Anthropometric Measurements

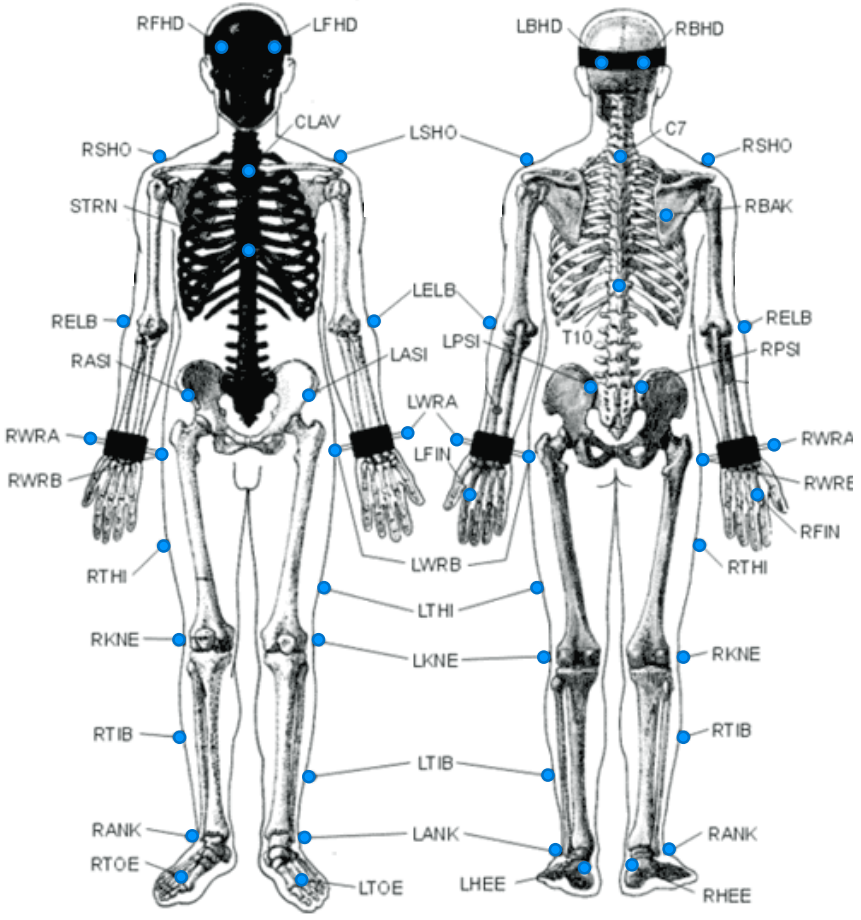
Metric measurements are in millimeter (mm)

- Global measurements
  - **Height** (mm)
  - **Weight** (kg)

- Measurements on Arms
  - **Shoulder Offset:** vertical distance from the center of the glenohumeral joint to the marker on the acromion clavicular joint (RSHO & LSHO)
    - some have used the (anterior/posterior girth)/2 to establish a guideline for the parameter
  - **Elbow Width:** distance between the medial and lateral epicondyles of the humerus
  - **Wrist Width:** distance between the ulnar and radial styloids
  - **Hand Thickness:** distance between the dorsal and palmar surfaces of the hand.

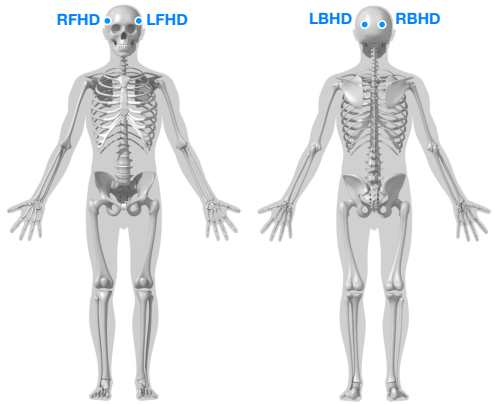
- Measurements on Legs
  - **Leg length:** distance between ASIS to medial malleolus
    - measure of the true skeletal leg length, i.e. sum of distances from ASIS to knee and from knee to malleolus
  - **Inter-ASIS** (Optional): distance between the two ASIS,
    - needed when markers cannot be placed directly on the ASIS (e.g. in obese patients)
  - **Knee width:** distance between the medial and lateral femoral epicondyles
  - **Ankle width:** distance between the medial and lateral malleoli

Full body



26 markers + 8 markers on head and wrist bands + 1 optional (RBAK)

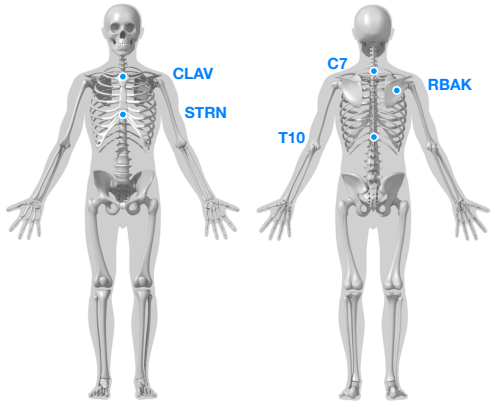
Head & Trunk Markers



LFHD, RFHD: front head (over the temples)

LBHD, RBHD: back head (on the back of the head)

- The 4 head markers define a horizontal plane.
- FHD markers define the origin, and the scale of the head.
- BHD markers define its orientation.



C7: spinous process of the 7th cervical vertebrae

CLAV: jugular notch where the clavicle meets the sternum.

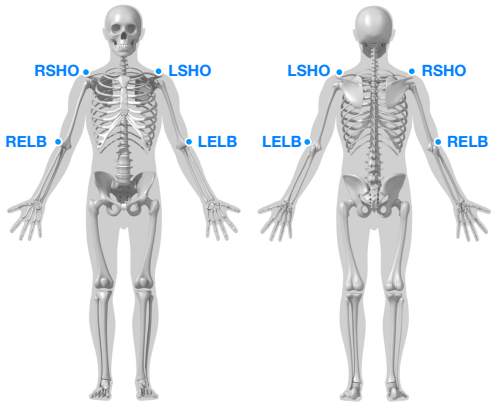
T10: spinous process of the 10th thoracic vertebrae.

STRN: xiphoid process of the sternum.

RBAK: mid scapula

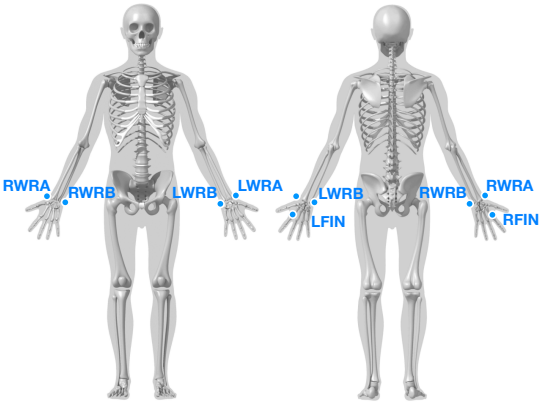
- The 4 trunk markers define a plane hence their lateral positioning is most important.
- C7: ask the subject to bend their head forward. Locate the C7 vertebra (most prominent spinal process on the back of the neck) and then ask the subject to straighten their neck. Place the marker on this point.
- T10: find the inferior angle of the scapula, then move horizontally across to the vertebrae, this should be T7. Get the subject to slump forward and count down to T10 by feeling for the bony spines of each vertebra.
- CLAV: placed on the bone and not in the jugular notch.
- STRN: placed on the bone just above the Xiphoid process.
- RBAK (optional): acts as an anti-symmetry marker strictly for autolabel purposes (put only one!).

Arm Markers



LSHO, RSHO: shoulder marker (on top of the acromio-clavicular joint)

LELB, RELB: elbow (on lateral epicondyle approximating elbow joint axis)

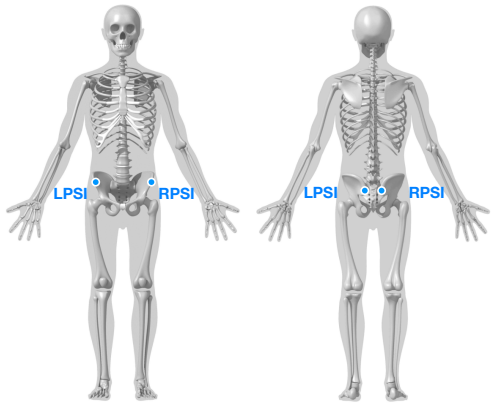


LWRA, RWRA: wrist thumb side

LWRB, RWRB: wrist pinkie side

LFIN, RFIN: on the dorsum of the hand just below the head of the 2nd metacarpal

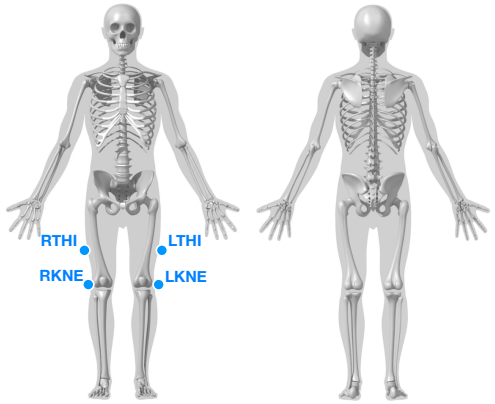
Upper Legs Markers



LASI, RASI: Anterior Superior Iliac Spine

LPSI, RPSI: Posterior Superior Iliac Spine

- The 4 markers must form a horizontal plane when the subject is standing upright.
- The medio-lateral and vertical positions of the PSI markers are very important.
  - LPSI and RPSI must be on the same vertical position than RASI and LASI.
  - mid-point between LPSI and RPSI must be placed in the center of the back.
- RASI and LASI can be moved laterally by an equal amount, along the interASIS axis (e.g. in case of obese patient). The true interASIS distance must then be recorded.

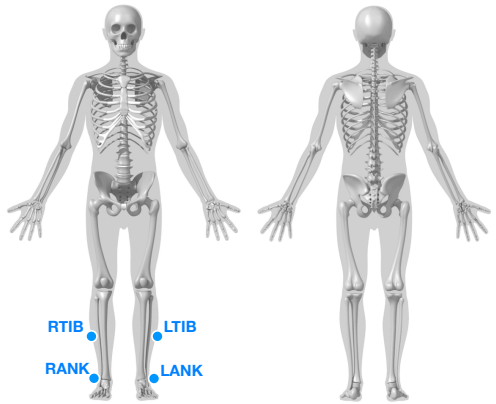


RTHI, LTHI: Lateral Thigh

RKNE, LKNE: Lateral Knee (most lateral aspect of the femur lateral epicondyle; on the knee flexion/extension axis)

- THI, KNE and the hip joint center must form the femural frontal plane.
- THI position is critical:
  - it has to be placed so to form the femural frontal plane with the KNE marker and the hip joint center.
  - position this marker standing and observe knee flexion/extension to confirm.
- The distal 1/3 of the thigh is the best location to decrease movement due to muscle bulk and avoid marker hiding by swing of the hand.

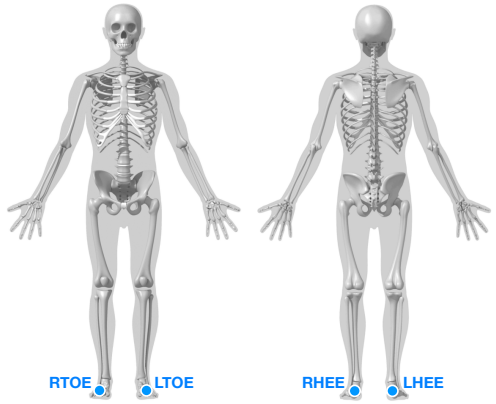
Lower Legs Markers



RTIB, LTIB: lateral Tibia

RANK, LANK: lateral malleolus (most lateral aspect of the lateral malleolus; on the transmalleolar axis)

- TIB, ANK and the knee joint center must form the tibial frontal plane.
- TIB position is critical:
  - it has to be placed so to form the tibial frontal plane with the ANK marker and the knee joint center.
  - position this marker standing and observe ankle flexion/extension to confirm.
- The distal 1/3 of the tibia is the best location to decrease movement due to muscle bulk.



LTOE, RTOE: second metatarsal head (proximal to the MP joint)

LHEE, RHEE: center of calcaneus (on the calcaneous where the medial/lateral position is in line with the ankle joint center)

- TOE and the ankle joint center projected onto the plantar surface of the foot must form a line along the long axis of the foot.
- HEE position is critical:
  - the height of HEE must be such that the line from HEE to TOE (when viewed from the sagittal plane) is parallel to the plantar surface of the foot.
- Care should be taken in feet with midfoot breakdown or collapse. The placement of TOE should be proximal to the deformity to avoid exaggerating dorsiflexion in stance.

NOTES

- General comment
  - mark the point where to place the marker with a pencil (for replacement of the marker in case of marker falling).
  - to help with joint center localization, mark the anterior projection of the joint center with a pencil.

- KNE
  - look at the lateral aspect of the knee joint and passively flex and extend the knee.
  - find the point appearing to be on the rotation axis (for flexion/extension) AND remaining fixed with respect to the thigh.

- THI
  - marker must be placed to be in the plane that contains the hip and knee joint centers and the knee flexion/extension axis.

- TIB
  - marker must be placed to be in the plane that contains the knee and ankle joint centers and the ankle flexion/extension axis.