A Static Hold Test Can Assess Stability of Hold and Postural Control for Biathlon Prone Shooting

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Prone shooting posture

Body support points

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Prone shooting posture

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Rifle-body connections

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Various possibilities for adjustments

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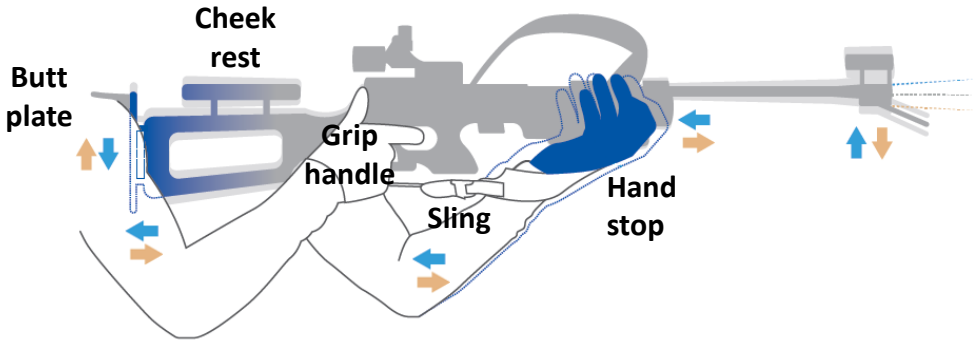

We lack methods to **objectively yet quickly** assess their effectiveness

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Various technical aspects have been analysed from prone shooting

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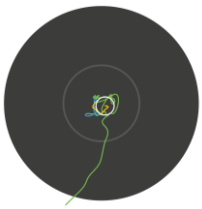
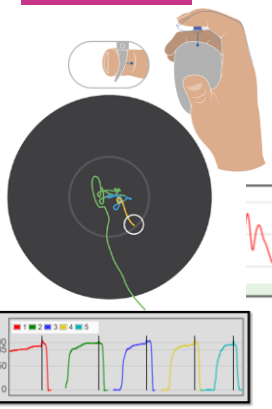
Aiming accuracy

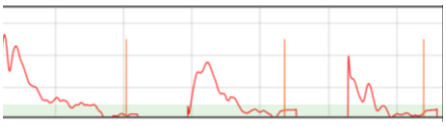
Hold stability



Triggering



Timing



Shoulder to butt plate force

Hoffman et al, 1992, IJSM
Sattlecker et al, 2017, IJSPP
Köykkä et al, 2022, SJMSS

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Postural control (balance) has been shown to play a key role in standing

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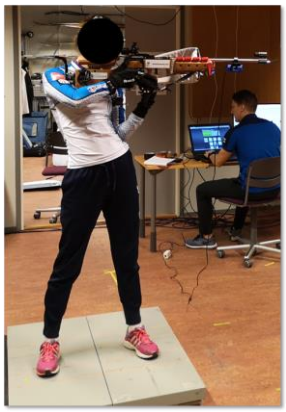

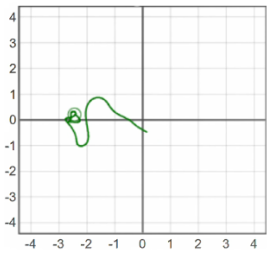

but no literature on its role in prone

Sattlecker et al, 2014, IJSSC
Sattlecker et al, 2017, IJSPP
Ihalainen et al, 2018, SJMSS
Köykkä et al, 2021, SJMSS

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Objectives

1) Examine associations between stability of hold, postural control, and shooting performance in biathlon prone shooting

2) Investigate correlations between key measures in prone shooting and static hold test

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27 biathletes (11 females)

20.1 ± 3.6 years old

8.1 ± 3.1 years of biathlon

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STATIC HOLD test

4 x 45-s in the prone posture

(each incl. 2x10-s holds, at 10 and 35 s)

- *”Approach as usual, then aim steadily at the target while holding breath”*

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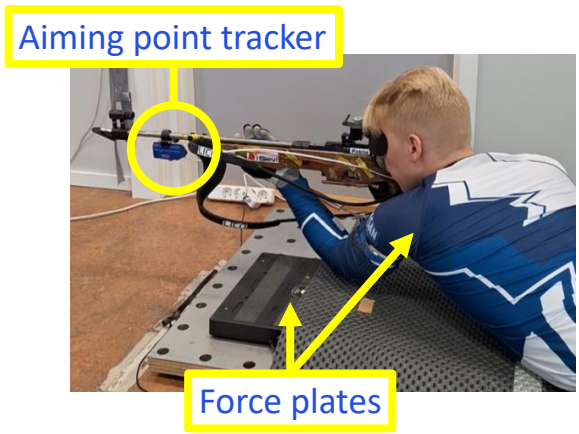
SHOOTING test

Prone (dry) shooting 6x5 shots at rest

- *”Use your natural biathlon shooting rhythm to hit the targets”*



STATIC HOLD test

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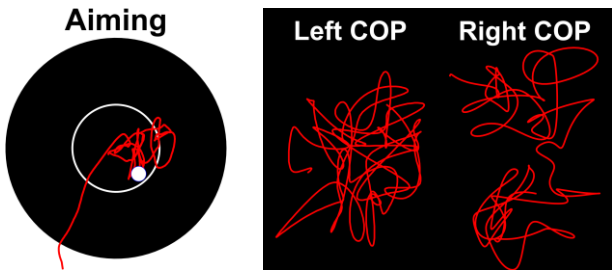
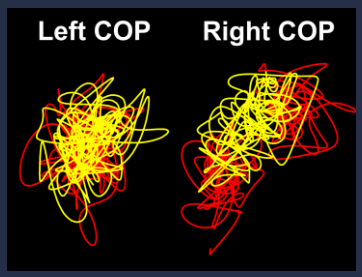
SHOOTING test



STATIC HOLD test

The most stable 5 s during each hold



→ Stability of hold

→ Postural control

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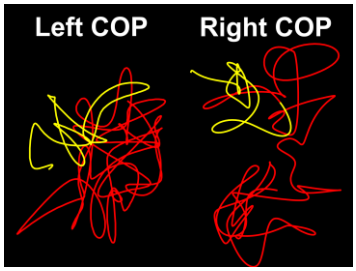
SHOOTING test

The final 0.6 s before triggering



→ Stability of hold
→ Hit point distance from the centre

→ Postural control

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What was found?

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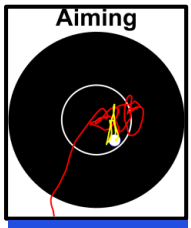
Correlations to hit point distance **during shooting**

Stability of hold	
Variable	R [95% CI]
Resultant Mean Velocity	.50**
Horizontal Mean Velocity	.53**
Horizontal Standard Deviation	.57**
Vertical Mean Velocity	.39*
95 % Confidence Ellipse Area	.51**

* P < .05
** P < .01
*** P < .001



Shooting test

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Correlations to hit point distance **during shooting**

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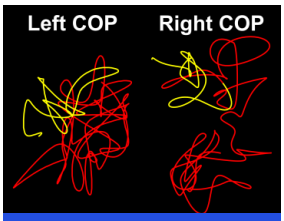

Shooting test

Front arm postural control	
Variable	R [95% CI]
Mean Velocity in shooting direction	.40*
Standard Deviation in shooting direction	.51**

* P < .05
** P < .01
*** P < .001

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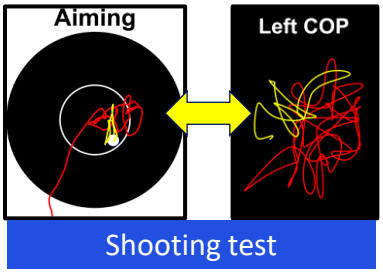
Correlations between stability of hold and postural control **during shooting**

Stability of hold	Front arm COP Standard Deviation in shooting direction
Variable	R [95% CI]
Resultant Mean Velocity	.42*
Horizontal Mean Velocity	.39*
Horizontal Standard Deviation	.45*

* P < .05
** P < .01
*** P < .001



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Correlations **between the tasks**

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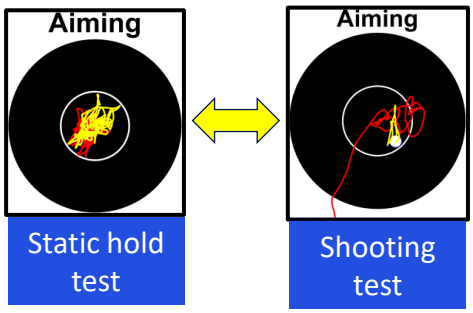
Stability of hold	
Variable	R [95% CI]
Resultant Mean Velocity	.90***
Horizontal Mean Velocity	.80***
Horizontal Standard Deviation	.64***
Vertical Mean Velocity	.60***
95 % Confidence Ellipse Area	.51**

* P < .05
** P < .01
*** P < .001



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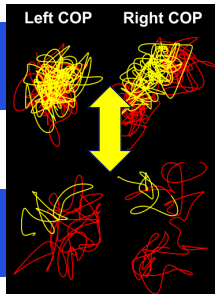
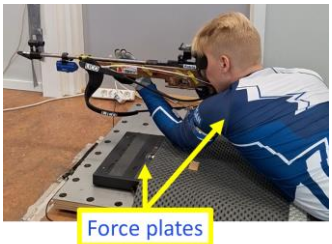
Correlation **between the tasks**

Static hold test

Shooting test





Front arm postural control	
Variable	R [95% CI]
Mean Velocity in shooting direction	.90***
Standard Deviation in shooting direction	.68***

* P < .05
** P < .01
*** P < .001

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What could we learn from it?

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Front arm postural control may contribute to successful biathlon prone shooting

- Correlated to shooting performance and stability of hold
  - BUT correlation with stability of hold not perfect (R ~ .40)

→ Has an independent role too?

Stability of hold is essential, as previously shown

- Can be assessed using a 5-min static holding test,

→ Objective yet quick assessment of the posture

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Effects of exercise intensity?

Stability of hold is known to ↓ when intensity ↑

How about…

- aiming accuracy
- cleanness of triggering
- timing of triggering
- postural control

Does the static test at rest provide reasonable information for shooting at high intensity?

And can it be measured with an IMU?

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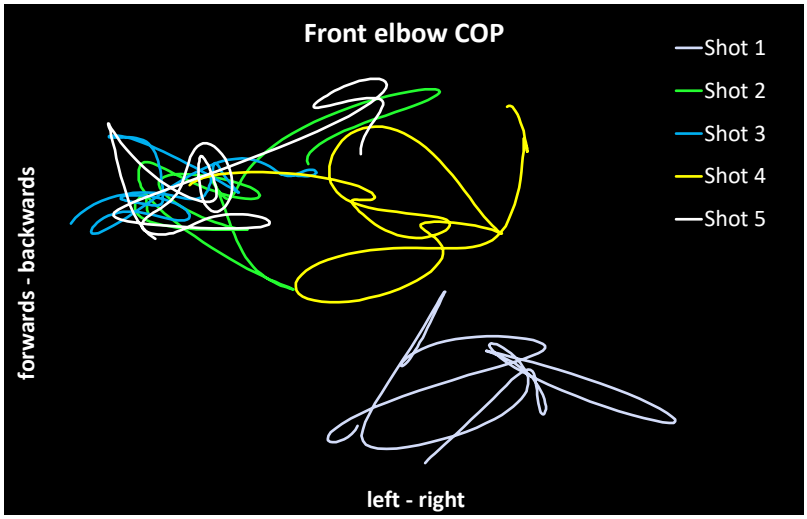
Do COP location changes within a set provide additional useful information?



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THANK YOU!

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