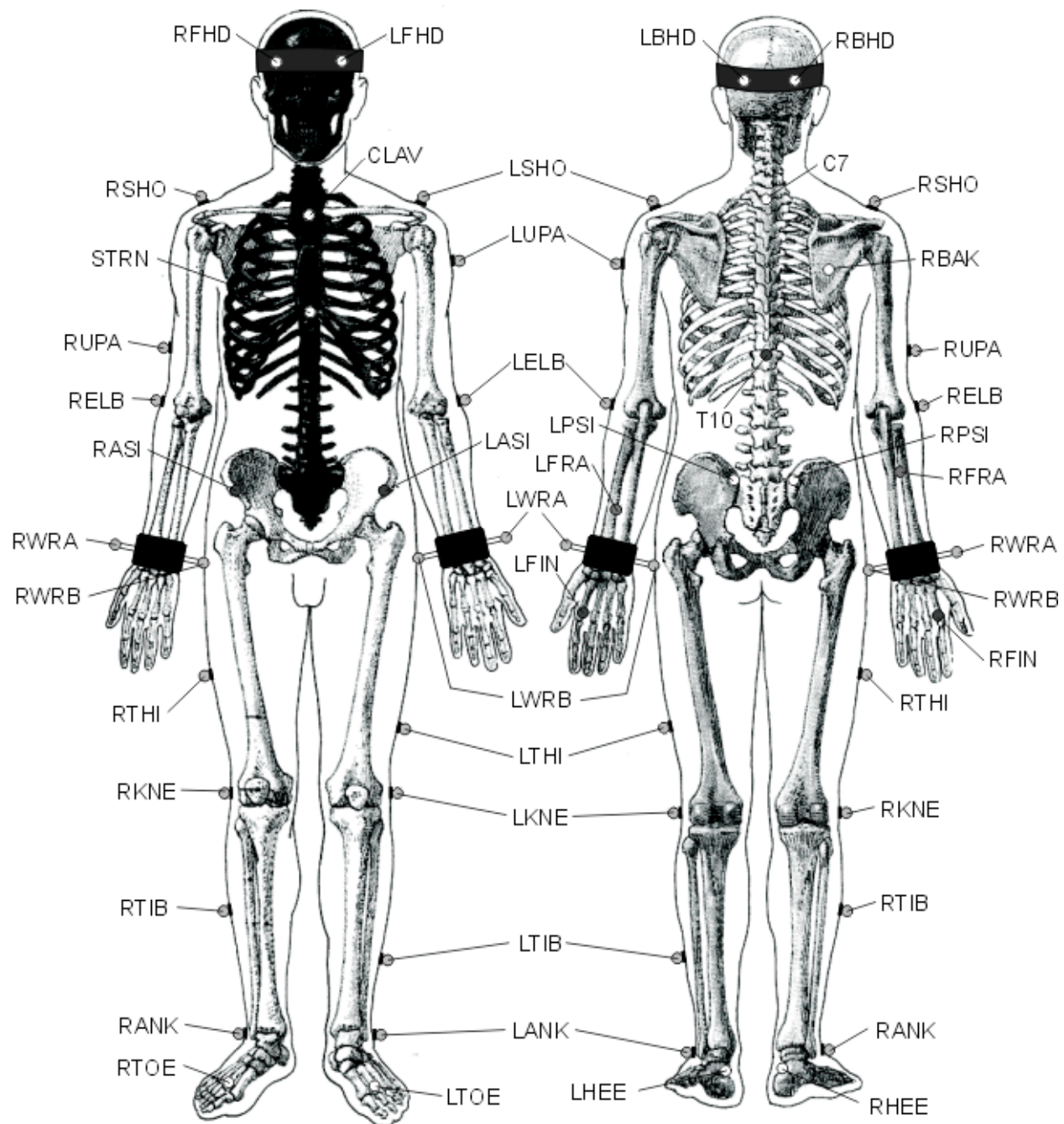


# Plug-in-Gait Marker Placement



The following describes in detail where the Plug-in-Gait markers should be placed on the subject. Where left side markers only are listed, the positioning is identical for the right side.

## Upper Body

### ***Head Markers***

|      |                  |                                                                                         |
|------|------------------|-----------------------------------------------------------------------------------------|
| LFHD | Left front head  | Located approximately over the left temple                                              |
| RFHD | Right front head | Located approximately over the right temple                                             |
| LBHD | Left back head   | Placed on the back of the head, roughly in a horizontal plane of the front head markers |
| RBHD | Right back head  | Placed on the back of the head, roughly in a horizontal plane of the front head markers |

The markers over the temples define the origin, and the scale of the head. The rear markers define its orientation. If they cannot be placed level with the front markers, and the head is level in the static trial, tick the "Head Level" check box under options on "Run static model" in the pipeline when processing the static trial. Many users buy a headband and permanently attach markers to it.

### ***Torso Markers***

|      |                                     |                                                                                                                                                                                             |
|------|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| C7   | 7 <sup>th</sup> Cervical Vertebrae  | Spinous process of the 7th cervical vertebrae                                                                                                                                               |
| T10  | 10 <sup>th</sup> Thoracic Vertebrae | Spinous Process of the 10th thoracic vertebrae                                                                                                                                              |
| CLAV | Clavicle                            | Jugular Notch where the clavicles meet the sternum                                                                                                                                          |
| STRN | Sternum                             | Xiphoid process of the Sternum                                                                                                                                                              |
| RBAK | Right Back                          | Placed in the middle of the right scapula. This marker has no symmetrical marker on the left side. This asymmetry helps the auto-labeling routine determine right from left on the subject. |

C7, T10, CLAV, STRN define a plane hence their lateral positioning is most important.

### ***Arm Markers***

|      |                       |                                                                                                           |
|------|-----------------------|-----------------------------------------------------------------------------------------------------------|
| LSHO | Left shoulder marker  | Placed on the Acromio-clavicular joint                                                                    |
| LUPA | Left upper arm marker | Placed on the upper arm between the elbow and shoulder markers. Should be placed asymmetrically with RUPA |
| LELB | Left elbow            | Placed on lateral epicondyle approximating elbow joint axis                                               |
| LFRA | Left forearm marker   | Placed on the lower arm between the wrist and elbow markers. Should be placed asymmetrically with RFRA    |
| LWRA | Left wrist marker A   | Left wrist bar thumb side                                                                                 |
| LWRB | Left wrist marker B   | Left wrist bar pinkie side                                                                                |

The wrist markers are placed at the ends of a bar attached symmetrically with a wristband on the posterior of the wrist, as close to the wrist joint center as possible.

|      |              |                                                                                        |
|------|--------------|----------------------------------------------------------------------------------------|
| LFIN | Left fingers | Actually placed on the dorsum of the hand just below the head of the second metacarpal |
|------|--------------|----------------------------------------------------------------------------------------|

## Lower Body

### ***Pelvis***

|      |            |                                                              |
|------|------------|--------------------------------------------------------------|
| LASI | Left ASIS  | Placed directly over the left anterior superior iliac spine  |
| RASI | Right ASIS | Placed directly over the right anterior superior iliac spine |

The above markers may need to be placed medially to the ASIS to get the marker to the correct position due to the curvature of the abdomen. In some patients, especially those who are obese, the markers either can't be placed exactly anterior to the ASIS, or are invisible in this position to cameras. In these cases, move each marker laterally by an equal amount, along the ASIS-ASIS axis. The true inter-ASIS Distance must then be recorded and entered on the subject parameters form. These markers, together with the sacral marker or LPSI and RPSI markers, define the pelvic axes.

|      |            |                                                               |
|------|------------|---------------------------------------------------------------|
| LPSI | Left PSIS  | Placed directly over the left posterior superior iliac spine  |
| RPSI | Right PSIS | Placed directly over the right posterior superior iliac spine |

LPSI and RPSI markers are placed on the slight bony prominences that can be felt immediately below the dimples (sacro-iliac joints), at the point where the spine joins the pelvis.

|      |                    |                                                                                                                 |
|------|--------------------|-----------------------------------------------------------------------------------------------------------------|
| SACR | Sacral wand marker | Placed on the skin mid-way between the posterior superior iliac spines (PSIS). An alternative to LPSI and RPSI. |
|------|--------------------|-----------------------------------------------------------------------------------------------------------------|

**SACR may be used as an alternative to the LPSI and RPSI** markers to overcome the problem of losing visibility of the sacral marker (if this occurs), the standard marker kit contains a base plate and selection of short "sticks" or "wands" to allow the marker to be extended away from the body, if necessary. In this case it must be positioned to lie in the plane formed by the ASIS and PSIS points.

### ***Leg Markers***

|      |           |                                                   |
|------|-----------|---------------------------------------------------|
| LKNE | Left knee | Placed on the lateral epicondyle of the left knee |
|------|-----------|---------------------------------------------------|

To locate the "precise" point for the knee marker placement, passively flex and extend the knee a little while watching the skin surface on the lateral aspect of the knee joint. Identify where knee joint axis passes through the lateral side of the knee by finding the lateral skin surface that comes closest to remaining fixed in the thigh. This landmark should also be the point about which the lower leg appears to rotate. Mark this point with a pen. With an adult patient standing, this pen

mark should be about 1.5 cm above the joint line, mid-way between the front and back of the joint. Attach the marker at this point.

|      |            |                                                                                                                                          |
|------|------------|------------------------------------------------------------------------------------------------------------------------------------------|
| LTHI | Left thigh | Place the marker over the lower lateral 1/3 surface of the thigh, just below the swing of the hand, although the height is not critical. |
|------|------------|------------------------------------------------------------------------------------------------------------------------------------------|

The thigh markers are used to calculate the knee flexion axis location and orientation. Place the marker over the lower lateral 1/3 surface of the thigh, just below the swing of the hand, although the height is not critical. The antero-posterior placement of the marker is critical for correct alignment of the knee flexion axis. Try to keep the thigh marker off the belly of the muscle, but place the thigh marker at least two marker diameters proximal of the knee marker. Adjust the position of the marker so that it is aligned in the plane that contains the hip and knee joint centers and the knee flexion/extension axis. There is also another method that uses a mirror to align this marker, allowing the operator to better judge the positioning.

|      |                         |                                                                                                                                     |
|------|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| LANK | Left ankle              | Placed on the lateral malleolus along an imaginary line that passes through the transmalleolar axis                                 |
| LTIB | Left tibial wand marker | Similar to the thigh markers, these are placed over the lower 1/3 of the shank to determine the alignment of the ankle flexion axis |

The tibial marker should lie in the plane that contains the knee and ankle joint centers and the ankle flexion/extension axis. In a normal subject the ankle joint axis, between the medial and lateral malleoli, is externally rotated by between 5 and 15 degrees with respect to the knee flexion axis. The placements of the shank markers should reflect this.

### ***Foot Markers***

|      |           |                                                                                                                  |
|------|-----------|------------------------------------------------------------------------------------------------------------------|
| LTOE | Left toe  | Placed over the second metatarsal head, on the mid-foot side of the equinus break between fore-foot and mid-foot |
| LHEE | Left heel | Placed on the calcaneus at the same height above the plantar surface of the foot as the toe marker               |