



# CASPER

CHILD ADVANCED SAFETY PROJECT FOR EUROPEAN ROADS

## Q3 and Q6 updates for submarining

P. Beillas, F. Alonzo (INRETS)

P. Lemmen, M. Burleigh (FTSS)

H. Johannsen (TUB)

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## Q3 and Q6 updates for submarining



- Aim: Investigate and improve the response of the Q3 and Q6 dummies
- Deliverable: prototype of an “Auxiliary equipment for Q3 and Q6 to improve belt interaction”

## APPROACH

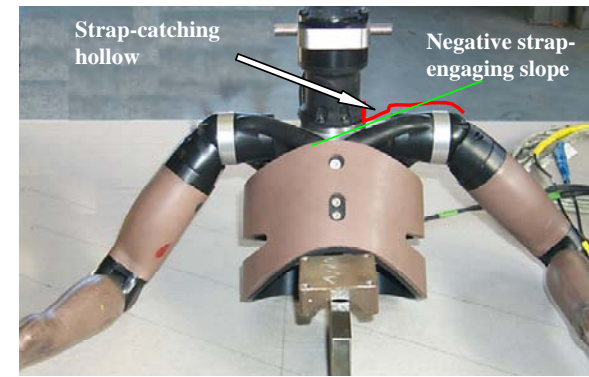


- 1) Identification of the possible shortcomings
- 2) Prioritization and selection for subsequent work
- 3) Definition of solutions
- 4) Implementation
- 5) Testing

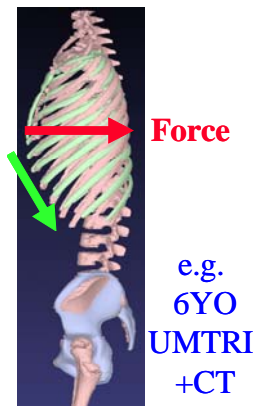
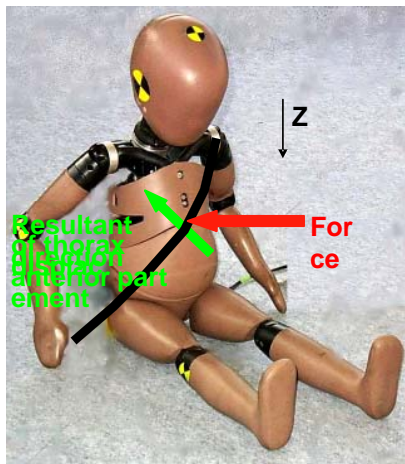
## Identification of the possible shortcomings



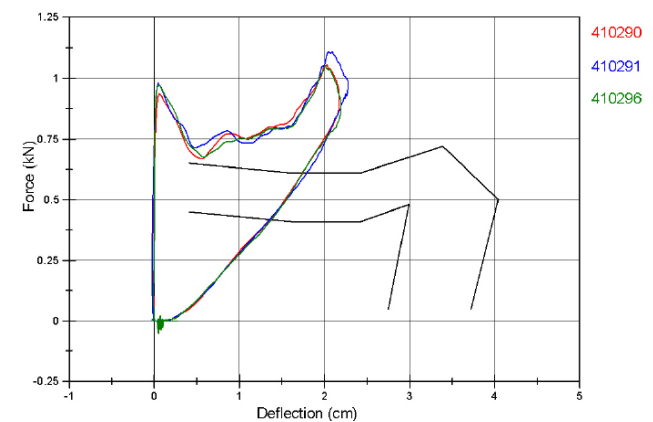
1) Shoulder



2) Thorax



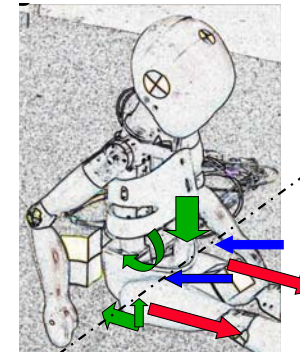
Q3 frontal thorax impactor test 4,3m/s



## Identification of the possible shortcomings



3) Abdomen



4) Lumbar



5) Pelvis-thighs junction



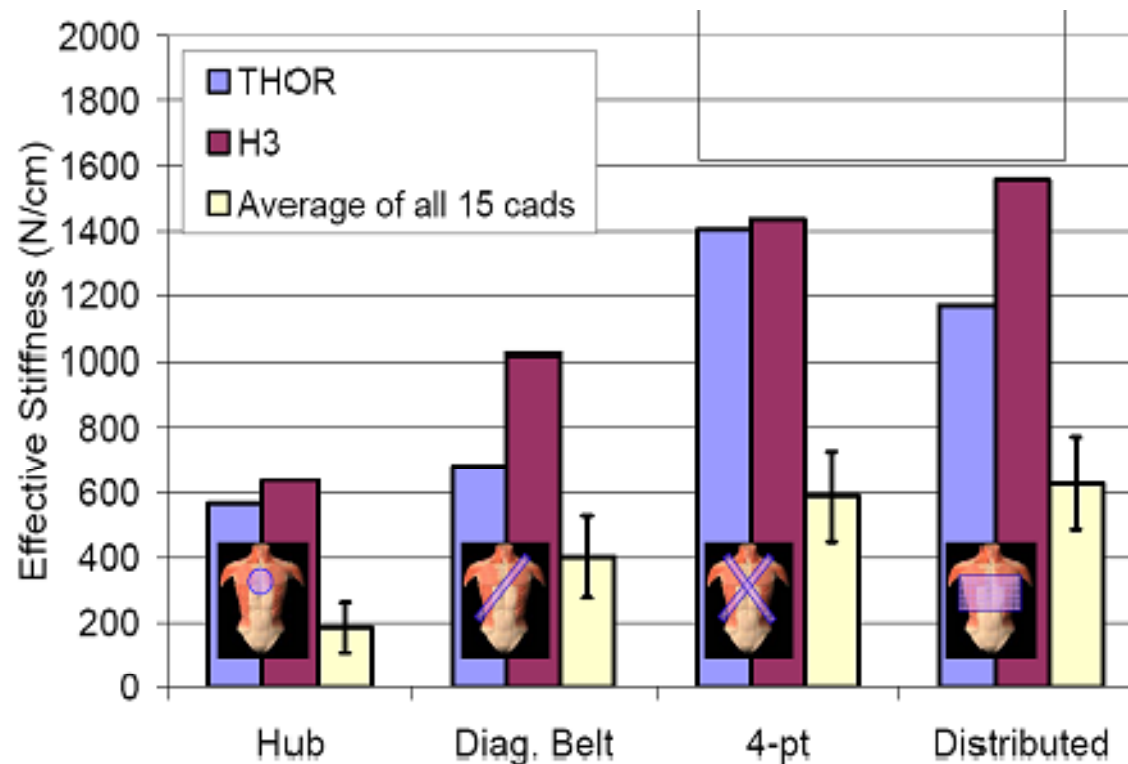
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## Discussions



### Example related to thorax stiffness:

Restraint type dependency of response PMHS and ATD's



**No info for  
child  
dummies!**

## Selected items

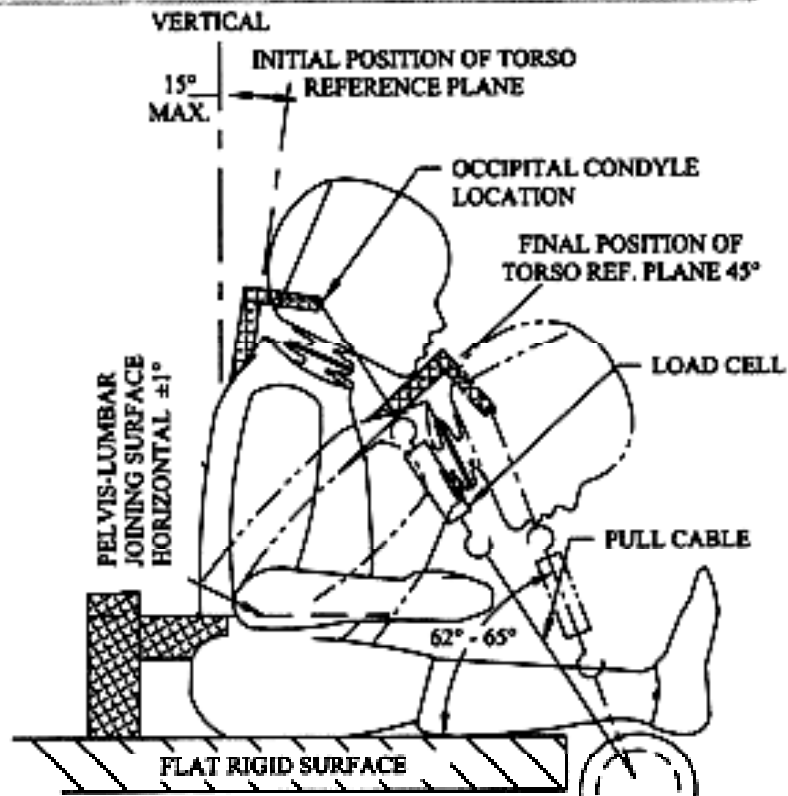


- Items for improvements discussed between INRETS, TU Berlin, FTSS.
  - Based on biomechanical info available, practical testing experience, etc.
- Selected topics based
  - 1) Lumbar stiffness
  - 2) Pelvis-thighs junction

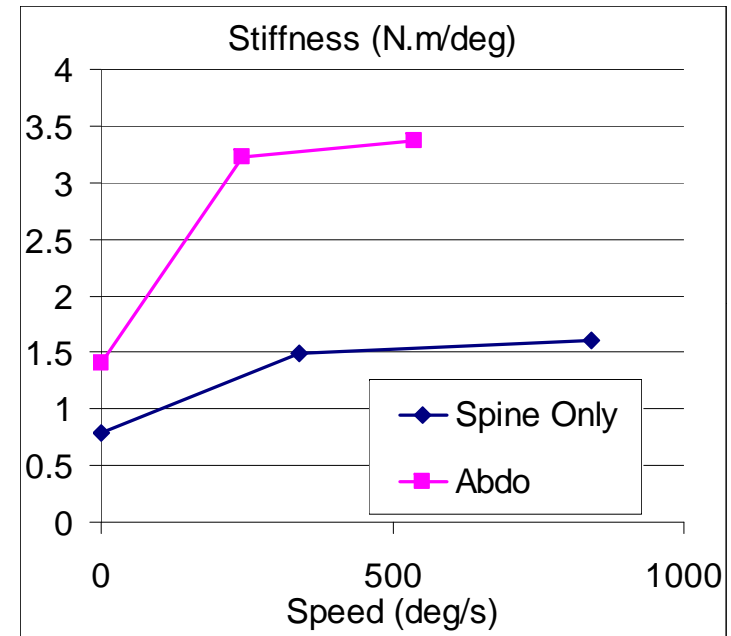
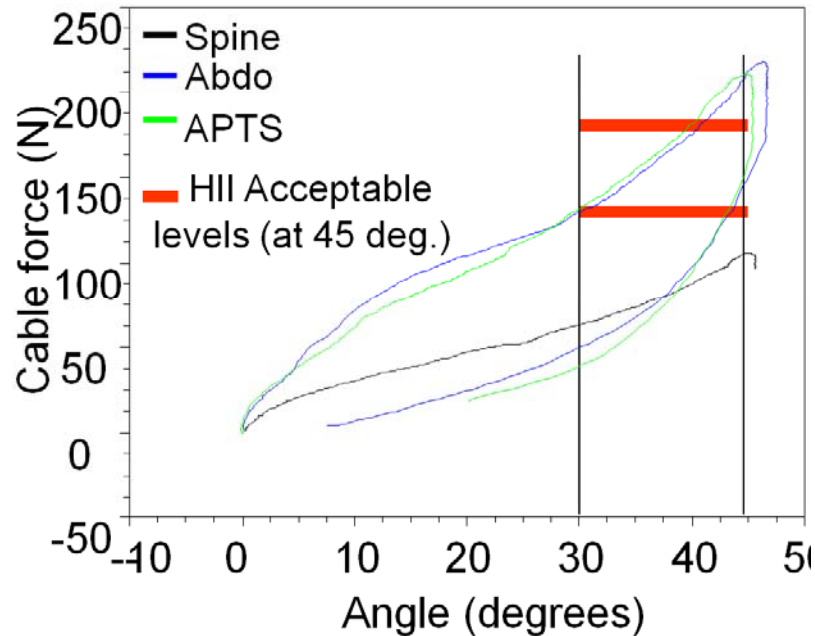
# Lumbar region stiffness in flexion



## TORSO FLEXION TEST SET-UP SPECIFICATION



## Lumbar region stiffness in flexion



- 1) Abdominal block accounts for ~50% of the region stiffness
- 2) Quasi-static stiffness similar to HII (despite setup differences)

→ In the absence of better biomechanical reference: no further action

## Gap at the pelvic-thigh junction



### Illustration of gap on the Q3



## Solution 1: Reinforced suit



Principle: patches held by Velcro on top of the gap



## Solution 2: (soft) silicone insert



Principle: insert filling the gap molded on the dummy



Plastiline model



Plaster mold



Molded inserts



3D scan for future replication

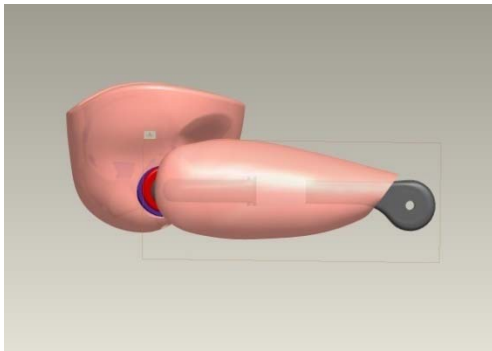
Material: Dow Corning Silastic 3481 (20 Shore A)



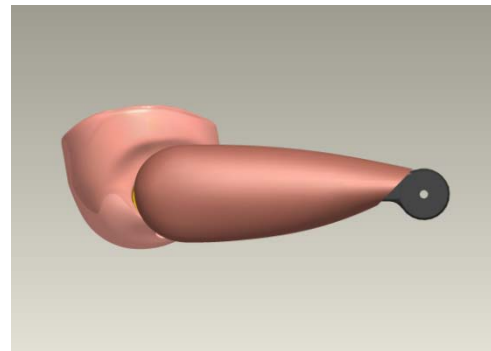
## Solution 3: Reduced gap Q10



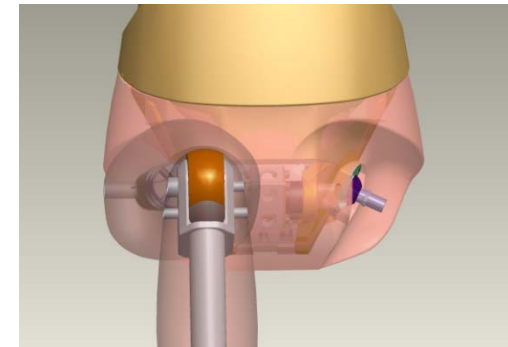
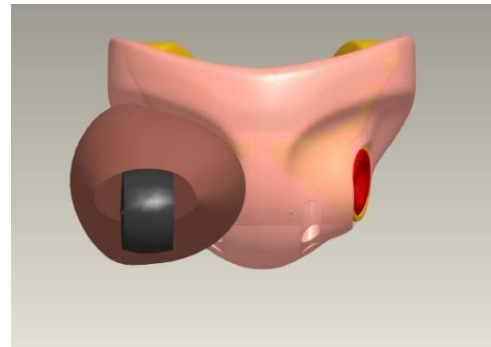
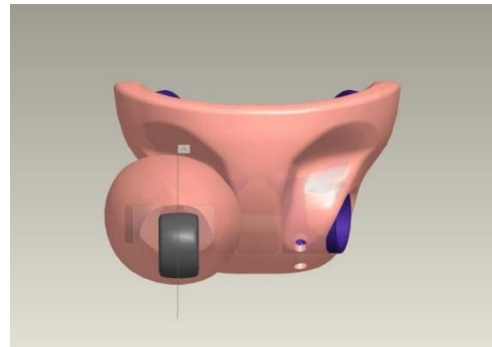
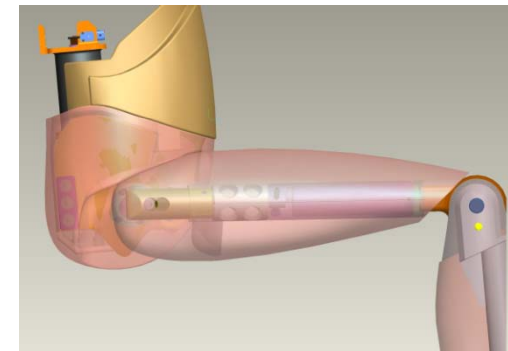
Q3



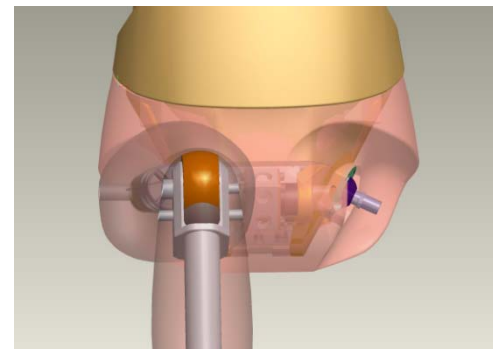
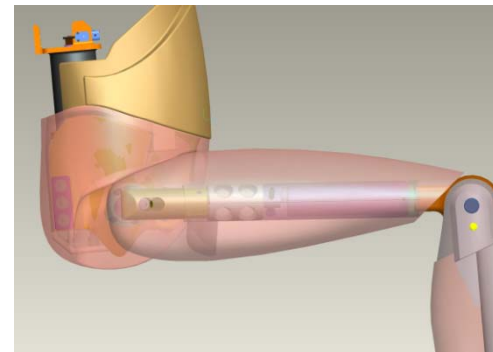
Q6



Q10



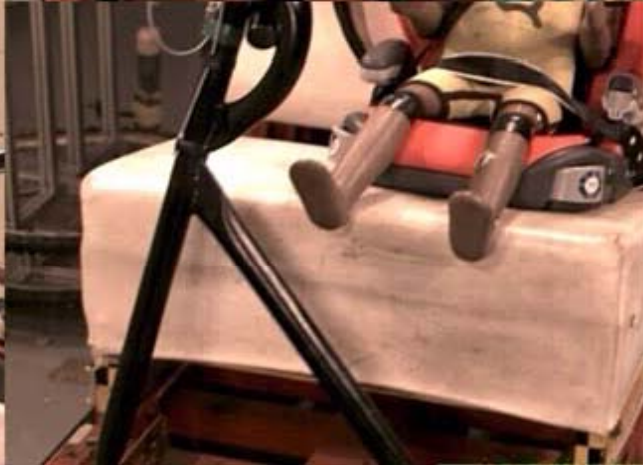
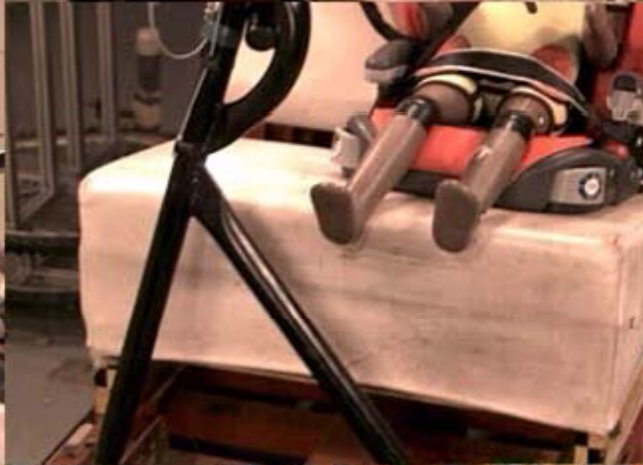
## Solution 4: Combinations



## Preliminary sled tests and analysis



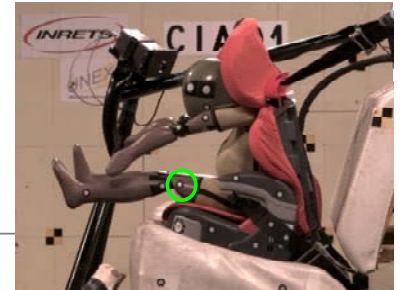
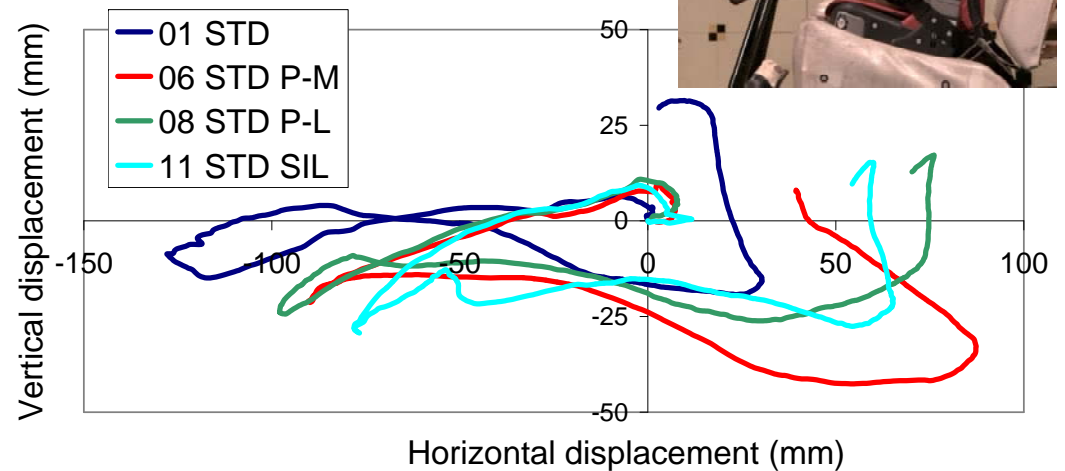
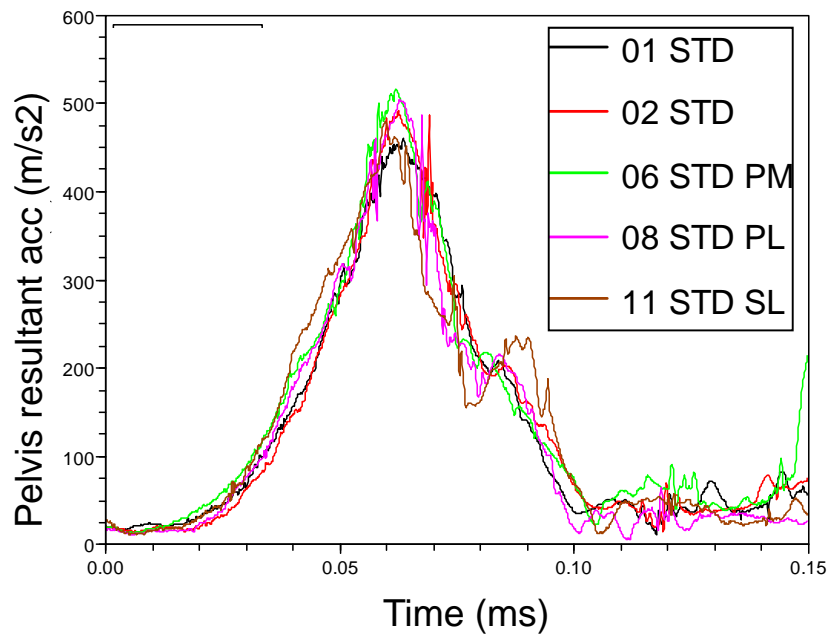
- So far 14 tests performed
- R44 like setup,
- Q3 with booster
- Dummy configuration:
  - Standard (without any auxiliary equipment)
  - With the thick pads (or medium)
  - With the silicon inserts
- Postures:
  - standard
  - Relaxed (pelvis forward)
  - Relaxed + misuse (incorrect belt path)
- Tests in configuration where submarining planned for 2011



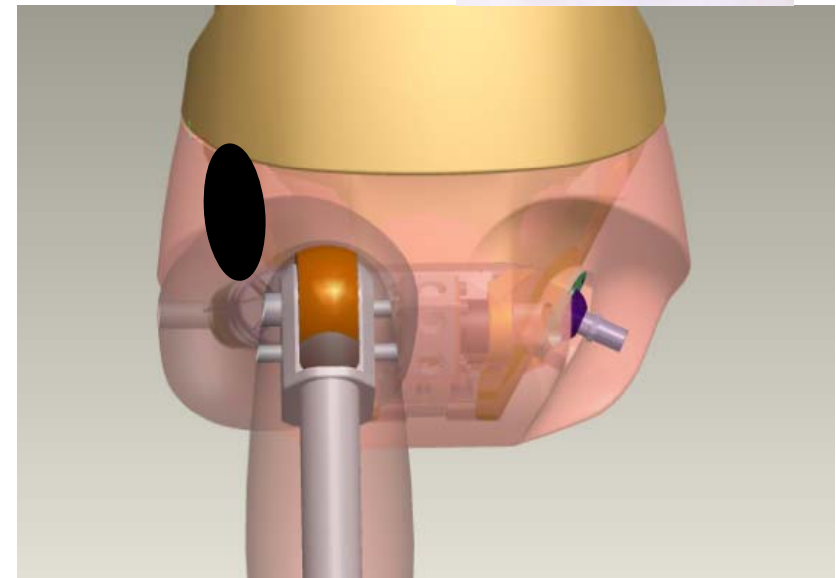
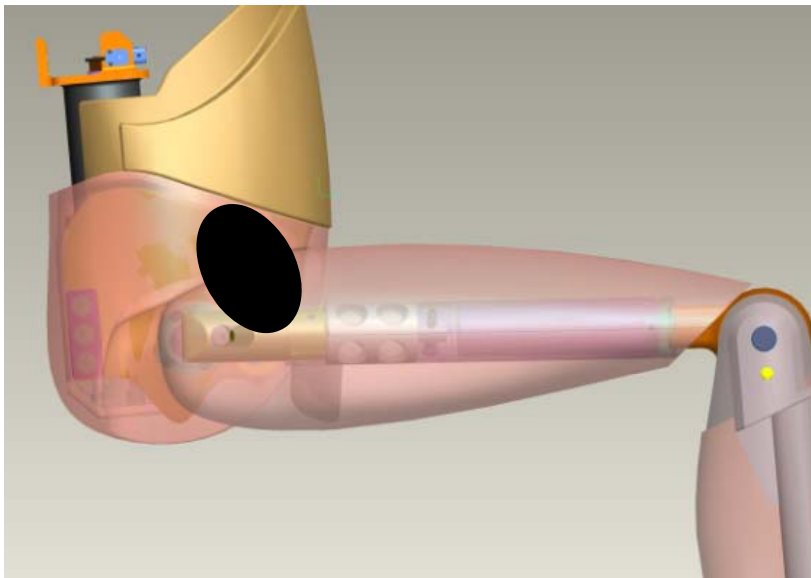
## Dummy output and kinematics



- Auxiliary equipment prevents belt penetration as can be seen from thigh trajectory
- Effects on other dummy outputs seem limited
  - Further analysis planned for 2011



# EPOCH: Patches will be applied for Q10



## Second series of tests



- 1) Evaluate the effects in different positions / misuse configuration
    - show the interest of the equipment = find posture where submarining does not occur because the lap belt gets locked.
    - Repeat with nothing, silicon, thick patch, medium patch (?)
  - 2) Use additional instrumentation
    - With and without APTS in standard and submarining configurations
    - Not needed in all tests because standard dummy preferred and tests will be repeated when new version of sensors available
  - 3) Perform a preliminary evaluation of the repeatability
    - Not in all configurations in order to reduce the number of tests
  - 4) Evaluate combined use of auxiliary equipment
    - Probably not needed since it seems to work as of now.
- Proposition: 1, 2 (and perhaps limited 3)
  - Other suggestions/propositions?

## Example test matrix: n=37



Test	Configuration	Auxiliary equipment	APTS	Repeats
1	Submarining	none	no	3
4	Submarining	medium patch	no	3
7	Submarining	silicone	no	3
10	Submarining	none	yes	3
13	Submarining	medium patch	yes	3
16	Submarining	silicone	yes	3
19	Standard	none	no	3
22	Standard	medium patch	no	3
25	Standard	silicone	no	3
28	Standard	none	yes	3
31	Standard	medium patch	yes	3
34	Standard	silicone	yes	3

## Conclusions and perspectives



- Stiffness of lumbar region was characterized
- Auxiliary equipment was developed. Seems to perform ok to prevent belt penetration in tested configurations
  - Overall kinematics preserved
  - But submarining condition not tested yet
- Further analysis could be performed to better evaluate the performance of the prototypes
  - Analysis of head kinematics
  - Perform some repeatability testing
  - Perform tests in a submarining condition

## Conclusions and perspectives



- All results will be included in a public CASPER deliverable D1.2 “Report associated with the deliverable D.1.2: Auxiliary equipment for Q3 and Q6 to improve belt interaction response”
- Expected to be available Q1 2011