

## Practical session Marker placement + electrodes



## Guidelines

- A variety of gait models
  - Newington
  - Helen Hayes
  - Vicon Clinical Manager & Plug In Gait
  - Davis
  - Kadaba
  - Gage
- Conventional gait model (R. Baker): 'a remarkable consensus in clinical gait labs around the world' (instructions on CD-rom, <http://www.rch.org.au/gait>)
- EMG guidelines => SENIAM (European Recommendations for Surface Electromyography)

## Overview

- Anatomical landmarks
- Antropometric measures
- EMG electrodes
- Marker placement
- Static and dynamic trial
- Consequences of marker misplacement

### Lower limb gait model

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## Anatomical landmarks

- SISA
- Lateral and medial femoral epicondyles
- Lateral and medial malleoli
- SIPS

## Antropometric measures

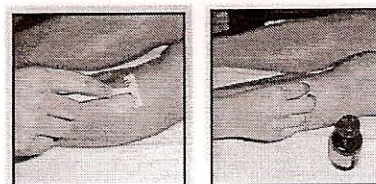
- For segmental inertia parameters
- For localisation of joint centres

Mass (kg)		
Height (m)		
Inter SISA distance		
	LEFT	RIGHT
Leg length (m)		
Bicondylar distance		
Bimalleor distance		

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## Skin preparation



Improve electrode-skin contact => reduce noise  
(Shaving and cleaning)

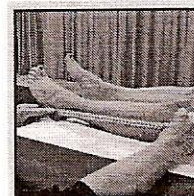
## Electrode placement and fixation of sensor



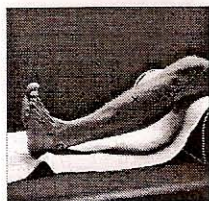
- Electrode selection:
  - Shape: circular/rectangular
  - Size: 10 mm
- Electrode distance: centre to centre distance
  - Large muscle: 20 mm
  - Small muscles:  $\frac{1}{4}$  of fibre length
- Electrode orientation: Line between two electrodes with respect to the direction of the muscle fibres
- Reference electrodes on electrically inactive tissue

## Sensor locations

- Position of the centre of two electrodes in a bipolar arrangement on the muscle
- To obtain a good and stable SEMG
- Guidelines take into account:
  - Presence of motor endplates
  - Between endplate and tendon (if possible)
  - Muscle tendons
  - Other muscles (cross talk)



## Tibialis anterior



M. Tibialis Anterior  
at 1/3 on the line between the tip of fibula and the tip of the medial malleolus

Testcontraction:  
apply resisted pressure and ask for dorsiflexion and inversion

## Gastrocnemius

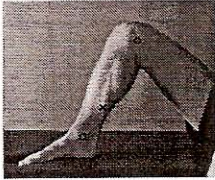


M. Gastrocnemius Lat.

at 1/3 of the line between the tip of the head of the fibula and the heel

Testcontraction:  
ask plantar flexion of the foot (heel rise) under resistance

## Soleus

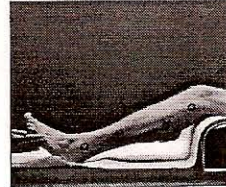


M. Soleus  
at 2/3 on the line between the tip of  
medial femoral condyle and the tip of  
the medial malleolus

Testcontraction:  
manually push the (flexed) knee  
downwards and ask to lift the heel up

Palpation!

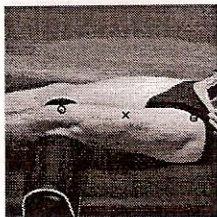
## Peroneus longus



M. Peroneus Longus  
at 1/4 on the line between the tip  
of fibula and the tip of the lateral  
malleolus

Testcontraction:  
apply resisted pressure and ask  
for eversion

## Rectus femoris

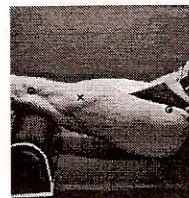


M. Rectus Femoris  
at 1/2 of the line of the ASIS and  
superior edge of the patella

Testcontraction:  
apply resisted pressure at the  
ankle and ask for knee extension  
(avoid thigh rotation)

Palpation!

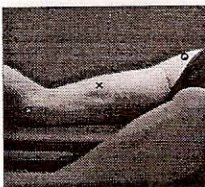
## Vastus lateralis



M. Vastus Lateralis  
at 2/3 of the line of the ASIS and  
the lateral side of the patella

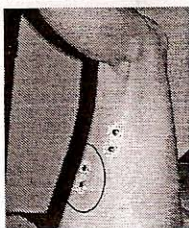
Testcontraction:  
apply resisted pressure at the ankle  
and ask for knee extension (avoid  
thigh rotation)

## Medial hamstrings

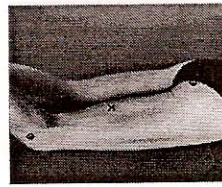


M. Semitendinosus  
at 1/2 of the line of the ischial  
tuberosity and the lateral epicondyle of  
the tibia

Testcontraction:  
apply resisted pressure at the ankle  
and ask for knee flexion

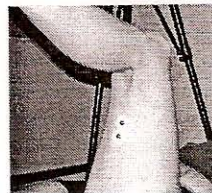


## Lateral hamstrings



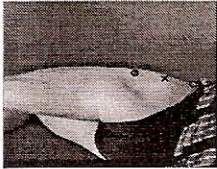
M. Biceps Femoris  
at 1/2 of the line of the ischial  
tuberosity and the lateral  
epicondyle of the tibia

Testcontraction:  
apply resisted pressure at the  
ankle and ask for knee flexion





## Gluteus medius



M. Gluteus Medius  
at 1/2 of the line of the iliac crest  
and the great trochanter

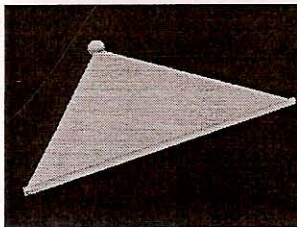
Test contraction:  
Side lying: hip abduction against  
resistance at the ankle

Or in stance

## Overview

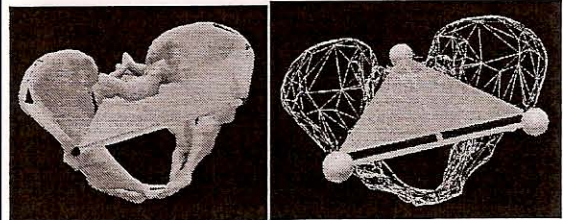
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## Anatomical definition of 7 segments



The basic principle  
underlying the  
Conventional Gait  
Model is that we can  
define a line and a  
point, and hence a  
triangle, for each of the  
seven anatomical  
segments.

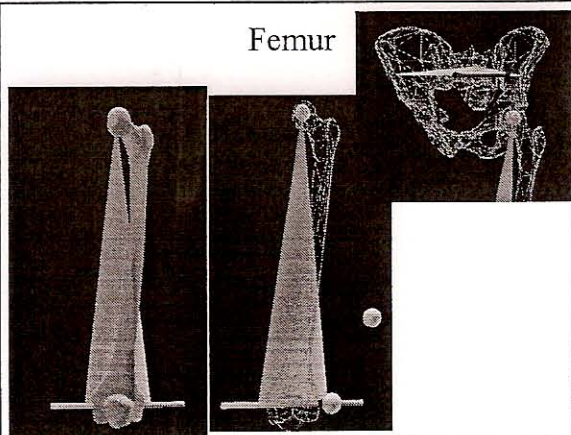
## Pelvis



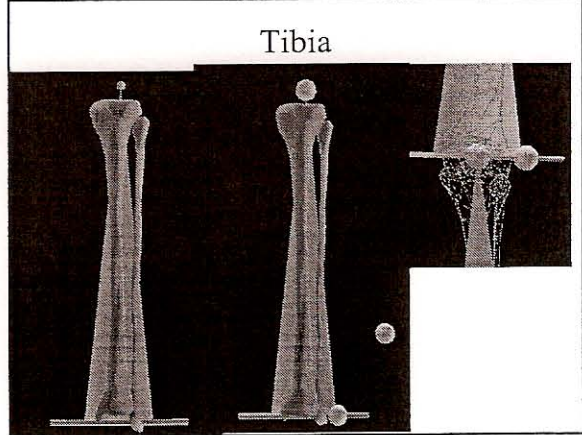
Two markers need to be placed over each of the anterior superior iliac spines. A single marker is placed over the mid-point of the posterior spines.

The sacral marker only defines the plane of the pelvis. The midline of the pelvis is defined as being halfway between the ASIS markers and perpendicular to the line joining them regardless of the position of the sacral marker

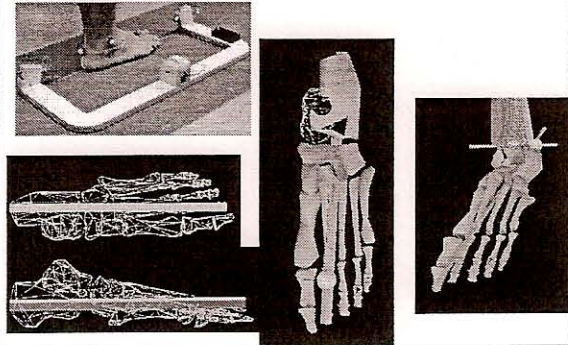
## Femur



## Tibia



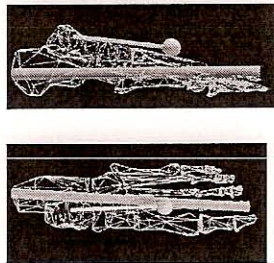
## Foot



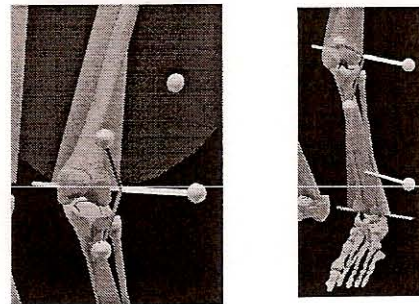
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## Foot – static calibration



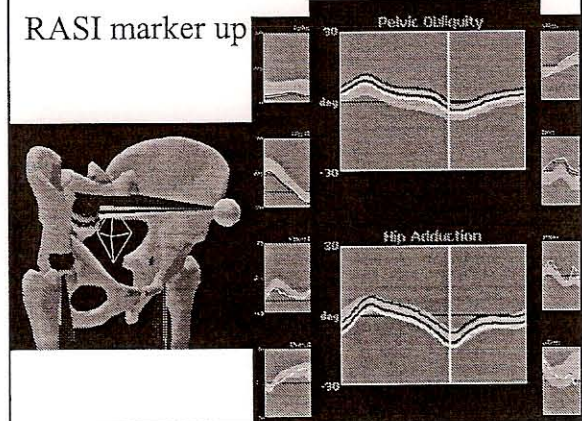
## Static trial: KAD



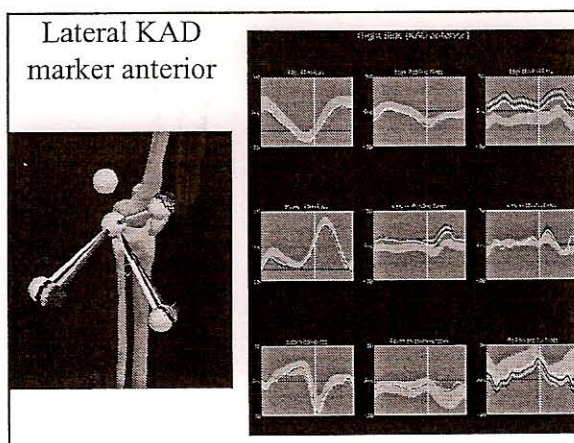
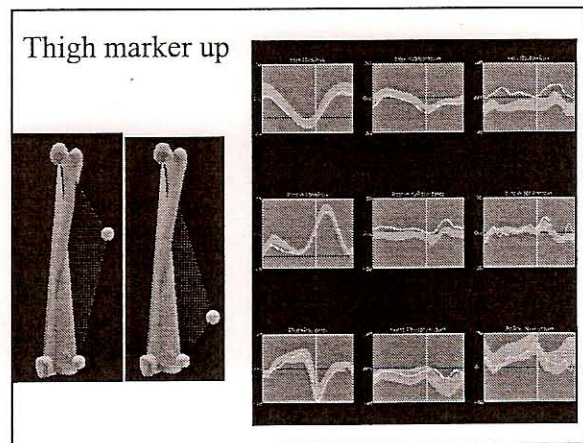
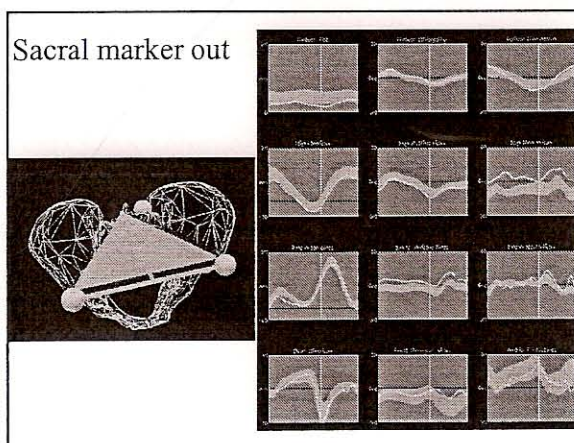
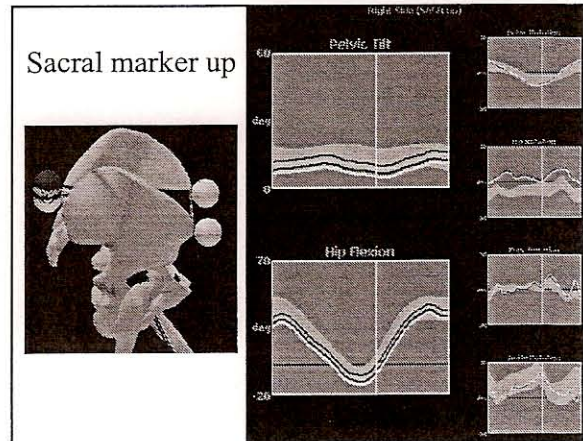
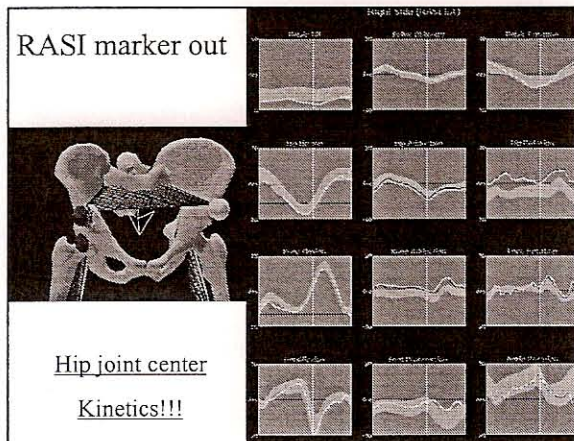
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## RASI marker up







Questions?