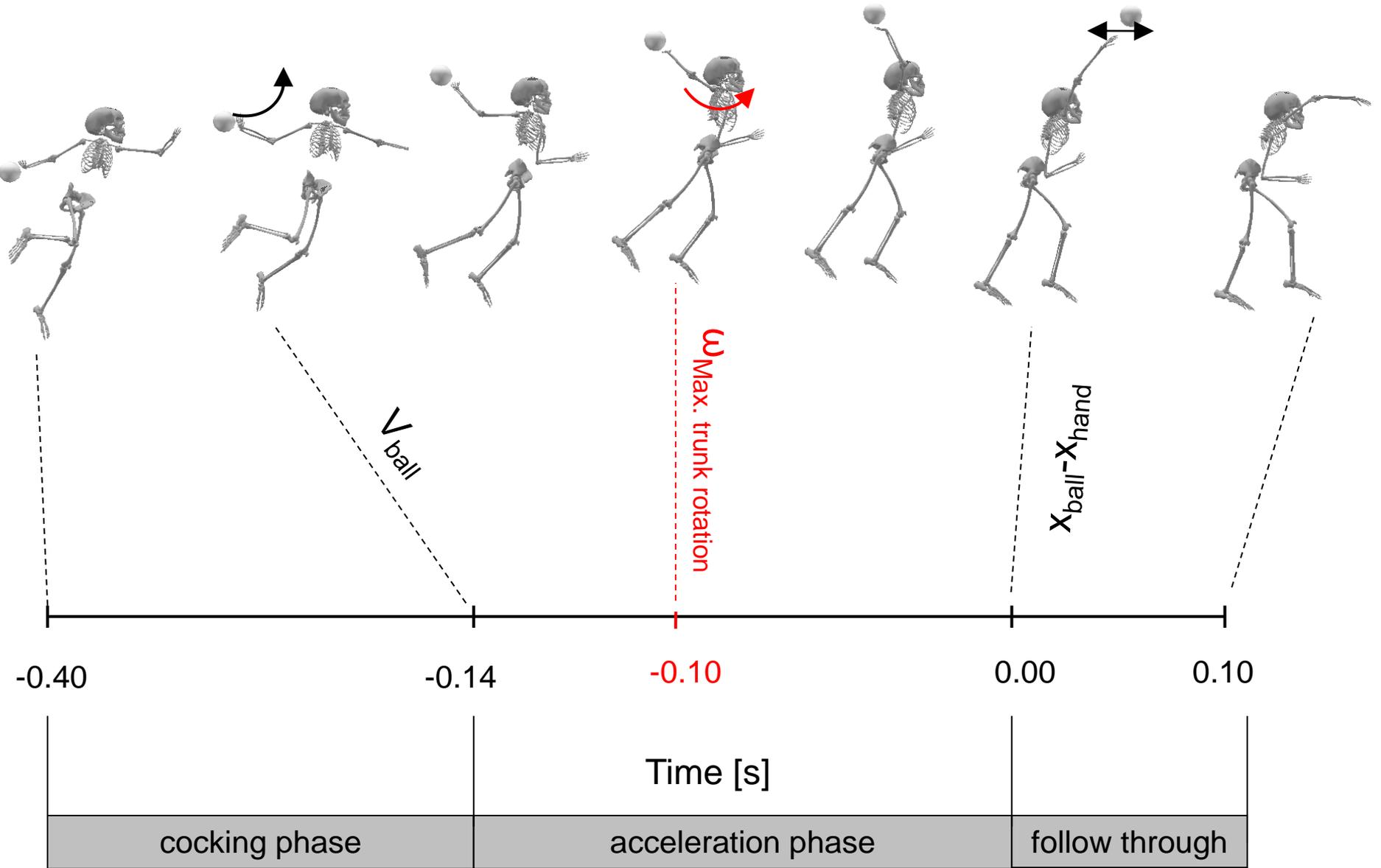






- Pelvis rotation
- Trunk rotation
- Shoulder rotation
- Elbow extension

Methods

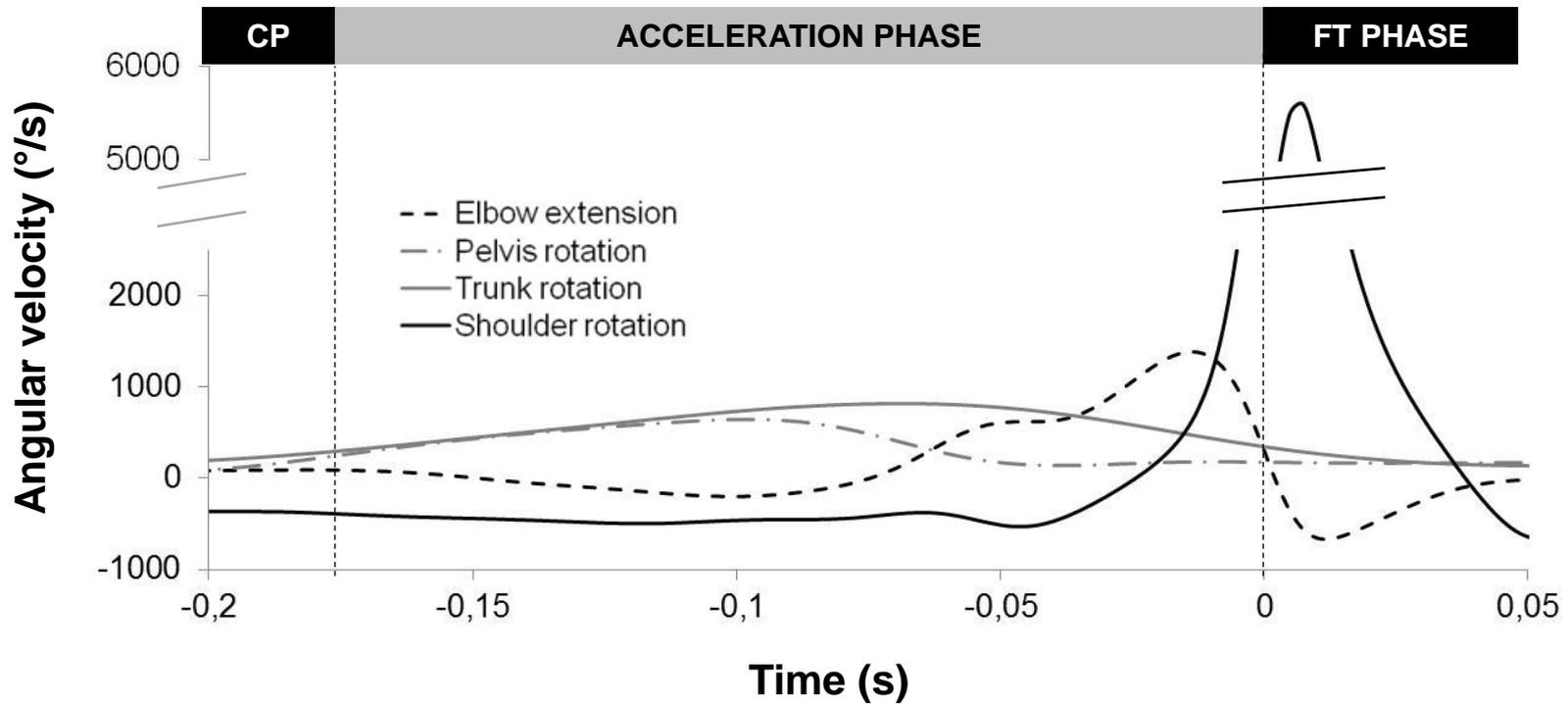
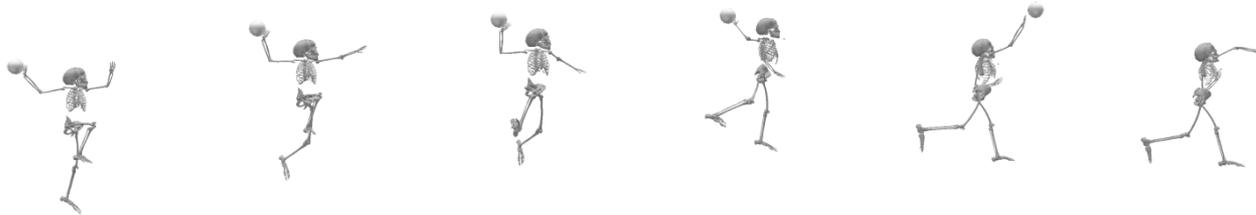


Statistics

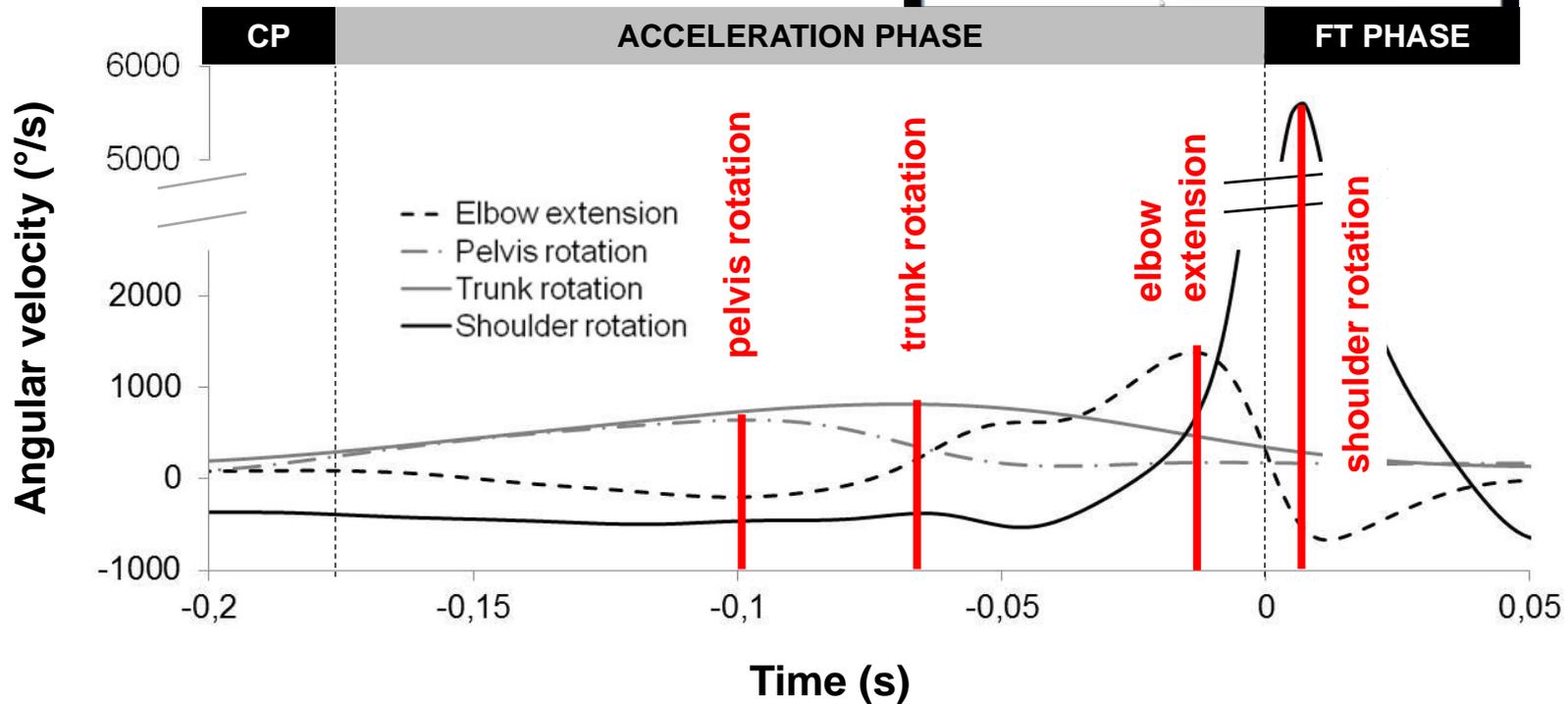
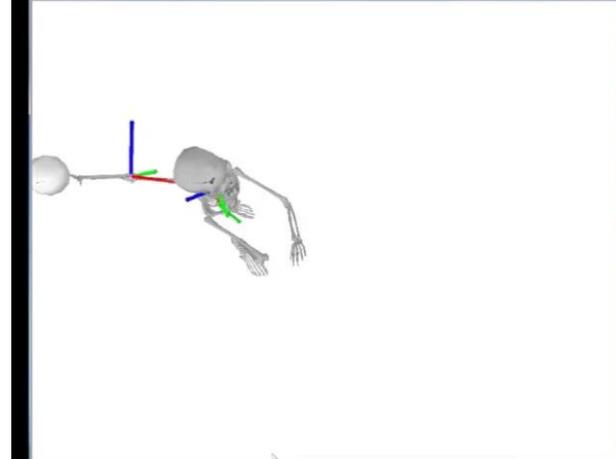
- General linear model with repeated measures, analyses of variance
- Bonferroni (post hoc):
 - Differences between throwing techniques
- Level of significance: $\alpha=0.05$



Results



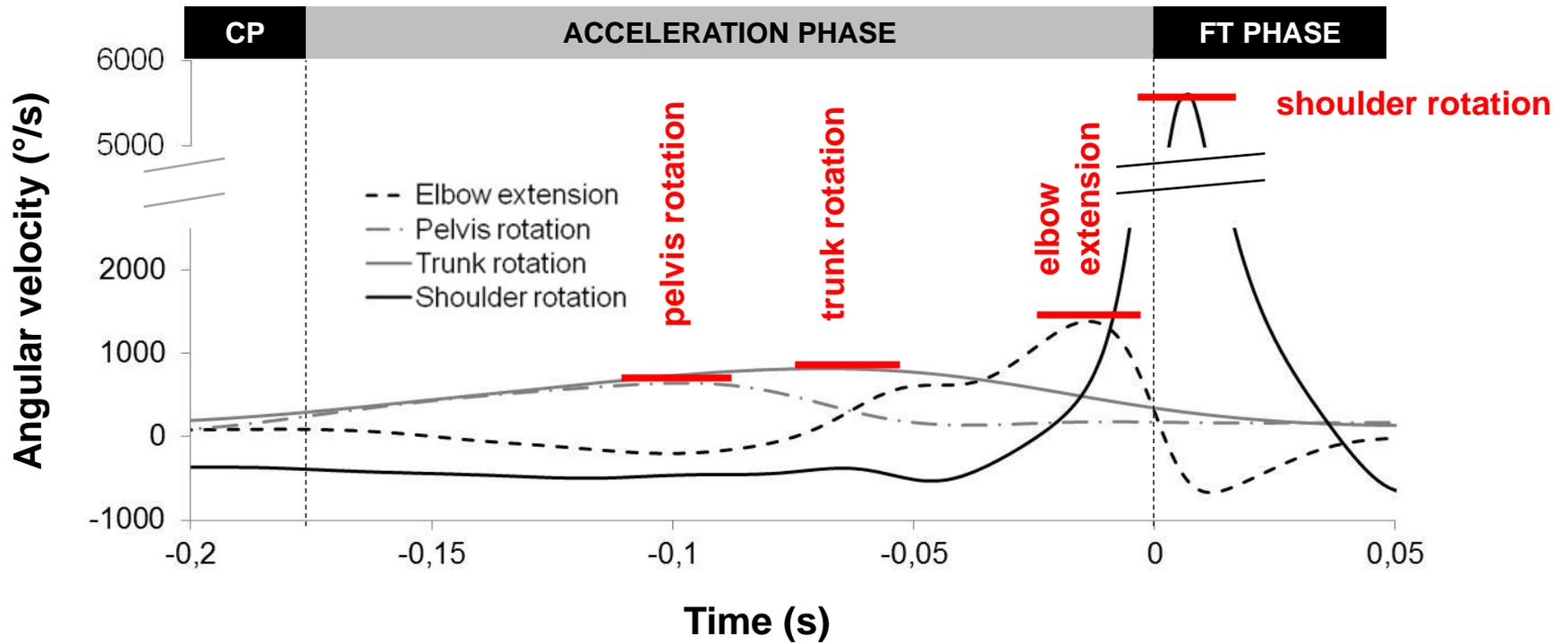
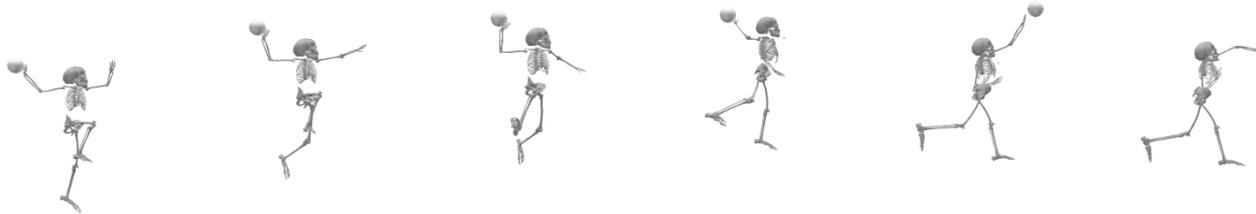
**team handball throwing
proximal-to-distal sequencing**



Proximal-to-distal sequencing

| | standing | throwing arm above | throwing arm beside | jump | pivot |
|--------------|--------------|--------------------|---------------------|--------------|--------------|
| pelvis (s) | -0.11 ± 0.02 | -0.11 ± 0.03 | -0.11 ± 0.03 | -0.12 ± 0.03 | -0.13 ± 0.02 |
| trunk (s) | -0.08 ± 0.02 | -0.08 ± 0.02 | -0.09 ± 0.02 | -0.09 ± 0.02 | -0.10 ± 0.02 |
| elbow (s) | -0.01 ± 0.00 | -0.01 ± 0.00 | -0.01 ± 0.01 | -0.02 ± 0.01 | -0.01 ± 0.01 |
| shoulder (s) | 0.00 ± 0.00 | 0.00 ± 0.01 | 0.01 ± 0.01 | 0.00 ± 0.00 | 0.00 ± 0.00 |

Results



Maximal angular velocity

| | standing | throwing arm above | throwing arm beside | jump | pivot |
|----------------|-------------|-----------------------|------------------------|------------|------------|
| pelvis (°/s) | 590 ± 70 | 610 ± 90 | 590 ± 160 | 440 ± 110 | 370 ± 80 |
| trunk (°/s) | 800 ± 60 | 830 ± 80 | 810 ± 160 | 730 ± 80 | 640 ± 60 |
| elbow (°/s) | 1670 ± 280 | 1700 ± 290 | 1580 ± 340 | 1630 ± 220 | 1420 ± 650 |
| shoulder (°/s) | 5700 ± 1050 | 5630 ± 1260 | 5150 ± 1400 | 4920 ± 950 | 4730 ± 910 |

Maximal angular velocity



| | standing | throwing arm above | throwing arm beside | jump | pivot | |
|----------------|-----------|-----------------------|------------------------|----------|----------|-----|
| pelvis (°/s) | 590±70 | 610±90 | 590±160 | 440±110 | 370±80 | *** |
| trunk (°/s) | 800±60 | 830±80 | 810±160 | 730±80 | 640±60 | *** |
| elbow (°/s) | 1670±280 | 1700±290 | 1580±340 | 1630±220 | 1420±650 | |
| shoulder (°/s) | 5700±1050 | 5630±1260 | 5150±1400 | 4920±950 | 4730±910 | |

Maximal angular velocity

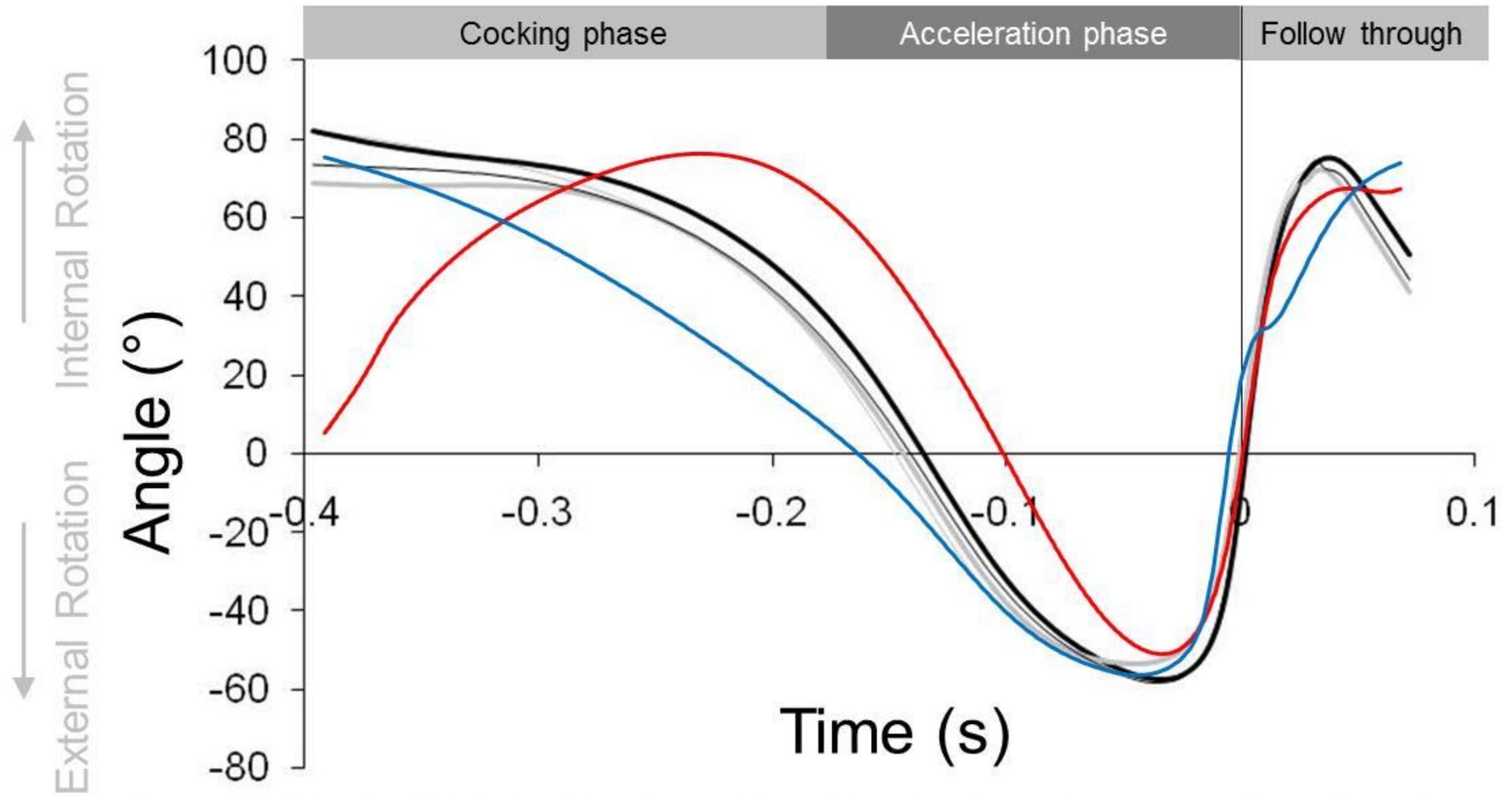


| | standing | throwing arm above | throwing arm beside | jump | pivot | |
|--------------------------------|-----------------|-----------------------|------------------------|-----------------|-----------------|------------|
| pelvis (°/s) | 590±70 | 610±90 | 590±160 | 440±110 | 370±80 | *** |
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| ball velocity (m/s) | 22.3±1.2 | 23.9±1.2 | 22.6±1.6 | 21.9±1.6 | 20.4±1.2 | *** |

Team handball throw



- Proximal-to-distal sequencing from the lower body to the throwing arm
- Maximal shoulder rotation after (2-7ms) ball release
- Highest ball velocity in the standing throw with run up (arm above the shoulder)





Prevent shoulder injuries

- Highest velocity in the human body
- Shoulder rotation velocity around $7000^{\circ}/s$
- Special training programs to strengthen the shoulder rotator muscles
- Catching the throwing arm during throwing from behind is absolutely forbidden



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Handball/Volleyball

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**Physical Determinants of Team Sports
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Thank you for your attention

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