TEGID-15

PARTNERSHIP FOR DUMMY TECHNOLOGY AND BIOMECHANICS

# Possible causes for the poor reproducibility of neck forces and moments of the BioRID-II First findings

L. Ferdinand, M. Hartlieb, K. Bortenschlager, C. Gehre

# Test Set-up

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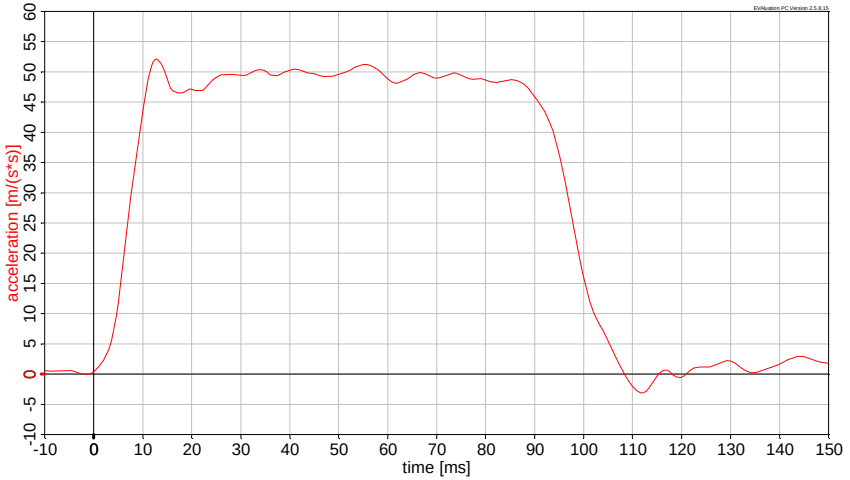
- Hard bucket seats (re-usable)
  - Test series 1: 4 dummies on one sled
  - Test series 2&3: 2 dummies on one sled
- Up to eight BioRID
- SRA16 crash pulse



# Reproducibility of some responses

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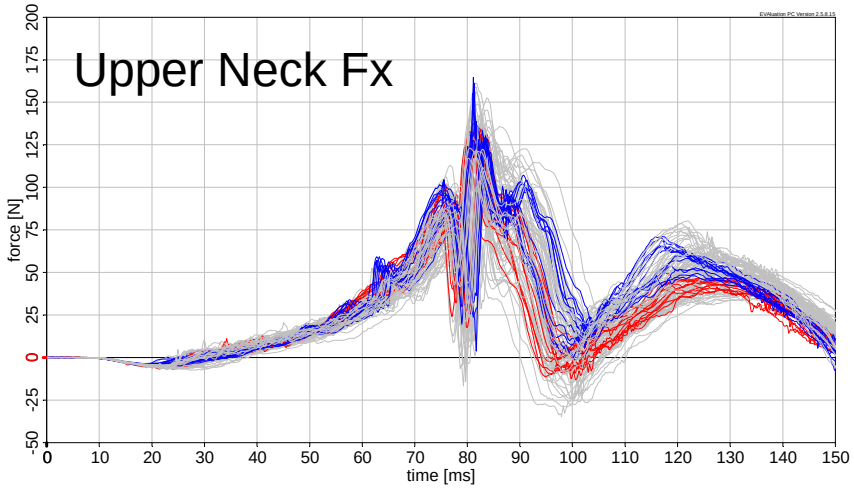
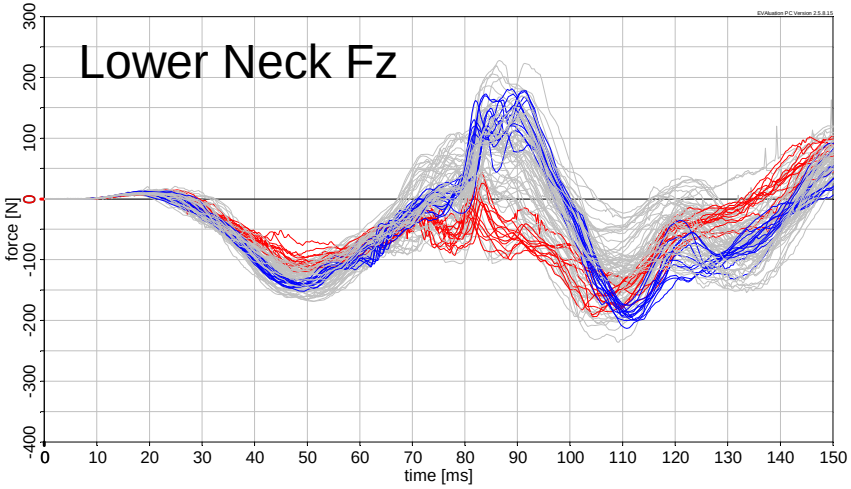
## Test series 1 (Jan. 2009)

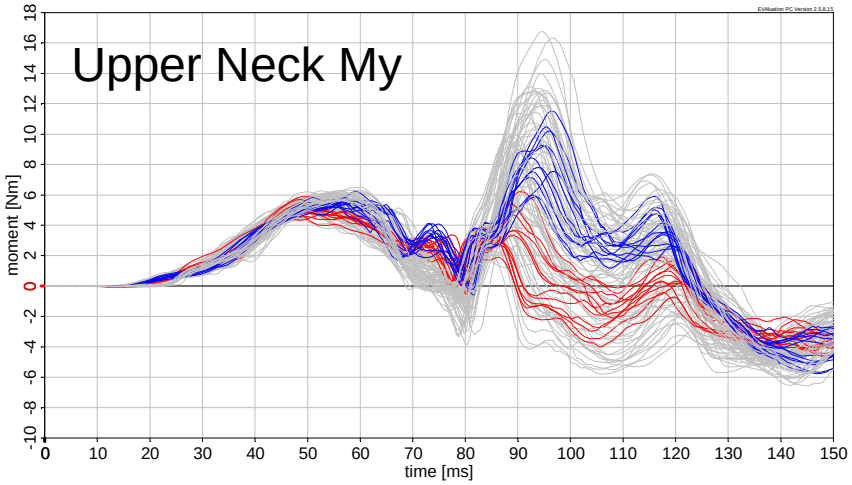
8 BioRID

Red – Dummy 007

Blue – Dummy 006



# Are those results reproducible? Yes

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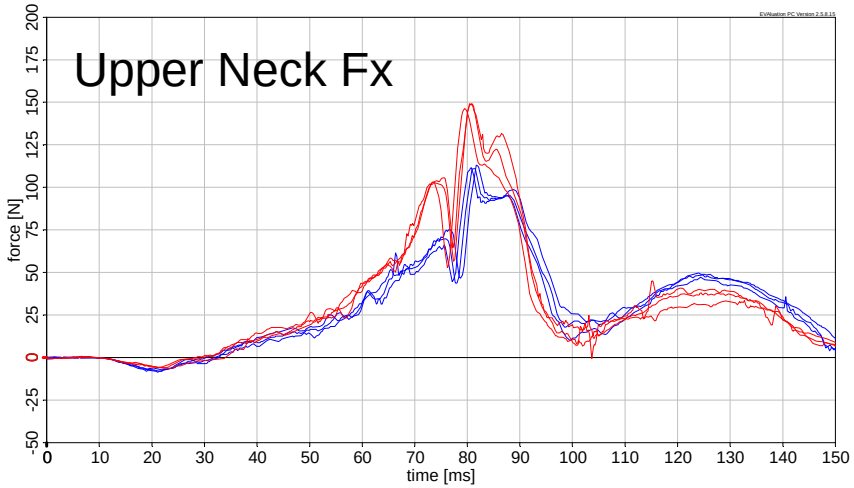
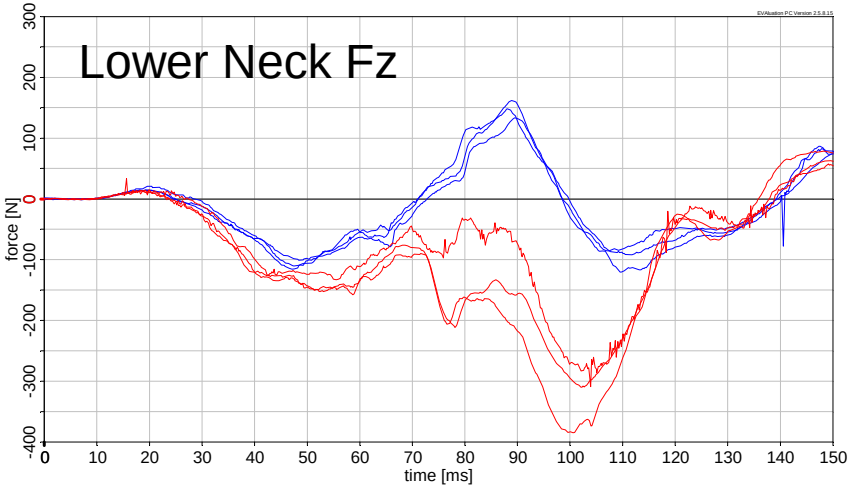
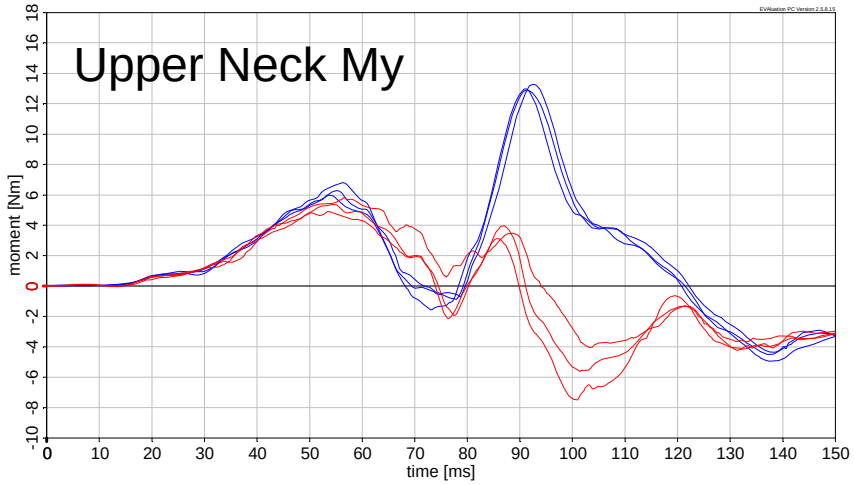
## Test series 2 (Dec. 2009)

Red – Dummy 007

Blue – Dummy 006



# What happened with the dummies between test series 1 and 2?

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- Certification at Denton COE in Heidelberg
  - Regular inspection
  - Sensor calibration
  - Cables replaced
  - Similar results of both dummies in the certification test

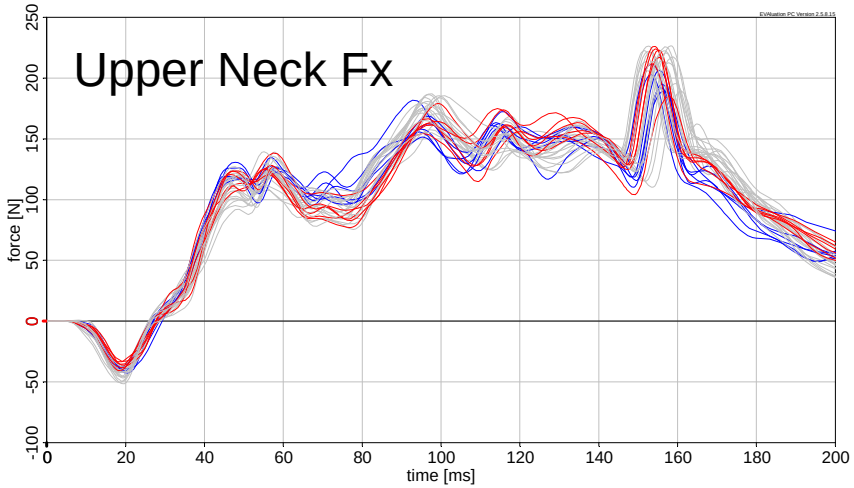
→Dummy 007 – similar to test series 1

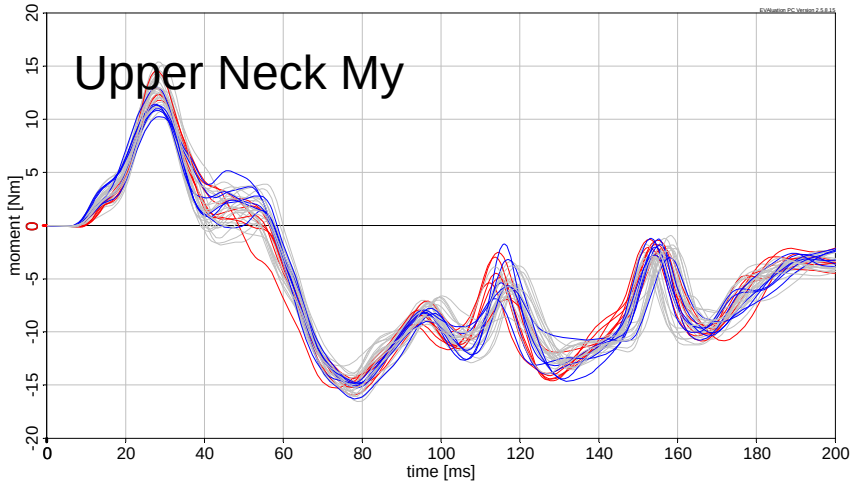
→Dummy 006 – similar to test series 1

# Differ those dummies in the certification test? No

- Certification tests
  - 9 BioRID (tested 2008 to 2010)
  - Red – Dummy 007
  - Blue – Dummy 006

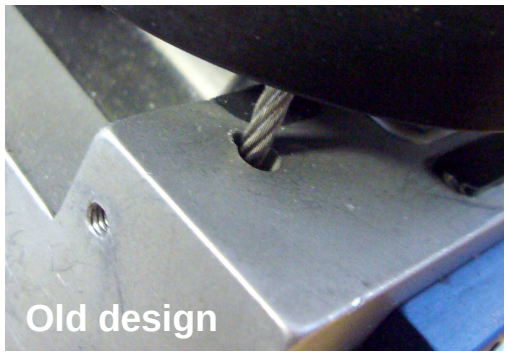
→ Similar responses of all dummies



# Possible causes for the poor reproducibility

- Based on the results of test series 1 and 2
  - Positioning of the dummies?
    - No, position of the dummies measured and controlled with a 3D measuring system
  - Stiffness of the pelvis foam?
    - Will be checked in test series 3
  - Friction between cables and vertebrae?
    - Will be checked in test series 3
  - Friction between head and seat?
    - Will be checked in test series 3
  - Friction between bolts and vertebrae?
    - No investigation at this time
  - Friction between vertebrae?
    - No investigation at this time



# Test series 3 – Baseline tests
# Are the results reproducible? Yes&No

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## Test series 3 (Jul. 2010)

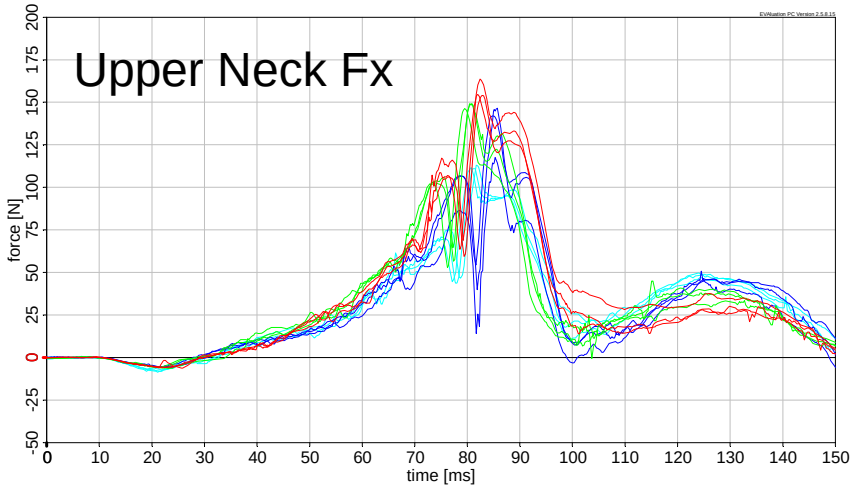
Red – Dummy 007

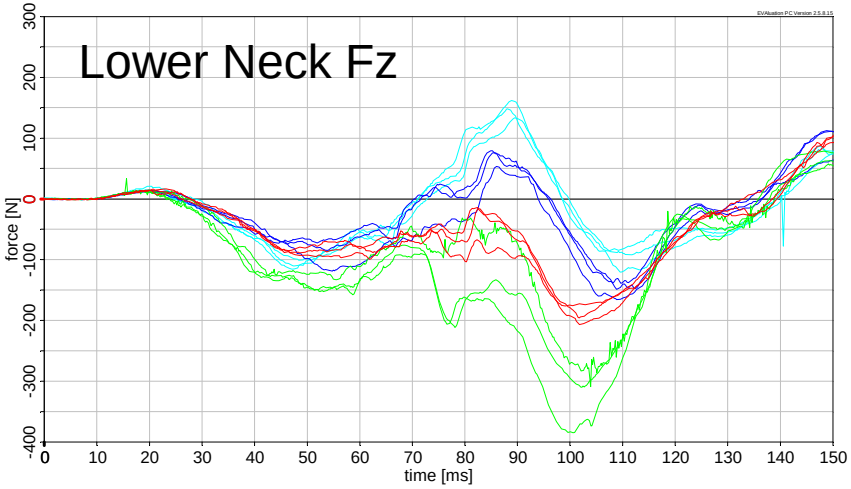
Blue – Dummy 006

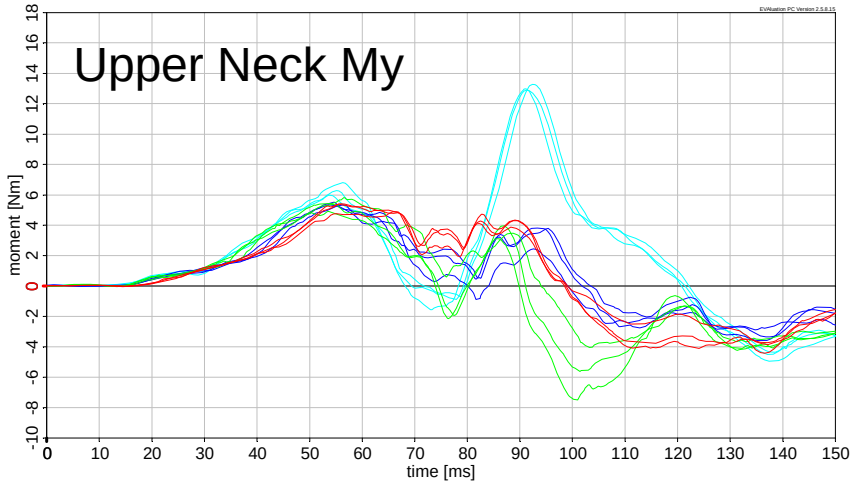
Test series 2 (Dec. 2009)

Green – Dummy 007

Cyan – Dummy 006



# What happened with the dummies between test series 2 and 3?

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- Certification at Denton COE, Heidelberg
  - Regular inspection
  - Sensor calibration
  - Cables replaced
  - Dummy 006 – Surface of bolt between C1 and C2 smoothed (corrosion)
  - Similar results of both dummies in the certification test

→Dummy 007 – almost similar to test series 1 & 2

→Dummy 006 – different responses

# Is there any influence of the stiffness of the pelvis foam? No

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Test series 3 (Jul. 2010)

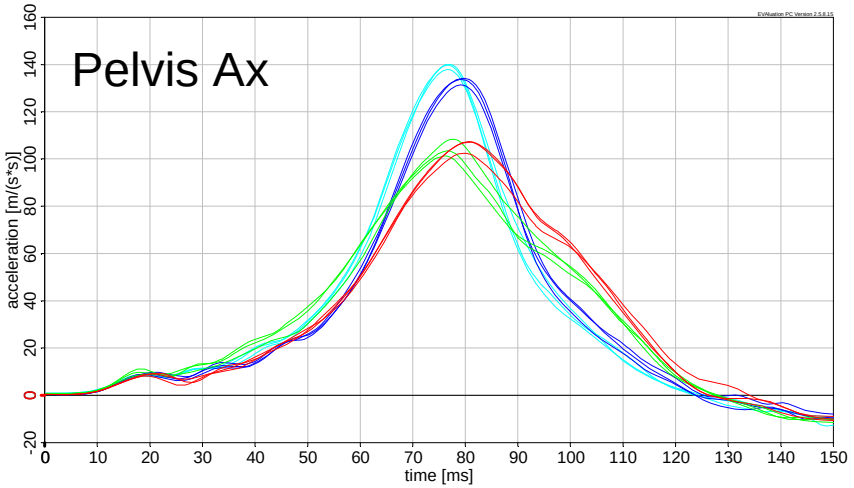
Red – Dummy 007 (soft)

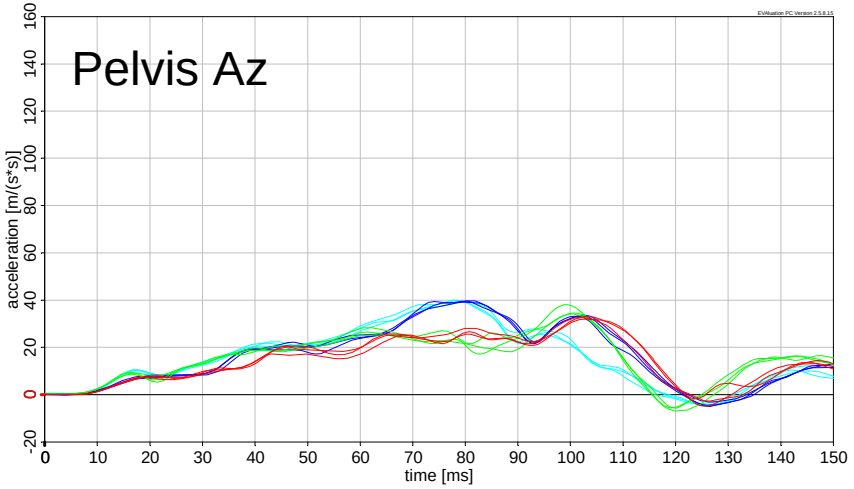
Blue – Dummy 006 (stiff)

Test series 2 (Dec. 2009)

Green – Dummy 007

Cyan – Dummy 006




- Change of the neck responses but no change of the pelvis responses

→ No influence of the pelvis foam on the variation of the neck responses

# Is there an influence of the cable friction? Yes&No

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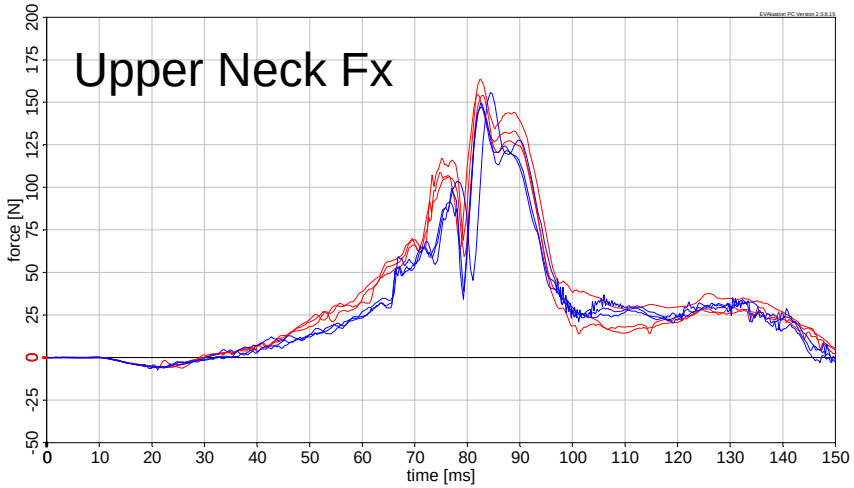
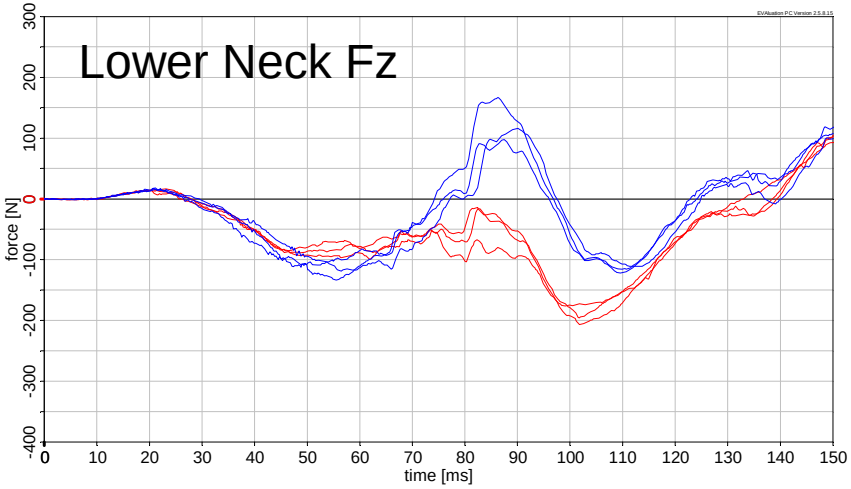
## Test series 3 (Jul. 2010)

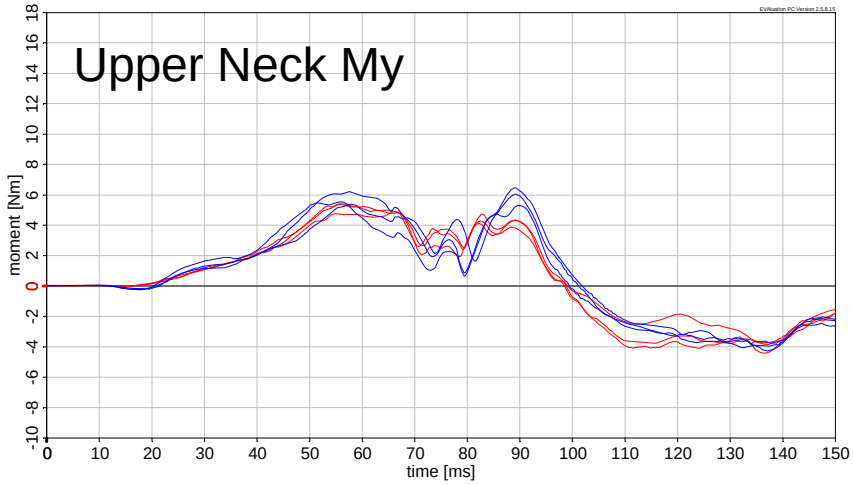
Dummy 007

Red – Baseline

Blue – Coated cables



# Is there an influence of the cable friction? Yes&No

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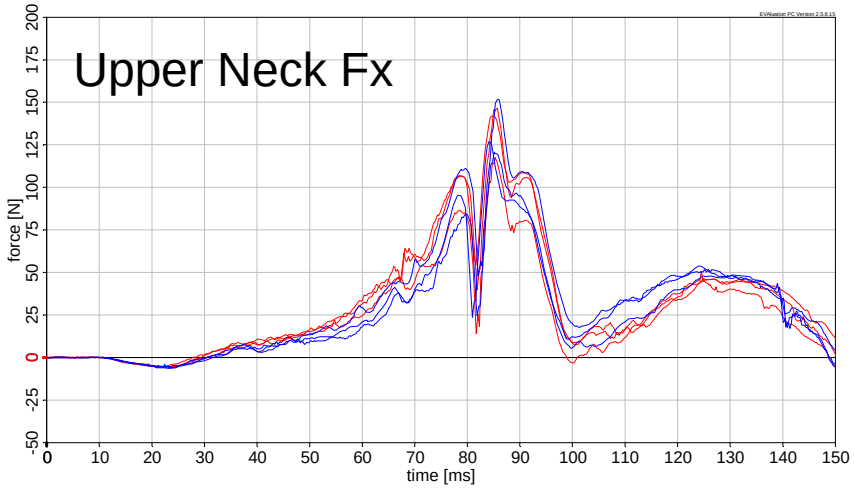
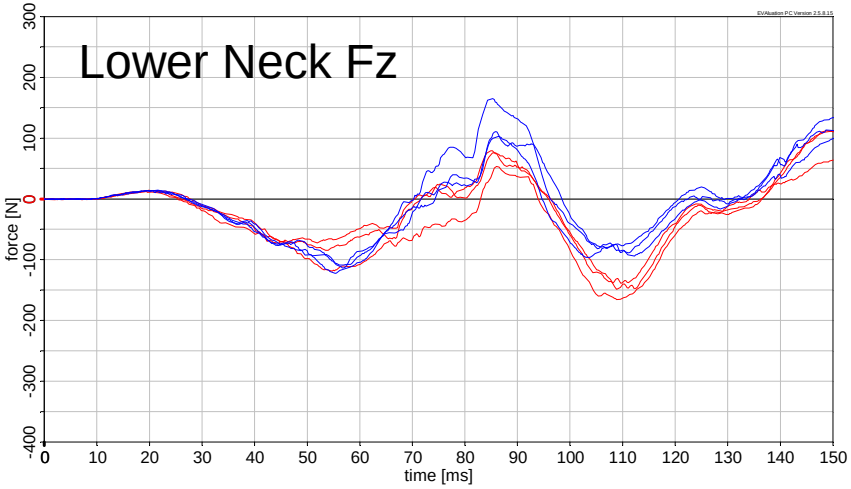
## Test series 3 (Jul. 2010)

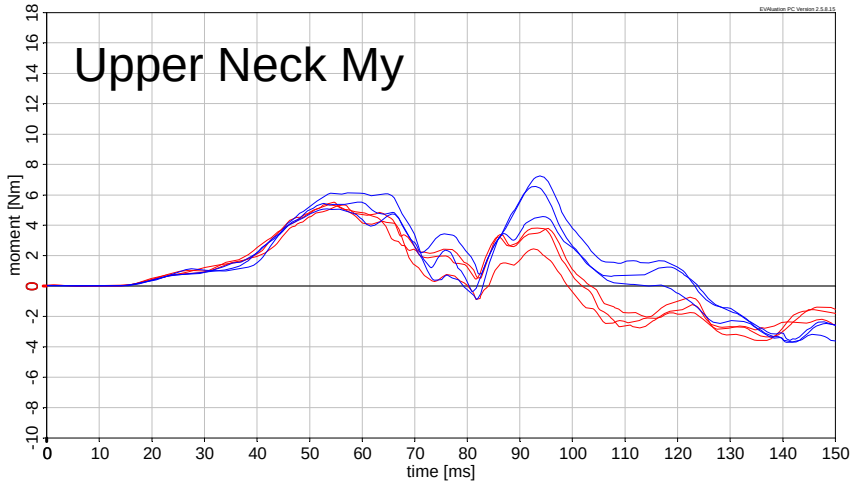
Dummy 006

Red – Baseline

Blue – Coated cables



# Cable friction
# Standard cables vs. coated cables

Coated cables

- No influence on upper neck force Fx
- Increased upper moment My and lower neck force Fz during head impact
  - Magnitude depends on the individual dummy

→ Cable friction probably not the cause of the variations of the neck forces and moments

- Remark: The dummies equipped with coated cables passed the certification requirements without any problem.

# Is there an influence of the friction between head and seat? Yes

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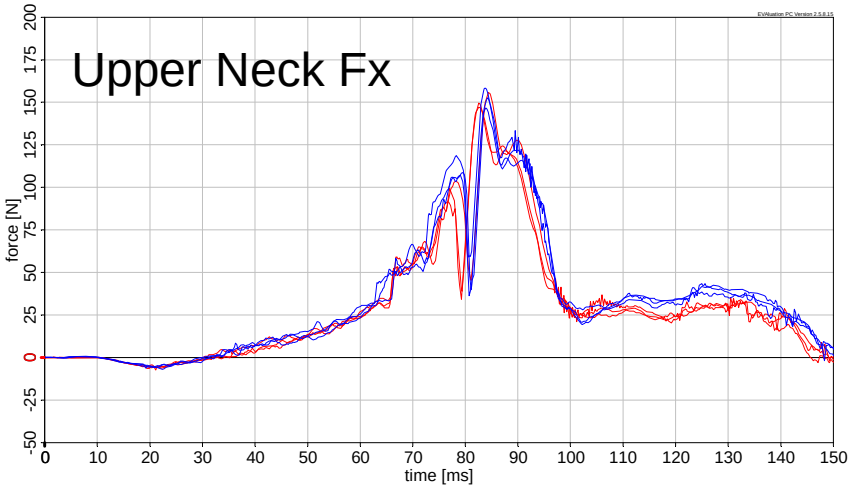
## Test series 3 (Jul. 2010)

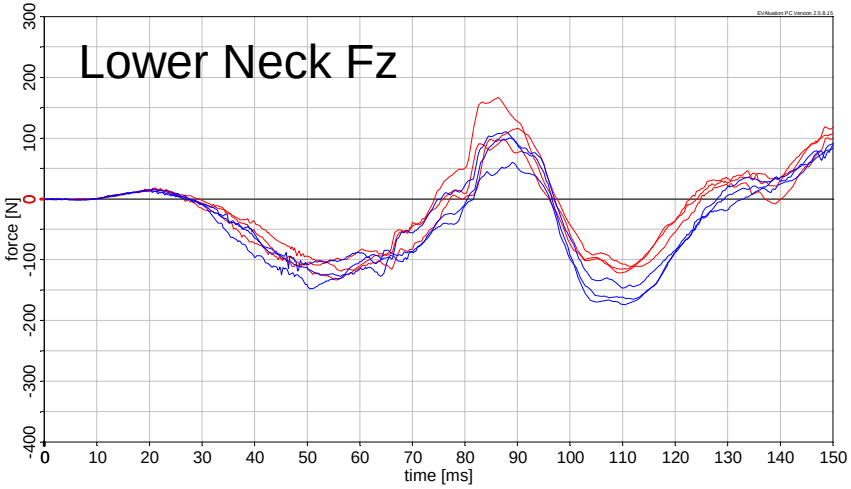
Dummy 007

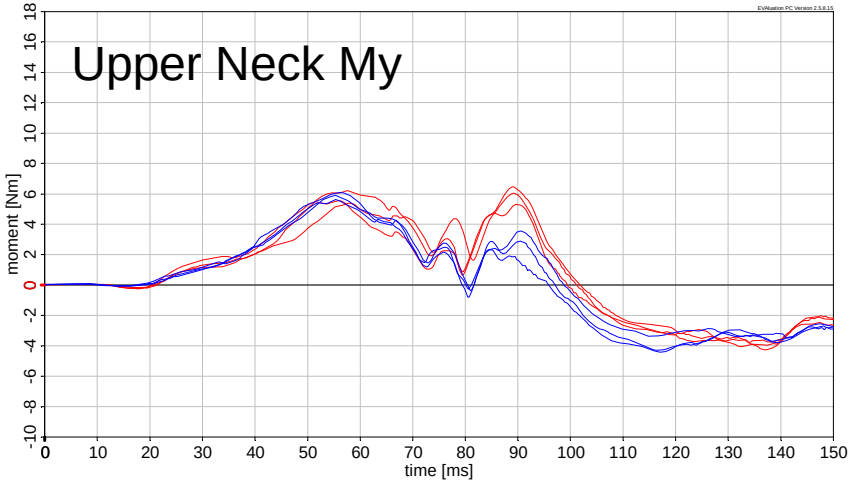
Red – Baseline

Blue – w/o skin of head cap

(both with coated cables)



# Is there an influence of the friction between head and seat? Yes

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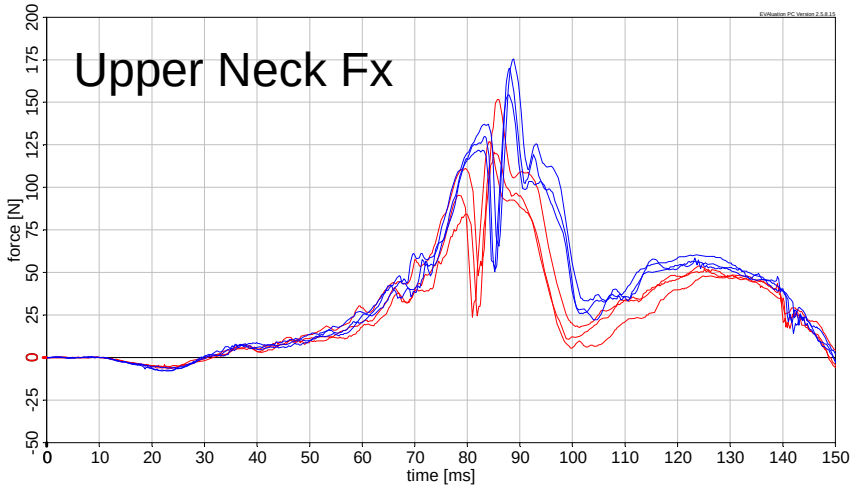
## Test series 3 (Jul. 2010)

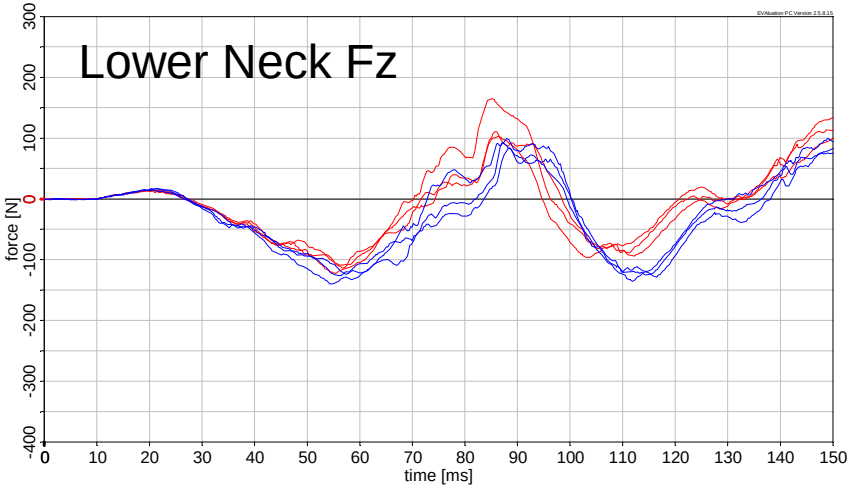
Dummy 006

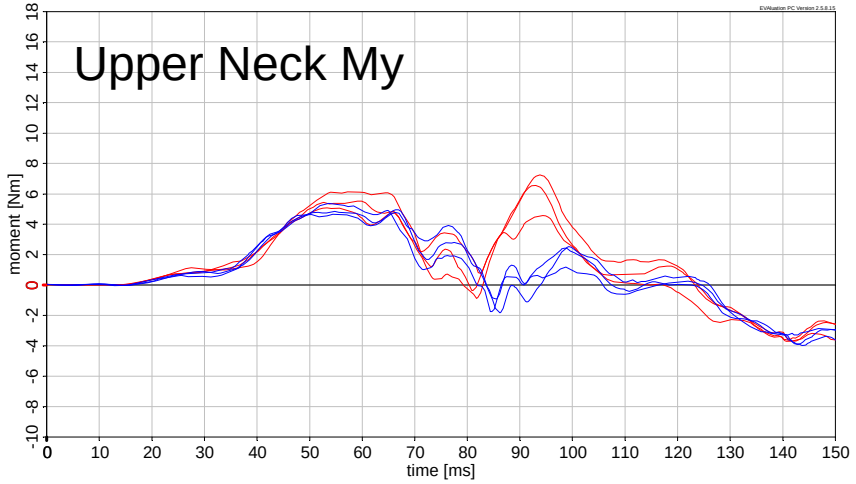
Red – Baseline

Blue – w/o skin of head cap

(both with coated cables)



# Head to seat friction

Reduced (controlled) friction

- Minor influence on upper neck force Fx and lower neck force Fz
- Significantly reduced upper moment My during head impact

→ Head to seat friction might be a cause for the variations of the neck moments

# Preliminary summary

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- The main cause of the variations of neck forces and moments is still unknown
- The dummy can change the characteristics of neck responses due to maintenance but the certification tests shows no difference
- The friction between head and seat influences the neck responses
- The stiffness of the pelvis seems to have no influence on the variations of the neck responses
- Coated cables are helpful to get better controlled friction between cables and vertebrae

# Preliminary conclusion

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- Neck forces and moments are not suitable to access WAD unless the huge variations of those responses are significantly reduced
- The current certification procedure does not detect the differences between individual dummies
- Better controlled friction parameters of the spine (vertebrae, bolts, cables) needed

# Outlook

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- In-depth analysis of the results of all test series
- Parametric studies by using computational models