

In vivo and in vitro assessment of joint kinematics

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Contents

- Joint kinematics
 - Segmental, not limb or body
 - In vivo & in vitro

- Electrogoniometry
- Optoelectronic tracking
- Kinematics and modelling

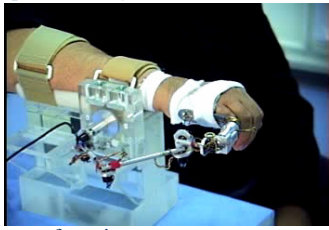


6-dof electrogoniometry



3D electrogoniometry

- Use of instrumented spatial linkages
 - Spine (CA-6000)
 - Wrist
 - Shoulder
 - (Knee)
- Principles
 - Kinematics analysis
 - Relative motion
 - Real 3D
- Various representations of motion
- Mobility and stability



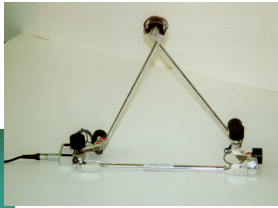
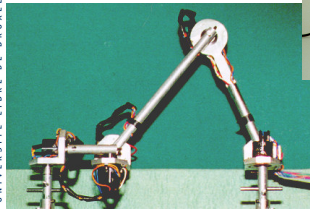
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3D electrogoniometry

Homemade ISL



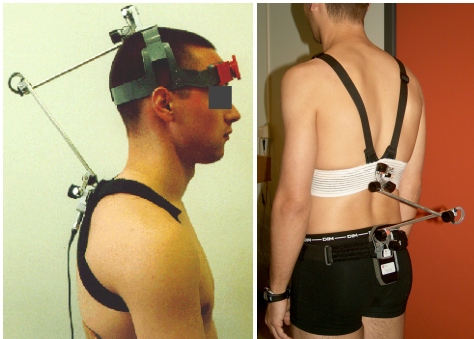
OSI CA 6000

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Spine kinematics



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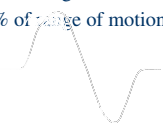

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Reliability and validity

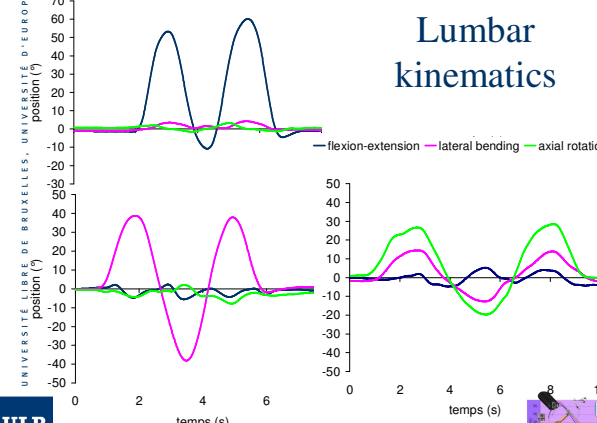
- OSI CA 6000
 - Accuracy: $< 2^\circ$
 - Precision: $< 1^\circ$
- Reliability (10 subjects, 2 observers, 2 repetitions)
 - Intra-variation: 4% of range of motion
 - Inter-variation: 3% of range of motion





Feipel et al 1999 LABORATOIRE D'ANATOMIE FONCTIONNELLE

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Lumbar kinematics

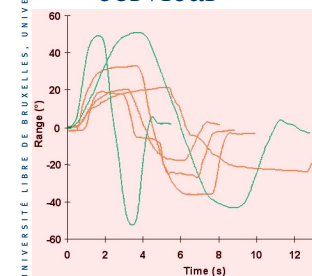


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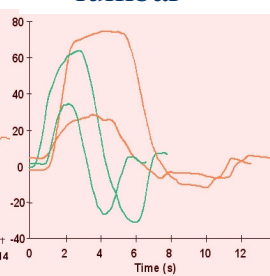
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
Motion patterns

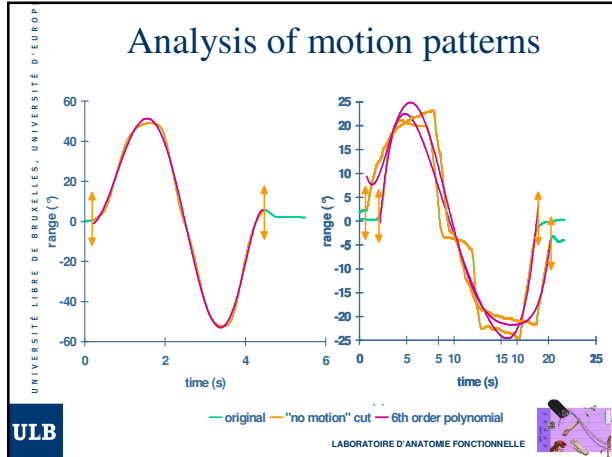
cervical

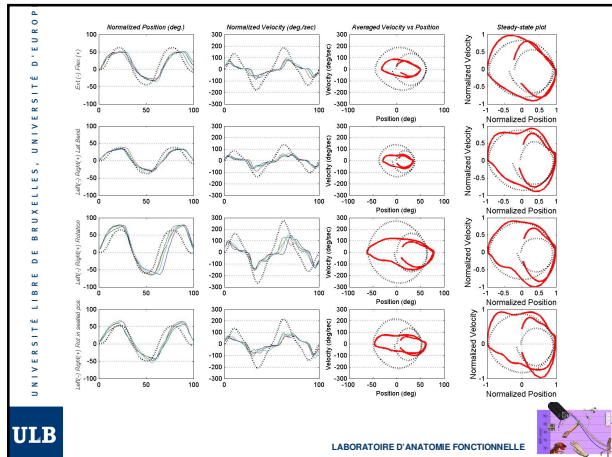


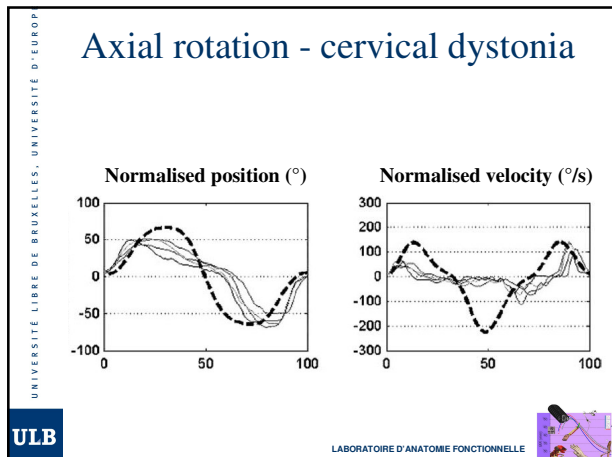
lumbar

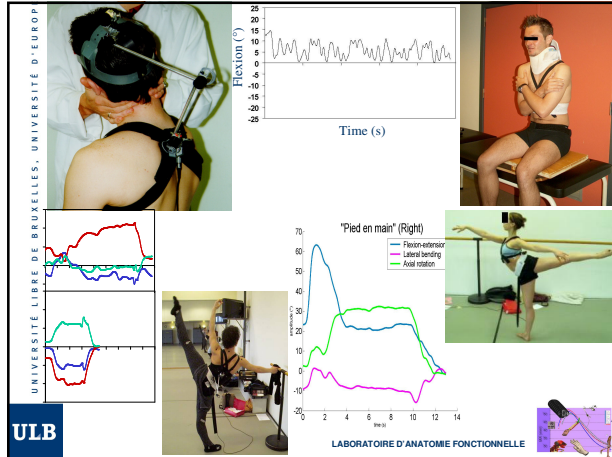


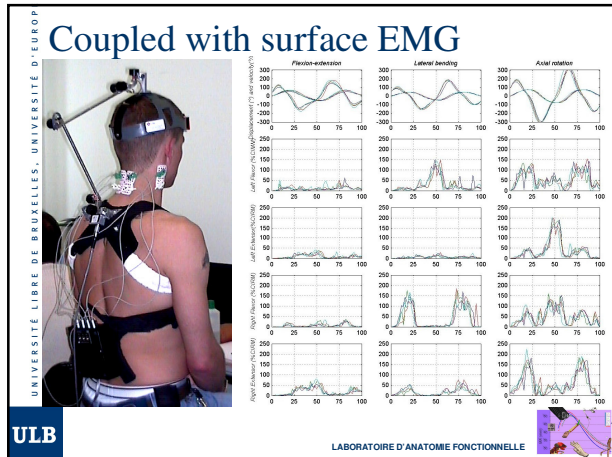
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- ### Samples (\pm)
- **Cervical**
 - 260 healthy volunteers
 - 14 – 70 years
 - 60 patients with DDD
 - 70 patients with WAD
 - 30 patients with dystonia
 - **Lumbar**
 - 130 healthy volunteers
 - 20 – 70 years
 - 70 patients with LBP
 - 50 with disc replacement
 - 50 patients with DDD
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Kinesthetic tests

Cervical	Lumbar
Neutral repositioning	Neutral repositioning
Simple and complex target posture repositioning	Simple and complex target posture repositioning
Cyclic repositioning	Balance in seated position
Complex motions	

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Neutral repositioning

- «neutral» position - ROM task - «neutral» position
- 4 repetitions
- Cervical: Eyes open and vision suppressed

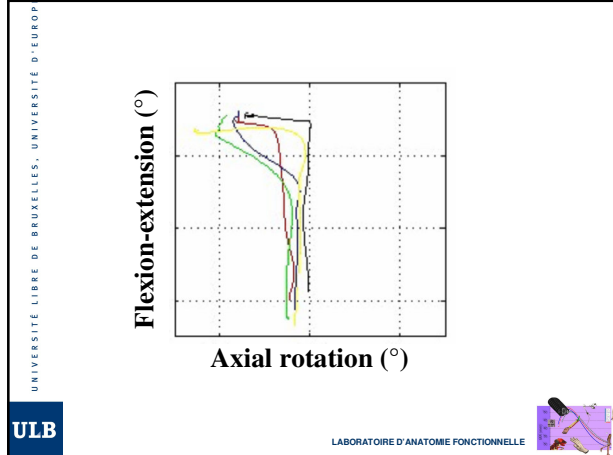
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Feipel et al 2003, 2006
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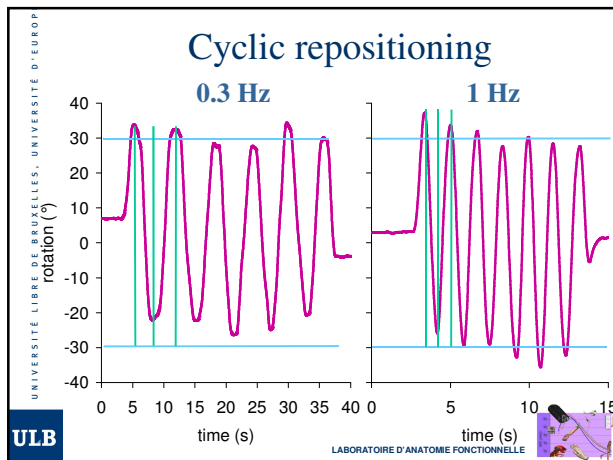
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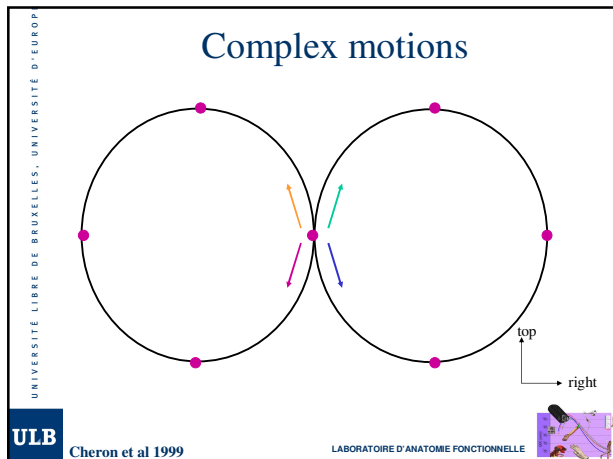
Target posture repositioning

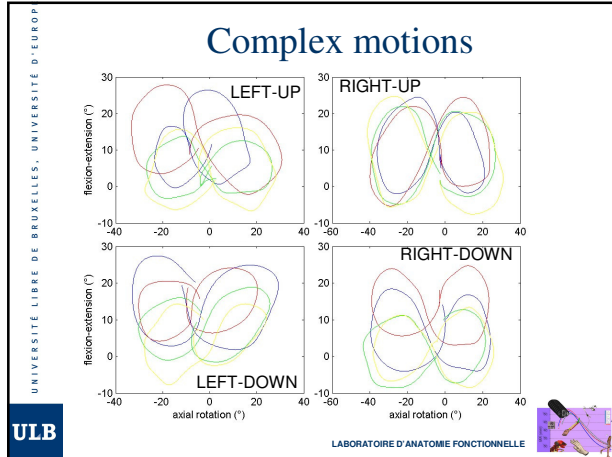
- 3 trials, no feed-back
- Verbal guiding to target position – memorisation – back to neutral - reproduction

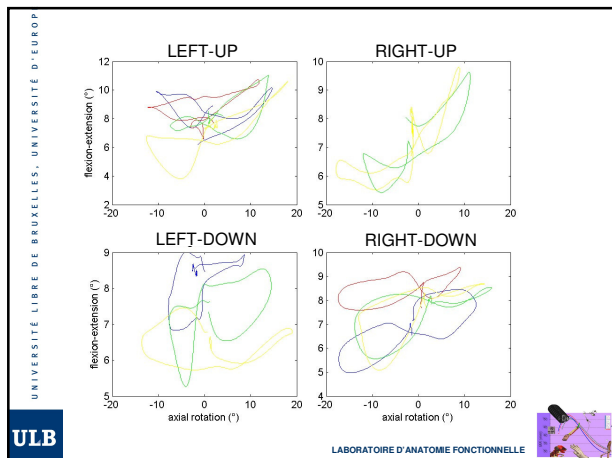
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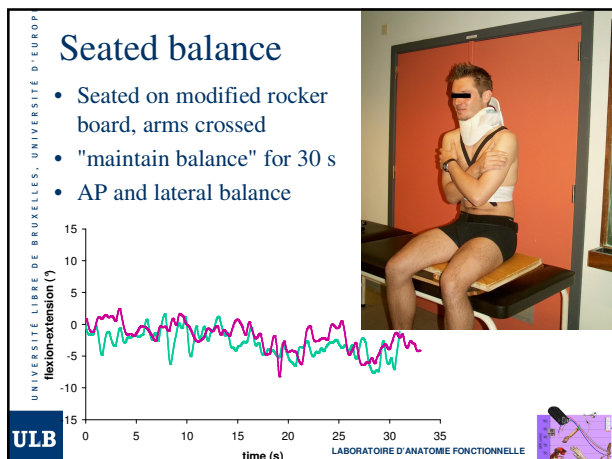






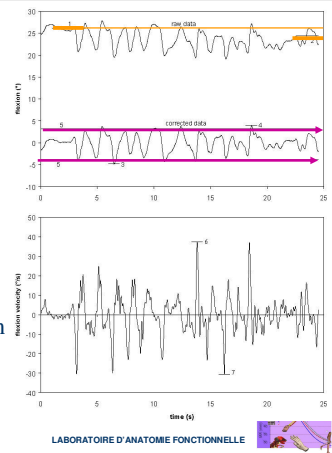




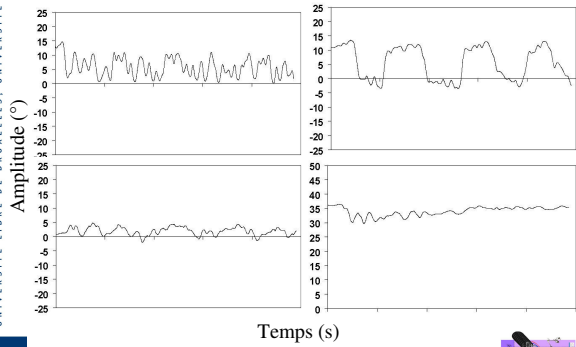


ANALYSIS

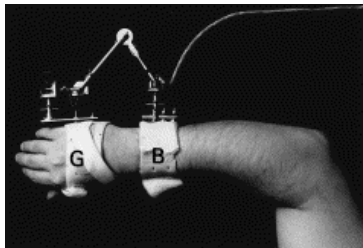
- Global drift
- Primary ROM
- Primary motion velocity
- Time "in balance"
- Frequency spectrum (MF)



Seated balance

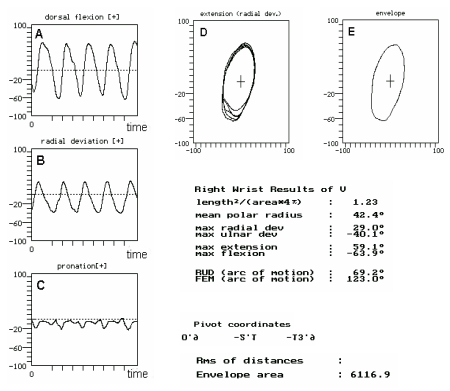


Homemade ISL



Accuracy: 1° and 1 mm
 Precision: 1° and 1 mm
 Reproducibility in vivo: 3° and 4 mm





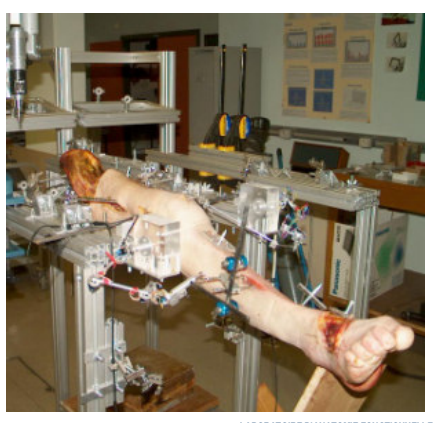
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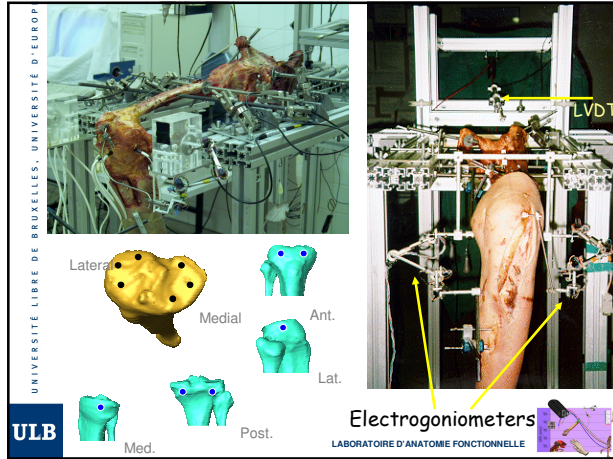
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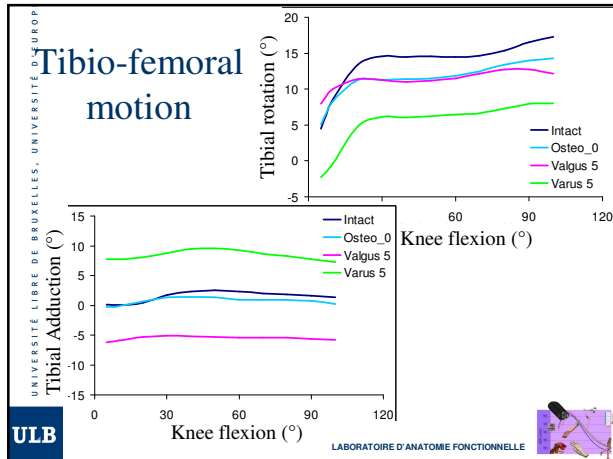


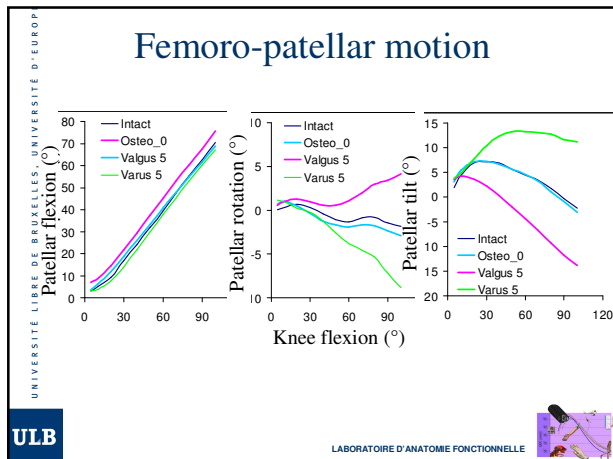


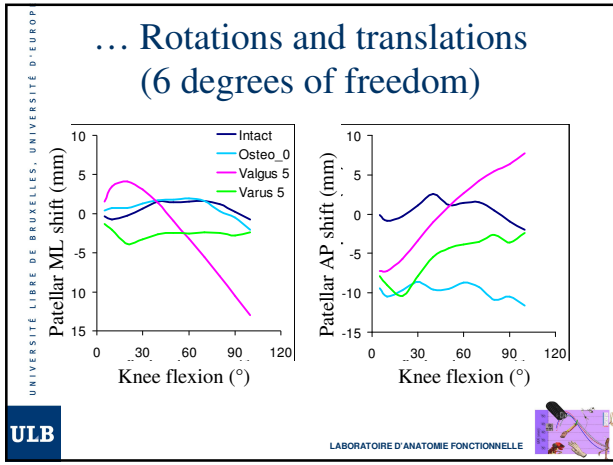
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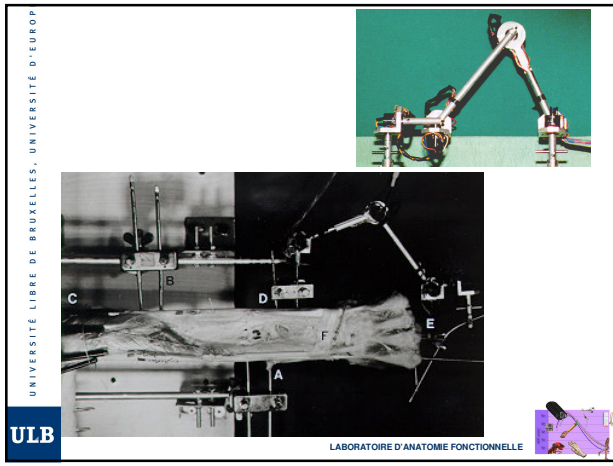












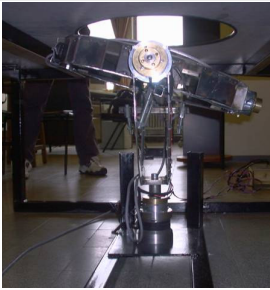
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3D kinematics platform

Ankle stabilisation

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Sobczak et al 2003

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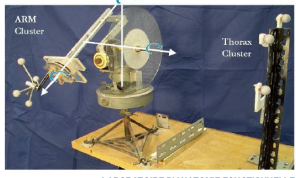


Optoelectronic tracking

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Salvia et al 2006

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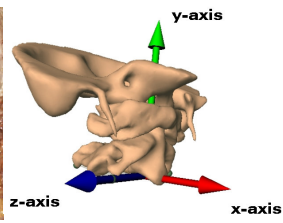
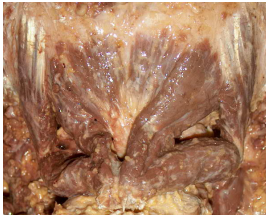
Kinematics and 3D modelling

In vitro



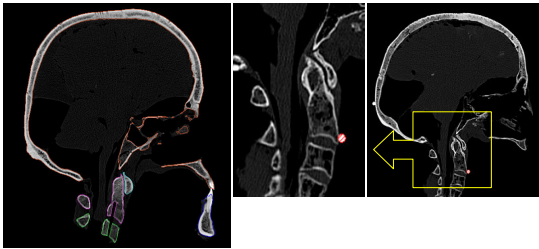
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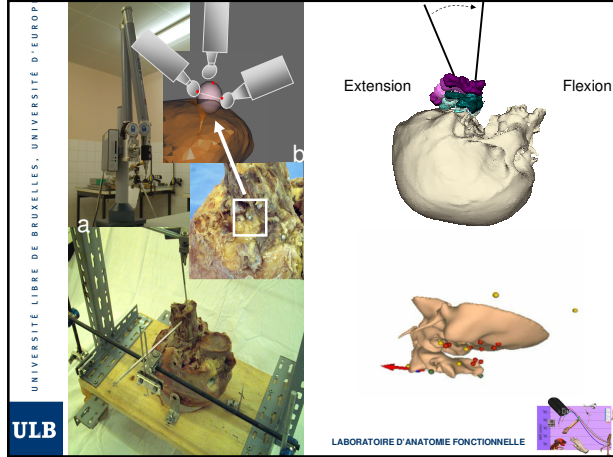
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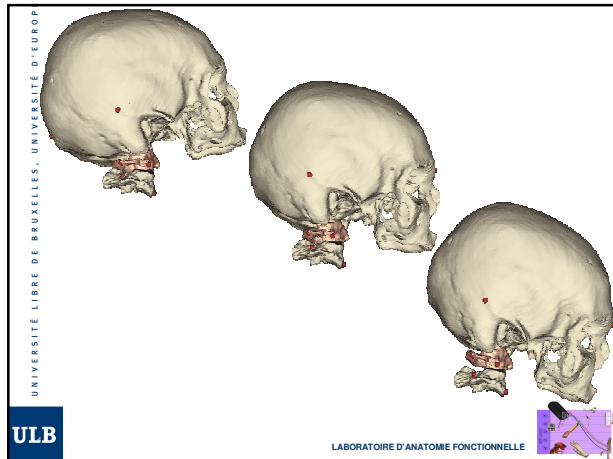


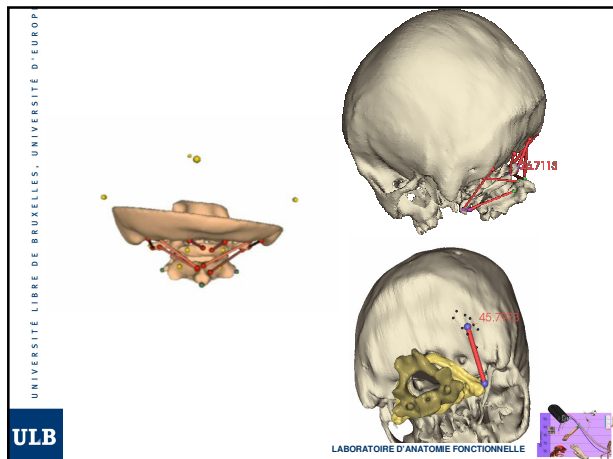


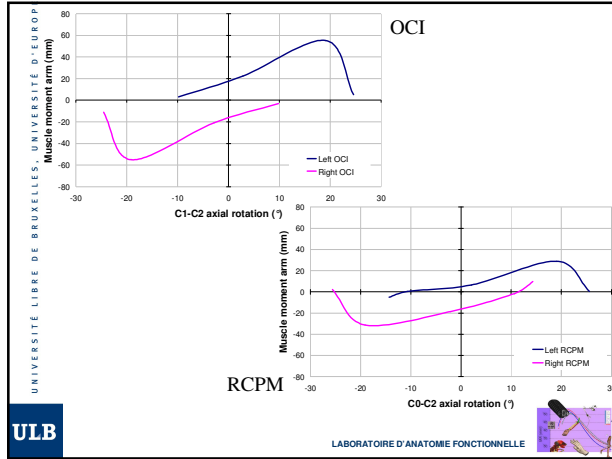
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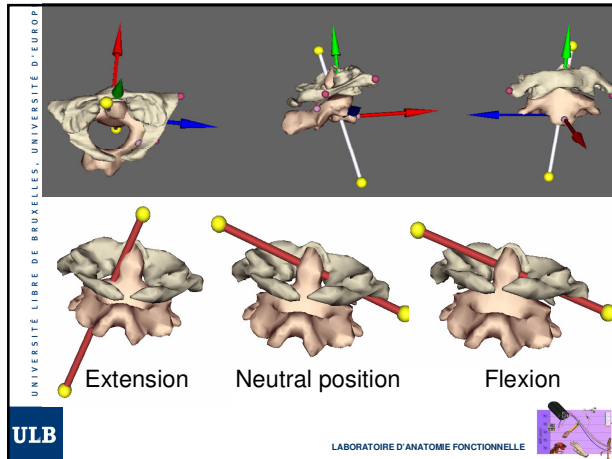


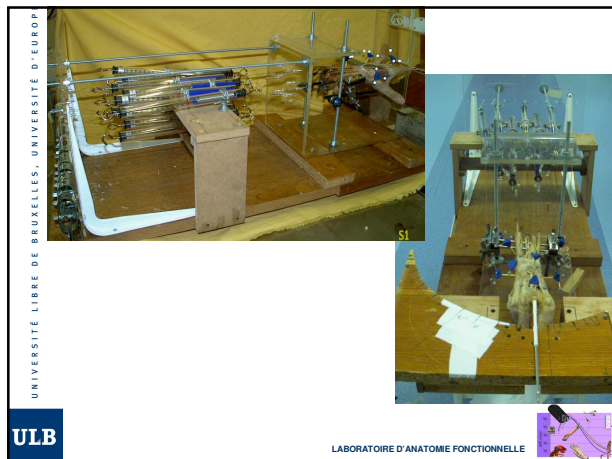


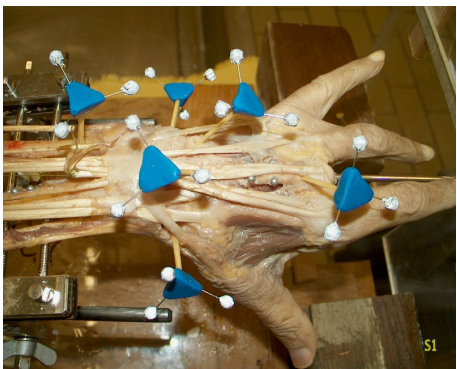


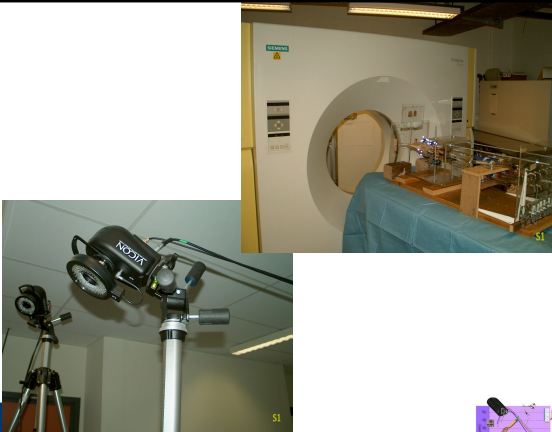


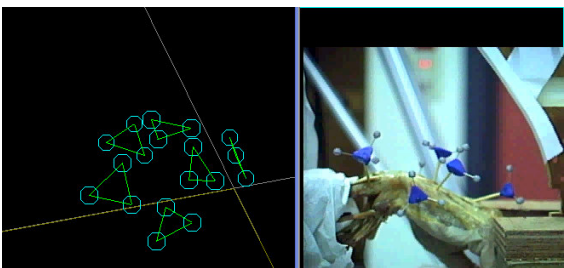


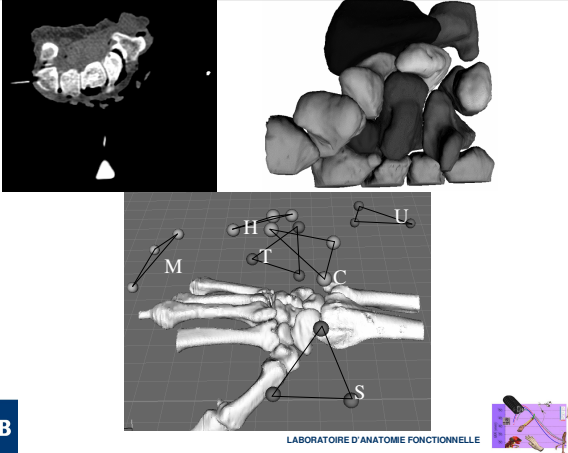






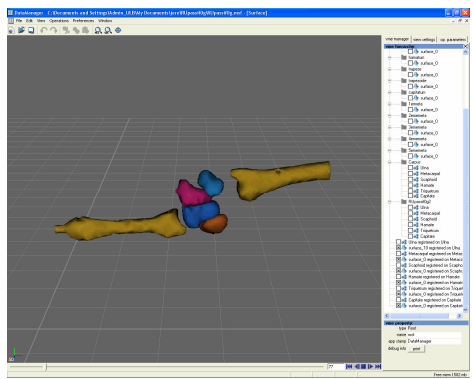






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Kinematics and 3D modelling

In vivo

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Visualisation of *in vivo* kinematics


Data sources

Morphological data




CT-Scan

Kinematical data




3-D electrogoniometry

Anatomical landmarks



3-D digitizer

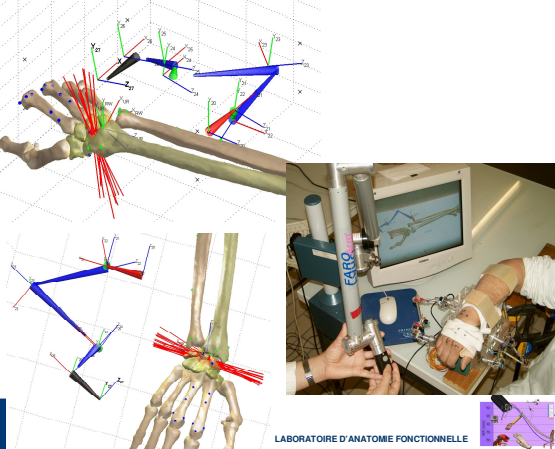


Registration

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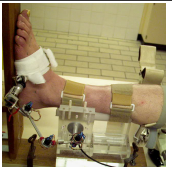
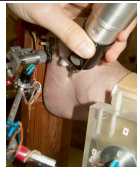

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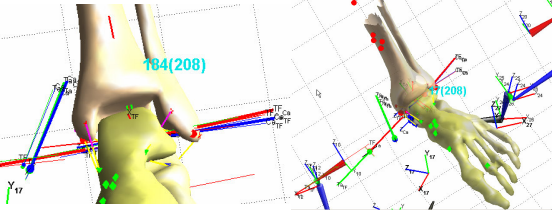


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