The Development and Testing of a Forensic Interpretation Framework for use on Anthropometric and Morphological Data Collected During Stance and Gait

Supplementary 1: Manual for Stance and Gait Assessment

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Glossary

Definitions (adapted from Farlex Inc, 2014; Kendall et al., 2005; Moore et al., 2011; Encyclopaedia Britannica, 2014)

Abduction - To draw a limb or body part away from the medial axis of the body or away from another adjacent body part or particular limb

Adduction – To draw a limb or body part towards the medial axis of the body or towards another adjacent body part or particular limb

Centre of Gravity: The concentration of the weight of the body that is considered to be at one point (where gravity acts upon a person), located 5cm anterior to the second sacral vertebra, where both linear forces and rotary forces (torque) acting on the body needs to be balances. The assumed point in the body that differs between the somatotypes and shifts during gait. To provide an example, endomorphs, have a low COG, while in ectomorphs it is positioned higher up (Scott, 2002)

Axes/Planes

Coronal: A vertical plane that divides the body into two (anterior and posterior halves) extending from side to side.

Sagittal: A vertical plane that divides the body into two (left and right halves) by extending from the front to the back.

Transverse: A horizontal plane, diving the body into cranial and caudal position (upper and lower).

Flexion: The movement between that decreases the angle between two body parts, which may include, the arm, leg, hip etc.

Extension: The movement between that increases the angle between two body parts (opposite direction of flexion).

*Abduction:*When the body or body part is moving away from the midsagittal plane.

Adduction: When the body or body part is moving towards from the midsagittal plane.

Lateral Flexion: The movements of the body (trunk, pelvis, head) from side to side (frontal plane)

Rotation: The movement of the segment or body part around a longitudinal axis of the body.

Tilt: Tilting refers to the movements of the body, for this manual, in particular to the pelvis. The tilting may refer to anterior, posterior or lateral tilting that the pelvis assumes whilst in stance, walking or running phase.

Anterior: The front of the body (ventral surface)
Posterior: The back of the body – or the rear of the body (dorsal surface)
Inferior: Towards the feet of the body
Superior: Towards the head of the body
Lateral: Relating to the side/s of the body – away from the midline
Medial: Towards the midline of the body
Distal: Further from the point of reference (i.e. trunk of the body, or heart).
Proximal: Nearest to the point of reference (i.e. trunk of the body, or heart).

Line of Reference/ Plumb Line: Plumb line (a cord with a weighted plumb attached to provide a vertical line), determines if the points of reference of the test subject are in alignment and if there are any deviations that indicate faulty alignment

Gait Phases

Heel Strike: Heel (calcaneus) comes in contact with the ground
Loading Response: The contralateral limb lifts from the ground and a weight shift occurs
Midstance: The phase within the gait cycle between opposite toe off and heel rise
Heel Rise: From mid-stance to the terminal stance phase
Toe Off: The ipsilateral extremity about to lift off from the ground and unload weight
Initial Swing: The ipsilateral limb lifts from the ground and is at maximum knee flexion
Intermediate Swing: The limb is in the air for advancement and is aligned with the ankle of the contralateral extremity
Terminal Swing: Final advancement phase, just prior to heel strike once again
Floating Phase: This feature occurs when both feet are airborne and the double limb support as seen in walking is replaced by the flight phase
Double Limb Support: The double support of the gait cycle occurs when both feet are in contact with the ground
Single Limb Support: The single support phase is when only one foot is in contact with the ground while the other is in the air

Genu Valgum: Knock-Kneed
Genu Varum: Bow Legged

Part 1: Stance

Body Orientation

The body is divided into two for analysis, however the measurements observed are taken from the subjects left and right and not from the observers as seen in the figure below (Figure 1).

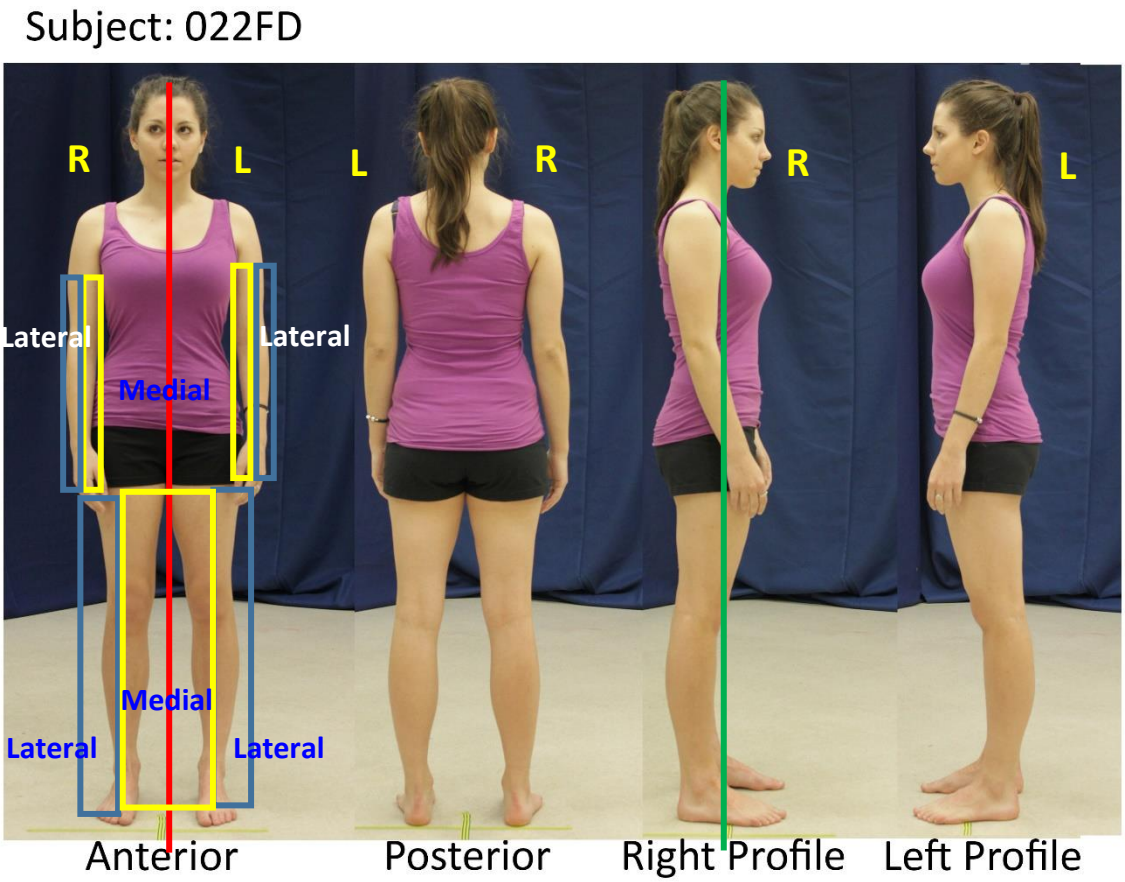


Figure 1 – Planes of the Body. The red line separating the participants body into left and right halves (or in other instances away from the midline) is known as the sagittal plane. The green line separates the body into anterior and posterior components (or in other instances away from the midline)is also known as the coronal plane. The lateral aspect of the body is the areas furthest from the midline (sagittal plane), whereas the medial areas are the parts of the body closest to the midline.

Anatomical Regions

The basic terminology outlining the areas or 'zones' of the body. Knowledge of these areas will help following the manual.

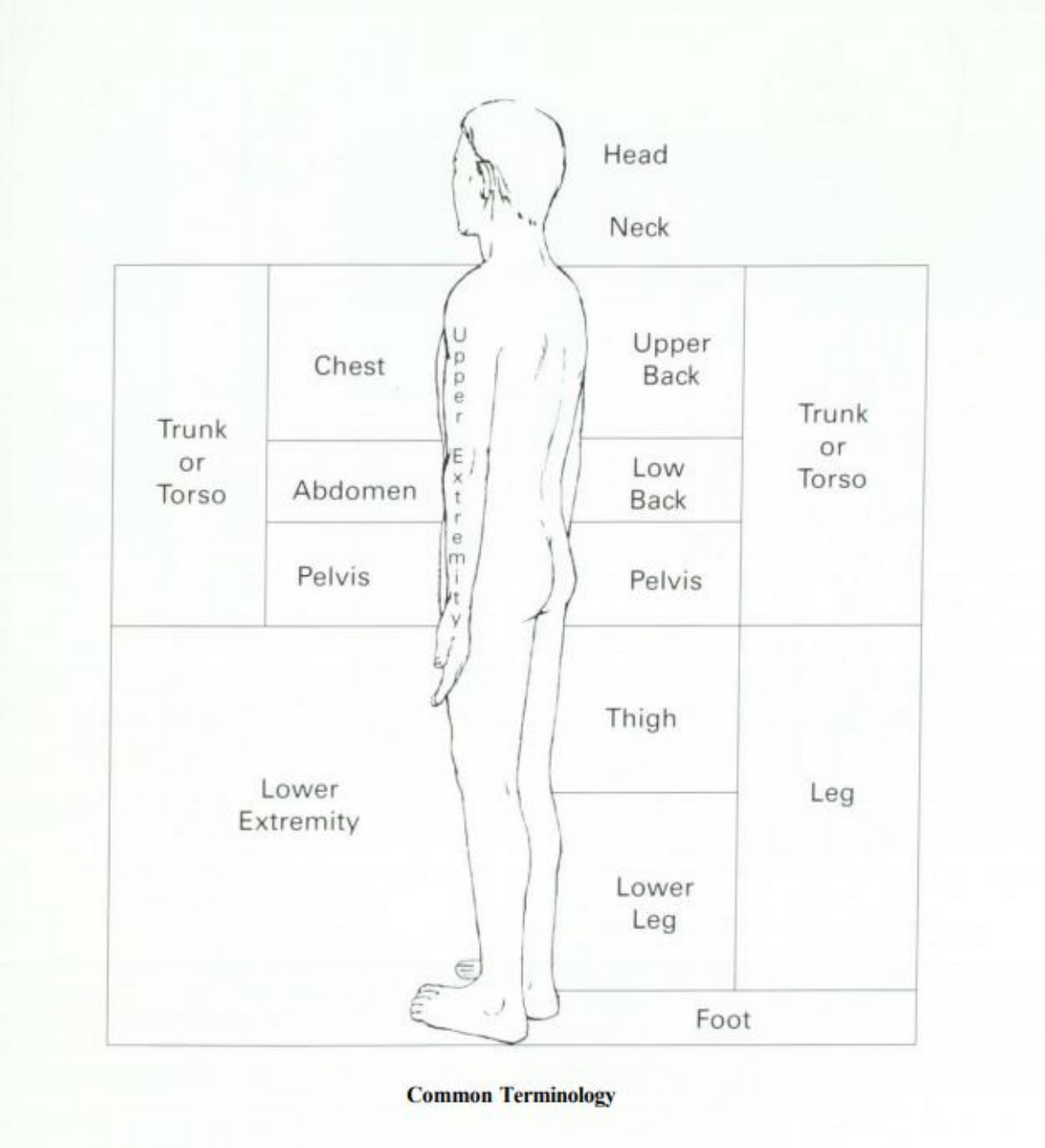


Figure 2 – Basic Terminology. Adapted from Kendall et al., 2005.

Anatomical Planes

The planes of the body are necessary to follow the manual. The sagittal plane (lateral plane) is a vertical plane that divides the body into left and right sides. The coronal plane (frontal plane) divides the body into front (anterior) and back (posterior) sections. The transverse plane (axial plane) divides the body into upper (superior) and lower (inferior) portions.

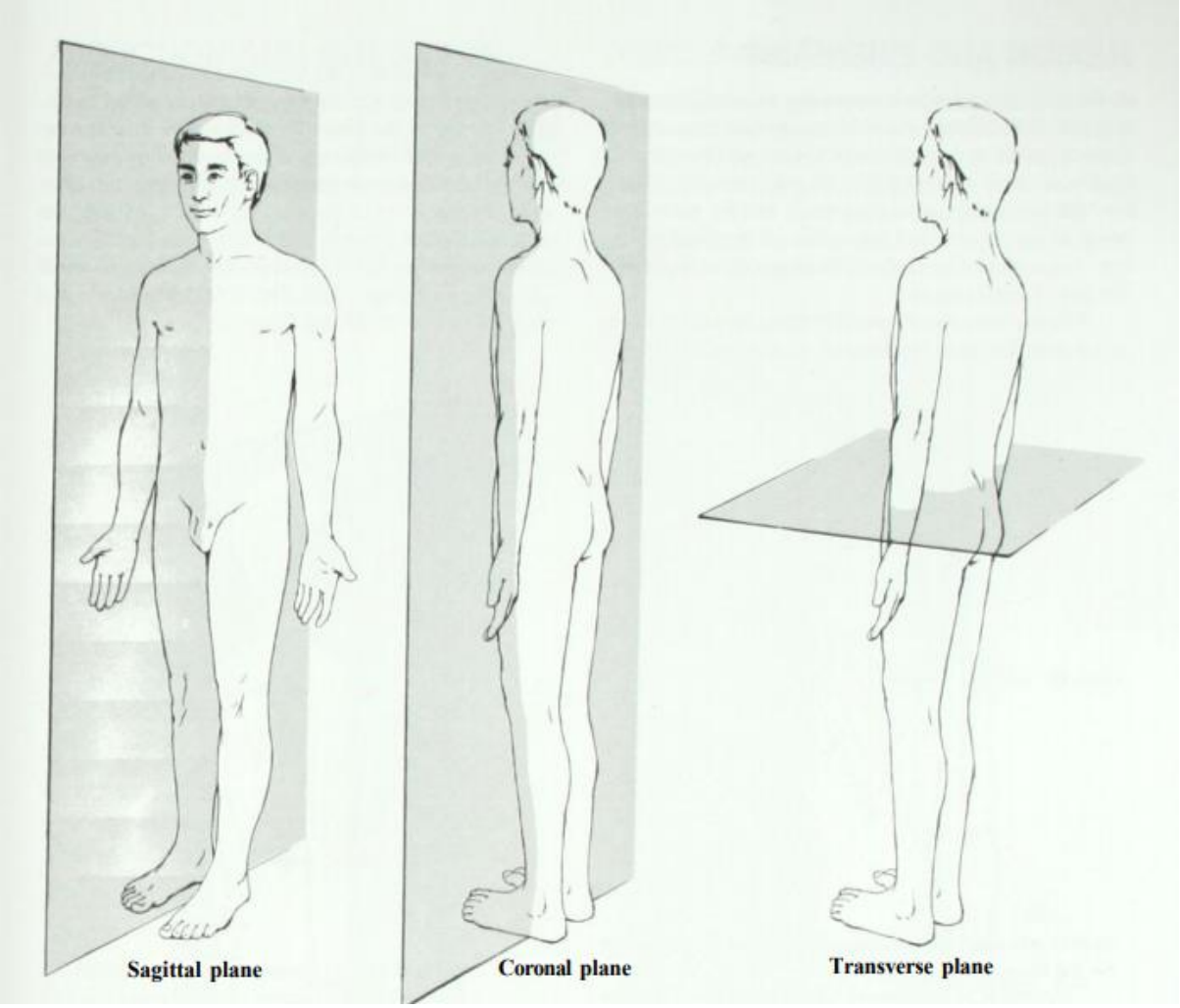


Figure 3 – Body Planes. Adapted from Kendall et al., 2005.

Plumb Line

The usage of a plumb line (a cord with a weighted plumb attached to provide a vertical line), determines if the points of reference of the test subject are in alignment and if there are any deviations that indicate faulty alignment (Kendall *et al.*, 2005). The test subjects stand with feet equidistant from the line of reference, and if deviations are observed, they are referred to as marked, moderate or slight depending on the varying inches or degrees present (see Figure 2 below for ideal plumb line alignment).

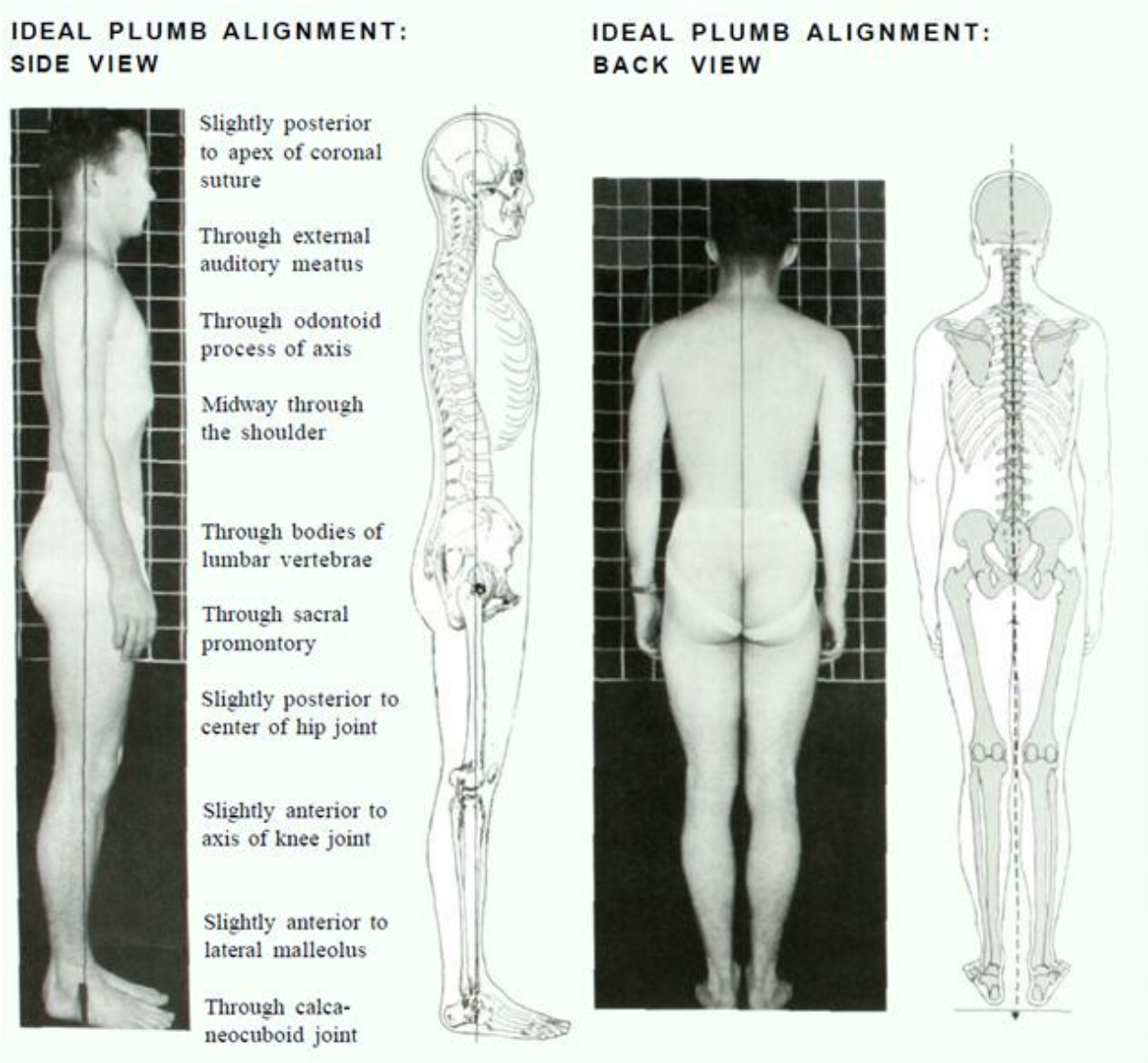


Figure 4 – Ideal Plumb Alignment. Adapted from Kendall et al., 2005.

Posture Types

The five different types of postures will be highlighted here as adapted by Kendall *et al.,* 2005.

Ideal Posture

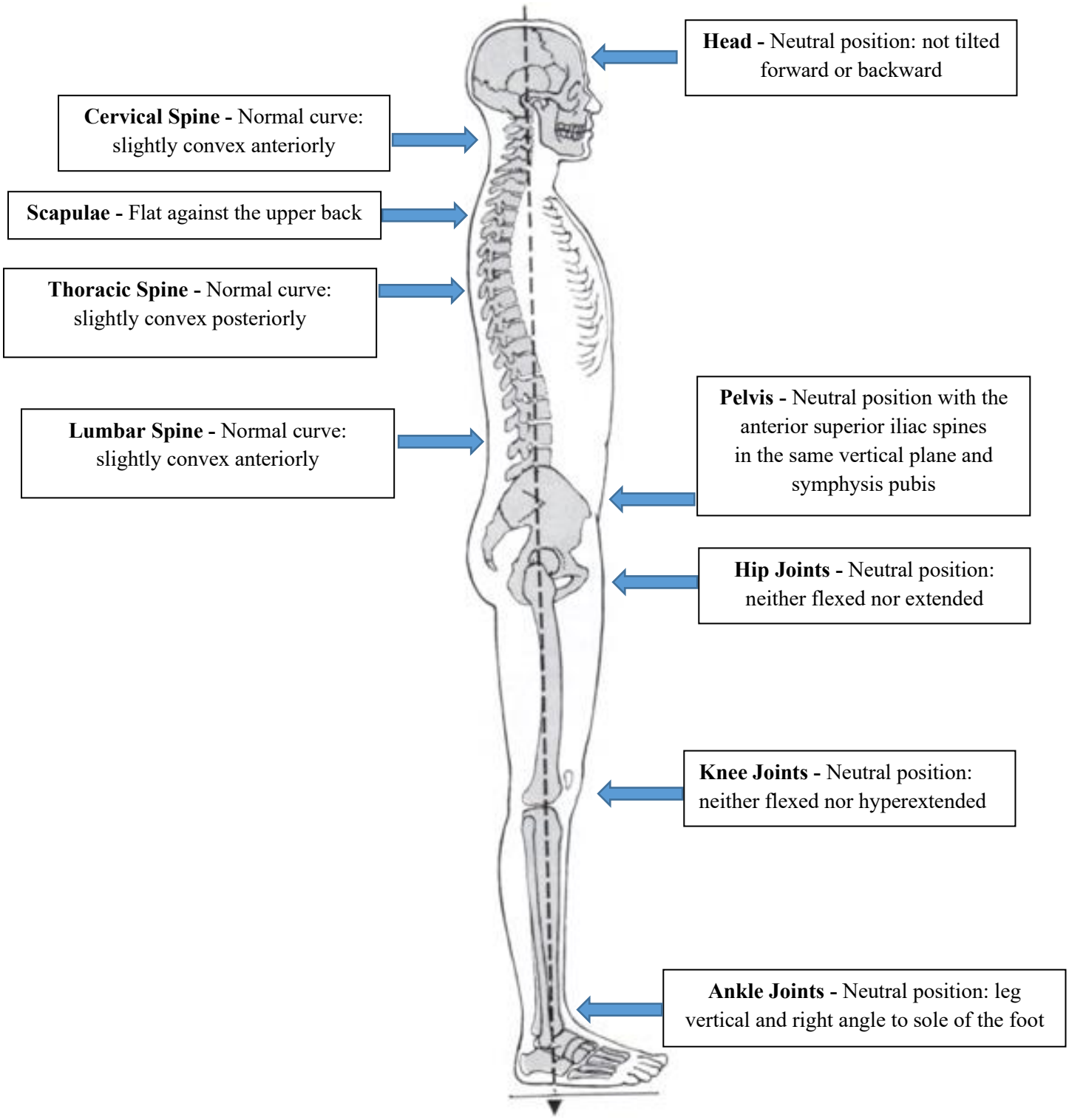


Figure 5 – Ideal Posture. Adapted from Kendall et al., 2005.

Kyphosis-Lordosis Posture

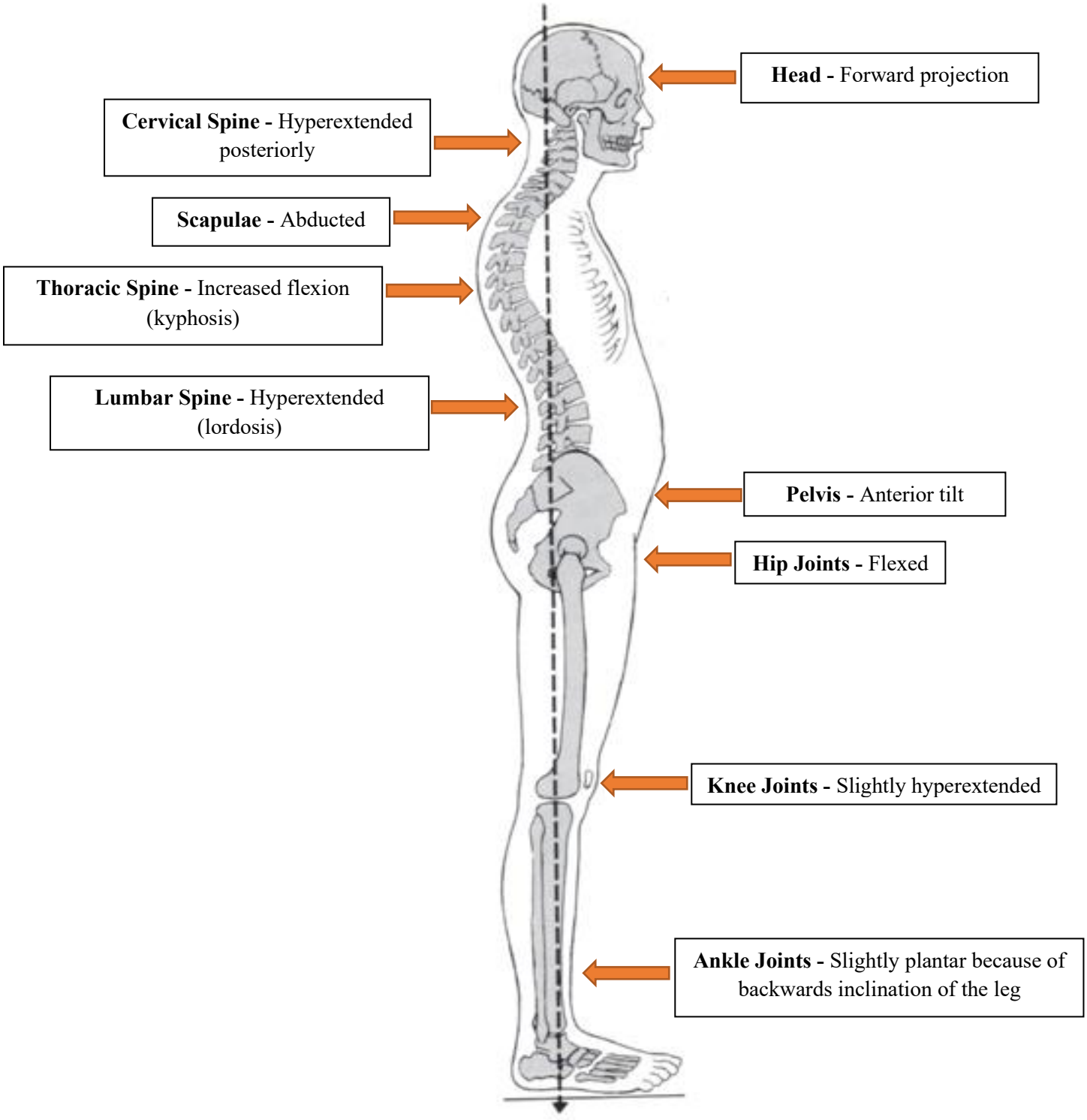


Figure 6 – Kyphosis-Lordosis Posture. Adapted from Kendall et al., 2005.

Flat-back Posture

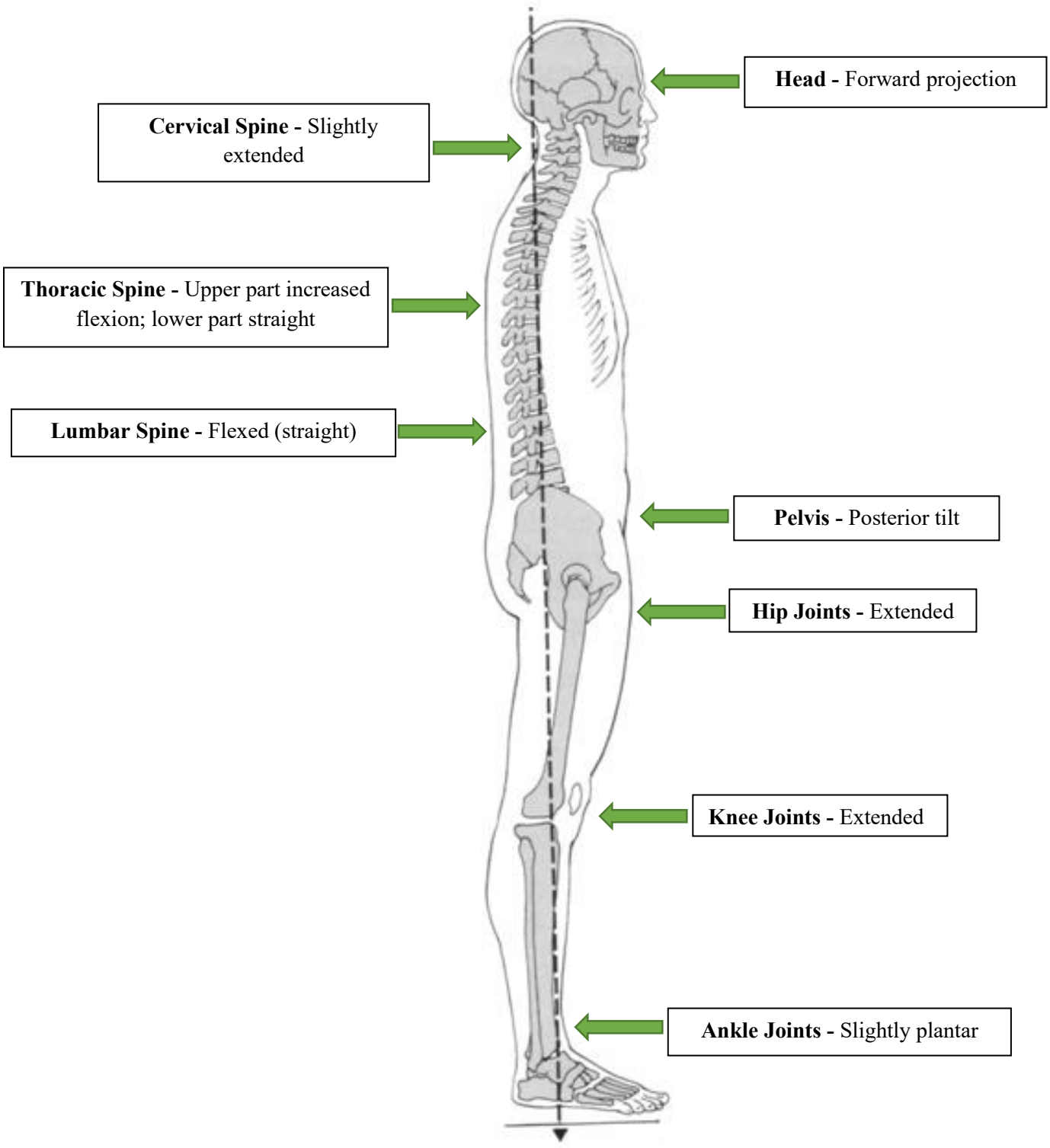


Figure 7 – Flat Back Posture. Adapted from Kendall et al., 2005.

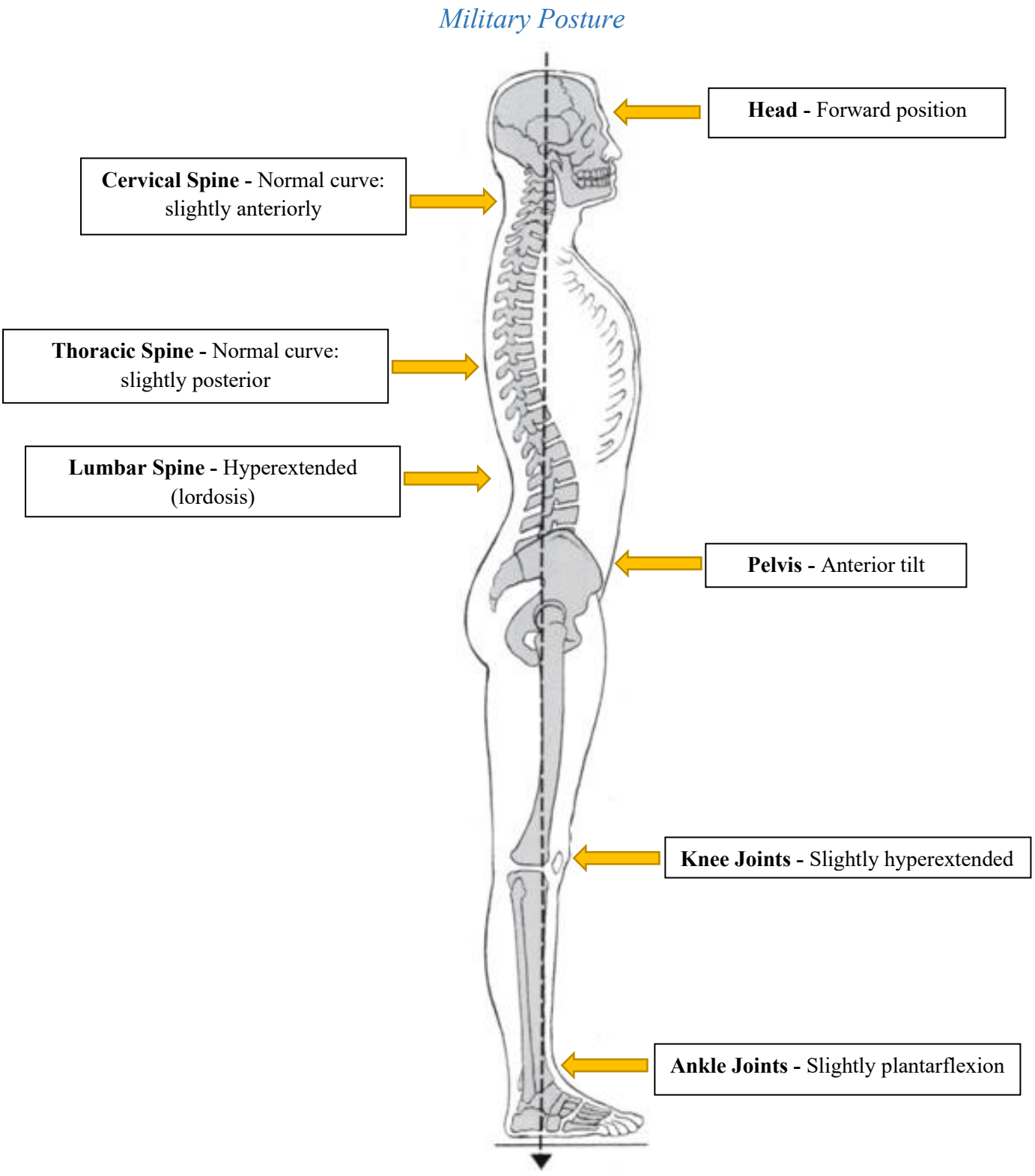


Figure 8 – Military Posture. Adapted from Kendall et al., 2005.

Sway-back Posture

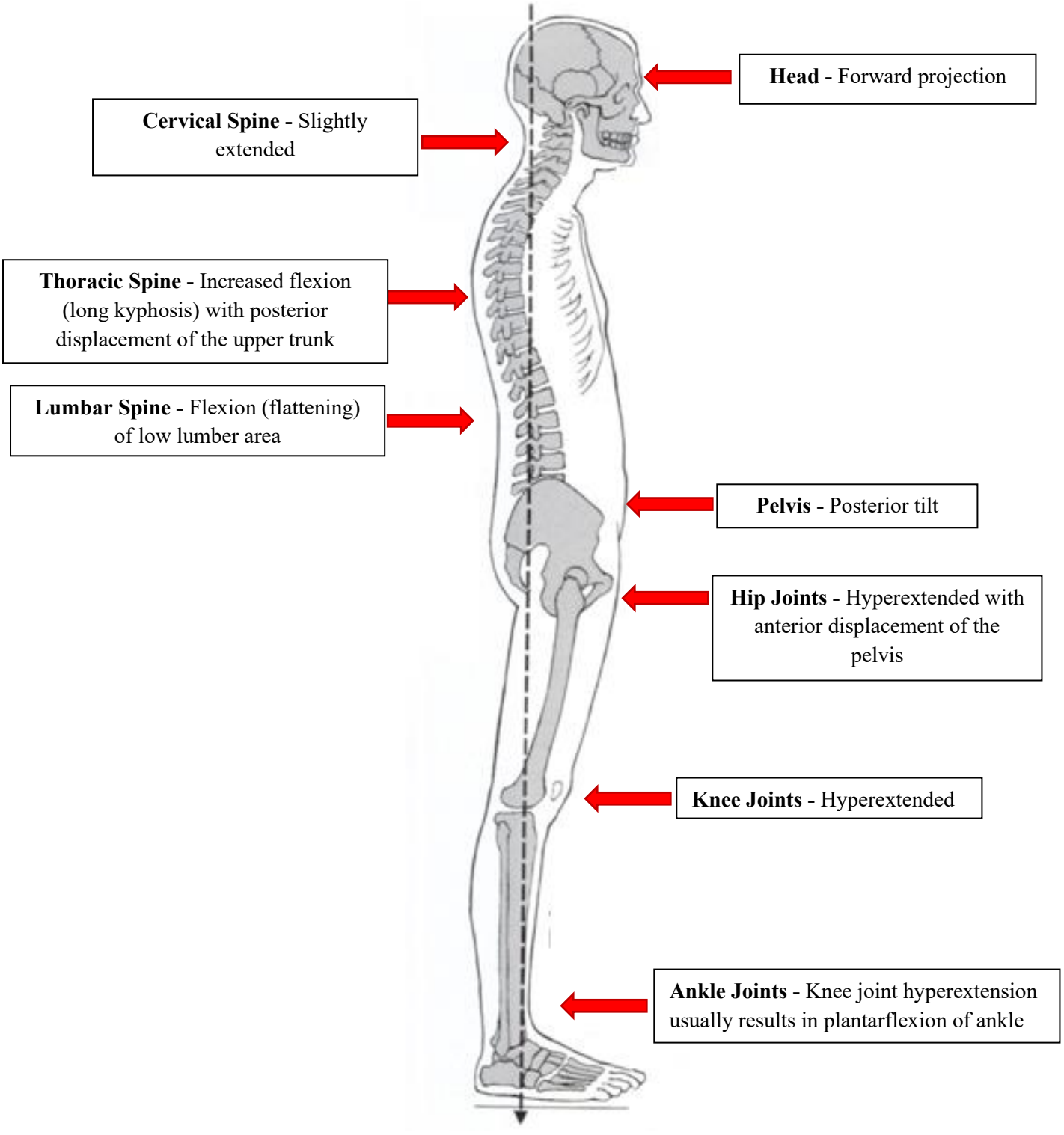


Figure 9 – Sway-Back Posture. Adapted from Kendall et al., 2005.

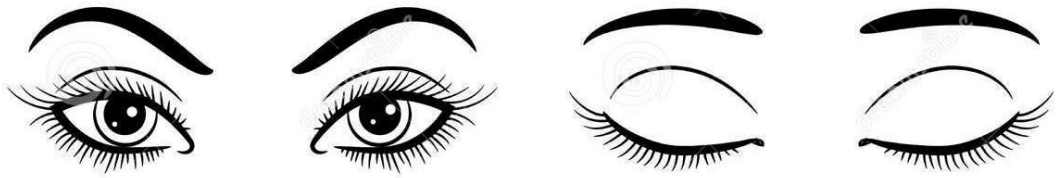
Difficulty and Visibility Scale

The manual and the development of all features are for the purpose of the interpretation framework developed as part of this exploratory PhD research. In which further validation studies, repeatability and reproducibility tests all need to be completed prior to operational applications.

For the purpose of the manual, there will be a scale next to each feature showing both the difficulty (green to red wheel) and visibility scale (open and shut eyes), from which the author experienced during the examination process. This will be further explored in future inter-observer repeatability studies. These figures highlight which features were commonly observed within footage unobstructed and those features that were easy or more difficult to analyse.

(a) Easy (b) Moderate (c) Hard

Figure 10 – Difficulty Scale. The scale indicates whether the features observed were (a) easy to determine, which is shown by the arrow pointing to green, (b) moderate, by the arrow pointing to yellow or (c) hard by the arrow pointing to red.



(a) Easily Visible (b) Not Visible

Figure 11 – Visibility Scale. Features that are (a) potentially easily visible have open eyes whereas those features which are harder to observe due to obstructions are (b) not visible.

Anthropometric Landmarks in Stance

Table 1 – Anthropometric Landmarks of the Upper Limbs

Abbreviation	Name	Description of Location
GHJ	Gleno-Humeral Joint	For the purpose of this study, the anatomical landmark is as follows: The projecting point (between the acromion and greater tuberosity) within the curved area of the shoulder before a small descending dip where the shoulder joint is visualized.
AcF	Antecubital Fossa	A triangular depression located on the anterior surface of the elbow joint. The centre point of the horizontal skin fold that runs along this area.
D	Dactylion	The most distal point of the third digit of the hand. The tip of the finger.
StyP	Styloid Process	Can be located on the distal end of the radius, specifically the side of the hand that contains the thumb. It is the most protruding point of the wrist and is visualised by a bump. A horizontal line is drawn from this styloid process (bump) and the middle point is the point of measurement.

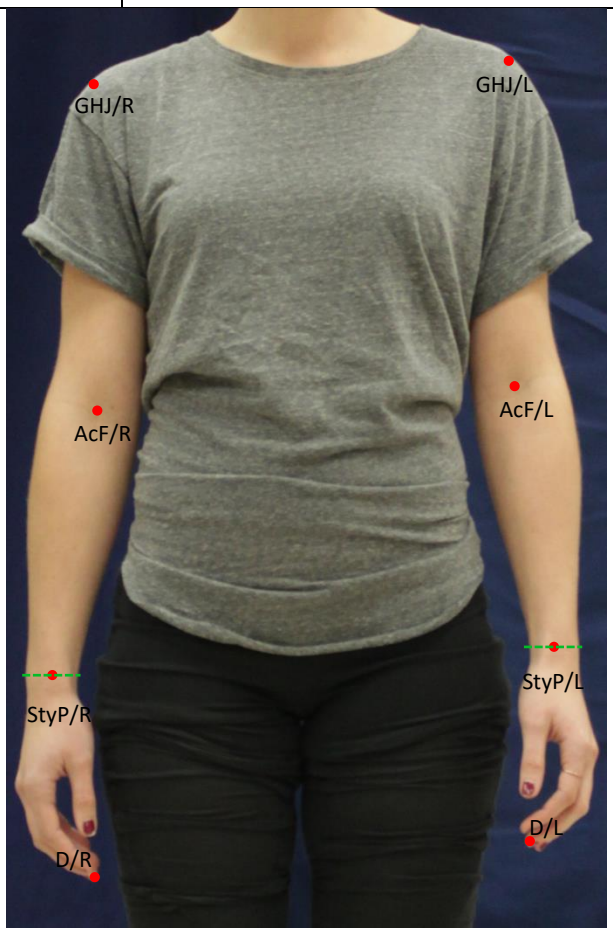


Figure 12 – Landmarks for the Upper Body

Table 2 – Anthropometric Landmarks of the Lower Limbs in Anterior View

Abbreviation	Name	Description of Location
PCen	Centre of Patella	In anterior view, the knee joint is located midway on the anterior side of the leg. The round protrusion containing the patella bone is embedded within the tendon of the knee. The centremost point (from all directions) is located. A horizontal line is drawn from this point to the most medial and lateral points to measure the knee width.
KJ	Outermost Point of Knee Joint	In anterior view, the most medial and lateral points that are the resultant of a horizontal line drawn from the Centre point of the patella (Pcen).
PI	Inferior Patella	In anterior view, the centremost inferior point of the rounded knee cap.
Cr	Crotch	The bottom of the pelvis (soft tissue or genitalia), inferior to the pubic tubercle, where the legs articulate with the pelvis of the body. A horizontal line is drawn across the bottom of the pelvis.
HaIn	Inferior Hallux	In anterior view, the most inferior point of the big toe of the foot that is closest to the ground surface. The centre of this point is located for measurement.
Mal	Malleolus	The most lateral and medial projections of the distal tibia and fibula of the lower leg. A small bump on either sides of the ankle joint are located and a line is drawn to connect these points horizontally. The centre of this line is the point used for measurement.
CMal	Centre of Malleolus	The centermost point of the horizontal line drawn from the Malleolus (Mal) measurement.
Phx	Phalanx	The bony projection of the proximal phalanx located on the outermost medial surface of the foot, visualised by a bump near the hallux (toe).
M5	Metatarsal 5	The outermost bony projection of the lateral surface of the foot, generally visualised with a small bump proximal to the 5th metatarsal of the foot.

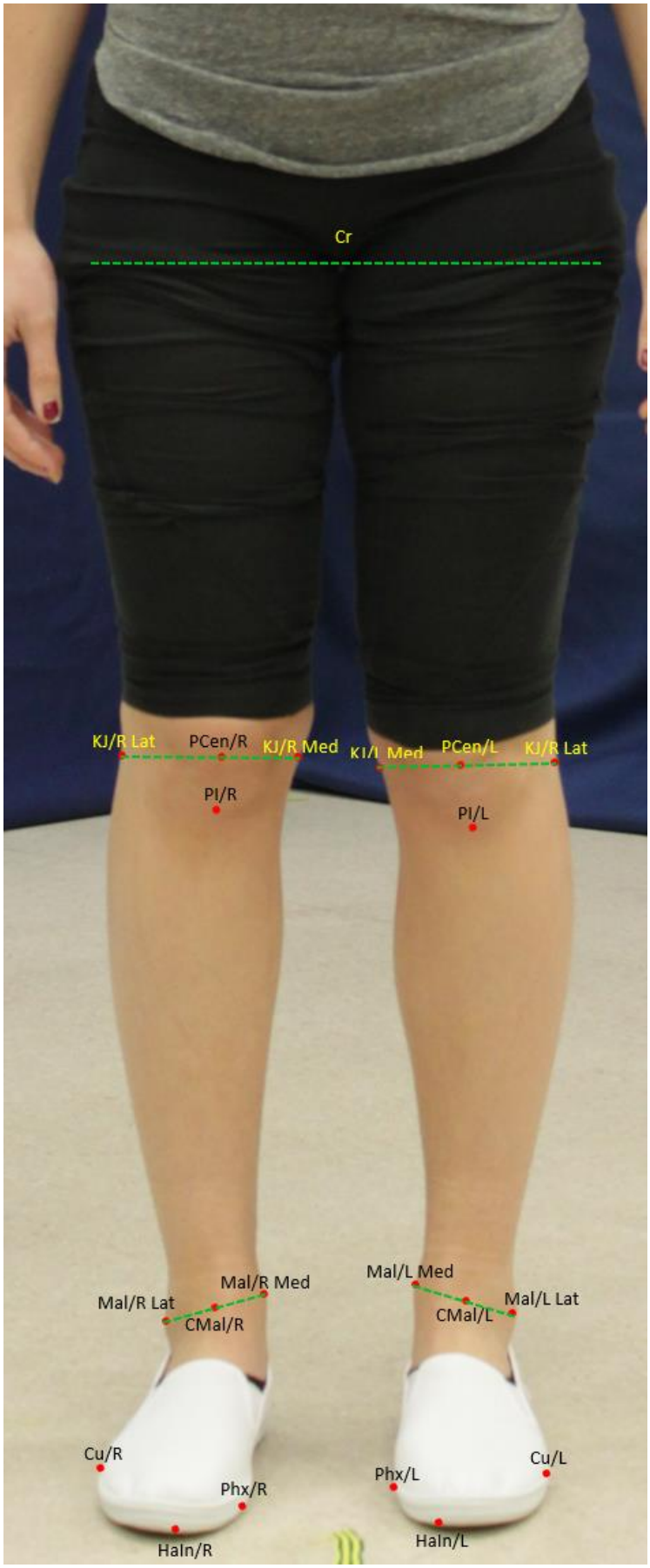


Figure 13 – Landmarks for the Lower Body in Anterior View

Table 3 – Anthropometric Landmarks of the Body in Profile Views

Abbreviation	Name	Description of Location
PP	Protruding point of Patella	In Profile view, the most protruding surface point of the patella is located.
Ha	Hallux	The great toe of the foot containing only two bones (the proximal and distal phalanges)
Ca	Calcaneus	In profile view, the outermost projection on the surface heel of the foot
V	Vertex	The highest point on the apex of the head.
PopF	Popliteal Fossa	The hollow area behind the knee located posteriorly to the patella. The outermost point of the posterior surface where a skin crease/fold is present is the point for measurement.
CaIn	Inferior Calcaneus	In posterior view, the centremost inferior point within heel of the foot, closest to the ground surface

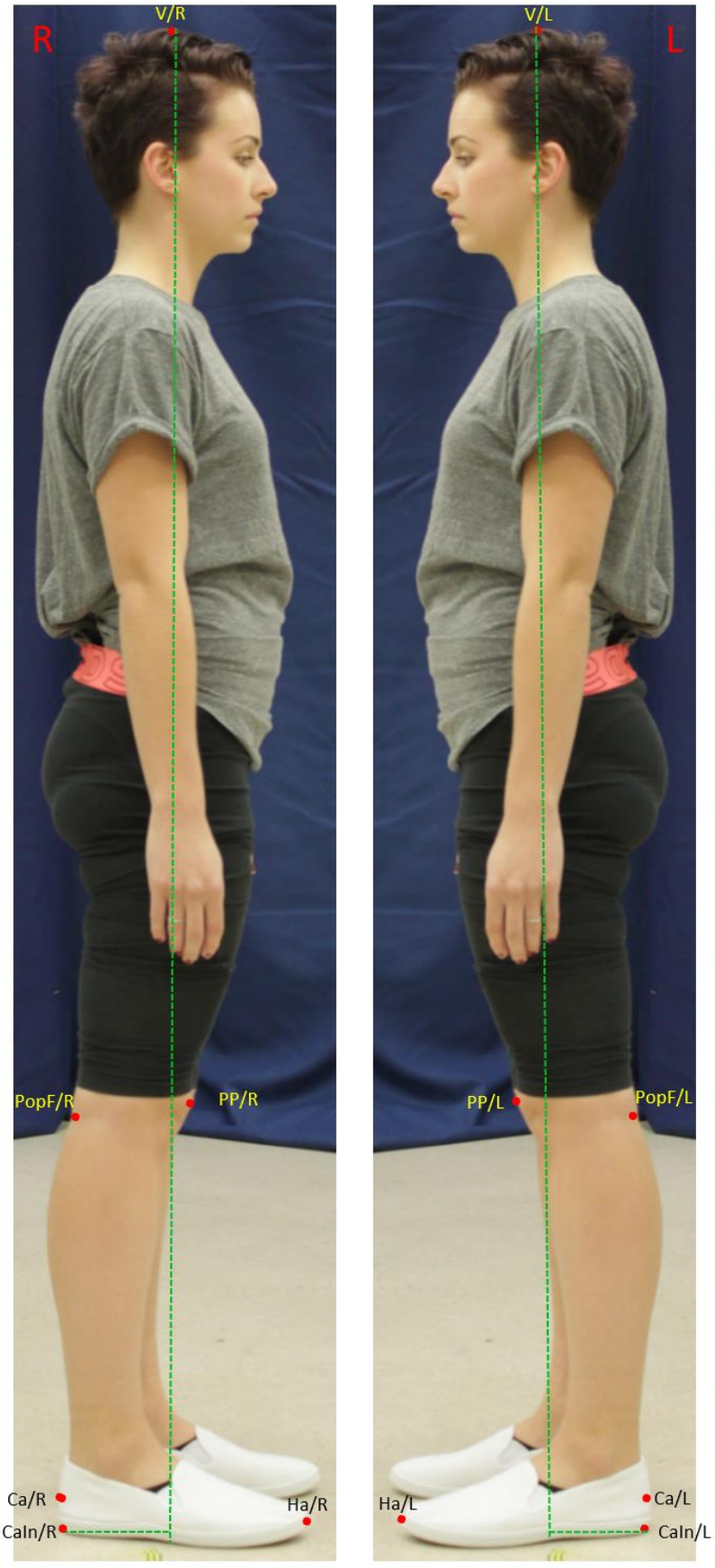


Figure 14 – Landmarks for the Lower Body in Profile View

Table 4 – Anthropometric Landmarks of the Lower Body in Posterior View

Abbreviation	Name	Description of Location
Gtr	Greater Trochanter	The outermost projecting points located on either sides of the hips. A horizontal line is drawn between these points.
CaIn	Inferior Calcaneus	In posterior view, the centremost inferior point within heel of the foot, closest to the ground surface

Figure 15 – Anthropometric Landmarks of the Lower Limbs in Posterior View

Table 5 – Anthropometric Landmarks of the Torso in Anterior View

Abbreviation	Name	Description of Location
AmT	Anterior margin of Trapezius muscle	Anterior margin of the trapezius muscle, at the base of the neck, at the centre of where it dips before it follows along the trapezius muscle
JugN	Jugular Notch	The centre of the jugular notch, located in between both left and right clavicle where a depression in the skin forms a 'V' shape
SupIng	Superior Inguinal region	The centermost point of the superior inguinal region which lines up with the thigh (proximal femur). Where the skin of the upper leg folds from the pelvis region taking a step.
LoUmb	Lower region of umbilicus	Below the umbilicus where the hips start flaring out to anatomically accommodate the pelvic bone. The blue dotted line is the umbilicus.
Ch	Most inferior point of chin	The inferior most centre point of the mandible.

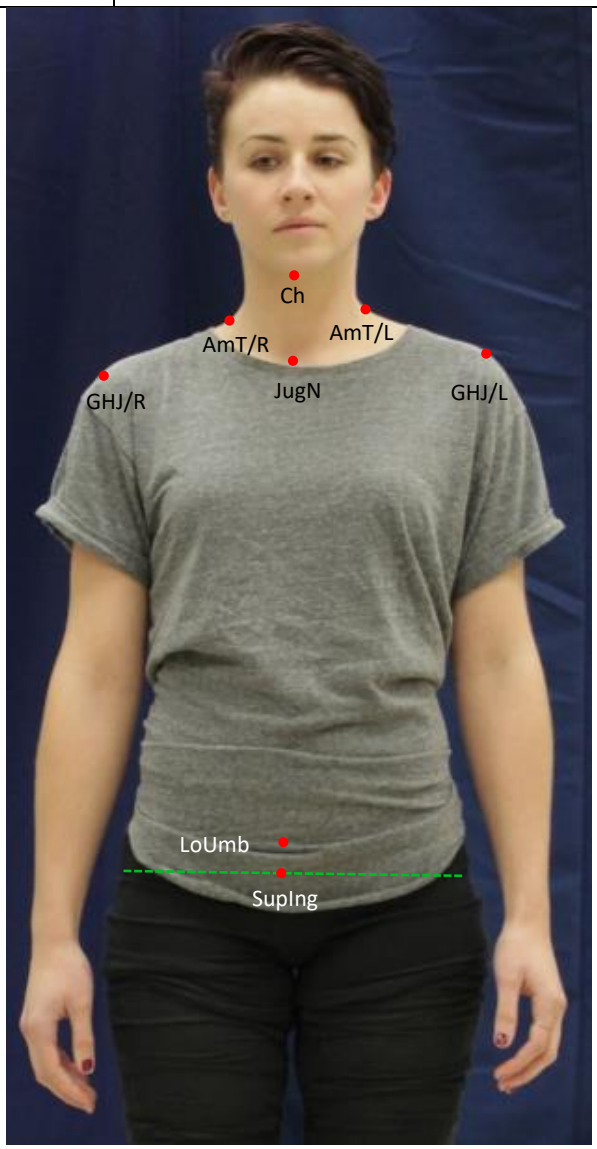


Figure 16 – Anthropometric Landmarks of the Torso in Anterior View

Anthropometric Measurements of Landmarks

Table 6 – Anthropometric Measurements

Measurement	Abbreviations
Shoulder – Elbow Length	GHJ - AcF
Forearm (elbow-wrist) Length	AcF - StyP
Hand length	StyP - D
Maximum Hip Width	Gtr/R – Gtr/L
Thigh length	Cr - PCen
Lower leg length	PI - CMal
Knee/Patella width	KJ/R – KJ/L
Knee Breadth	PP - PopF
Foot (or shoe) length	Ha - Ca
Bi Malleolar Width	Mal/R – Mal/L
Foot (or shoe) Width	M5 - Phx
Mid Patella Height	HaIn - PCen
Leg Length-Crotch	HaIn - Cr
Leg Length-Trochanter	CaIn - Gtr
Total Height (stature)	V - CaIn
Trapezius Length	AmT – GHJ
Head Height	V - Ch
Torso Length	JugN - LoUmb
Shoulder Width	GHJ/R – GHJ/L
Jugular to Inguinal Length	JugN - SupIng

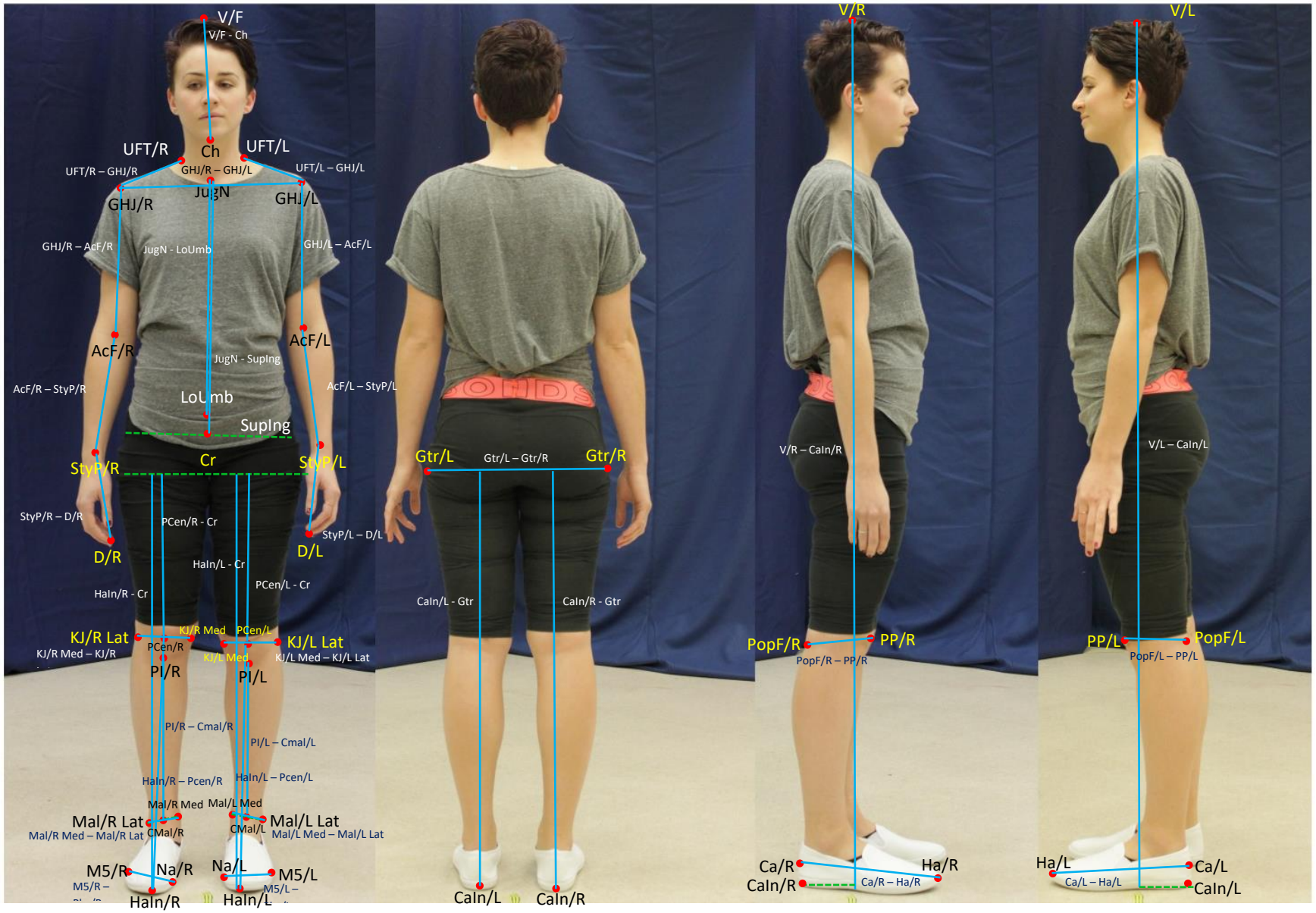


Figure 17 – Anthropometric Measurements taken in all Views

Table 7 – Numbering of Anthropometric Measurements

Measurement Number	Measurement	Abbreviations
1	Shoulder – Elbow Length	GHJ - AcF
2	Forearm (elbow-wrist) Length	AcF - StyP
3	Hand length	StyP - D
4	Maximum Hip Width	Gtr/R – Gtr/L
5	Thigh length	Cr - PCen
6	Lower leg length	PI - CMal
7	Knee/Patella width	KJ/R – KJ/L
8	Knee Breadth	PP - PopF
9	Foot (or shoe) length	Ha - Ca
10	Bi - Malleolar Width	Mal/R – Mal/L
11	Foot (or shoe) Width	Cu - Phx
12	Mid Patella Height	HaIn - PCen
13	Leg Length-Crotch	HaIn - Cr
14	Leg Length-Trochanter	CaIn - Gtr
15	Trapezius Length	AmT – GHJ
16	Head Height	V - Ch
17	Torso Length	JugN - LoUmb
18	Jugular to Inguinal Length	JugN - SupIng
19	Shoulder Width	GHJ/R – GHJ/L
20	Total Height (stature)	V - CaIn

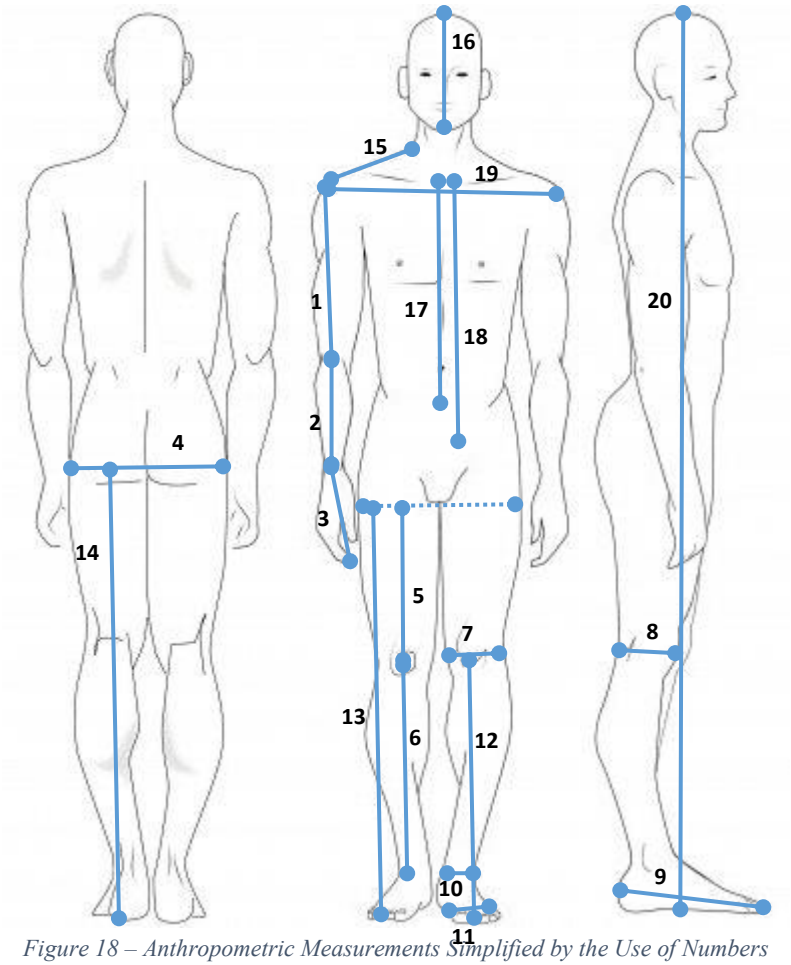


Figure 18 – Anthropometric Measurements Simplified by the Use of Numbers

Anthropometric Landmarks

1. Gleno-Humeral Joint (GHJ)

Location

The projecting point within the curved area of the shoulder before a small descending dip where the shoulder joint is visualised.

Figure 19 – The location of the Gleno-Humeral Joint without a Shirt

Adjustment

The projecting point of the shoulder that is visualised through the shirt.

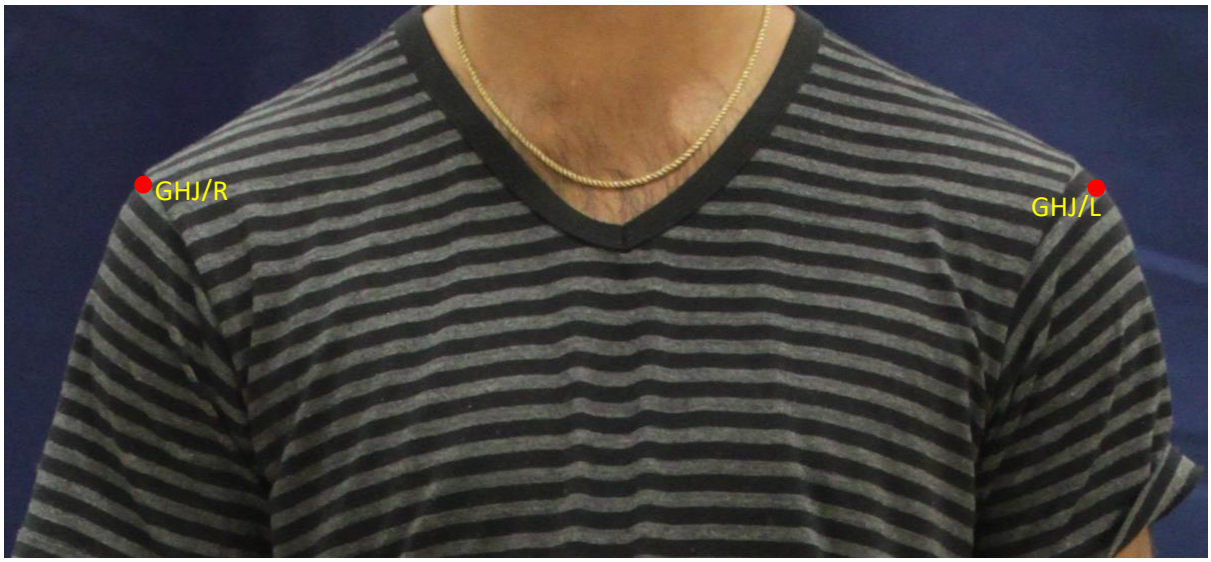


Figure 20 – The location of the Gleno-Humeral Joint with a Shirt

2. Antecubital Fossa (AcF)

Location

A triangular depression located on the anterior surface of the elbow joint. The centre point of the horizontal skin fold that runs along this area.

Figure 21 – The location of the Antecubital Fossa Crest without a Shirt

Adjustment

The centre point where the antecubital fossa dips (caused by the flexion of the elbow joint) that is visualised through the clothing.

Figure 22 – The location of the Antecubital Fossa Crest with a Shirt

3. Dactylion (D)

Location

The most distal point of the third phalanx of the hand. The tip of the finger.

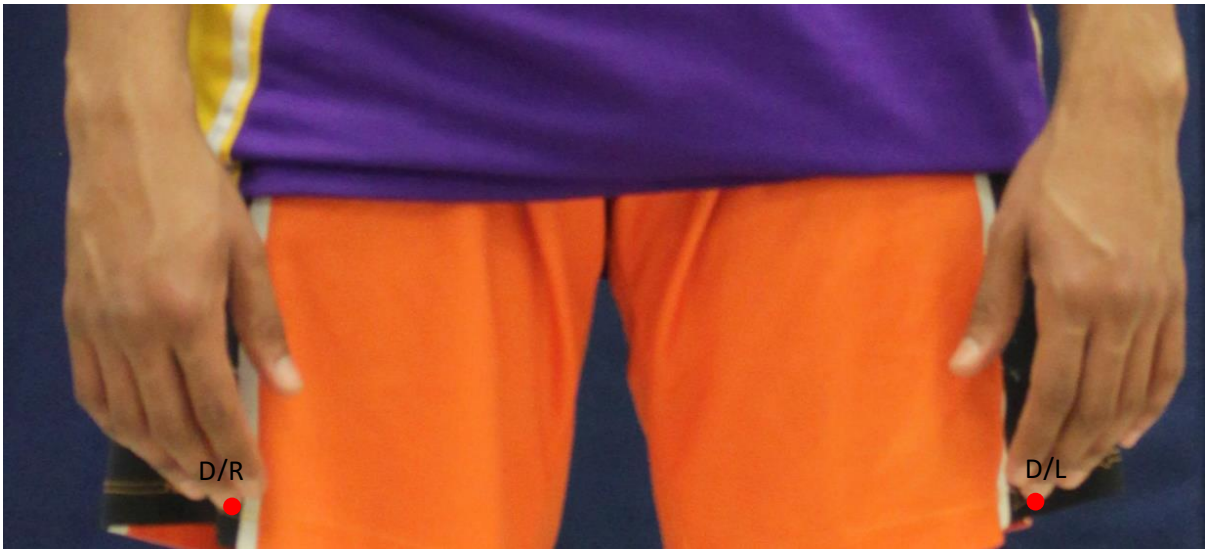


Figure 23 – The Dactylion

Adjustment

When the fingers are curled inwards, the most distal part of the proximal finger (phalanx) is used as a point of measurement.

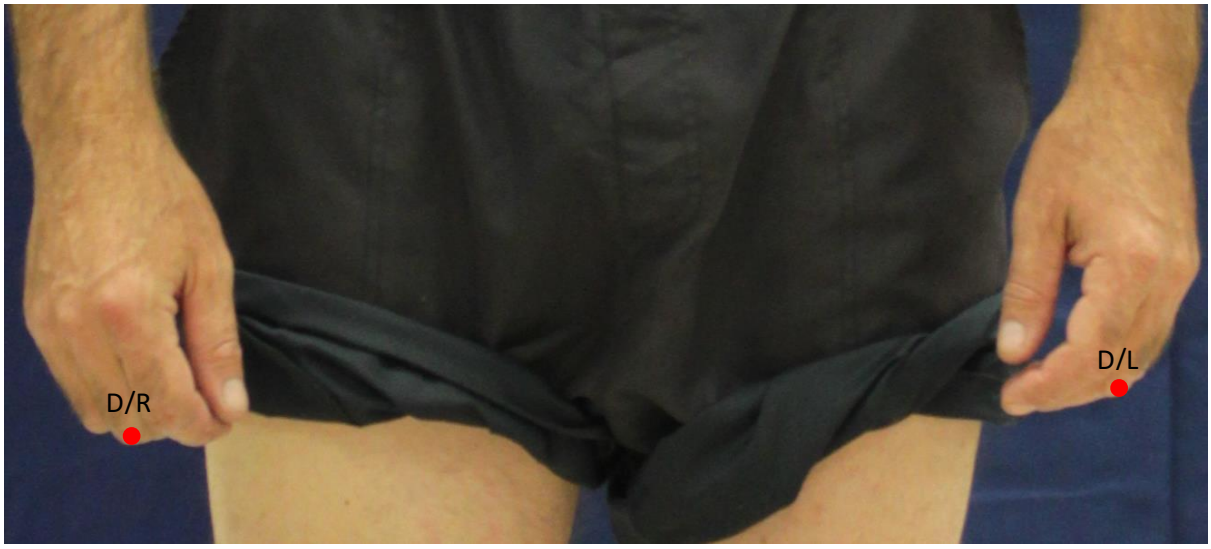


Figure 24 – The Proximal Point of Proximal Phalanx

4. Styloid Process (StyP)

Location

Can be located on the distal end of the radius, specifically the side of the hand that contains the thumb. It is the most protruding point of the wrist and is visualised by a bump. A horizontal line is drawn from this styloid process (bump) and the middle point is the point of measurement.

Figure 25 – The Styloid Process

5. Centre of Patella (PCen)

Location

In anterior view, the knee joint is located midway on the anterior side of the leg. The round protrusion containing the patella bone is embedded within the tendon of the muscles around the knee. The centremost point (from all directions) is located. A horizontal line is drawn from this point to the most medial and lateral points to measure the knee width.

Figure 26 – Centre of the Patella

6. Outermost Point of Knee Joint (KJ)

Location

In anterior view, the most medial and lateral points that are the resultant of a horizontal line drawn from the centre point of the patella (Pcen).

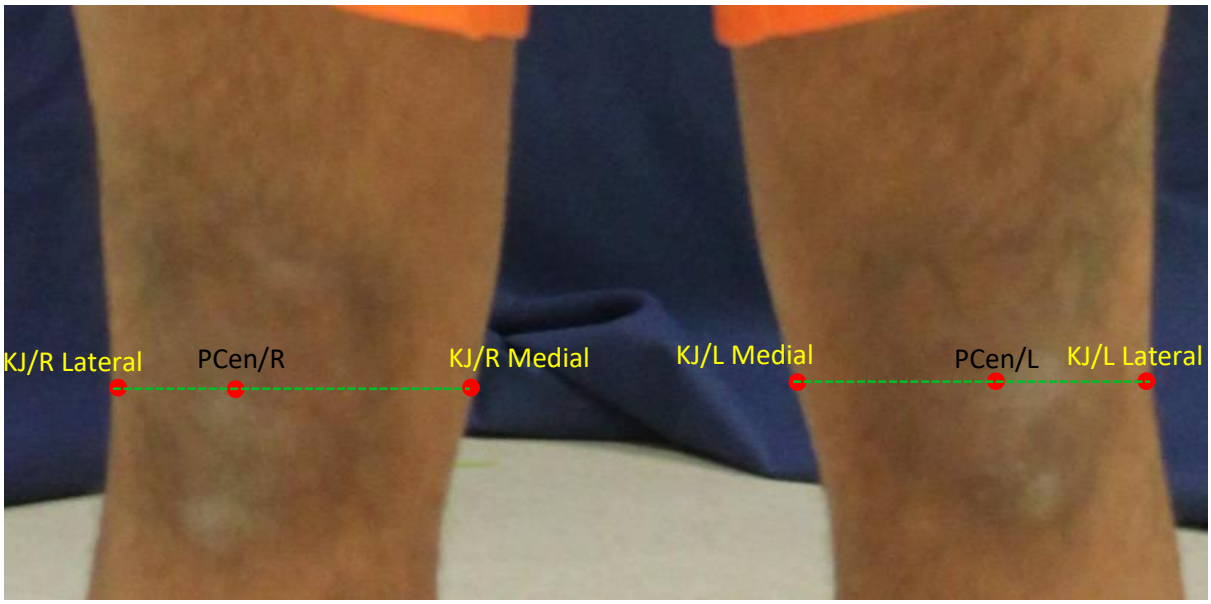


Figure 27 – Outermost point of Knee Joint

7. Inferior Patella (PI)

Location and Adjustment

Location - in anterior view, the centremost inferior point of the rounded kneecap as seen on the left knee. Adjustment - Infrapatella tendons and fat may be abundant, in this instance (seen on right knee), the most inferior point of this tendon is marked as an area for measurement.

Figure 28 – Inferior point of Knee Joint

8. Protruding Point of Patella (PP)

Location

In profile view, the most protruding surface point of the patella.

Figure 29 – Protruding point of Knee Joint

9. Popliteal Fossa (PopF)

Location

The hollow area behind the knee located posteriorly to the patella. The outermost point of the posterior surface where a skin crease/fold is present is the point for measurement.

Figure 30 – Popliteal Fossa

10. Malleolus (Mal)

Location

The most lateral and medial projections of the distal tibia and fibula of the lower leg. A small bump on either side of the ankle joint are located and a line is drawn to connect these points. The centre of this line is the point used for measurement.

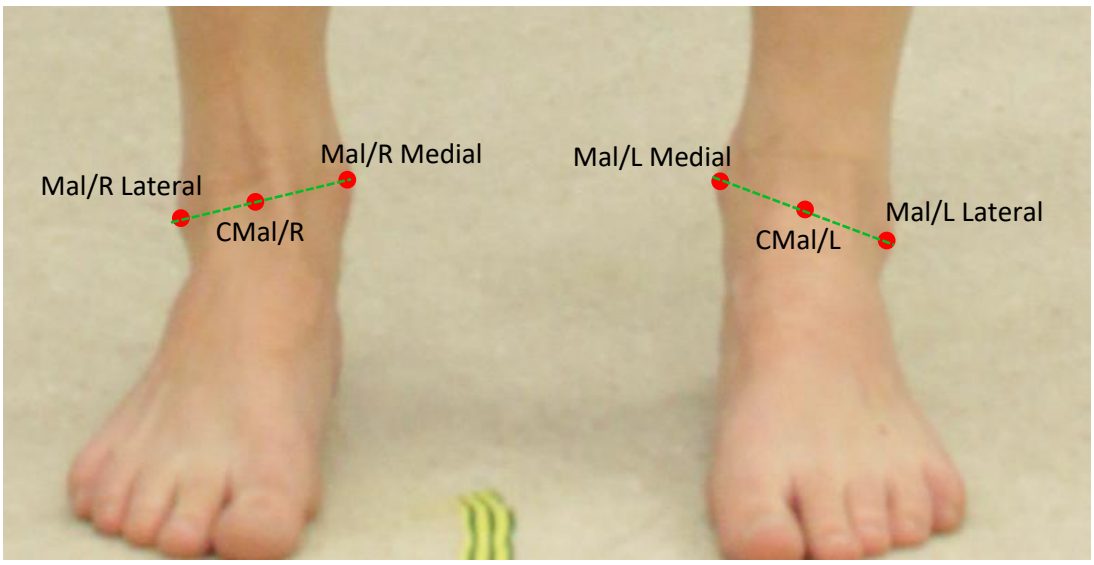


Figure 31 – Locating Malleolus without Socks

Adjustment

When the individual is wearing socks, the most lateral and medial projections of the ankle are measured.

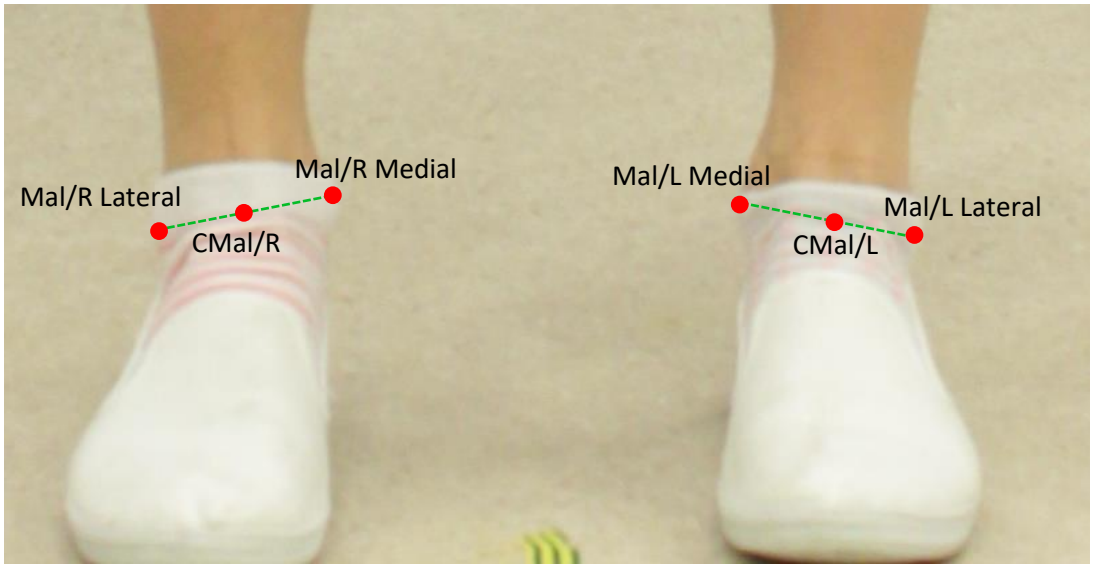


Figure 32 – Locating Malleolus with Socks

11. Centre of Malleolus (CMal)

Location

The centremost point of the horizontal line drawn from the Malleolus (Mal) measurement.

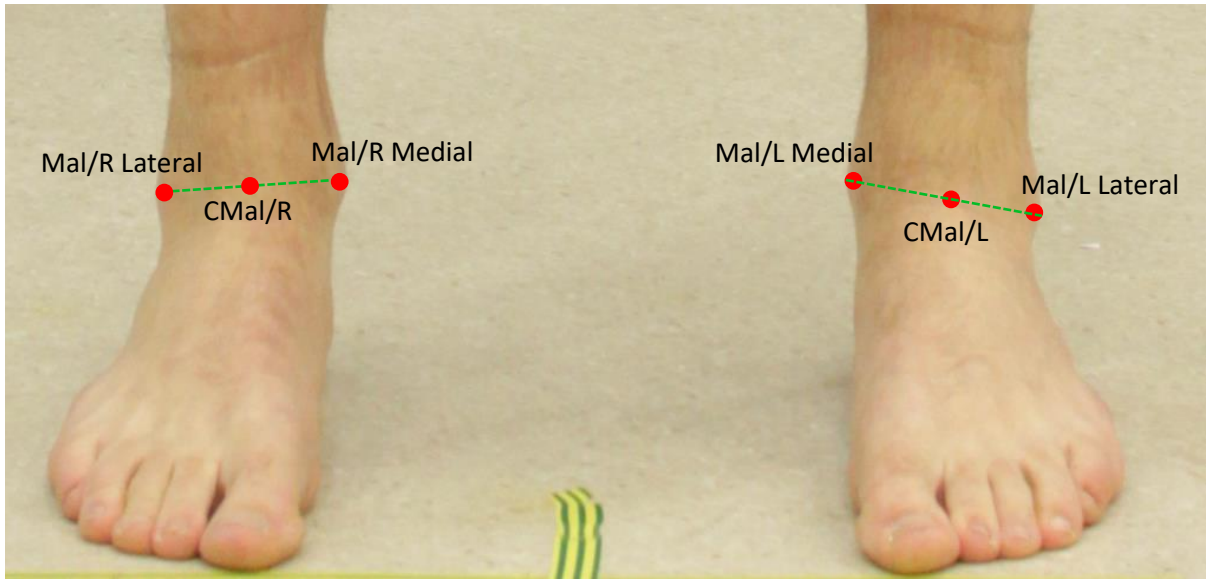


Figure 33 – Centre of Malleolus

12. Metatarsal 5 (M5)

Location

The outermost bony projection of the lateral surface of the foot, generally visualised with a small bump proximal to the 5th metatarsal of the foot.

Figure 34 – Metatarsal Location

Adjustment

If the person is wearing shoes, the most prominent projection of the lateral (outermost) surface of the foot.

Figure 35 – Metatarsal Location with Shoes

13. Phalanx (Phx)

Location

The first phalanx is a bony projection located on the innermost medial surface of the foot, visualised by a bump (also known as the metatarsophalangeal joint) of the hallux (toe). The anterior point of this joint is where the anatomical landmark is placed.

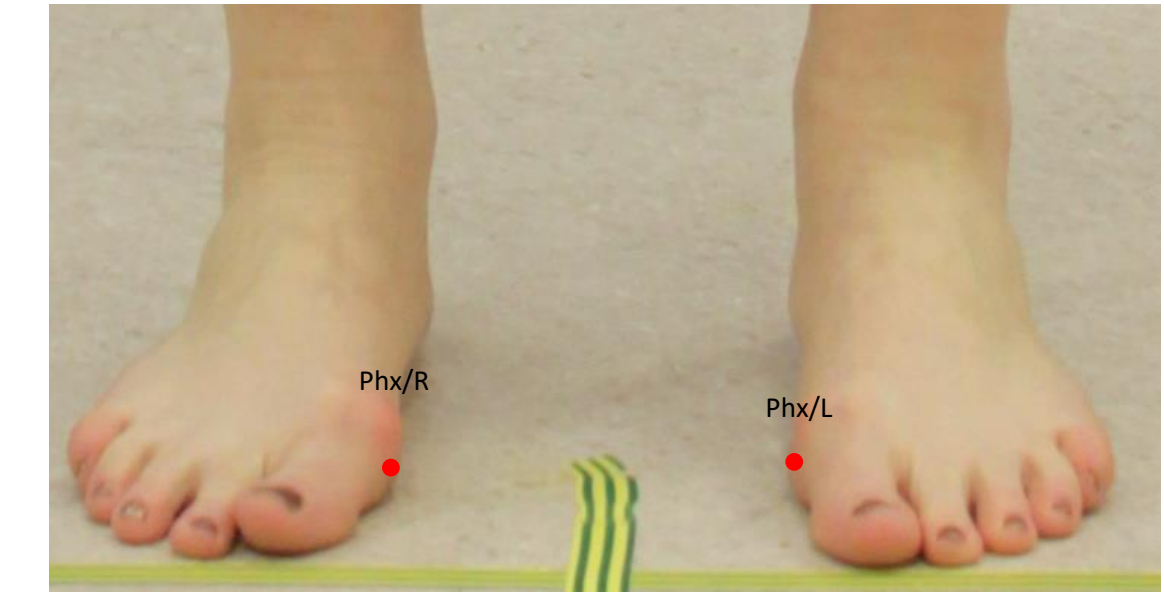


Figure 36 – Location of First Phalanx

Adjustment

The most projecting point within the inner (medial) surface of the foot.

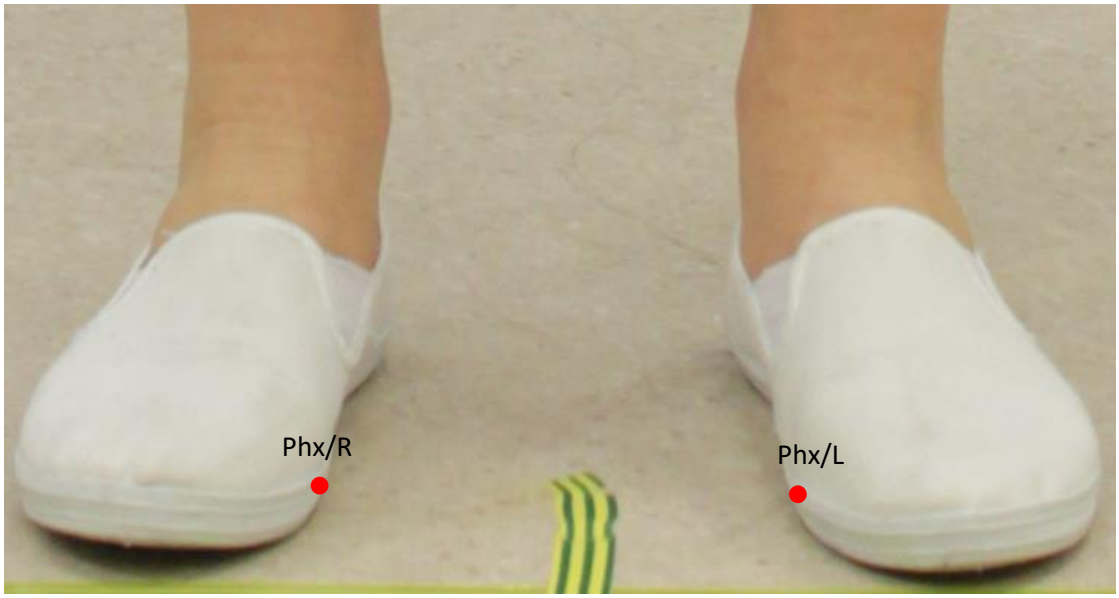


Figure 37 – Location of First Phalanx with Shoes

14. Inferior Hallux (HaIn)

Location

In anterior view, the most inferior point of the big toe of the foot that is closest to the ground surface. The centre of this point is located for measurement.

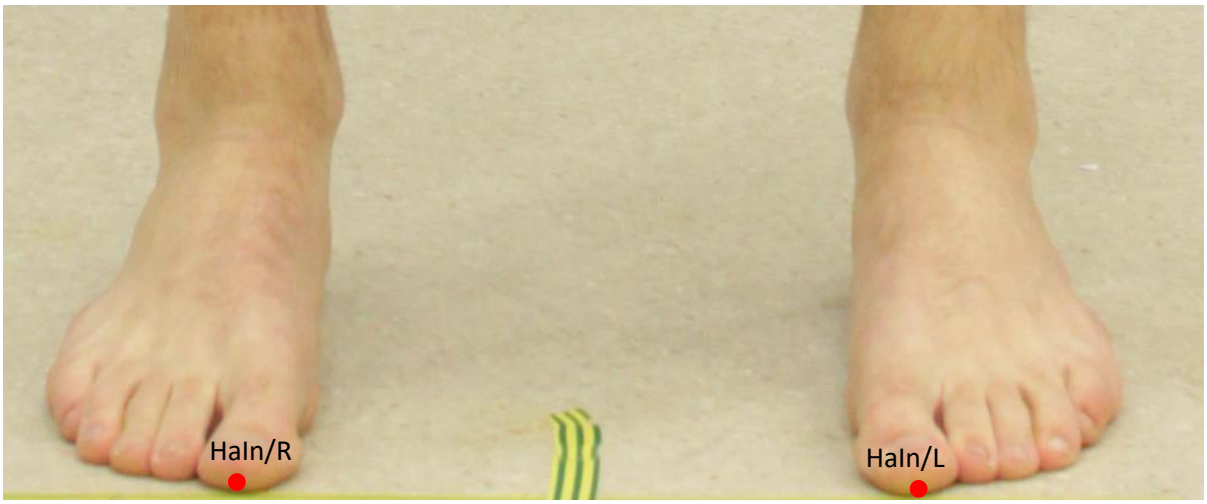


Figure 38 – Inferior Hallux

Adjustment

If the participant is wearing shoes, the most inferior point of the (closest to ground surface is located towards the medial area of the respective foot. The most projecting area of the anterior aspect of the foot is located.

Figure 39 – Inferior Hallux with Shoes

15. Hallux (Ha)

Location

In profile view, the most distal aspect of the hallux.

Figure 40 – Protruding Point of Hallux

Adjustment

If the individual is wearing shoes, the most protruding point of the anterior aspect on shoe is measured.

Figure 41 – Protruding Point of Hallux with Shoes

16. Calcaneus (Ca)

Location

In profile view, the outermost posterior surface projection on the heel of foot.

Figure 42 – Location of Calcaneus

Adjustment

If shoes are worn, the most projecting surface of the posterior aspect of the heel of the shoes are measured.

Figure 43 – Location of Calcaneus with Shoes

17. Inferior Calcaneus (CaIn)

Location

In posterior view, the centremost inferior point within heel of the foot, closest to the ground surface.

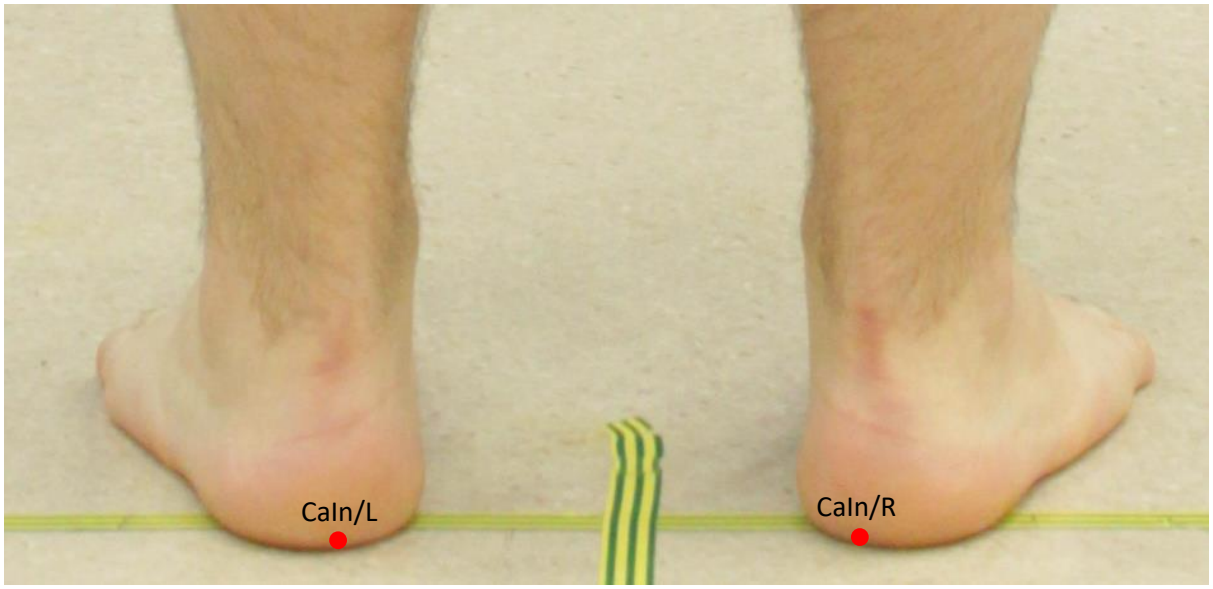


Figure 44 – Location of Inferior Calcaneus

Adjustment

In this instance, the inferior centremost point within the heel of the shoe (closest to ground surface is taken for measurement.

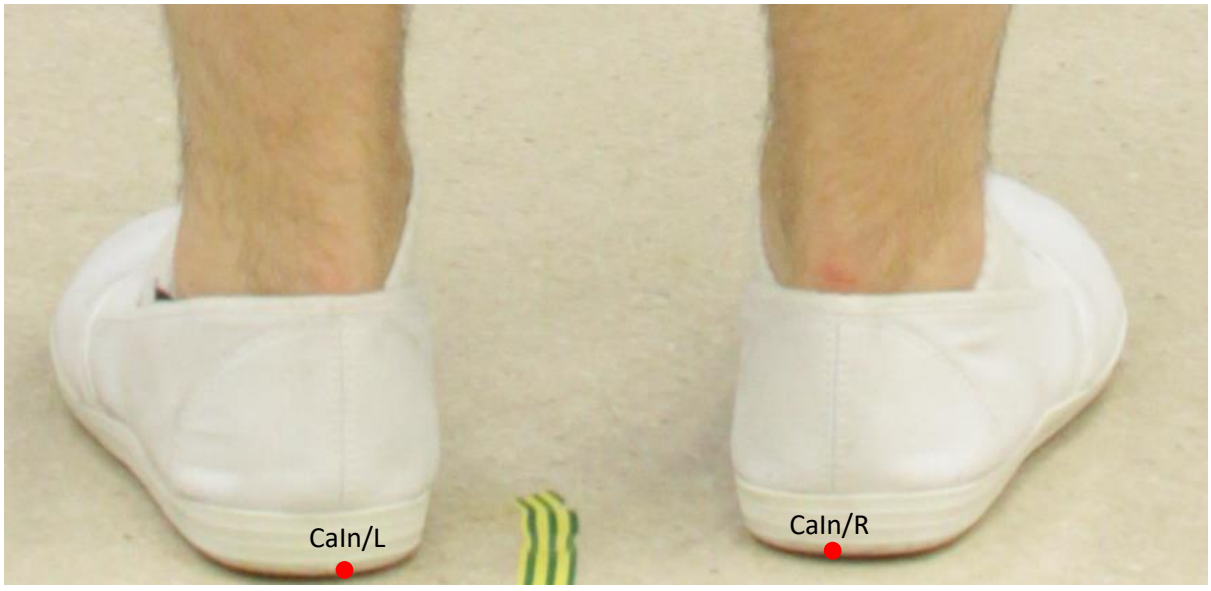


Figure 45 – Location of Inferior Calcaneus with Shoes

18. Crotch (Cr)

Location

The bottom of the pelvis (soft tissue or genitalia), inferior to the pubic tubercle, where the legs articulate with the pelvis of the body. A horizontal line is drawn across the bottom of the pelvis.

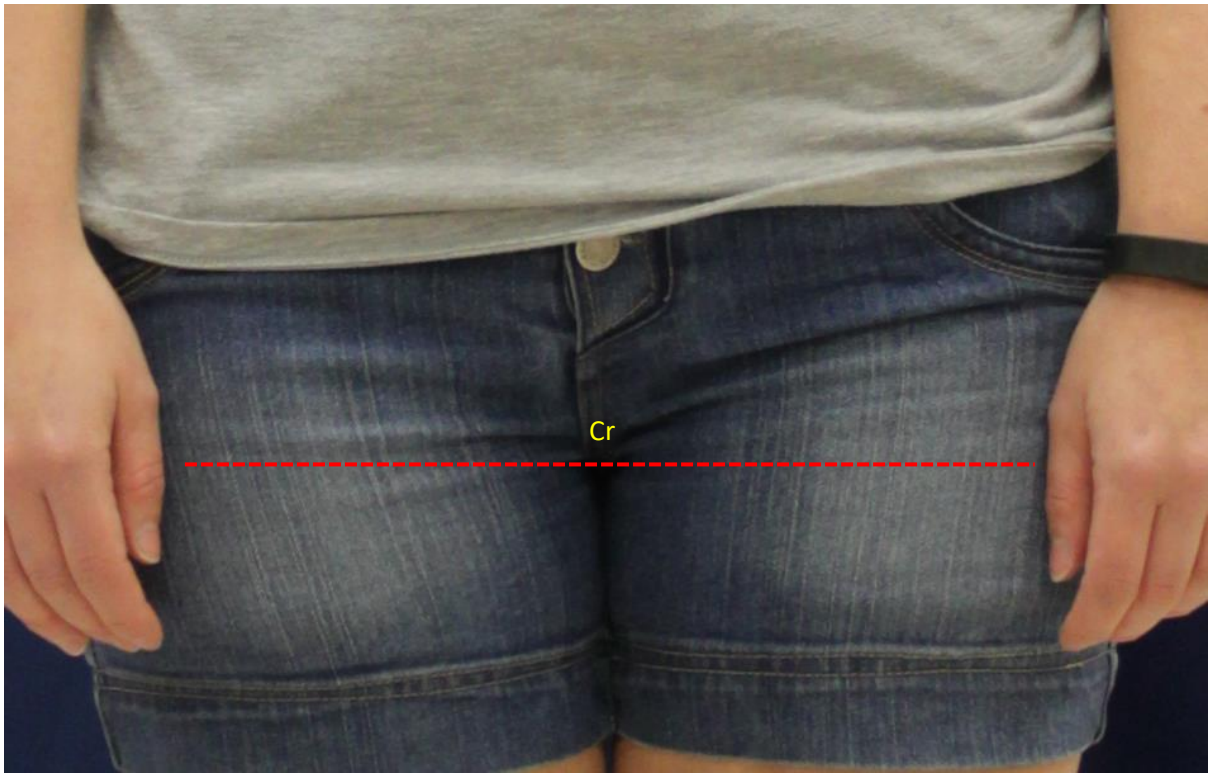


Figure 46 – Location of the Crotch Landmark

19. Greater Trochanter (Gtr)

Location

For the purpose of this manual and research study, the outermost projecting points located on either sides of the hips. A horizontal line is drawn between these points.

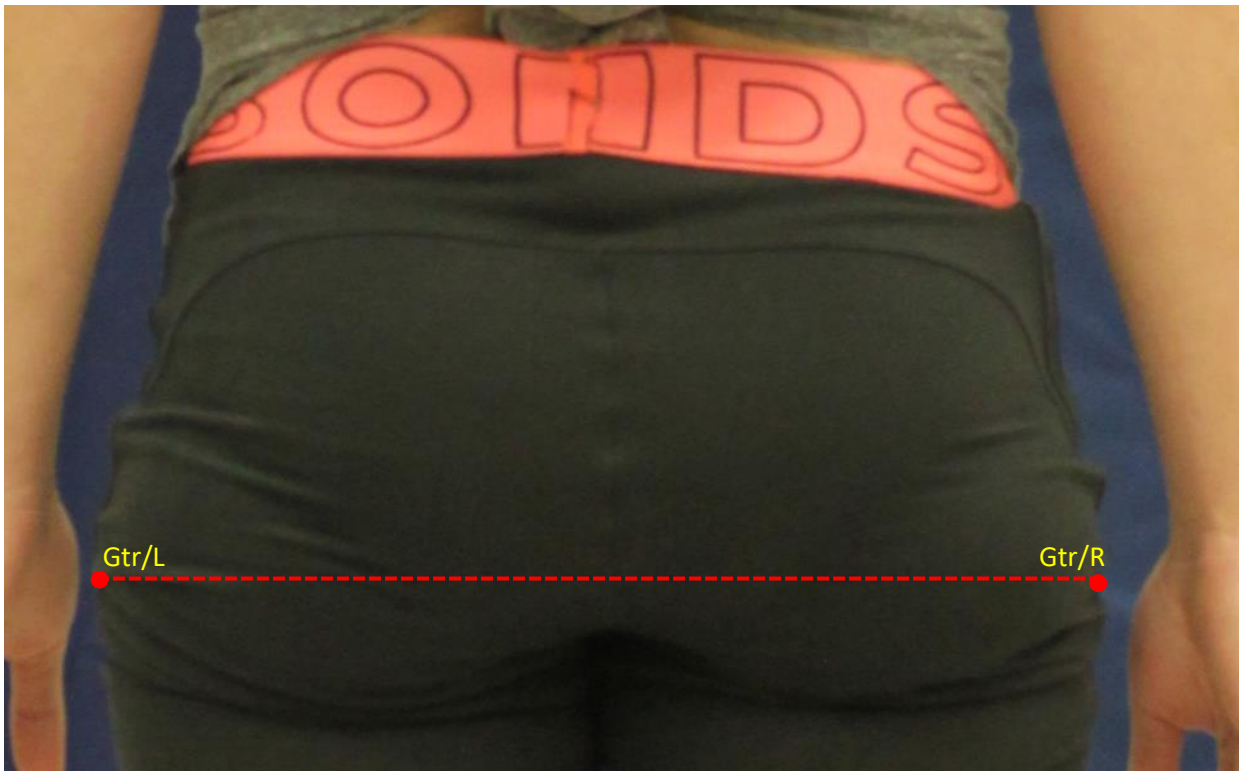


Figure 47 – Location of the Greater Trochanter

20. Vertex (V)

Location

The highest point on the apex of the head. V/F indicates the vertex of the head in anterior view.

Figure 48 – The Vertex

21. Upper Fibres of trapezius Muscle (UFT)

Location

Upper fibres of the trapezius muscle, at the base of the neck, at the centre of where it dips before it follows along the trapezius muscle

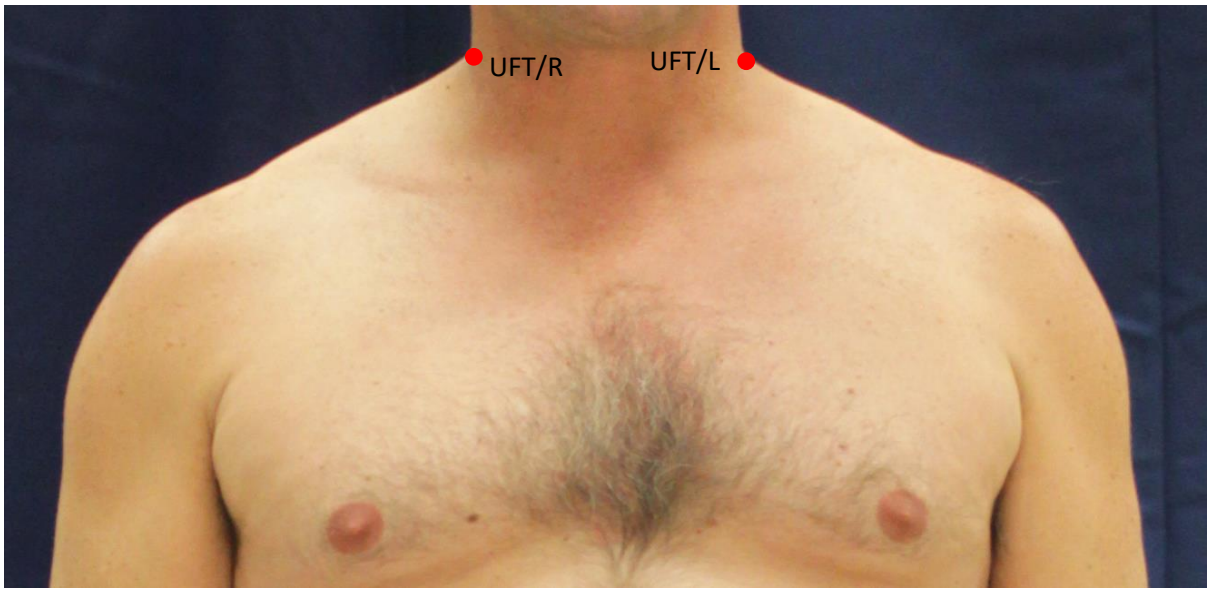


Figure 49 – The location of the anterior margin of the trapezius muscle

22. Jugular Notch (JugN)

Location

The centre of the jugular notch (superior border of the manubrium), located in between both left and right clavicle where a depression in the skin forms a 'V' shape

Figure 50 – The location of the jugular notch

23. Superior Inguinal Region (SupIng)

Location

The centermost point of the superior inguinal region which lines up with the thigh (proximal femur). Where the skin of the upper leg folds (as seen by a dip) from the pelvis region taking a step.

Figure 51 – The location of the superior inguinal ligament

24. Lower Region of Umbilicus (LoUmb)

Location

Below the umbilicus where the hips start flaring out to anatomically accommodate the pelvic bone. The blue dotted line is the umbilicus.

Figure 52 – The location of the lower region of umbilicus

25. Most Inferior Point of Chin (Ch)

Location

The inferior most centre point of the mandible.

Figure 53 – The location of the inferior point of chin

Morphological Assessment/Classifications

Table 8 – Morphological Definitions of Variables

Stance - Morphological Feature	Simple Definition
1. Head Level	The vertical movement and subsequent positioning of the head
2. Lateral Head Tilt	The 'side-to-side' tilting of the head
3. Projection of Head	The aligned or forward displacement of the head relative to plumb line (coronal plane)
4. Head Displacement	The aligned, left or right displacement of the head relative to the plumb line (sagittal plane)
5. Thoracic Projection (bust size)	The levels of thoracic projection
6. Abdominal Projection	The levels of abdominal projection
7. Upper Torso Shape	The shape of the upper torso
8. Torso Musculature	The build of the muscles within the torso
9. Upper Thoracic Curvature	The curvature of the upper back within the upper thoracic region
10. Thoracic Curvature	The curvature of the back within the thoracic region
11. Lumbar Curvature	The curvature of the back within the lumbar region
12. Shoulder Level	The level of the shoulder in relation to the neck
13. Position of Shoulder	The alignment of the shoulder relative to the plumb line (coronal plane)
14. Rotational Position Shoulder	The rotational direction (medial/lateral) the shoulder assumes relative to the plumb line (sagittal plane)
15. Antero-Posterior Placement of Upper Arm	The placement of the upper arm antero-posteriorly relative to the plumb line (coronal plane)
16. Lateral Placement of Upper Arm	The abduction or adduction of the upper arm laterally relative to the plumb line (sagittal plane)
17. Upper Arm Muscle Definition	The build of the muscles within the upper arm
18. Antero-Posterior Placement of Forearm	The antero-posterior placement of the forearm relative to the position over thighs and further relative to the plumb line (coronal plane)
19. Lateral Placement of Forearm	The abduction or adduction of the lower arm laterally relative to the plumb line (sagittal plane)
20. Lateral Rotation of the Forearm	The rotational direction (medial/lateral) , otherwise known as pronation and supination, that the forearm assumes relative to the plumb line (sagittal plane)
21. Lower Arm Muscle Definition	The build of the muscles within the lower arm
22. Antero-Posterior Placement of Hand	The antero-posterior placement of the hand relative to the position over thighs and further relative to the plumb line (coronal plane)
23. Lateral Rotation of the Hand	The rotational direction (medial/lateral) , otherwise known as pronation and supination, that the hand assumes relative to the plumb line (sagittal plane)
24. Finger Flexion	The flexion or extension of the fingers
25. Antero-Posterior Pelvic Tilt	The antero-posterior tilting of the pelvis
26. Lateral Pelvic (Surface Anatomy) Asymmetry	The asymmetry of the surface anatomy of the pelvis, where the pelvis appears higher on the left or right side

27. Gluteal Projection	The levels of gluteal projection
28. Gluteal Shape	The shape of the gluteal region
29. Antero-Posterior Hip Deviation	The hips in relation to the abdomen are either flexed or extended
30. Lateral Hip Deviation	The deviation of the hips laterally (abduction) or medially (adduction)
31. Orientation of Lower Extremities	The levels of genu varum and genu valgum as a result of knee rotation
32. Lateral Placement of Upper Leg	The abduction or adduction of the upper leg laterally relative to the plumb line (sagittal plane)
33. Upper Leg Muscle Definition	The build of the muscles within the upper leg
34. Antero-Posterior Knee Joint Position	The extension or flexion of the knee relative to the plumb line (coronal plane)
35. Position/Orientation of the Knee Joint	The direction (medial/lateral) the knee assumes relative to the plumb line (sagittal plane)
36. Patella Level	The elevated or depressed position the patella assumes, resultant of tendon and adipose distribution
37. Level of Infrapatella Fat Pad	The number of folds and level of adipose tissue distribution (considering the position of the tendon) within the distal (inferior) end of the knee
38. Lateral Placement of Lower Leg	The abduction or adduction of the lower leg laterally relative to the plumb line (sagittal plane)
39. Lower Leg Muscle Definition	The build of the muscles within the lower leg
40. Antero-Posterior Ankle Deviation	The plantarflexion or dorsiflexion of the ankle (giving the appearance of the lower limb of the leg leaning either backward or forward)
41. Lateral Ankle Deviation	The angling of the calcaneus towards (pronation - eversion) or away (supination - inversion) from the sagittal plumb line
42. Placement of Feet	The placement of feet laterally relative to the plumb line (sagittal plane)
43. Lateral Positioning of the feet	The positioning of the lateral area of the feet
44. Somatotype	The general body shape

Head

1. Head level – *Frontal*

The vertical movement and subsequent positioning of the head

Classification	Number	Description
Tilted down	1	The head gravitates down towards the neck
Facing ahead	2	The head is facing directly ahead, neither tilted down towards the neck nor upwards away from the neck
Tilted up	3	The head gravitates up and away from the neck

Figure 54 – Tilted Down

Figure 55 – Facing Ahead

Figure 56 – Tilted Up

2. Lateral head tilt - *Profile*

The 'side-to-side' tilting of the head. This measurement does not currently include the variability associated with hair style

Classification	Number	Description
Tilted left	1	The head gravitates away from the sagittal plane to the left
Centered	2	The head is in line with the sagittal plane
Tilted right	3	The head gravitates away from the sagittal plane to the right

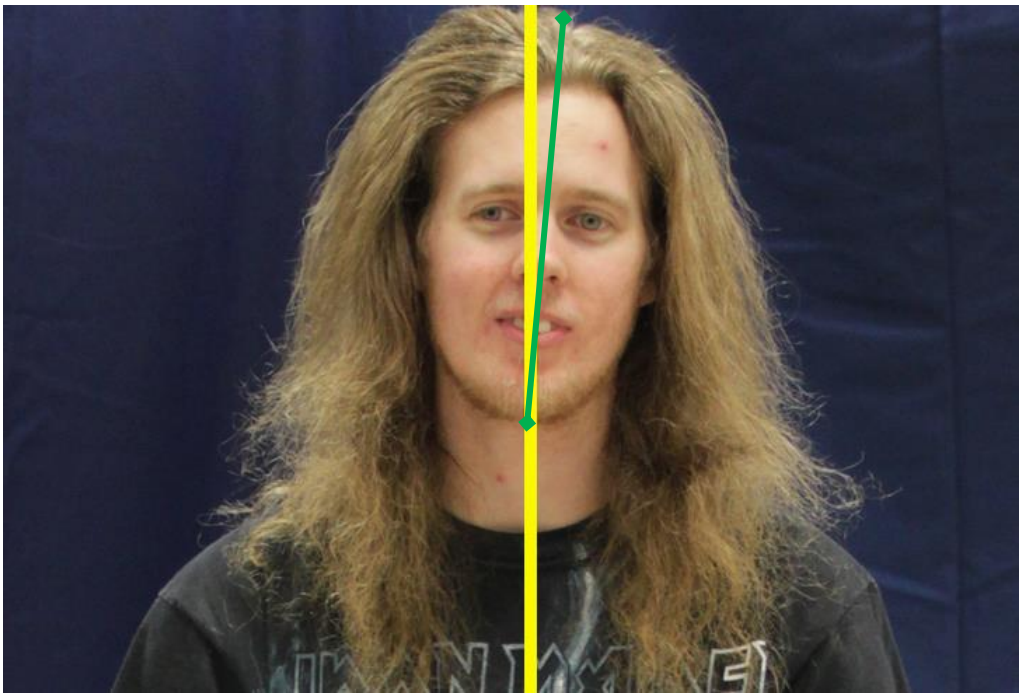


Figure 57 – Tilted Left

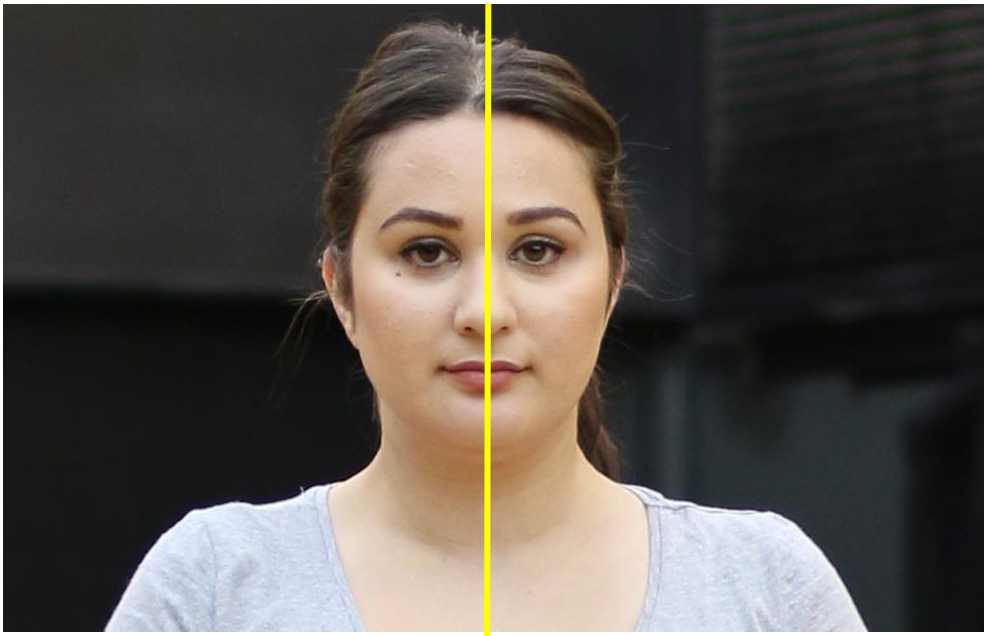


Figure 58 – Centred

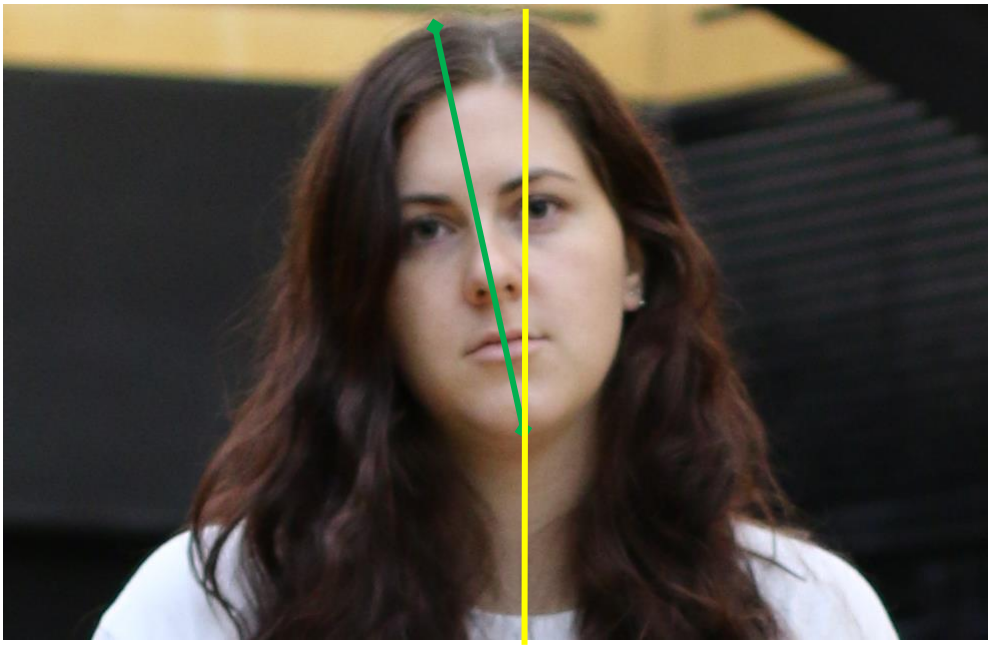


Figure 59 – Tilted Right

3. Projection of Head – *Profile* (adapted from Bradshaw, 2007)

The aligned or forward displacement of the head relative to plumb line (coronal plane)

Classification	Number	Description
Neutral	1	The head is in alignment with the plumb line (coronal) and no displacement is observed
Slight forward projection	2	The head projects forward in displacement, past the neutral alignment of the plumb line (plumb line still on ear)
Marked forward projection	3	The head markedly projects forward in displacement, further past the neutral alignment of the plumb line (plumb line does not run along ear)

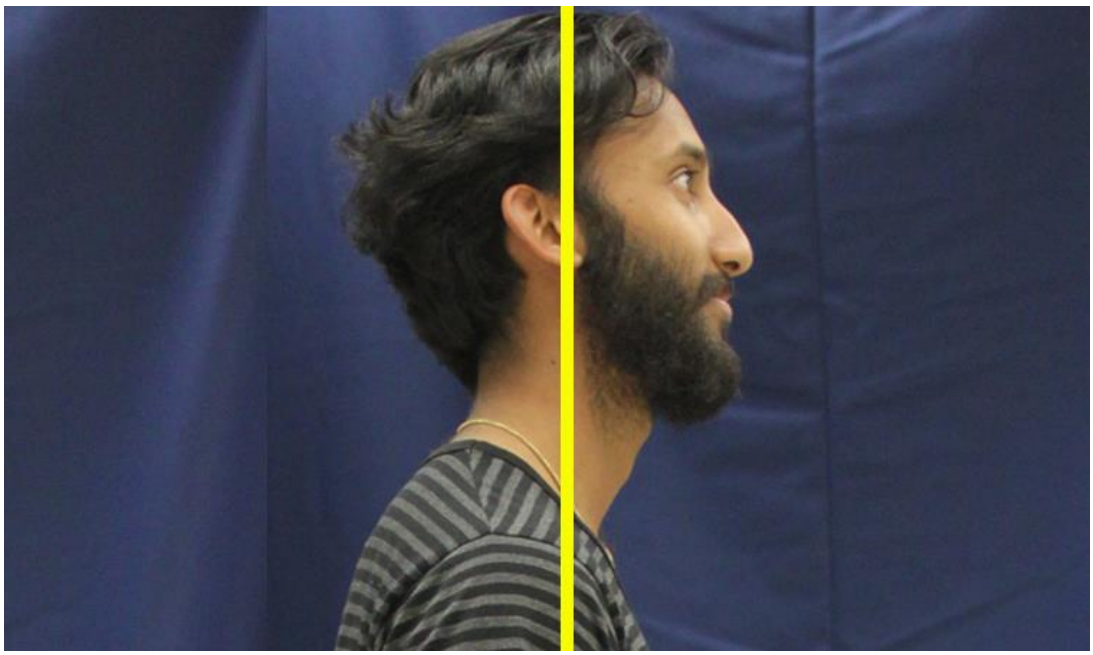


Figure 60 – Neutral

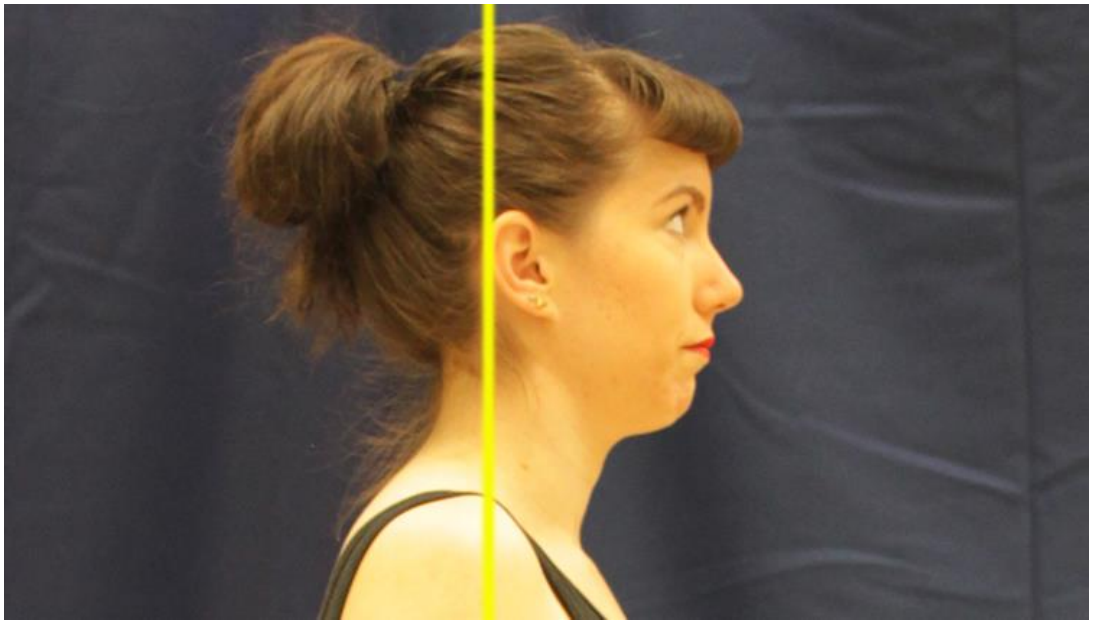


Figure 61 – Slight Forward Projection

Figure 62 – Marked Forward Projection

4. Head Displacement – *Frontal* (adapted from Wright, 2012)

The aligned, left or right displacement of the head relative to the plumbline (sagittal plane)

Classification	Number	Description
Right Displacement	1	The head is positioned more to the right of the plumb line, leading to a displacement
Central	2	The head is in alignment with the plumb line (sagittal) and no displacement is observed
Left Displacement	3	The head is positioned more to the left of the plumb line, leading to a displacement

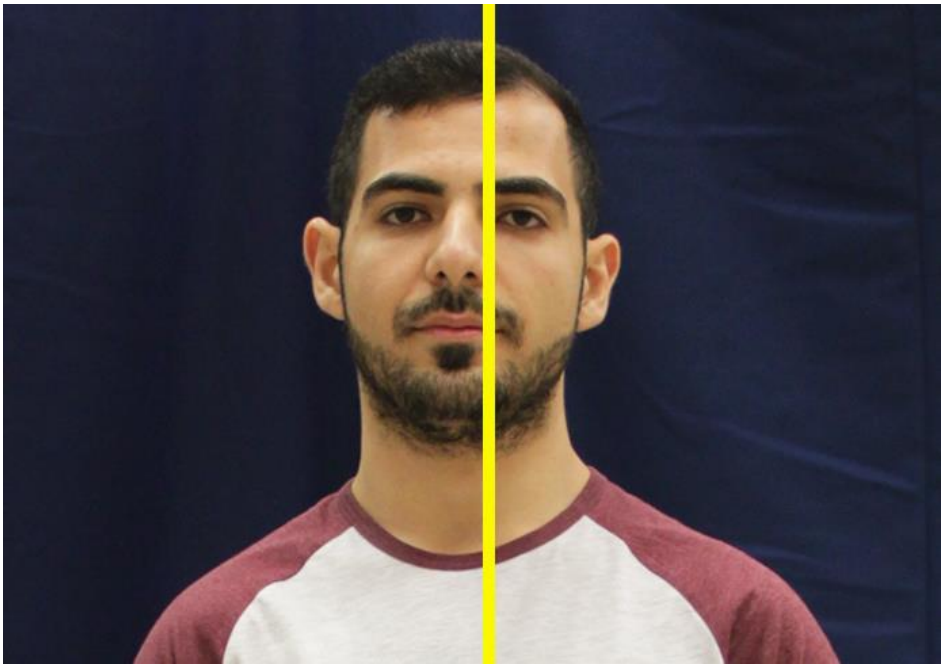


Figure 63 – Right Displacement

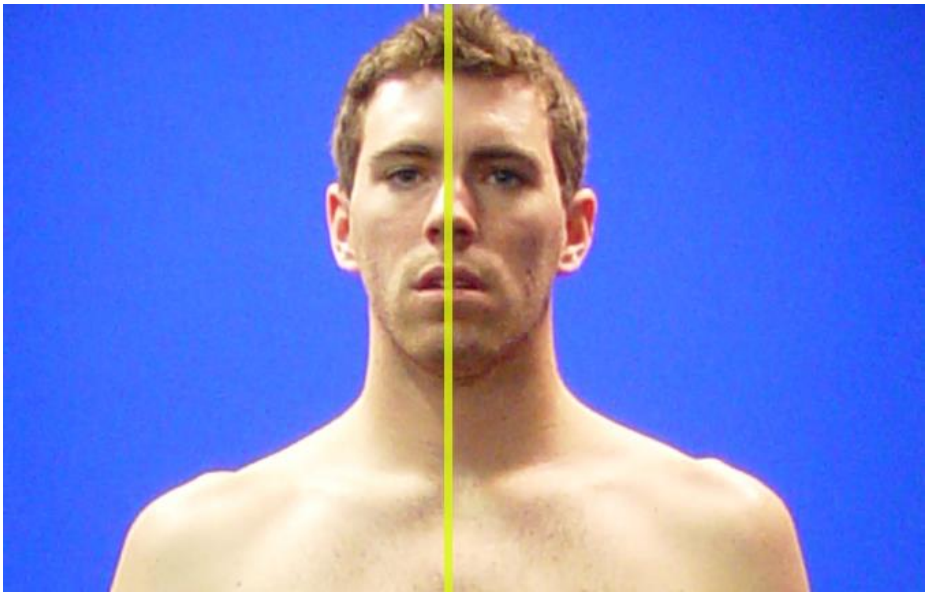


Figure 64 – Central

Figure 65 – Left Displacement

Torso

5. Thoracic Projection (bust size) - *Profile*

The levels of thoracic projection

Classification	Number	Description
Flat	1	The thoracic region (bust size) is flat where no/minimal projection is observed relative to the abdominal region
Slightly Projecting	2	The thoracic region (bust size) projects slightly, past the point of the relative abdominal region
Markedly Projecting	3	The thoracic region (bust size) projects markedly, past the point of the relative abdominal region

Figure 66 – Flat

Figure 67 – Slightly Projecting

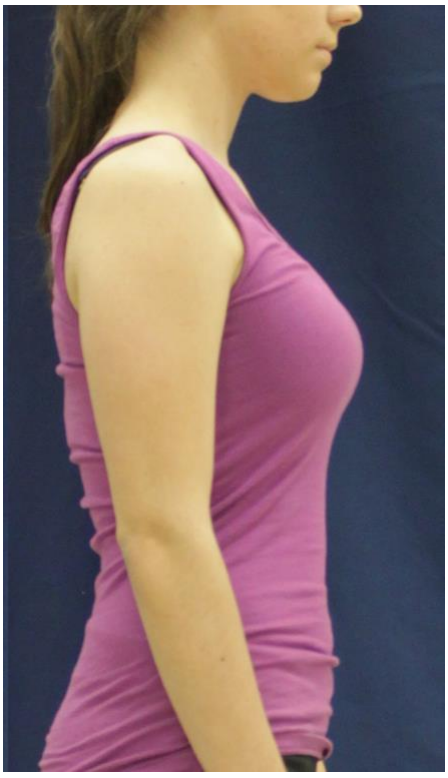


Figure 68 – Markedly Projecting

6. Abdominal Projection - *Profile*

The levels of abdominal projection

Classification	Number	Description
Flat	1	The abdominal region is flat where no/minimal projection is observed relative to the pelvic region
Slightly Projecting	2	The abdominal region projects slightly, past the point of the relative pelvic region
Markedly Projecting	3	The abdominal region projects markedly, past the point of the relative pelvic region

Figure 69 – Flat

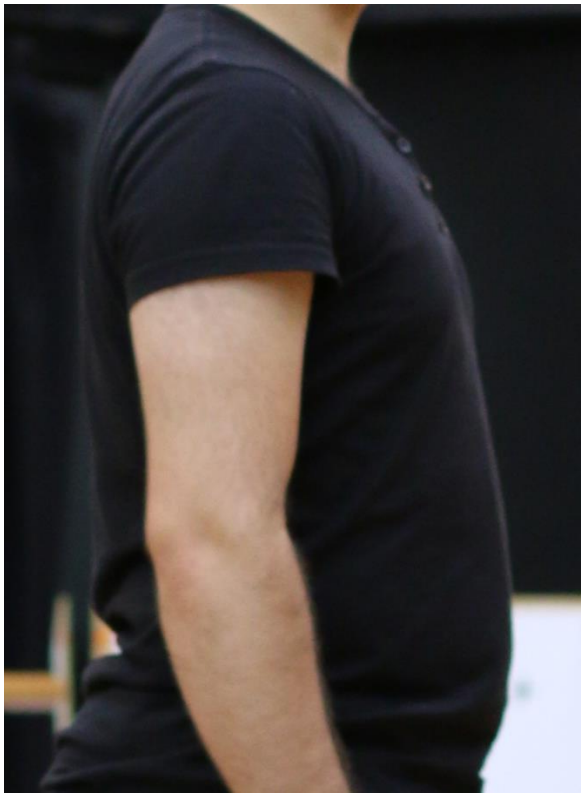


Figure 70 – Slightly Projecting

Figure 71 – Markedly Projecting

7. Upper Torso Shape - *Frontal*

The shape of the upper torso

Classification	Number	Description
V Shape	1	The 'V' shape of the upper torso as a result of anatomical structure
Rectangle	2	The rectangular or 'square-like' shape of the upper torso as a result of anatomical structure
A Shape	3	The 'A' shape of the upper torso as a result of anatomical structure and the overlaying adipose tissue that is generally observed in the 'A' shape

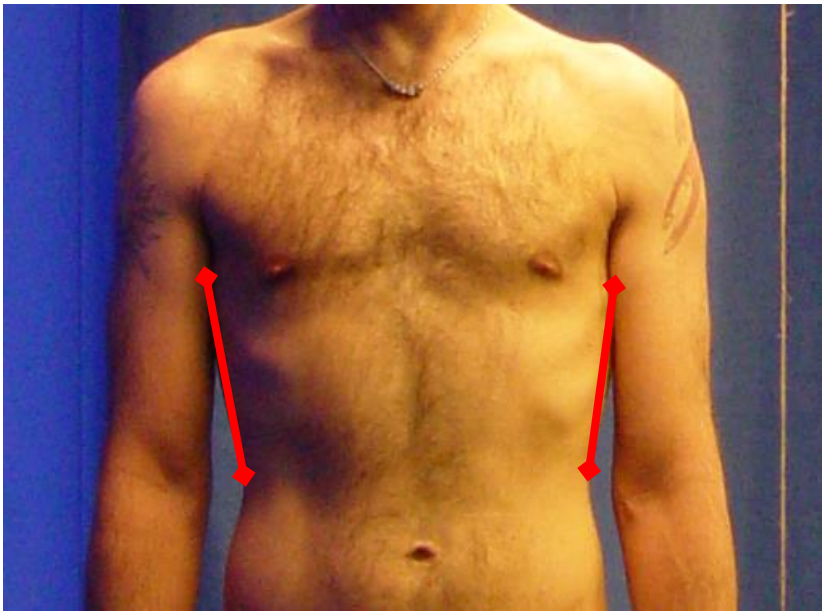


Figure 72 – V Shape

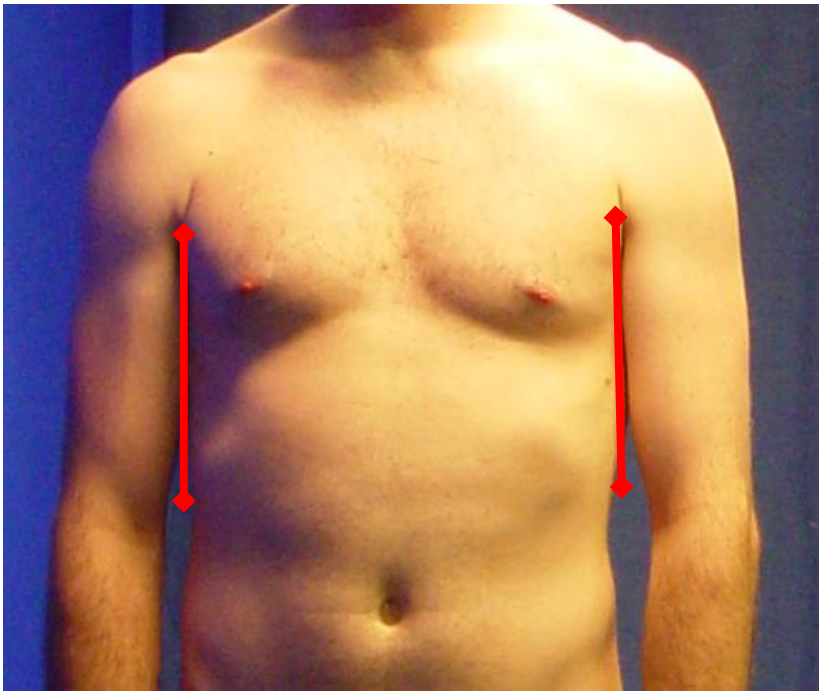


Figure 73 – Rectangle

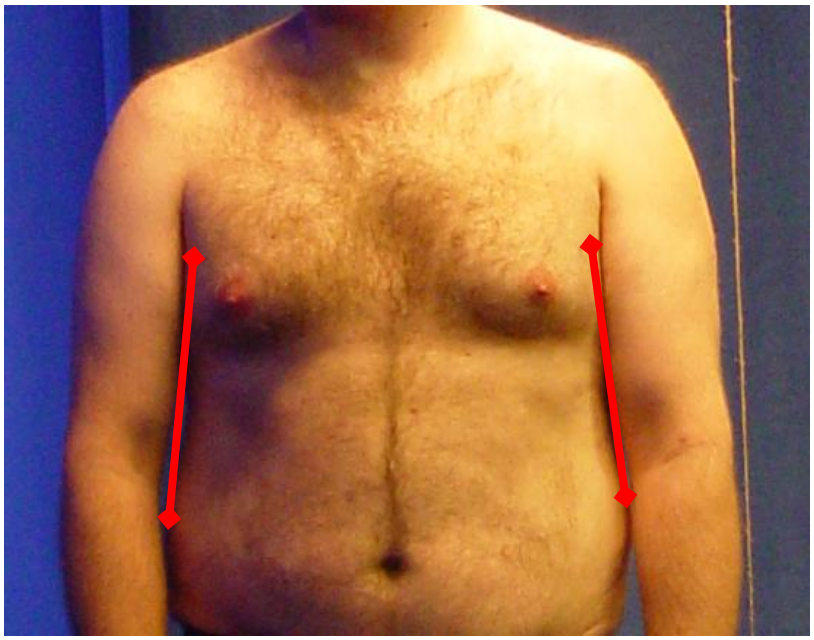


Figure 74 – A Shape

8. Torso Musculature - *Frontal*

The build of the muscles within the torso

Classification	Number	Description
Underdeveloped	1	The build/contours of the muscles are not visible due to lack in muscle size and definition
Developed	2	The build and contours of the muscles in the arm are visible and projecting due to minimal fat with well-developed muscles
Overlaying Adipose	3	The build/contours of the muscles are not visible due to fatty tissue overlaying the muscle

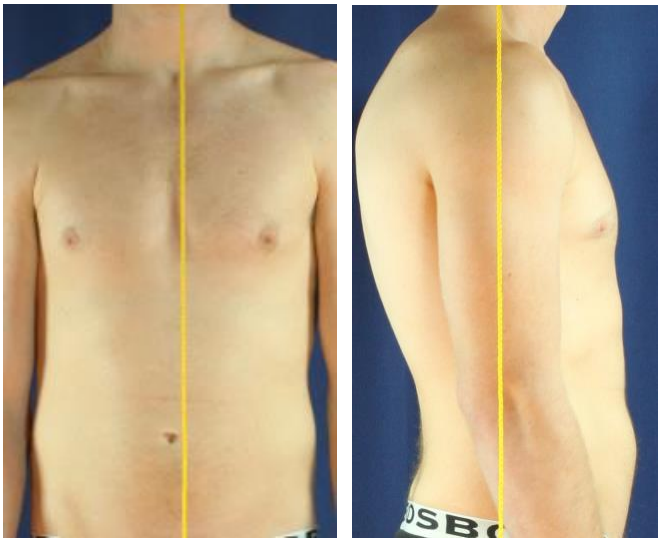


Figure 75 – Underdeveloped

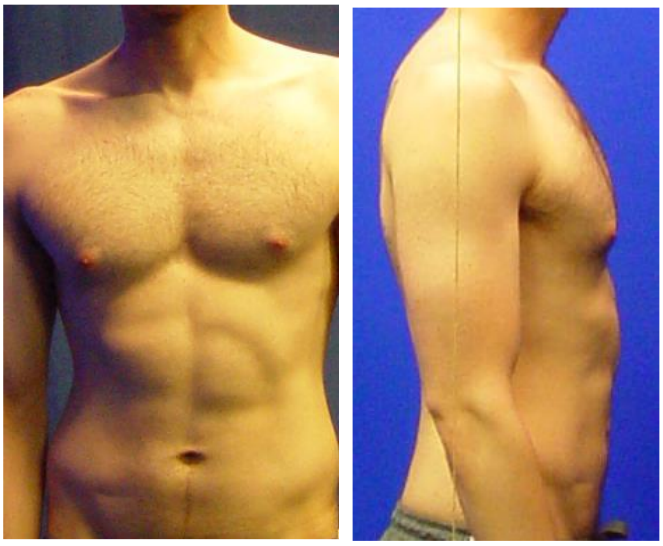


Figure 76 – Developed

Figure 77 – Overlaying Adipose

Posture

9. Upper Thoracic Curvature – *Profile* (adapted from Bradshaw, 2007)

The curvature of the upper back within the upper thoracic region

Classification	Number	Description
Curved	1	The posteriorly curved appearance of the upper thoracic region, which can present the appearance of a 'hunch' due to anatomical structure, or overlaying adipose tissue
Neutral	2	The neutral appearance of the upper thoracic region, can be observed to be slightly curved (convex)
Flattened	3	The flattened appearance of the upper thoracic region, can be observed to be straight in structure

Figure 78 – Curved

Figure 79 – Neutral

Figure 80 – Flattened

10. Thoracic Curvature – *Profile* (adapted from Bradshaw, 2007)

The curvature of the back within the thoracic region

Classification	Number	Description
Curved	1	The exaggerated posterior curvature of the thoracic spine (kyphosis)
Neutral	2	The neutral appearance of the thoracic region, can be observed to be slightly curved (convex)
Flattened	3	The flattened appearance of the thoracic region, can be observed to be visibly flattened in structure

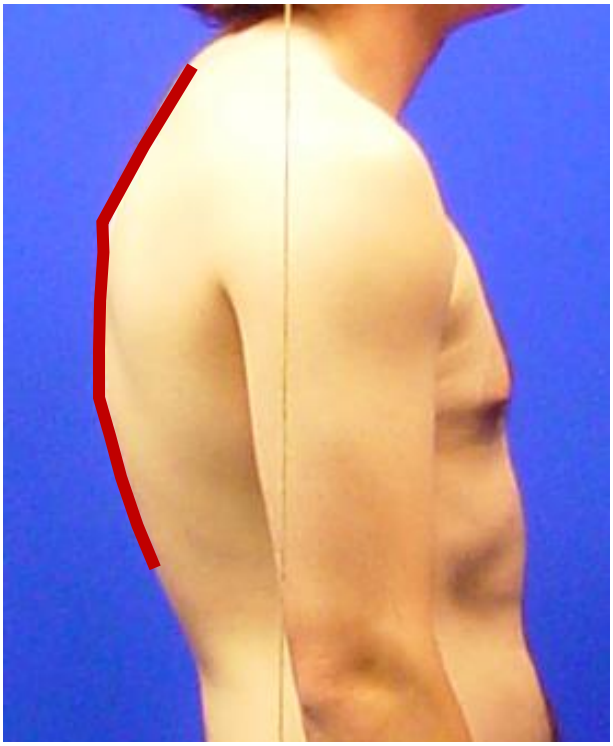


Figure 81 – Curved

Figure 82 – Neutral

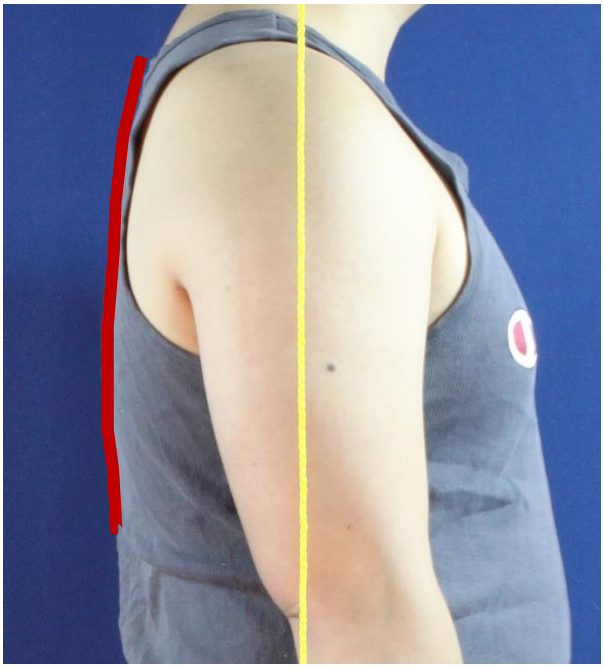


Figure 83 – Flattened

11. Lumbar Curvature – *Profile* (adapted from Bradshaw, 2007)

The curvature of the back within the lumbar region

Classification	Number	Description
Curved	1	The exaggerated anterior curvature (towards midline of torso) of the lumbar spine
Normal	2	The neutral appearance of the lumbar region, can be observed to be slightly curved
Flattened	3	The flattened appearance of the lumbar region, can be observed to be relatively flattened in structure

Figure 84 – Curved

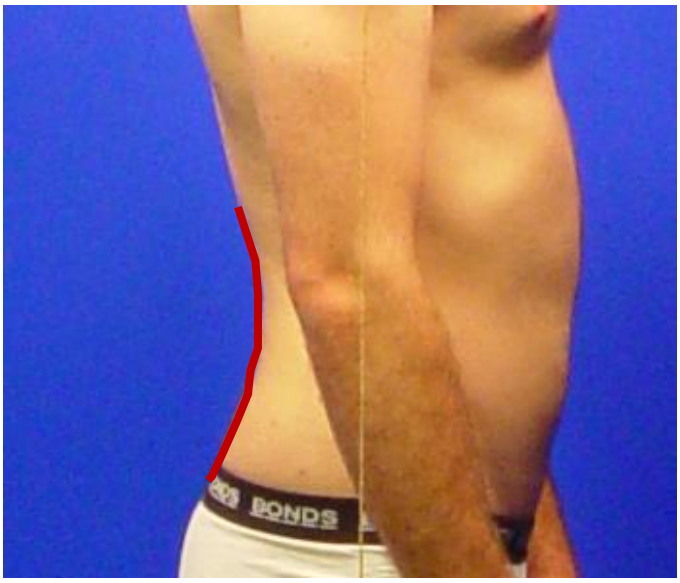


Figure 85 – Normal

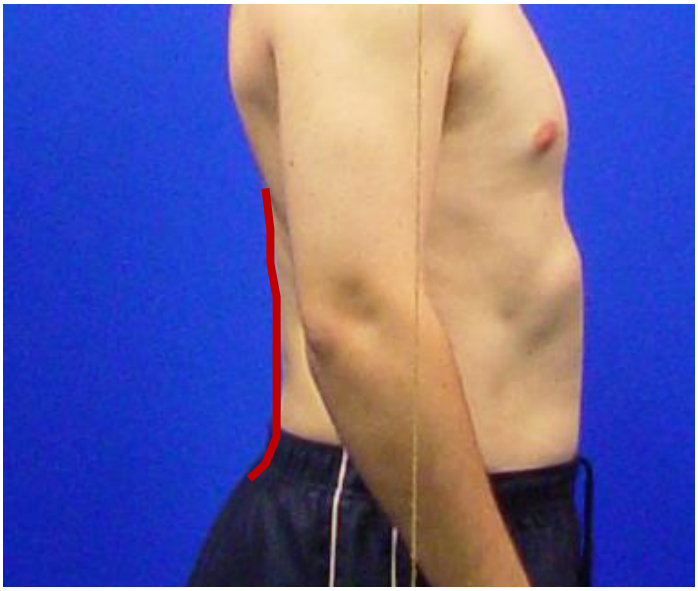


Figure 86 – Flattened

Shoulder

12. Shoulder Level - *Posterior*

The level of the shoulder in relation to the neck

Classification	Number	Description
Lowered	1	A markedly visible downward angle (depression) of the shoulder, measured >20 degree angle
Neutral	2	A medium downward angle of the shoulder, measured at approximately 15 - 20 degree angle
Raised	3	A markedly visible elevation of the shoulder, measured <15 degree angle

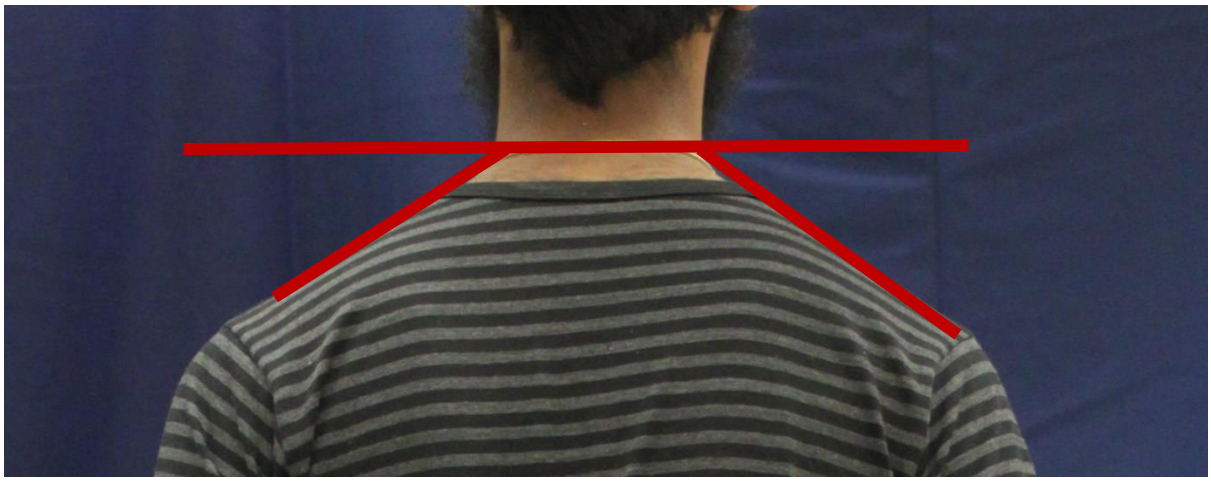


Figure 87 – Lowered

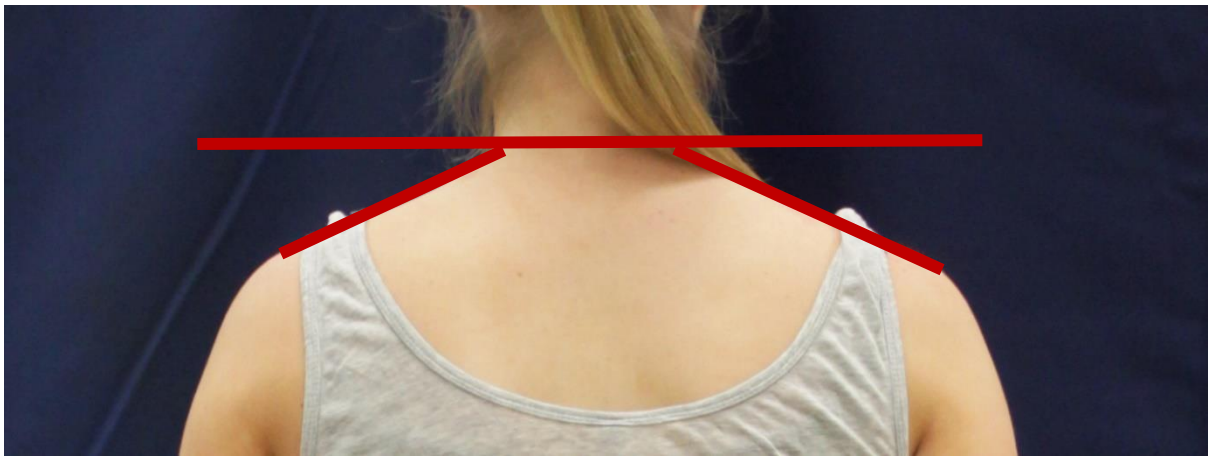


Figure 88 – Neutral

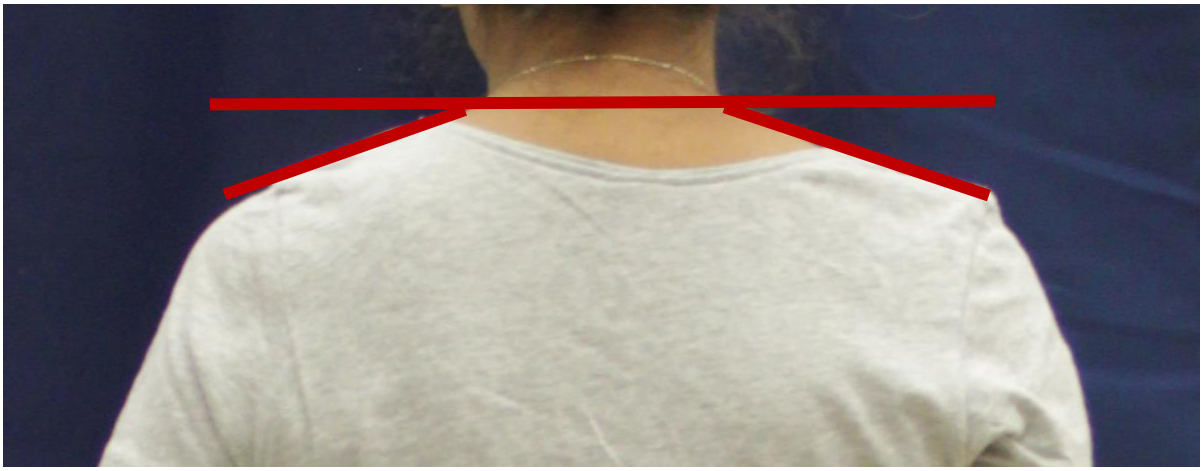


Figure 89 – Raised

13. Position of Shoulder - *Profile*

The alignment of the shoulder relative to the plumbline (coronal plane)

Classification	Number	Description
Posterior	1	The shoulder falls posterior to plumb line
Neutral	2	The plumb line runs through the middle of the shoulder
Anterior	3	The shoulder falls anterior to plumb line

Figure 90 – Posterior Shoulder Position

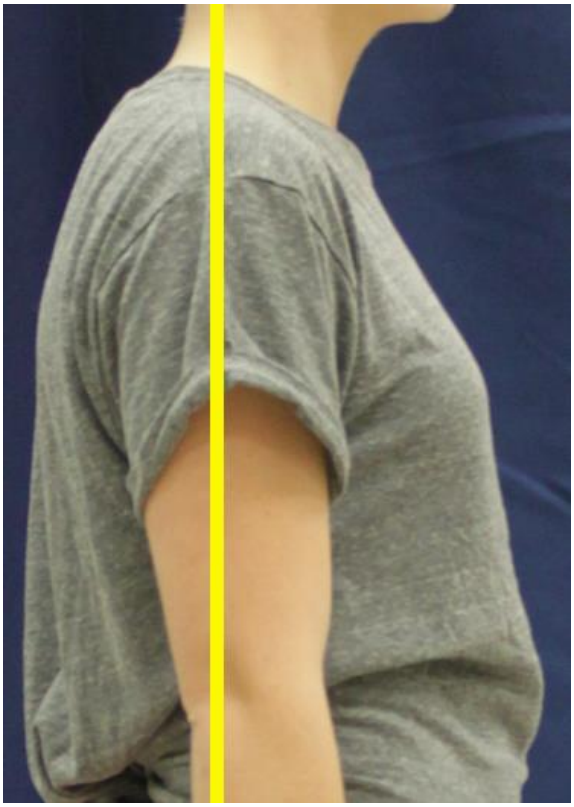


Figure 91 – Neutral Shoulder Position

Figure 92 – Anterior Shoulder Position

14. Rotational Position Shoulder - *Frontal*

The rotational direction (medial/lateral) the shoulder assumes relative to the plumbline (sagittal plane)

Classification	Number	Description
Medial Rotation	1	The shoulder rotates medially towards sagittal plumb line assuming a 'hunched' appearance
Neutral	2	The shoulder does not rotate medially nor laterally
Lateral Rotation	3	The shoulder rotates laterally away from sagittal plumb line assuming a 'military' appearance

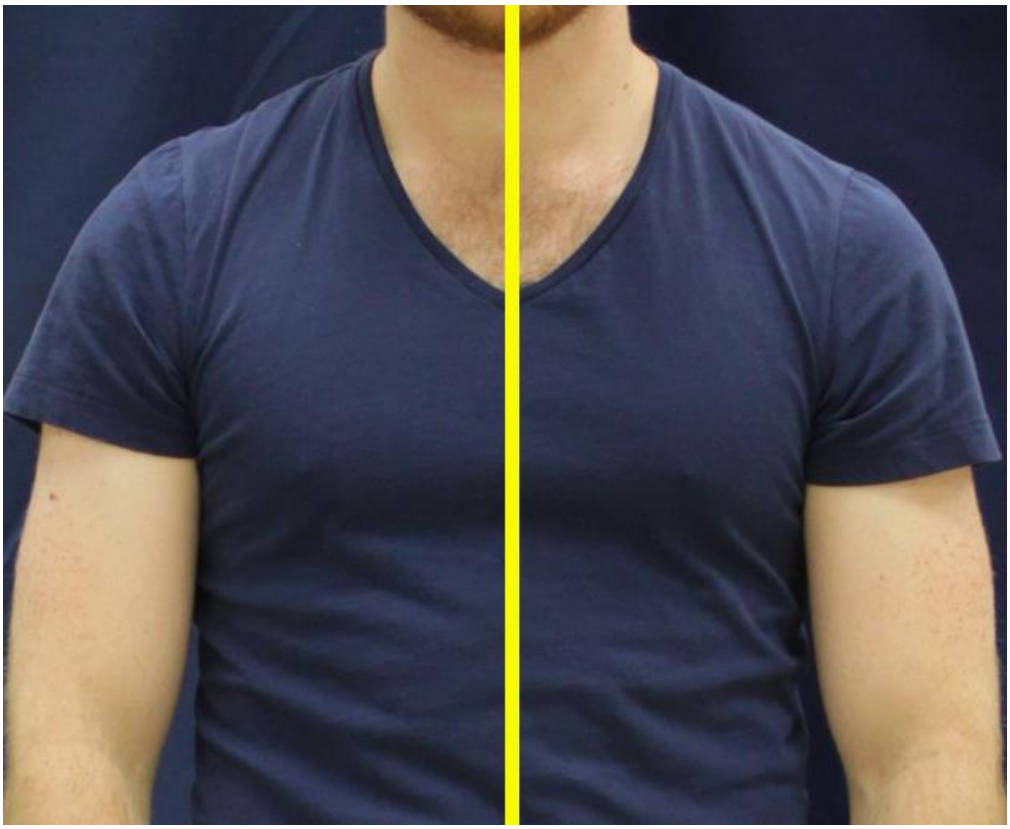


Figure 93 – Medial Rotation of Upper Arm/Shoulder

Figure 94 – Neutral Rotation of Upper Arm/Shoulder

Figure 95 – Lateral Rotation of Upper Arm/Shoulder

Upper Arm

15. Antero-Posterior Placement of Upper Arm - *Profile* (adapted by Wright, 2012)

The placement of the upper arm antero-posteriorly relative to the plumbline (coronal plane)

Classification	Number	Description
Posterolateral	1	The upper arm falls posterior to coronal plumb line
Lateral	2	The upper arm falls in the middle of the coronal plumb line
Slightly Anterolateral	3	The upper arm falls slightly anterior to coronal plumb line
Markedly Anterolateral	4	The upper arm falls markedly anterior to coronal plumb line

Figure 96 – Posterior Placement of Upper Arm

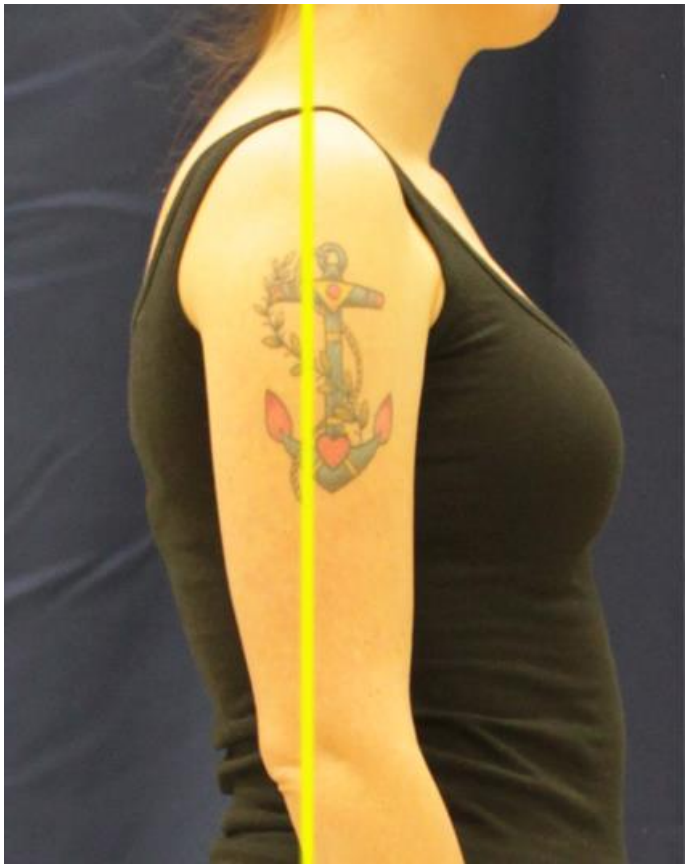


Figure 97 – Lateral Placement of Upper Arm

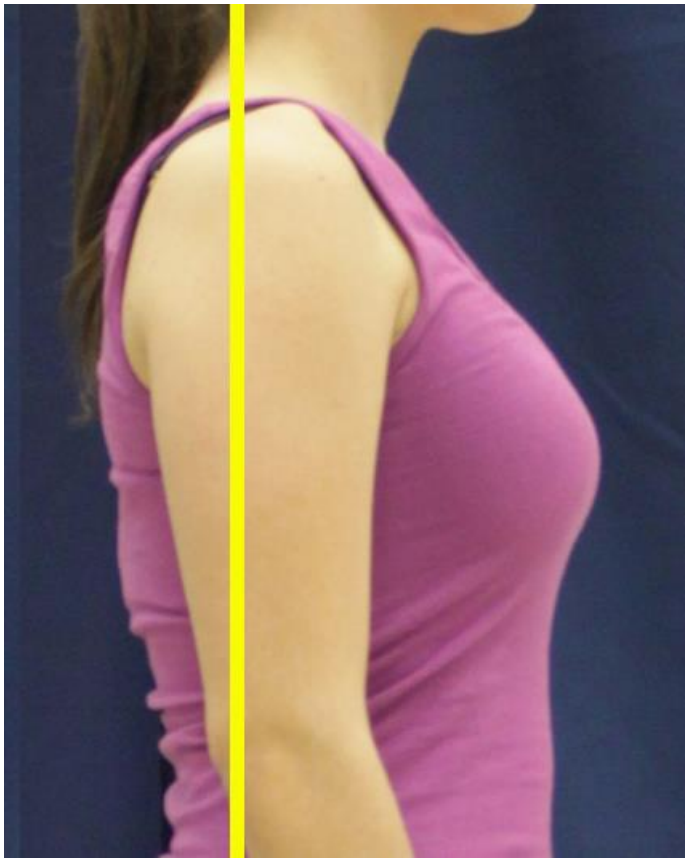


Figure 98 – Slight Anterior Placement of Upper Arm

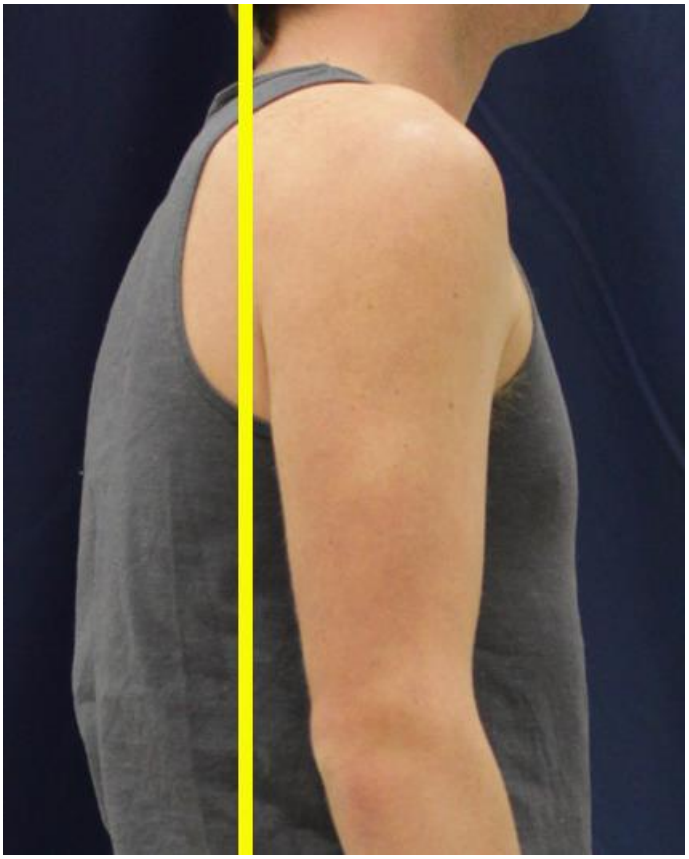


Figure 99 – Marked Anterior Placement of Upper Arm

16. Lateral Placement of Upper Arm - *Frontal*

The abduction or adduction of the upper arm laterally relative to the plumbline (sagittal plane)

Classification	Number	Description
Abduction	1	The upper arm deviates away from the torso of the body and the plumb line with increased space between body and arms
Neutral	2	The arms rest naturally by the sides of the torso and neither abducts nor adducts. Space between arms and torso is minimal
Adduction	3	The upper arm is positioned closely towards the torso of the body, with minimal space visible between body and arms

Figure 100 – Upper Arm Abducted

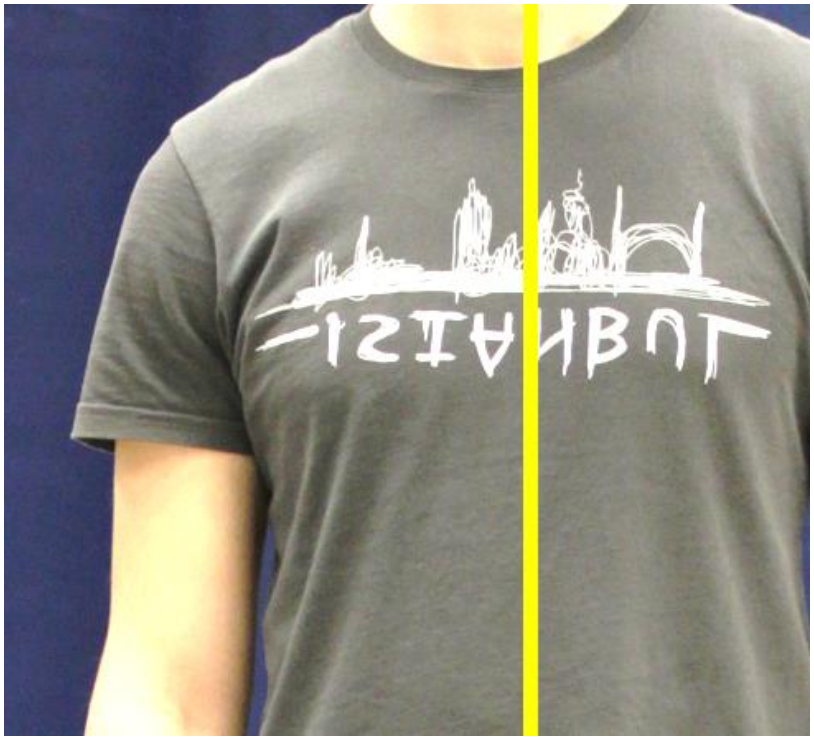


Figure 101 – Upper Arm Neutral

Figure 102 – Upper Arm Adducted

17. Upper Arm muscle definition - *Frontal*

The build of the muscles within the upper arm

Classification	Number	Description
Underdeveloped	1	The build/contours of the muscles are not visible due to lack in muscle size
Developed	2	The build and contours of the muscles in the arm are visible and projecting due to minimal fat with well-developed muscles
Overlaying Adipose	3	The build/contours of the muscles are not visible due to fatty tissue overlaying the muscle

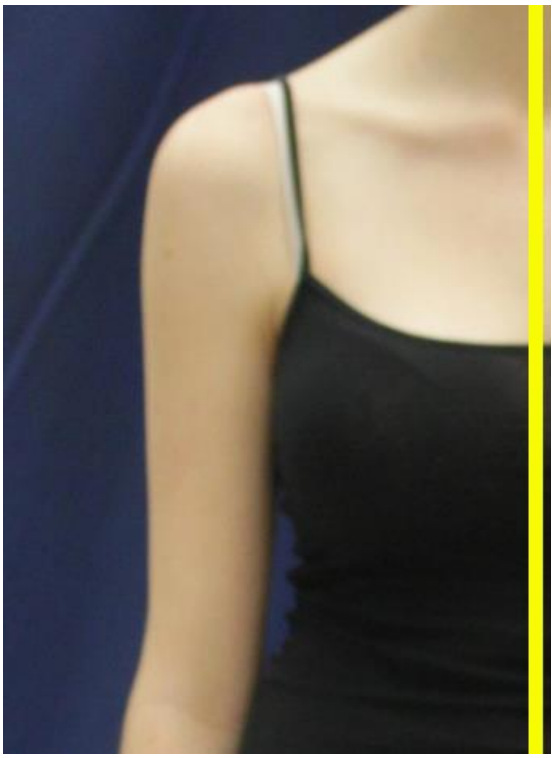


Figure 103 – Underdeveloped Upper Arm Muscle Definition

Figure 104 – Developed Upper Arm Muscle Definition

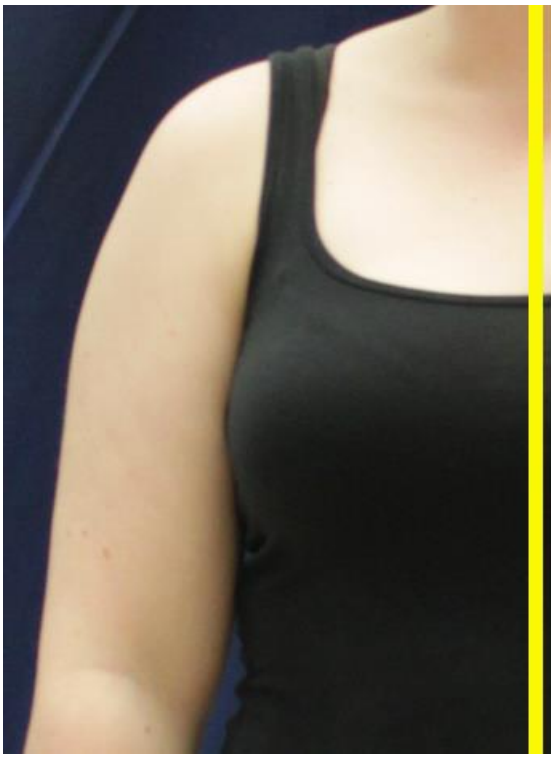


Figure 105 – Overlaying Adipose Upper Arm Muscle Definition

Forearm

18. Antero-Posterior placement of forearm - *Profile*

The antero-posterior placement of the forearm relative to the position over thighs and further relative to the plumbline (coronal plane)

Classification	Number	Description
Posterolateral	1	The forearm falls primarily posterior to the coronal plumb line
Lateral	2	The forearm falls in the middle (through) the coronal plumb line
Slightly Anterolateral	3	The forearm falls slightly anterior to coronal plumb line
Markedly Anterolateral	4	The forearm falls markedly anterior to coronal plumb line

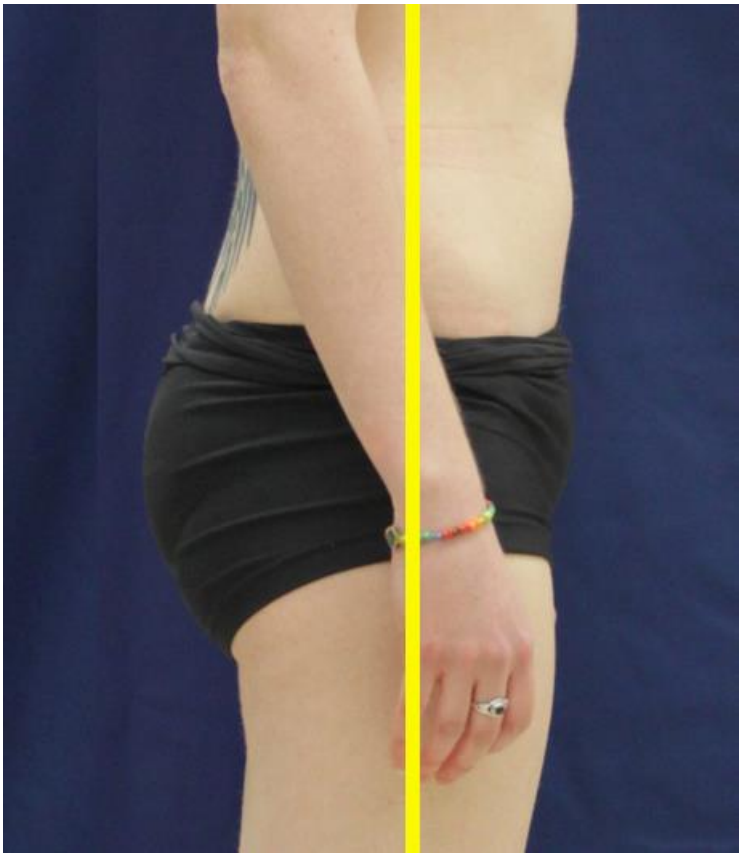


Figure 106 – Forearm is Posterolateral to Thighs

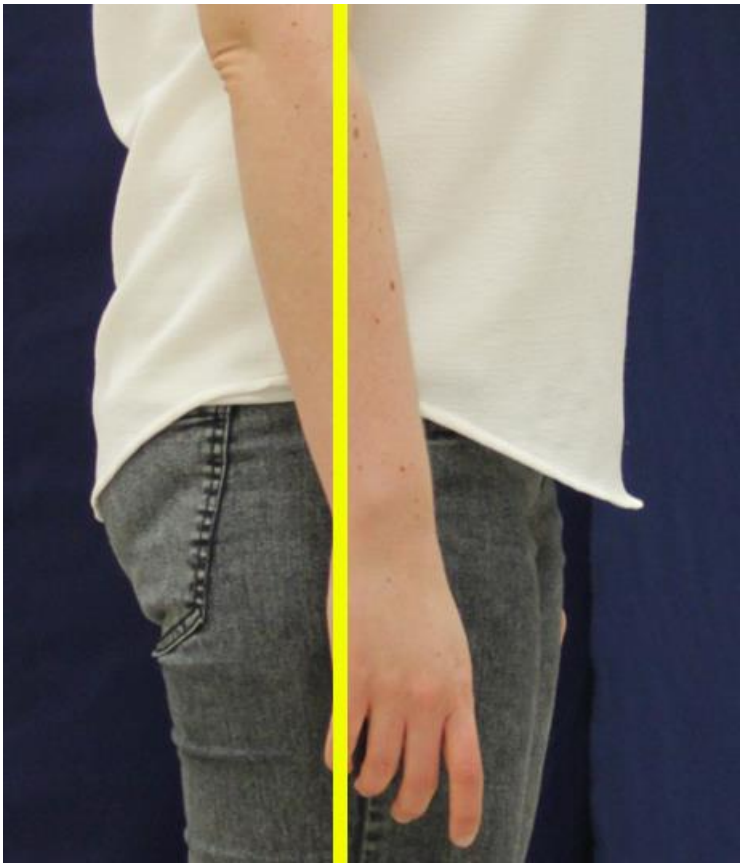


Figure 107 – Forearm is Lateral to Thighs

Figure 108 – Forearm is Slightly Anterolateral to Thighs

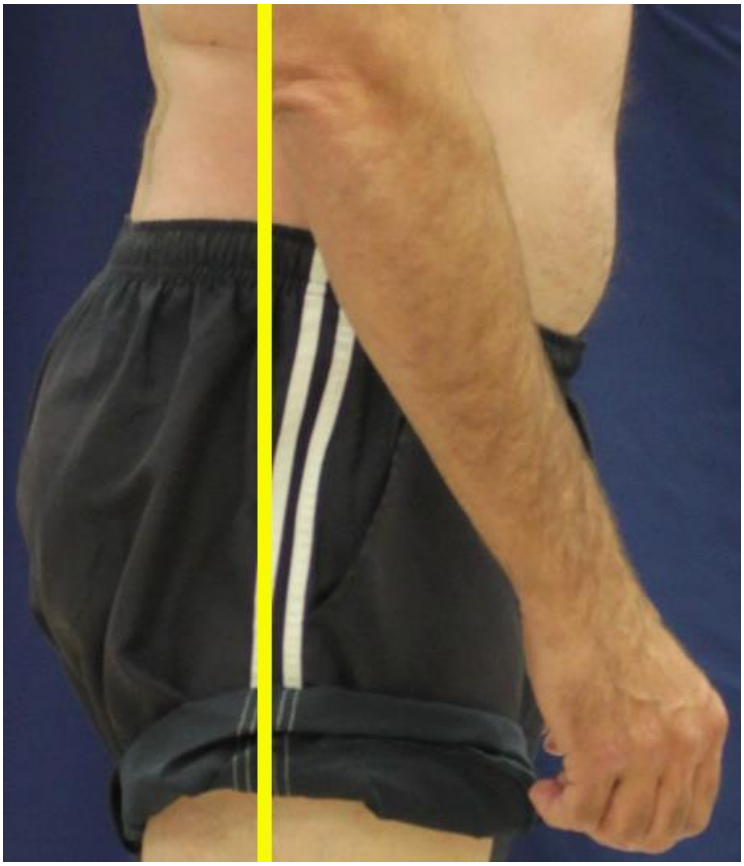


Figure 109 – Forearm is Markedly Anterolateral to Thighs

19. Lateral placement of the forearm - *Frontal*

The abduction or adduction of the lower arm laterally relative to the plumbline (sagittal plane)

Classification	Number	Description
Abduction	1	The forearm deviates away from the torso of the body and the plumb line with increased space between body and forearm
Neutral	2	The forearm rests naturally by the sides of the torso and neither abducts nor adducts. Space between forearm and torso is minimal
Adduction	3	The forearm is positioned closely towards the torso of the body, with minimal space visible between body and arms

Figure 110 – Lateral Abduction of Forearm

Figure 111 – Neutral Lateral Placement of Forearm

Figure 112 – Lateral Adduction of Forearm

20. Lateral rotation of the forearm - *Frontal*

The rotational direction (medial/lateral), otherwise known as pronation and supination, that the forearm assumes relative to the plumbline (sagittal plane)

Classification	Number	Description
Medial Rotation	1	The forearm rotates medially towards plumb line (where the ulna and radius is in pronation)
Neutral	2	The forearm does not rotate medially nor laterally
Lateral Rotation	3	The forearm rotates laterally away from plumb line (where the ulna is in supination)

Figure 113 – Medial Rotation of Forearm

Figure 114 – Neutral Forearm Rotation

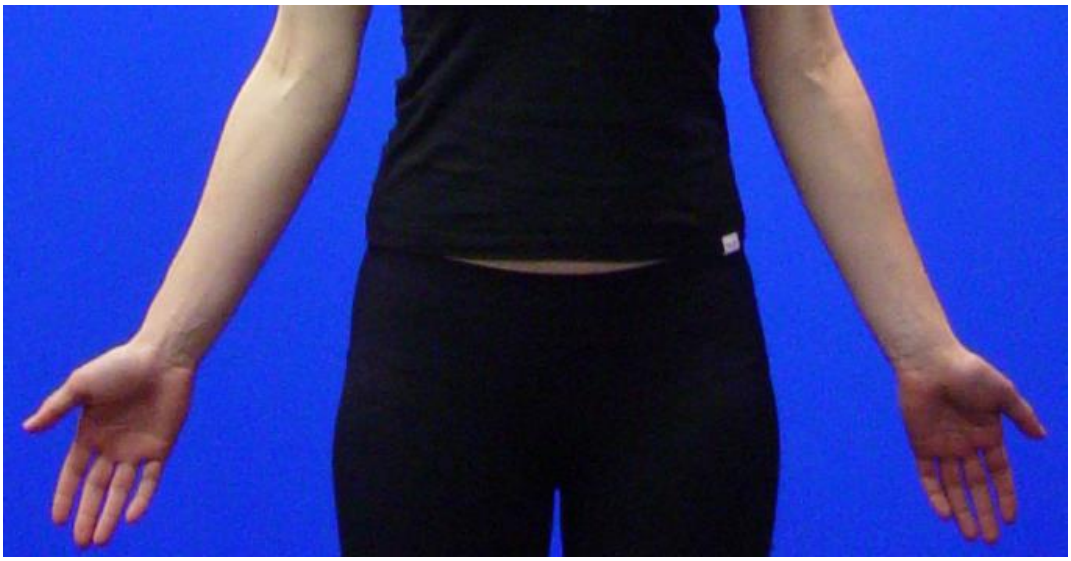


Figure 115 – Lateral Rotation of Forearm

21. Lower arm muscle definition - *Frontal*

The build of the muscles within the lower arm

Classification	Number	Description
Underdeveloped	1	The build/contours of the muscles are not visible due to lack in muscle size
Developed	2	The build and contours of the muscles in the arm are visible and projecting due to minimal fat with well-developed muscles
Overlaying Adipose	3	The build/contours of the muscles are not visible due to fatty tissue overlaying the muscle

Figure 116 – Underdeveloped Muscle Definition of Forearm

Figure 117 – Developed Muscle Definition of Forearm

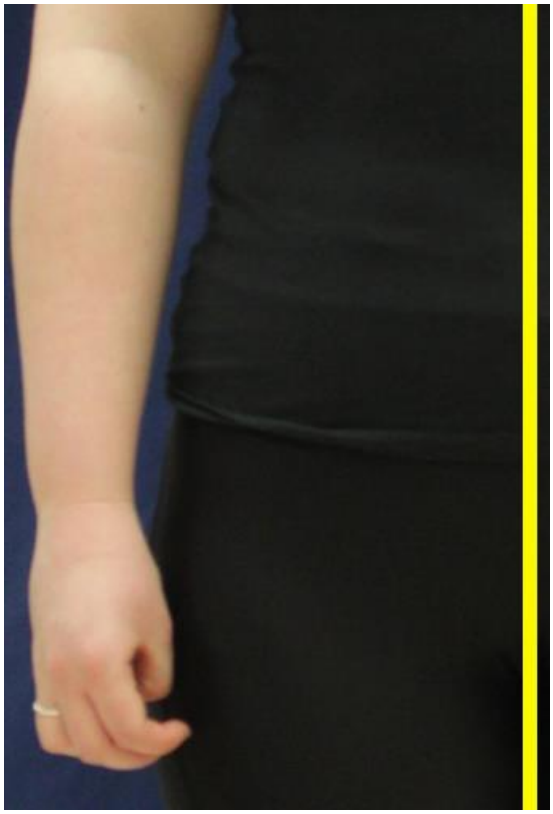


Figure 118 – Overlaying Adipose Muscle Definition of Forearm

Hand

22. Antero-Posterior placement of Hand - *Profile* (adapted by Wright, 2012)

The antero-posterior placement of the hand relative to the position over thighs and further relative to the plumbline (coronal plane)

Classification	Number	Description
Posterolateral	1	The hand falls primarily posterior to the coronal plumb line
Lateral	2	The hand falls in the middle of the coronal plumb line
Slightly Anterolateral	3	The hand falls slightly anterior to coronal plumb line
Markedly Anterolateral	4	The hand falls markedly anterior to coronal plumb line

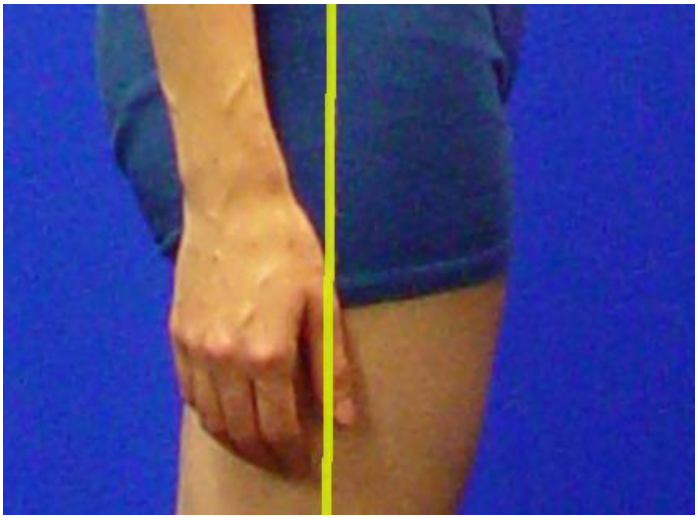


Figure 119 – Posterolateral Hand Placement

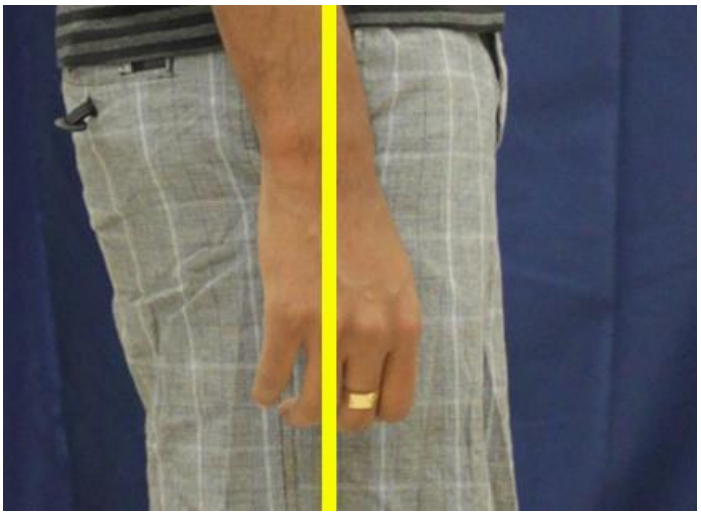


Figure 120 – Lateral hand Placement

Figure 121 – Slightly Anterolateral Hand Placement

Figure 122 – Markedly Anterolateral Hand Placement

23. Lateral rotation of the Hand - *Frontal*

The rotational direction (medial/lateral), otherwise known as pronation and supination, that the hand assumes relative to the plumbline (sagittal plane)

Classification	Number	Description
Medial Rotation	1	The hand rotates medially towards plumb line where the thumbs are closest to the coronal plane
Neutral	2	The hand does not rotate medially nor laterally where the thumbs are facing the camera or 'observer view'
Lateral Rotation	3	The hand rotates laterally away from plumb line where the thumb is furthest from the coronal plane

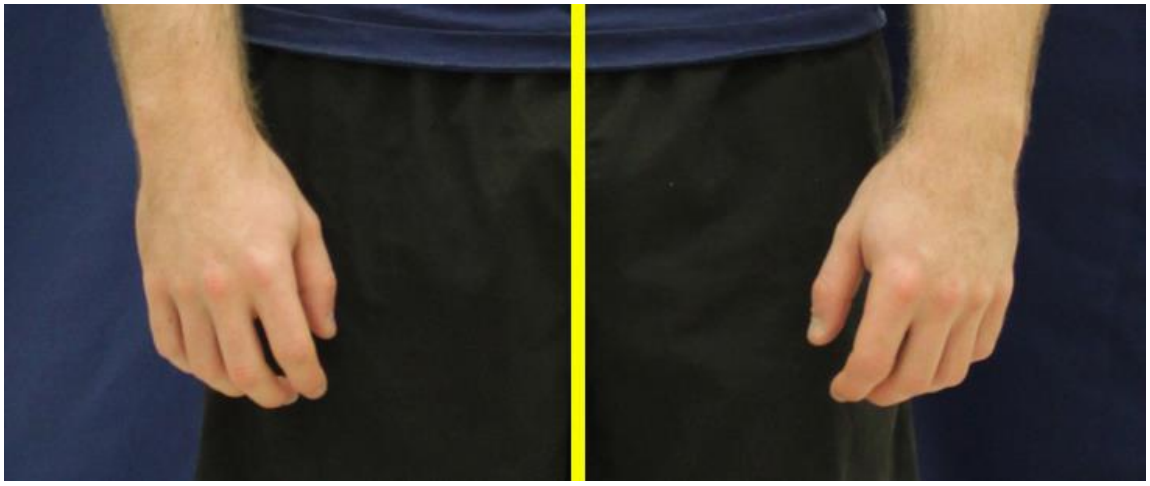


Figure 123 – Hand Medially Rotated

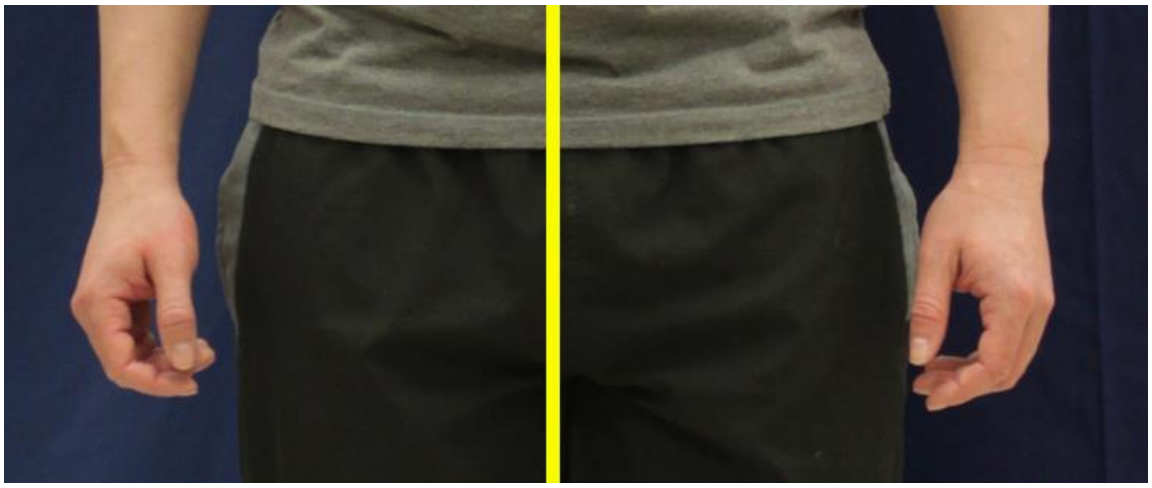


Figure 124 – Hand in Neutral Rotation

Figure 125 – Hand Laterally Rotated

24. Finger Flexion – *Frontal/Profile*

The flexion or extension of the fingers

Classification	Number	Description
Flexed	1	The fingers are flexed loosely or clenched, and fingertips may not be visible
Neutral/Partially flexed	2	The fingers are slightly flexed in a comfortable position where no visible extension or clenching is visible
Extended	3	The fingers are extended and fingertips are visible

Figure 126 – Flexed Fingers

Figure 127 – Partially Flexed Fingers

Figure 128 – Extended Fingers

Pelvis

25. Antero – Posterior Pelvic Tilt - *Profile* (adapted by Bradshaw, 2007)

The antero-posterior tilting of the pelvis (subjective observation)

Classification	Number	Description
Posterior	1	The top of the pelvis is posteriorly 'tipped' back where the front (anterior) of the pelvis/hypogastric region is raised above the posterior region
Neutral	2	The posterior and anterior regions of the pelvis is level
Anterior	3	The top of the pelvis is anteriorly 'tipped' forward as observed by arching of the lower back and the pelvis/hypogastric region is below the posterior region

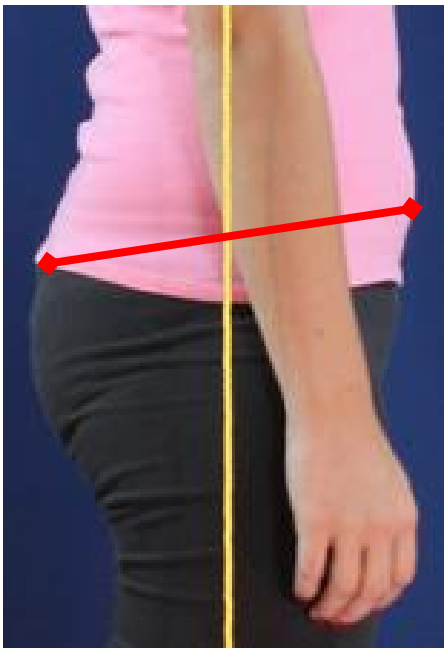


Figure 129 – Posterior

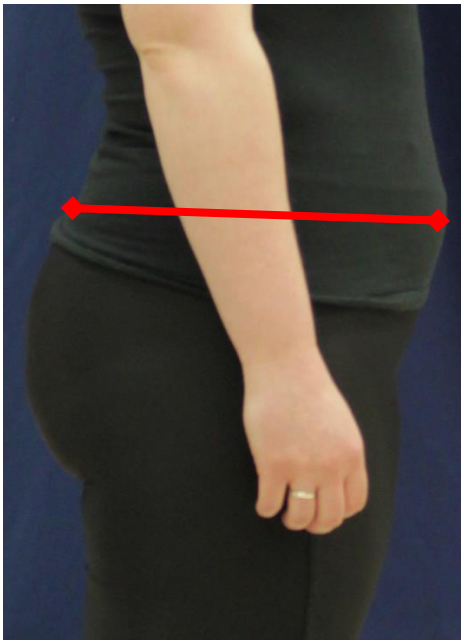


Figure 130 – Neutral

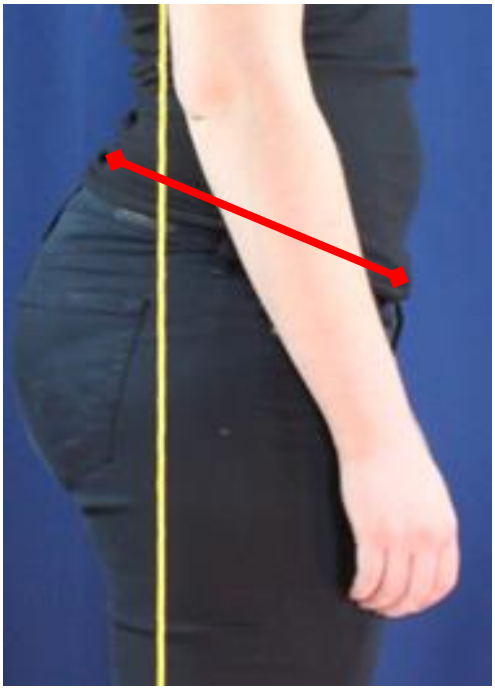


Figure 131 – Anterior

26. Lateral Pelvic (Surface Anatomy) Asymmetry - *Frontal* (adapted by Bradshaw, 2007)

The asymmetry of the surface anatomy of the pelvis, where the pelvis appears higher on the left or right side

Classification	Number	Description
Right Elevated	1	Asymmetry of the surface pelvis is lateral where the right side is higher than the left side
Neutral	2	The right and left sides are both level
Left Elevated	3	Asymmetry of the surface pelvis is lateral where the left side is higher than the right side

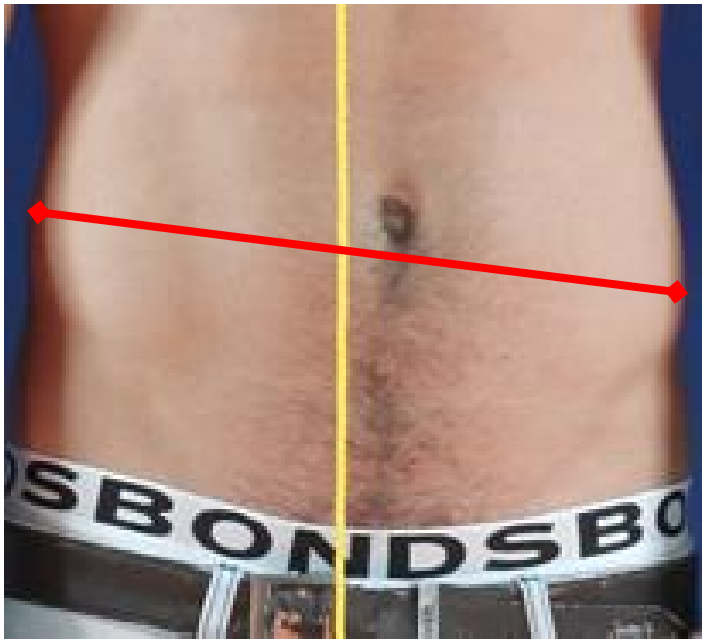


Figure 132 – Right Elevated

Figure 133 – Neutral

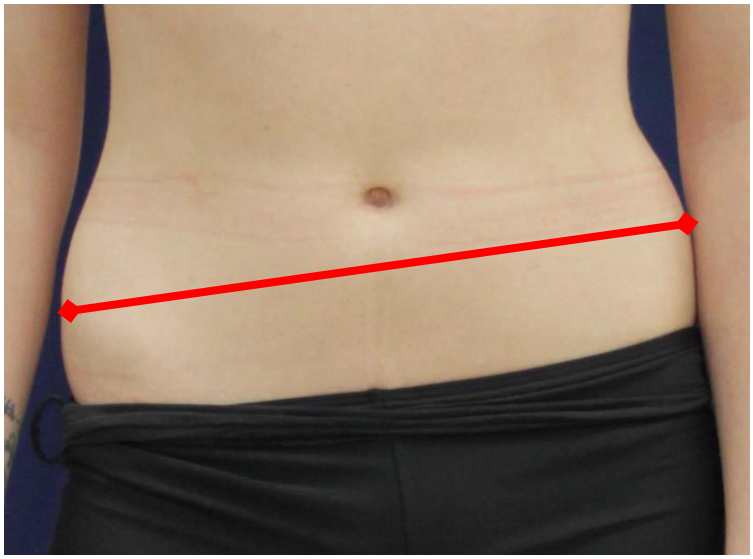


Figure 134 – Left Elevated

27. Gluteal Projection - *Profile*

The levels of gluteal projection

Classification	Number	Description
Flat	1	The underdevelopment of the gluteal or 'buttock' region combined with the lack of fatty adipose tissue, results in the flattened appearance of the gluteus
Slight Projection	2	The relative development of the 'buttock' region or increased levels of fatty adipose tissue, results in the slightly projecting appearance of the gluteus
Marked Projection	3	The development of the 'buttock' region or abundance of fatty adipose tissue, results in the markedly projecting appearance of the gluteus

Figure 135 – Flat

Figure 136 – Slight Projection

Figure 137 – Marked Projection

28. Gluteal Shape - *Posterior*

The shape of the gluteal region

Classification	Number	Description
V-Shape	1	The gluteus (or rear) appears ‘v-like’ in shape where the inferior lateral sides of rear appear inwards distally, compared to the superior of the rear
Square	2	The gluteus (rear) appears ‘square-like’ in shape where lateral sides of rear are even when travelling distally
Round	3	The gluteus (rear) is rounded or curved
Heart	4	The gluteus (rear) is round in shape with a narrow waist, giving the appearance of a ‘heart’ shape

Figure 138 – V-Shape

Figure 139 – Square

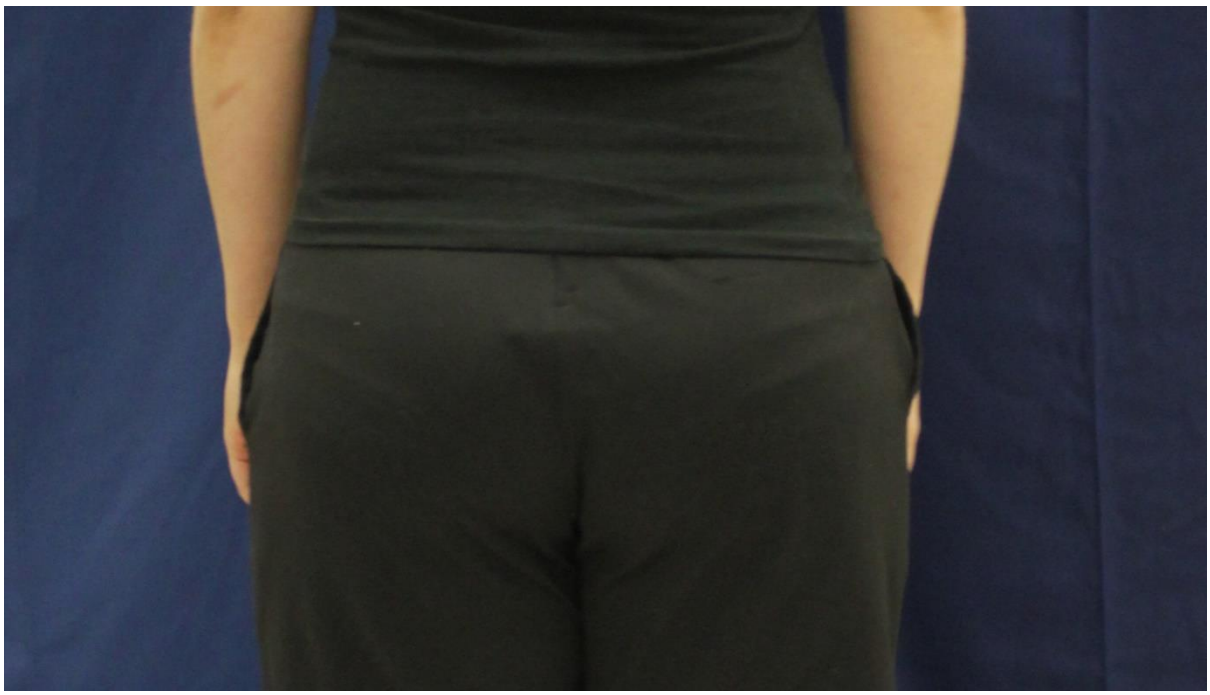


Figure 140 – Round

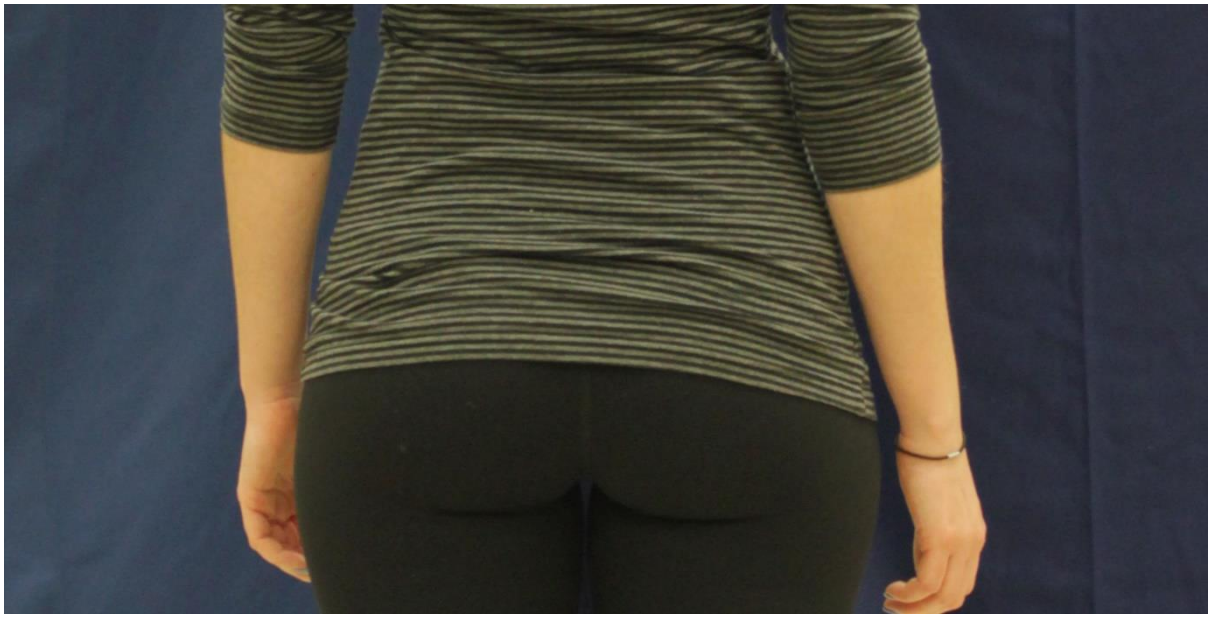


Figure 141 – Heart

29. Antero-Posterior Hip Deviation - *Profile* (adapted by Bradshaw, 2007)

The hips in relation to the abdomen are either flexed or extended

Classification	Number	Description
Flexion	1	The hips are flexed in relation to the abdomen (obtuse angle seen)
Neutral	2	The hips are a combination of flexed and extended in relation to the abdomen
Extension	3	The hips are extended in relation to the abdomen where the pelvic region appears to be pushing forward

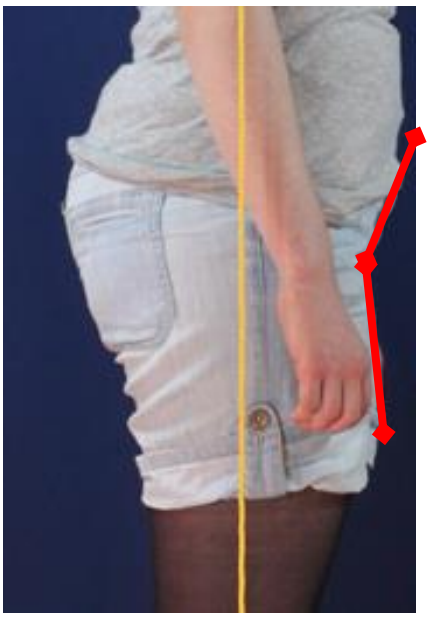


Figure 142 – Flexion

Figure 143 – Neutral

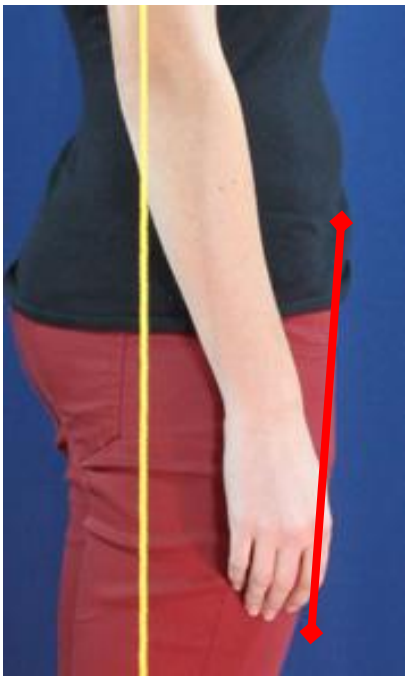


Figure 144 – Extension

30. Lateral Hip Deviation - *Frontal* (adapted by Bradshaw, 2007)

The deviation of the hips laterally (abduction) or medially (adduction)

Classification	Number	Description
Abduction	1	The hip abducts away from the sagittal plumb line as it travels distally
Neutral	2	The hip neither abducts nor adducts from the sagittal plumb line as it travels distally, but rather remains straight
Adduction	3	The hip adducts towards the sagittal plumb line as it travels distally

Figure 145 – Abduction

Figure 146 – Neutral

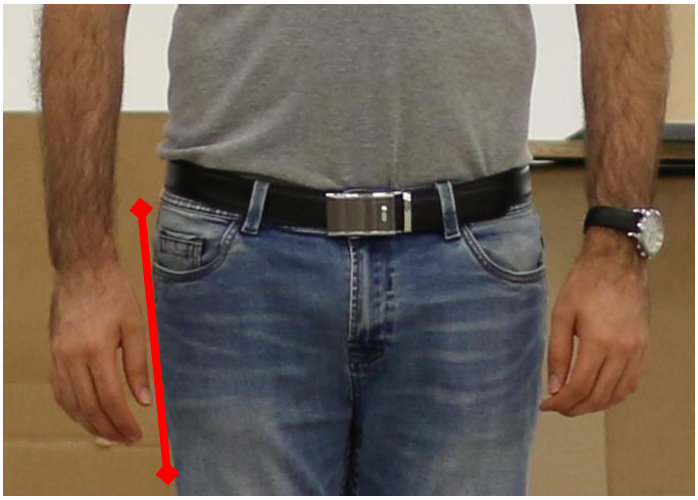


Figure 147 – Adduction

Legs

31. Orientation of Lower Extremities - *Frontal*

The levels of genu varum and genu valgum as a result of knee rotation

Classification	Number	Description
Moderate Bow Legs	1	Moderate bow leg (Genu Varum) is visualised, which results from the leg rotating medially towards the sagittal plane (exaggerated curved appearance)
Slight Bow Legs	2	Slight bow leg (Genu Varum) is visualised, which results from the leg rotating slightly medially towards the sagittal plane (curved appearance)
Straight	3	There is no medial or lateral rotation of the leg as they are parallel to the sagittal plane
Slight Knock knees	4	Slight lateral rotation of one or both knees results in a 'knock kneed' (Genu Valgum) appearance where there is adduction of the upper leg (towards sagittal plane) and abduction of the lower leg (away from sagittal plane)
Moderate Knock knees	5	Moderate lateral rotation of one or both knees results in an 'exaggerated knock kneed' (Genu Valgum) appearance where there is adduction of the upper leg (towards sagittal plane) and abduction of the lower leg (away from sagittal plane)

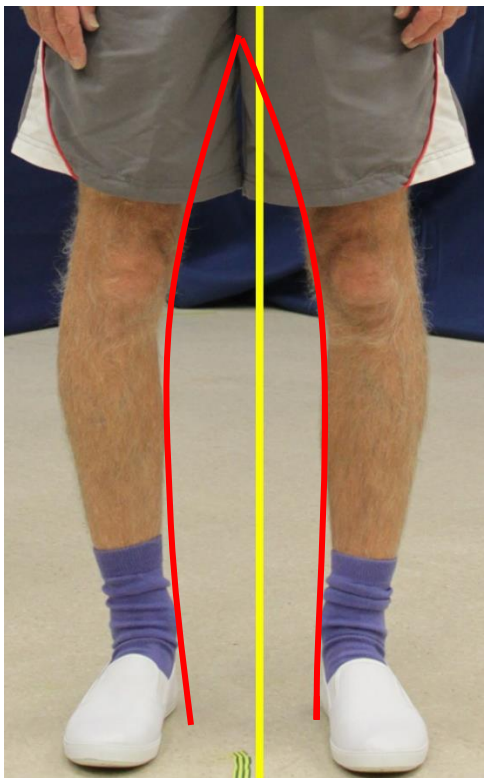


Figure 148 – Moderately Bow Legged

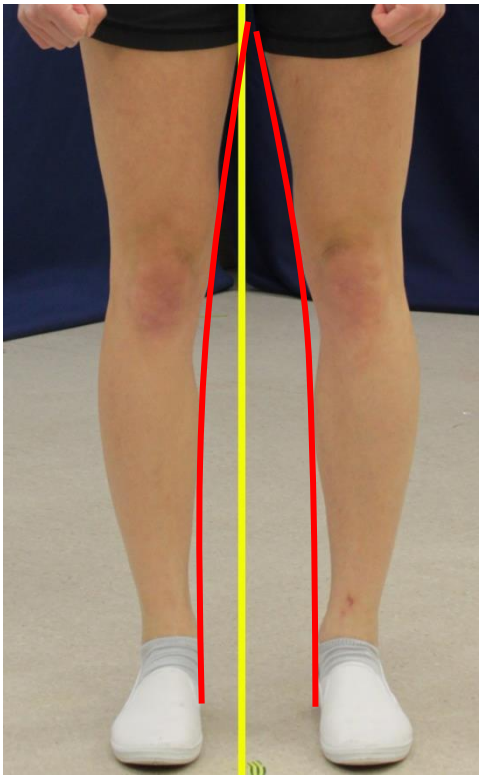


Figure 149 – Slightly Bow Legged

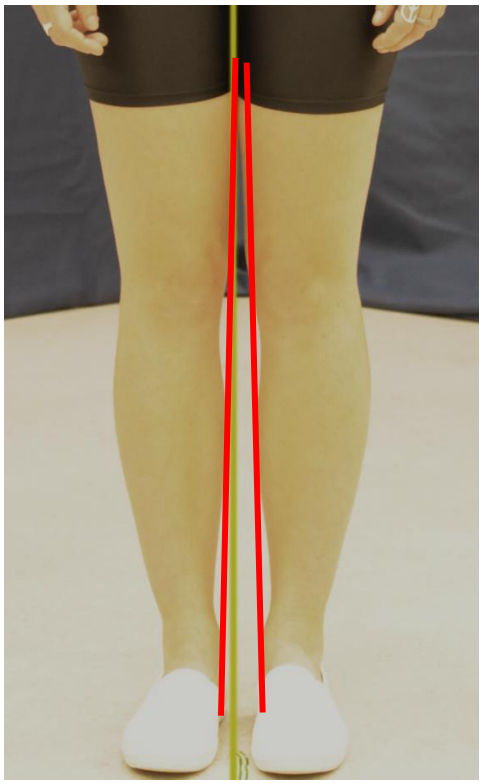


Figure 150 – Straight Legged

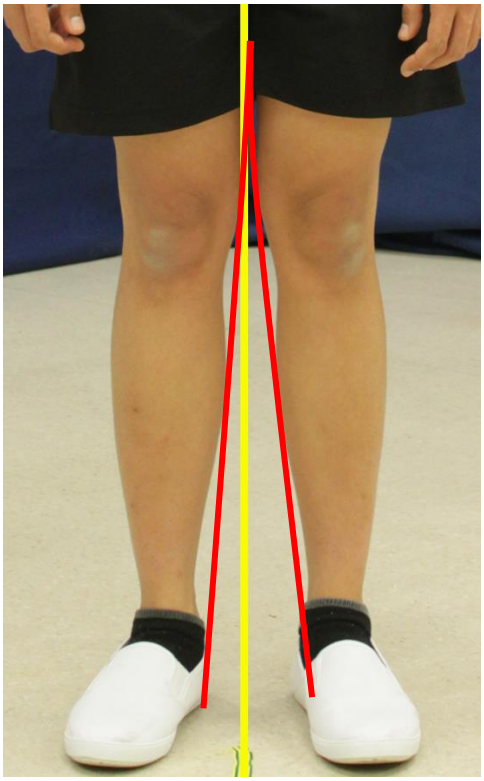


Figure 151 – Slightly Knock Kneed

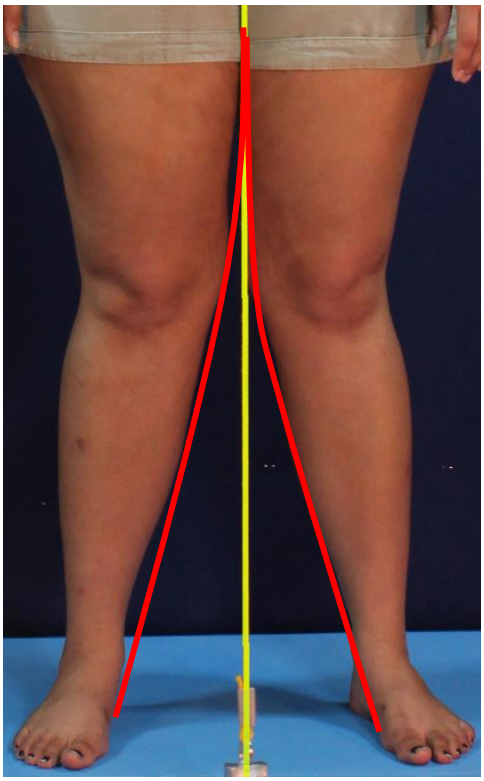


Figure 152 – Moderately Knock Kneed

Upper Leg

32. Lateral Placement of Upper Leg - *Frontal*

The abduction or adduction of the upper leg laterally relative to the plumbline (sagittal plane)

Classification	Number	Description
Abduction	1	The upper leg deviates away from the sagittal plane of the body with abundant space between both lower limbs
Neutral	2	The upper leg neither abducts nor adducts. Space between both upper legs are minimal
Adduction	3	The upper leg deviates towards the sagittal plane of the body with no space between both upper limbs

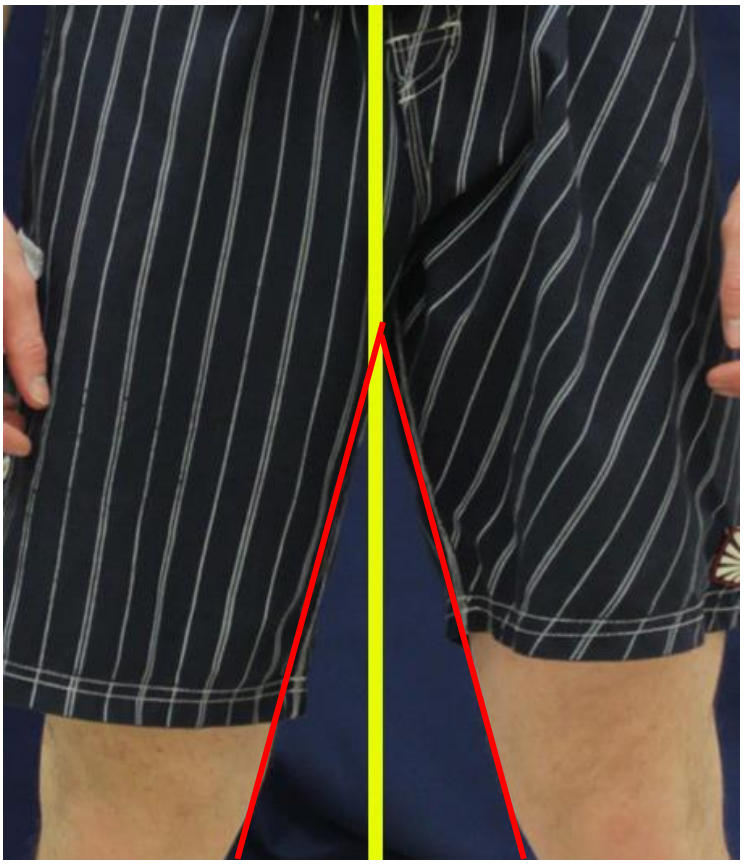


Figure 153 – Lateral Abduction of Upper Leg

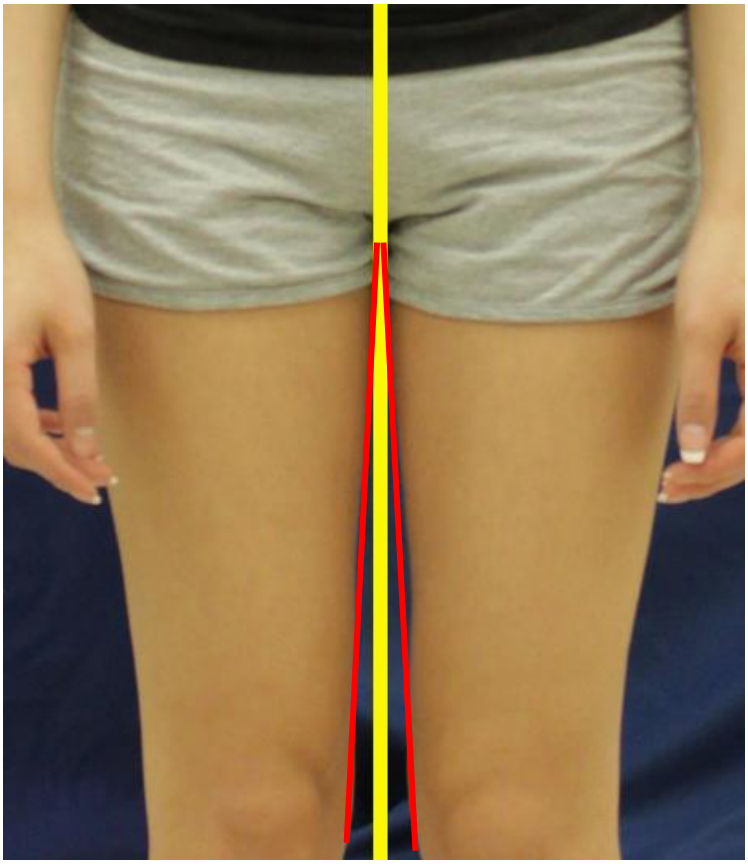


Figure 154 – Neutral Lateral Placement of Upper Leg

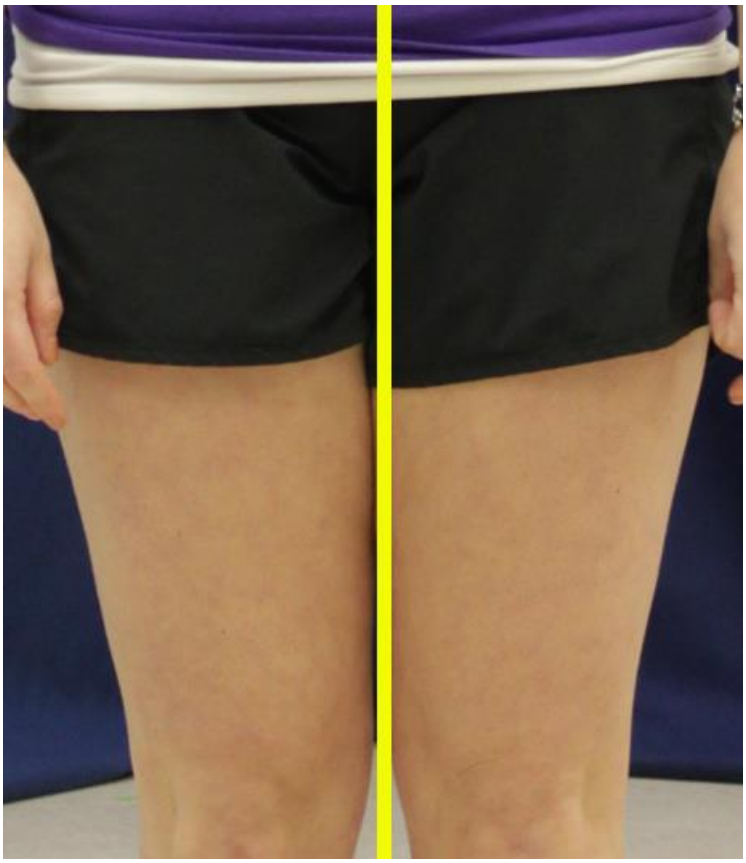


Figure 155 – Lateral Adduction of Upper Leg

33. Upper Leg muscle definition - *Frontal*

The build of the muscles within the upper leg

Classification	Number	Description
Underdeveloped	1	The build/contours of the muscles are not visible due to lack in muscle size
Developed	2	The build and contours of the muscles in the arm are visible and projecting due to minimal fat with well-developed muscles
Overlaying Adipose	3	The build/contours of the muscles are not visible due to fatty tissue overlaying the muscle

Figure 156 – Underdeveloped Upper leg

Figure 157 – Developed Upper leg

Figure 158 – Overlaying Adipose Upper leg

Knees

34. Antero-Posterior Knee Joint Position - *Profile* (adapted by Bradshaw, 2007)

The extension or flexion of the knee relative to the plumbline (coronal plane)

Classification	Number	Description
Hyperextended	1	The hyperextension of the knee causes an extreme curved appearance as it posteriorly abducts from the plumb line
Extended	2	The extension of the knee causes a slight curved appearance as it slightly posteriorly abducts from the plumb line
Neutral	3	The knee neither extends nor flexes, with the knee slightly anterior to plumb line
Flexed	4	The knee joint is flexed and is markedly anterior to plumb line

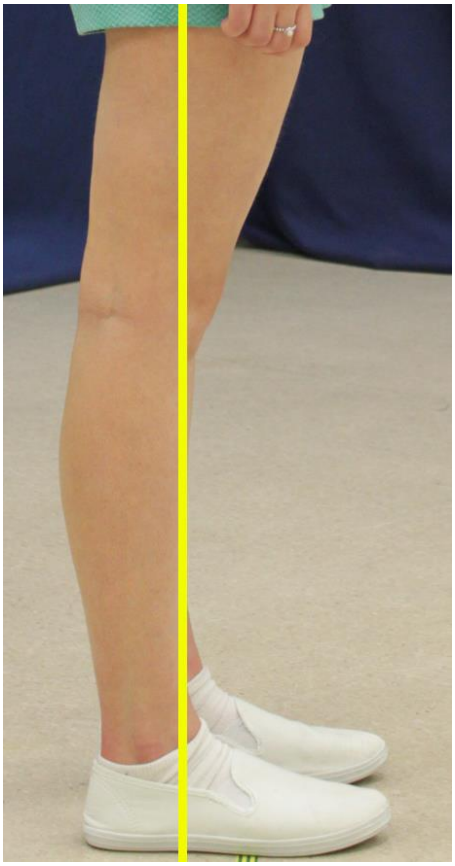


Figure 159 – Hyperextended Knee Joint Position

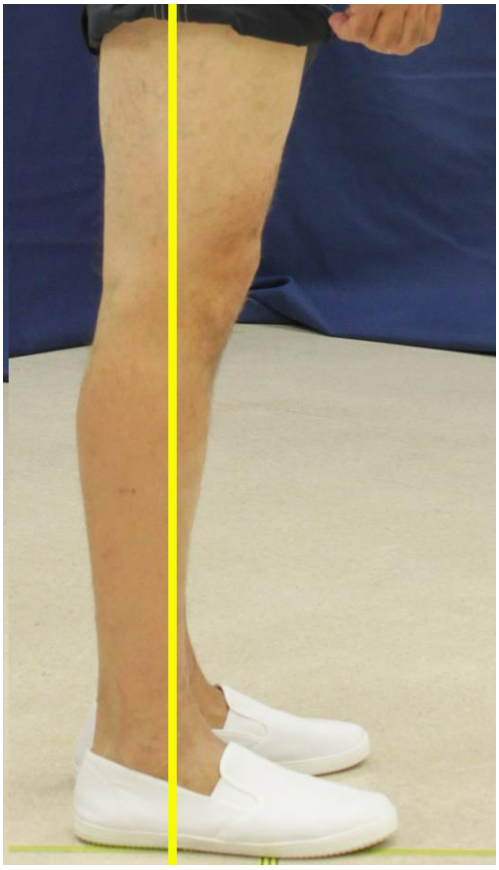


Figure 160 – Extended Knee Joint Position

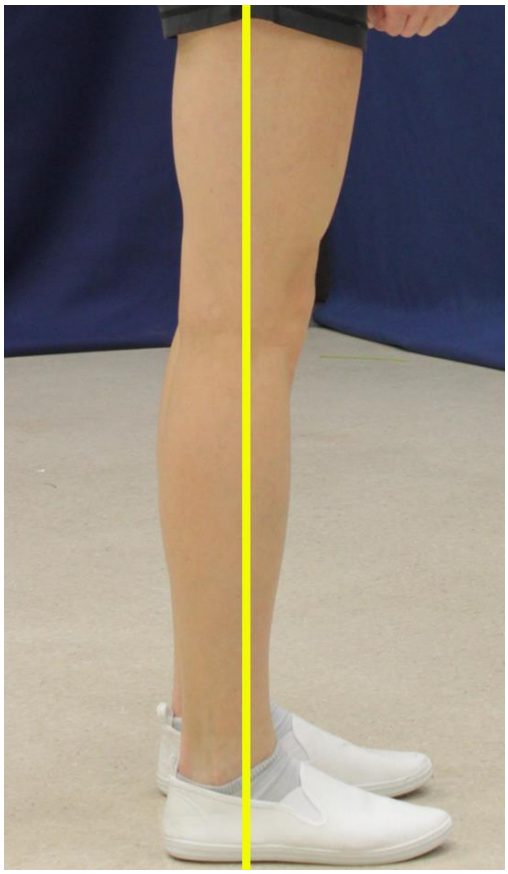


Figure 161 – Neutral Knee Joint Position

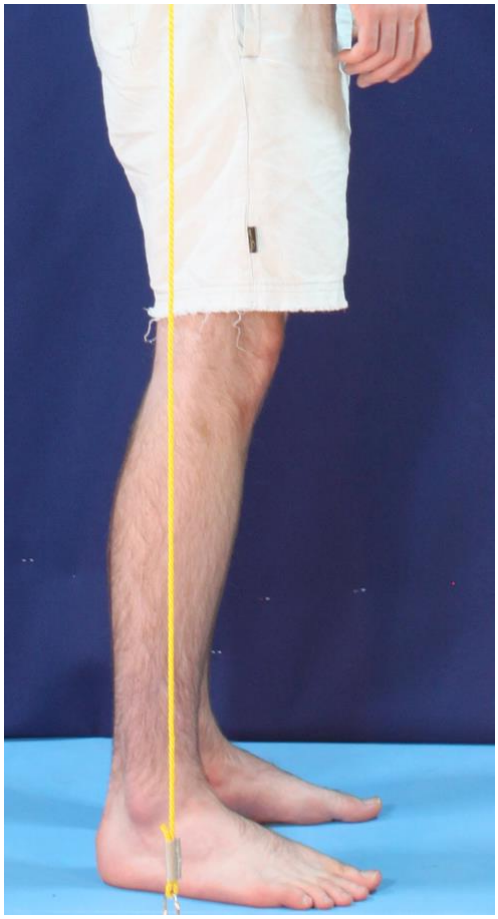


Figure 162 – Flexed knee Joint Position

35. Position/Orientation of the knee joint - *Frontal* (adapted by Bradshaw, 2007)

The direction (medial/lateral) the knee assumes relative to the plumbline (sagittal plane)

Classification	Number	Description
Medial Rotation	1	The knee rotates medially towards plumb line
Neutral	2	The knee does not rotate medially nor laterally
Lateral Rotation	3	The knee rotates laterally away from plumb line

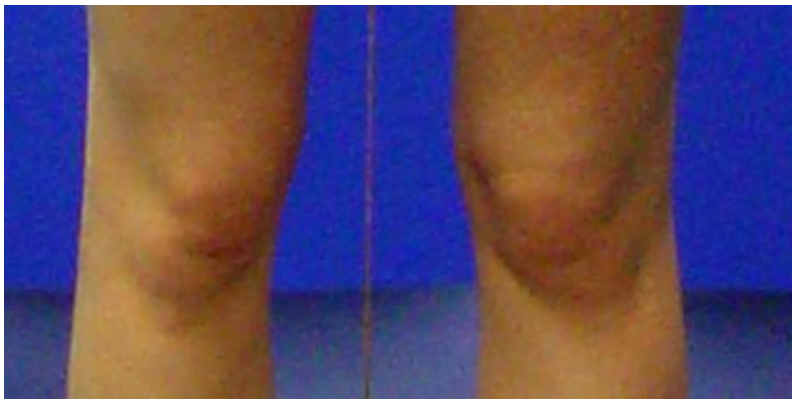


Figure 163 – Medially Rotated Knee Joint

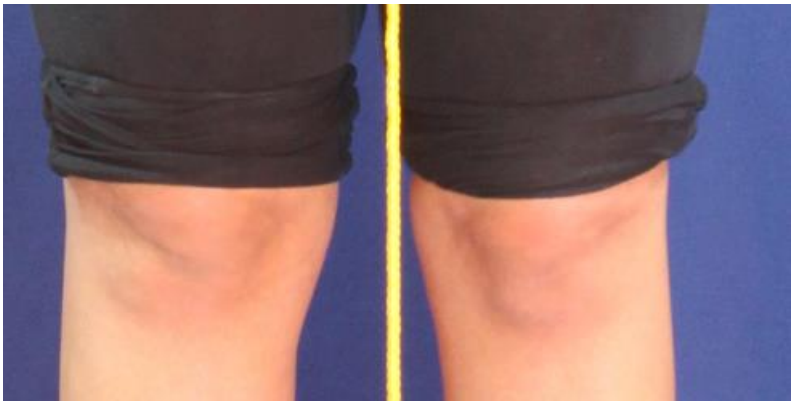


Figure 164 – Neutral Knee Joint Rotation

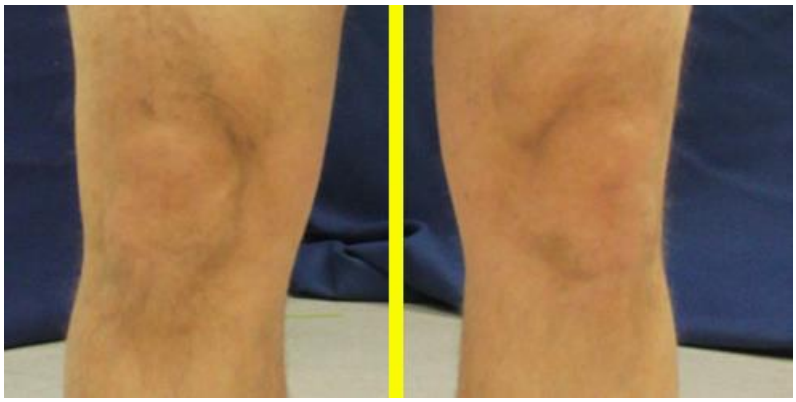


Figure 165 – Laterally Rotated Knee Joint

36. Patella level - *Frontal*

The elevated or depressed position the patella assumes, resultant of tendon and adipose distribution

Classification	Number	Description
Depressed	1	The patella is angled downwards giving a depressed appearance
Neutral	2	The patella is neither depressed nor elevated
Elevated	3	The patella is angled upwards with giving an elevated appearance

Figure 166 – Depressed Patella

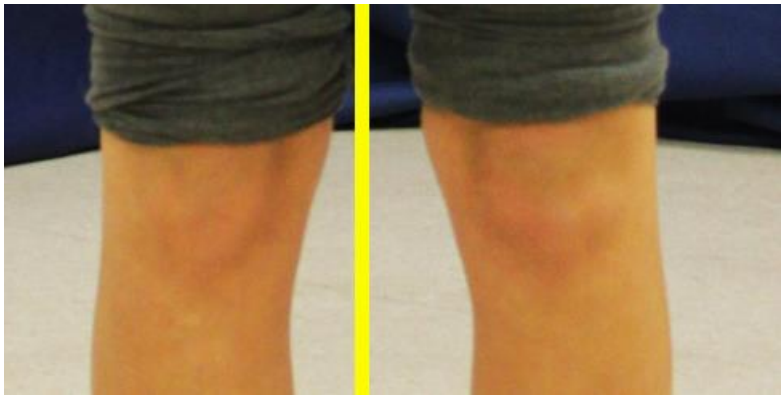


Figure 167 – Neutral Patella Level

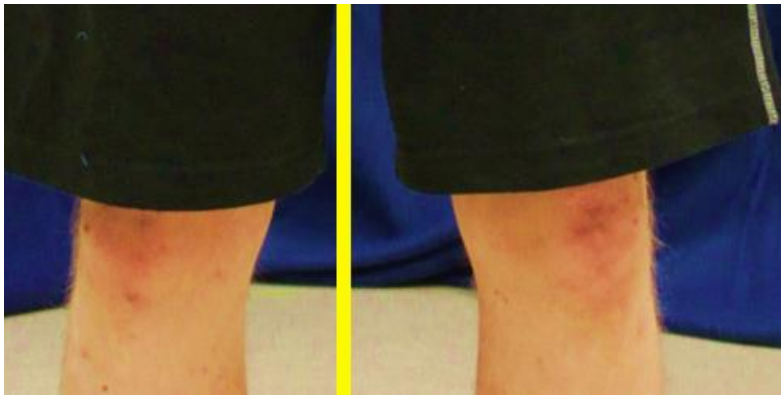


Figure 168 – Elevated Patella

37. Level of Infrapatella fat pad - *Frontal*

The number of folds and level of adipose tissue distribution (considering the position of the tendon) within the distal (inferior) end of the knee

Classification	Number	Description
High	1	Very high levels of adipose as seen by three or more folds and tendon is very visible (seen by the various bumps of fat and tendon)
Neutral	2	Neither high nor low levels of adipose as seen by two folds. The tendon can be seen extending from the patella slightly
Low	3	The inferior (distal end) of the patella is very contoured and no adipose or tendon is visible below the knee, as seen by the one fold

Figure 169 – High Infrapatella Fat Pad

Figure 170 – Neutral Infrapatella Fat Pad

Figure 171 – Low Levels of Infrapatella Fat Pad

Lower Leg

38. Lateral Placement of Lower Leg - *Frontal*

The abduction or adduction of the lower leg laterally relative to the plumbline (sagittal plane)

Classification	Number	Description
Abduction	1	The lower leg deviates away from the sagittal plane of the body with abundant space between both lower limbs
Neutral	2	The lower leg neither abducts nor adducts. Space between both lower legs are minimal
Adduction	3	The lower leg deviates towards the sagittal plane of the body with no space between both lower limbs

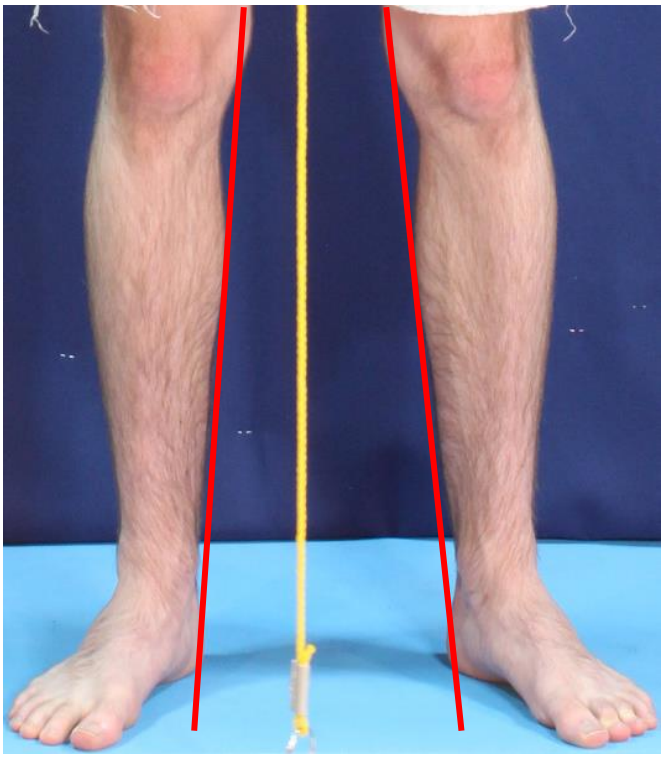


Figure 172 – Lower Leg Abduction

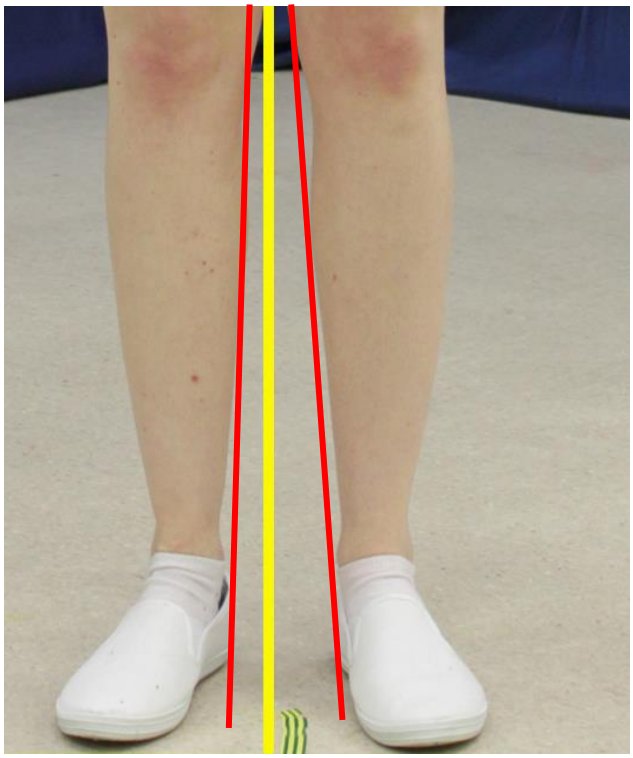


Figure 173 – Neutral Placement of Lower Leg

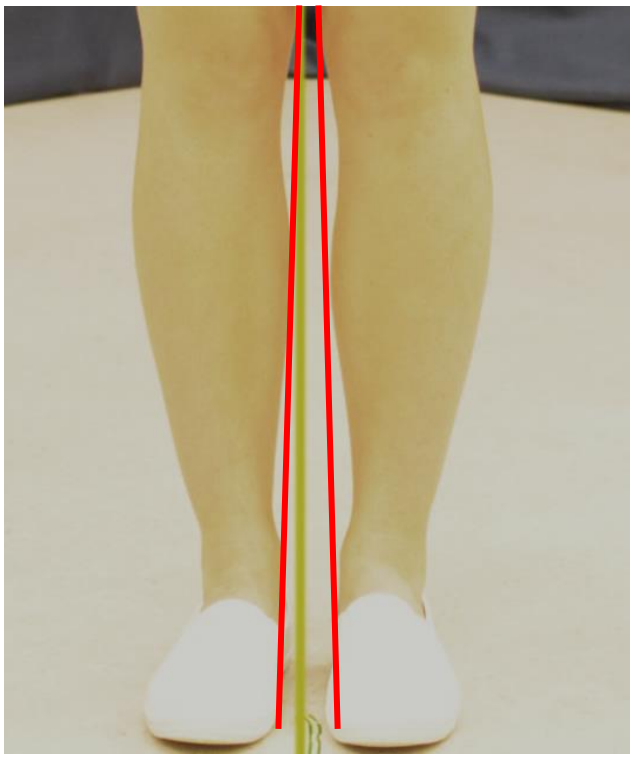


Figure 174 – Adduction of Lower Leg

39. Lower Leg muscle definition - *Frontal*

The build of the muscles within the lower leg

Classification	Number	Description
Underdeveloped	1	The build/contours of the muscles are not visible due to lack in muscle size
Developed	2	The build and contours of the muscles in the arm are visible and projecting due to minimal fat with well-developed muscles
Overlaying Adipose	3	The build/contours of the muscles are not visible due to fatty tissue overlaying the muscle

Figure 175 – Underdeveloped Lower Leg

Figure 176 – Developed of Lower Leg

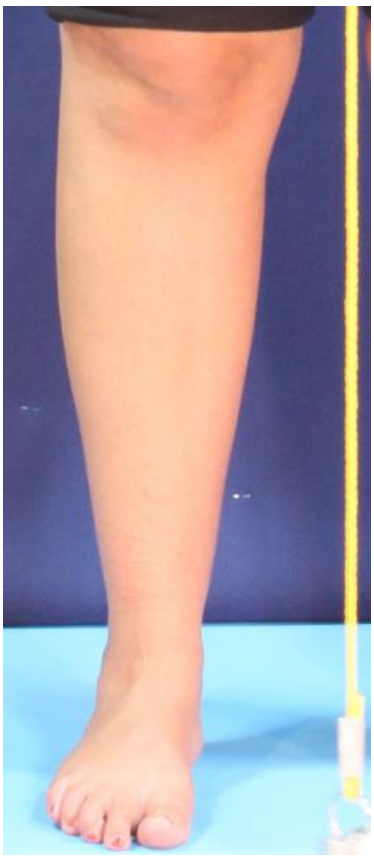


Figure 177 – Overlaying Adipose of Lower Leg

Ankles

40. Antero-Posterior Ankle Deviation - *Profile* (adapted by Bradshaw, 2007)

The plantarflexion or dorsiflexion of the ankle (giving the appearance of the lower limb of the leg leaning either backward or forward)

Classification	Number	Description
Marked Plantar Flexion	1	The ankle is markedly plantarflexed giving the appearance of lower leg leaning backwards
Slight Plantar Flexion	2	The ankle is slightly plantarflexed giving the appearance of lower leg leaning faintly backwards
Neutral	3	The ankle is neither plantarflexed nor dorsiflexed and remains parallel to the plumbline
Dorsiflexion	4	The ankle is dorsiflexed, giving the appearance of the lower leg leaning forwards

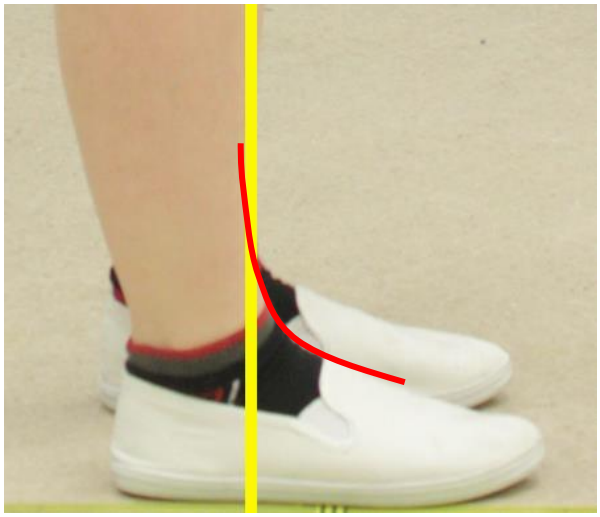


Figure 178 – Marked Plantarflexion of the Ankle

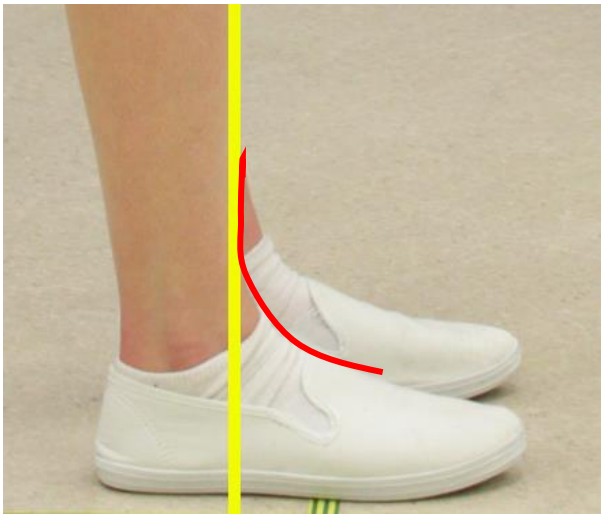


Figure 179 – Slight Plantarflexion of the Ankle

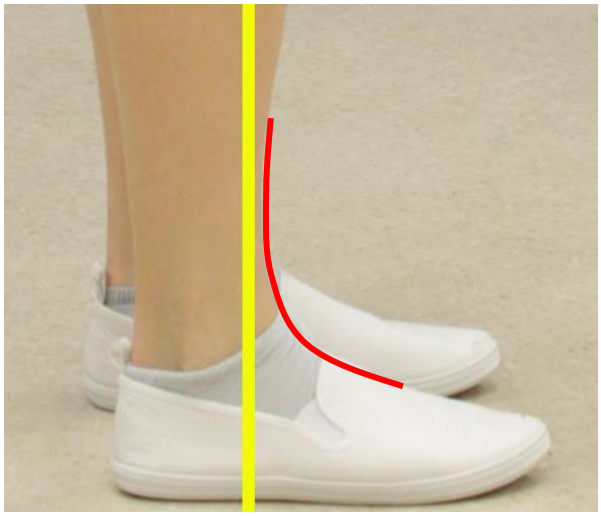


Figure 180 – Neutral position of the Ankle

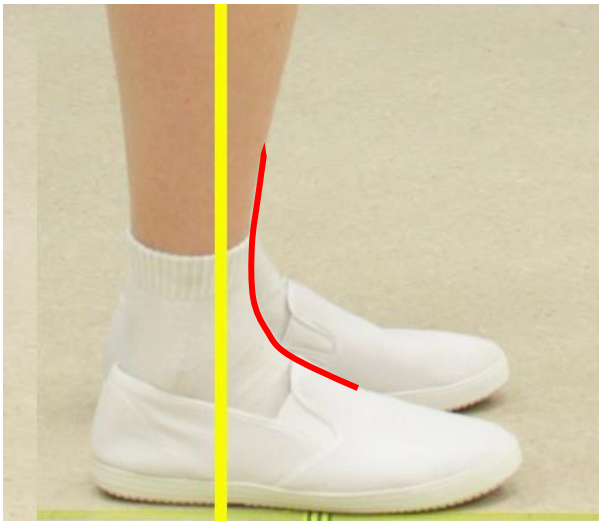


Figure 181 – Dorsiflexion of the Ankle

41. Lateral ankle deviation - *Posterior*

The angling of the calcaneus towards (pronation - eversion) or away (supination - inversion) from the sagittal plumb line

Classification	Number	Description
Marked Pronation	1	The heel of the foot and the ankle is markedly angled towards the plumb line
Slight Pronation	2	The heel of the foot and the ankle is slightly angled towards the plumb line
Straight	3	The heel of the foot and the ankle is neither angled towards or away from the plumb line
Slight Supination	4	The heel of the foot and the ankle is slightly angled away from the plumb line
Marked Supination	5	The heel of the foot and the ankle is markedly angled away from the plumb line

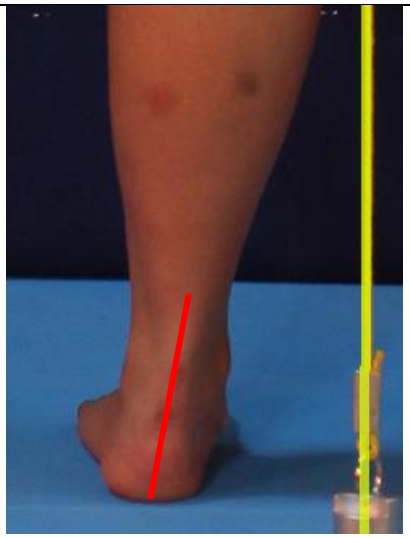


Figure 182 – Marked Pronation of the Ankle

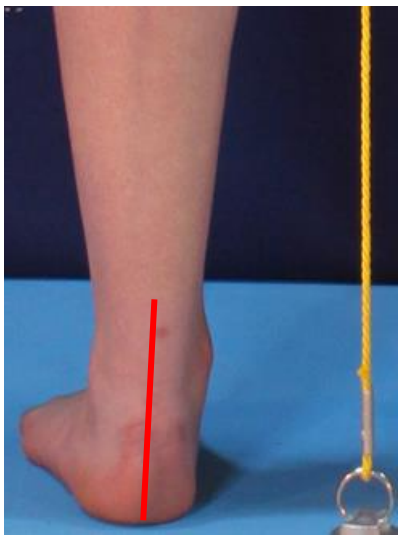


Figure 183 – Slight Pronation of the Ankle

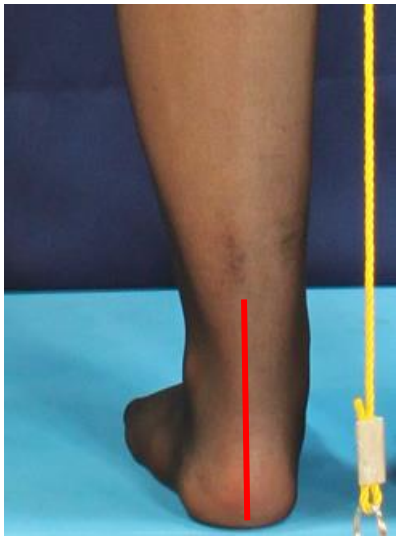


Figure 184 – Straight position of the Ankle

Figure 185 – Slight Supination of the Ankle

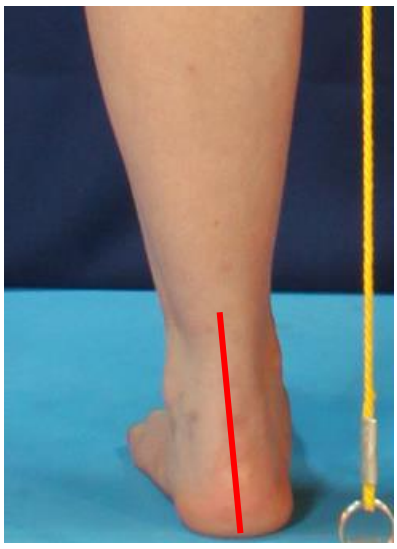


Figure 186 – Marked Supination of the Ankle

Feet

42. Placement of the feet - *Frontal*

The placement of feet laterally relative to the plumbline (sagittal plane)

Classification	Number	Description
Moderate Out-toeing	1	The feet are laterally rotated outwards, away from the plumb line
Neutral	2	The feet are neither laterally nor medially rotated
In-toeing	3	The feet are medially rotated inwards, towards the plumb line

Figure 187 – Out Toeing of the Feet

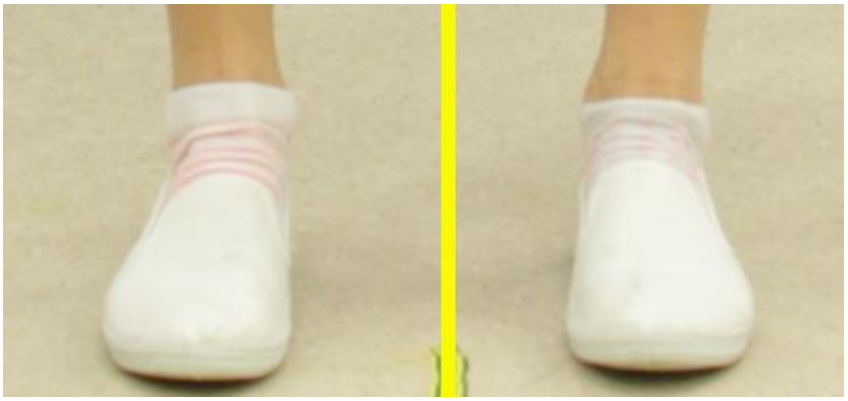


Figure 188 – Neutral Placement of the Feet

Figure 189 – In-toeing of the Feet

43. Lateral positioning of the feet - *Frontal*

The positioning of the lateral area of the feet

Classification	Number	Description
Inner foot	1	The position appears distributed to the inner sides of the feet
Neutral	2	The position appears evenly distributed on the whole foot
Outer foot	3	The position appears distributed to the outer sides of the feet

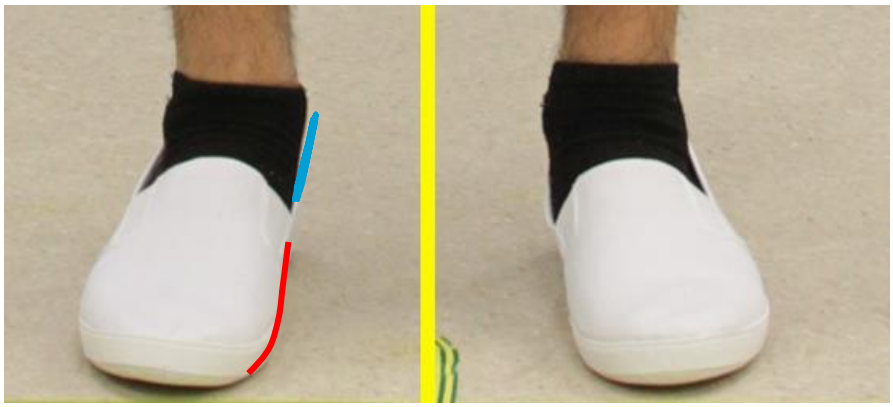


Figure 190 – Inner Foot

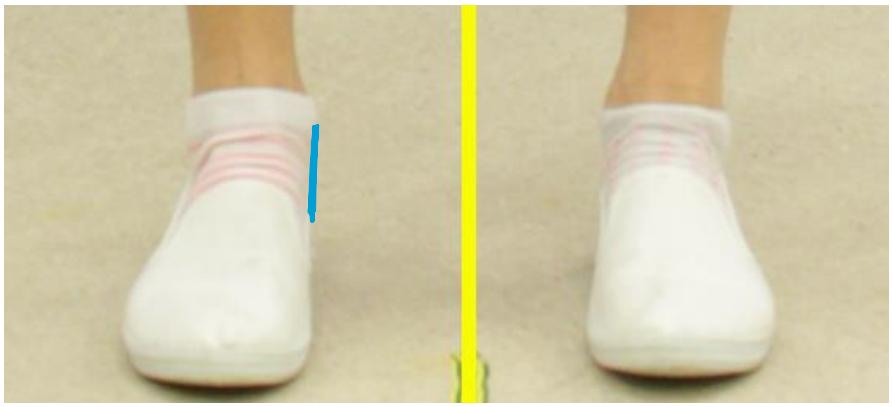


Figure 191 – Whole Foot

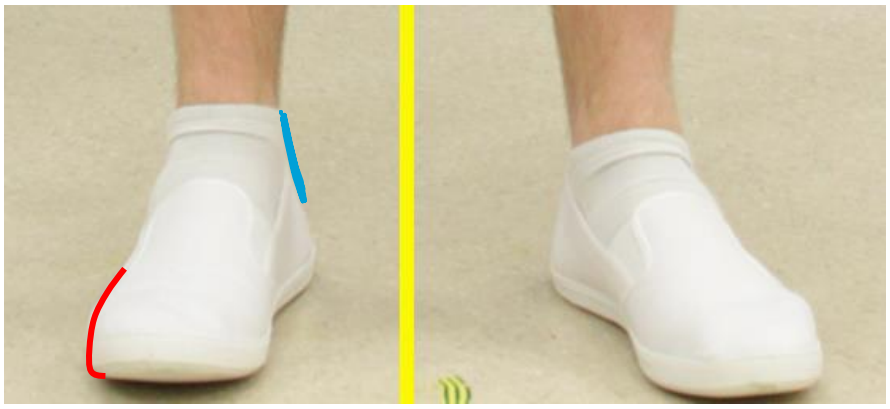


Figure 192 – Outer Foot

Full Body

44. Somatotype - *Frontal*

The general body shape

Classification	Number	Description
Ectomorph	1	An ectomorph shape is observed by long appendicular limbs with a skinny build with delicate muscle build
Mesomorph	2	A mesomorph is characterised by a naturally athletic muscular build with a rectangular shaped body
Endomorph	3	An endomorph is observed by a short, round and wider body with higher levels of adipose tissue

Figure 193 – Ectomorph, Mesomorph, and Endomorph

Datasheets

Stance - Morphology Datasheets						
Subject Number:		Sex:		Age:	Ancestry:	
Body Region	Feature	View	Left/Right	Classification	Ordinal	Nominal
Head	1. Head Level	Profile		Tilted Down	1	
				Facing Ahead	2	
				Tilted Up	3	
	2. Lateral Head Tilt	Frontal		Tilted left	1	
				Centered	2	
				Tilted right	3	
	3. Projection of Head	Profile		Neutral	1	
				Slight forward projection	2	
				Marked forward projection	3	
	4. Head Displacement	Frontal		Right Displacement	1	
				Central	2	
				Left Displacement	3	
Torso	5. Thoracic Projection (bust size)	Profile		Flat	1	
				Slightly Projecting	2	
				Markedly Projecting	3	
	6. Abdominal Projection	Profile		Flat	1	
				Slightly Projecting	2	
				Markedly Projecting	3	
	7. Upper Torso Shape	Frontal		V Shape	1	
				Rectangle	2	
				A Shape	3	
	8. Torso Musculature	Frontal		Underdeveloped	1	
				Developed	2	
				Overlaying Adipose	3	

Posture	9. Upper Thoracic Curvature	Profile		Curved	1	
				Neutral	2	
				Flattened	3	
	10. Thoracic Curvature	Profile		Curved	1	
				Neutral	2	
				Flattened	3	
	11. Lumbar Curvature	Profile		Curved	1	
				Neutral	2	
				Flattened	3	
Shoulder	12. Shoulder Level	Posterior		Lowered	1	
				Neutral	2	
				Raised	3	
	13. Position of Shoulder	Profile		Posterior	1	
				Neutral	2	
				Anterior	3	
	14. Rotational Position Shoulder	Frontal		Medial Rotation	1	
				Neutral	2	
				Lateral Rotation	3	
Upper Arm	15. Antero-Posterior Placement of Upper Arm	Profile		Posterolateral	1	
				Lateral	2	
				Slightly Anterolateral	3	
				Markedly Anterolateral	4	
	16. Lateral Placement of Upper Arm	Frontal		Abduction	1	
				Neutral	2	
				Adduction	3	
	17. Upper Arm Muscle Definition	Frontal		Underdeveloped	1	
				Developed	2	
				Overlaying Adipose	3	

Forearm	18. Antero-Posterior Placement of Forearm	Profile		Posterolateral	1	
				Lateral	2	
				Slightly Anterolateral	3	
				Markedly Anterolateral	4	
	19. Lateral Placement of Forearm	Frontal		Abduction	1	
				Neutral	2	
				Adduction	3	
	20. Lateral Rotation of the Forearm	Frontal		Medial Rotation	1	
				Neutral	2	
				Lateral Rotation	3	
	21. Lower Arm Muscle Definition	Frontal		Underdeveloped	1	
				Developed	2	
				Overlaying Adipose	3	
Hand	22. Antero-Posterior Placement of Hand	Profile		Posterolateral	1	
				Lateral	2	
				Slightly Anterolateral	3	
				Markedly Anterolateral	4	
	23. Lateral Rotation of the Hand	Frontal		Medial Rotation	1	
				Neutral	2	
				Lateral Rotation	3	
	24. Finger Flexion	Frontal / Profile		Flexed	1	
				Neutral/Partially Flexed	2	
				Extended	3	

Pelvis	25. Antero-Posterior Pelvic Tilt	Profile		Posterior	1	
				Neutral	2	
				Anterior	3	
	26. Lateral Pelvic Tilt	Frontal		Right Elevated	1	
				Neutral	2	
				Left Elevated	3	
	27. Gluteal Projection	Profile		Flat	1	
				Slight Projection	2	
				Marked Projection	3	
	28. Gluteal Shape	Posterior		V Shape	1	
				Square	2	
				Round	3	
				Heart	4	
	29. Antero-Posterior Hip Deviation	Profile		Flexion	1	
				Neutral	2	
				Extension	3	
	30. Lateral Hip Deviation	Frontal		Abduction	1	
				Neutral	2	
				Adduction	3	
Legs	31. Orientation of Lower Extremities	Frontal / Posterior		Moderate Bow Legs	1	
				Slight Bow Legs	2	
				Straight	3	
				Slight Knock Knees	4	
				Moderate Knock Knees	5	

Upper Leg	32. Lateral Placement of Upper Leg	Frontal		Abduction	1	
				Neutral	2	
				Adduction	3	
	33. Upper Leg Muscle Definition	Frontal		Underdeveloped	1	
				Developed	2	
				Overlaying Adipose	3	
Knees	34. Antero-Posterior Knee Joint Position	Profile		Hyperextended	1	
				Extended	2	
				Neutral	3	
				Flexed	4	
	35. Position/Orientation of the Knee Joint	Frontal		Medial Rotation	1	
				Neutral	2	
				Lateral Rotation	3	
	36. Patella Level	Frontal		Depressed	1	
				Neutral	2	
				Elevated	3	
	37. Level of Infrapatella Fat Pad	Frontal		High	1	
				Neutral	2	
				Low	3	
Lower Leg	38. Lateral Placement of Lower Leg	Frontal		Abduction	1	
				Neutral	2	
				Adduction	3	
	39. Lower Leg Muscle Definition	Frontal		Underdeveloped	1	
				Developed	2	
				Overlaying Adipose	3	

Ankles	40. Antero-Posterior Ankle Deviation	Profile		Marked Plantar Flexion	1	
				Slight Plantar Flexion	2	
				Neutral	3	
				Dorsiflexion	4	
	41. Lateral Ankle Deviation	Posterior		Marked Pronation	1	
				Slight Pronation	2	
				Straight	3	
				Slight Supination	4	
				Marked Supination	5	
Feet	42. Placement of Feet	Frontal		Moderate Out-toeing	1	
				Neutral (facing ahead)	2	
				In-toeing	3	
	43. Lateral Positioning of the feet	Frontal		Inner Foot	1	
				Neutral (evenly balanced)	2	
				Outer Foot	3	
Full Body	44. Somatotype	Frontal		Ectomorph	1	
				Mesomorph	2	
				Endomorph	3	

Stance - Anthropometry Datasheets			
Subject Number:	Sex:	Age:	Ancestry:
Feature	View	Measurement Raw	Proportional Indices
1. Shoulder – Elbow Length Right	Frontal		
2. Shoulder – Elbow Length Left			
3. Forearm Length Right			
4. Forearm Length Left			
5. Hand Length Right			
6. Hand Length Left			
7. Maximum Hip Width	Posterior		
8. Thigh Length Right	Frontal		
9. Thigh Length Left			
10. Lower Leg Length Right			
11. Lower Leg Length Left			
12. Knee/Patella Width Right			
13. Knee/Patella Width Left			
14. Knee Breadth Right	Profile		
15. Knee Breadth Left			
16. Foot Length Right			
17. Foot Length Left			
18. Bi-Malleolar Width Right	Frontal		
19. Bi-Malleolar Width Left			
20. Foot Width Right			
21. Foot Width Left			
22. Mid Patella Height Right			
23. Mid Patella Height Left			
24. Leg Length – Crotch Length Right			
25. Leg Length – Crotch Length Left			
26. Leg Length – Trochanter Right	Posterior		
27. Leg Length – Trochanter Left			
28. Trapezius Length Right	Frontal		
29. Trapezius Length Left			
30. Head Height			
31. Torso Length	Frontal		
32. Jugular to Inguinal Length			
33. Shoulder Width			
34. Total Height - Stature	Profile		

Part 2: Gait

Normal Gait

Human gait involves the repeated sequence of motions, advancing the body forward and divided into 7 phases (Perry, 2014). Locomotion patterns occur with humans walking in a bipedal manner acting upon the actions of skeletal muscles (synergistic) branched from the lumbosacral plexus (*ibid*). The four joints that involve the most movement during gait include the hip, knee, ankle and the hallux (metatarsophalangeal joint) of the foot (Figure 194) (Muscle and Joint Pain Clinic, 2011). The foot not only allow the forward motion of the body, the joints between the 26 bones within the foot and the knee joint act as shock absorbers that prevent damage that may occur to the limbs during locomotion (*ibid*).

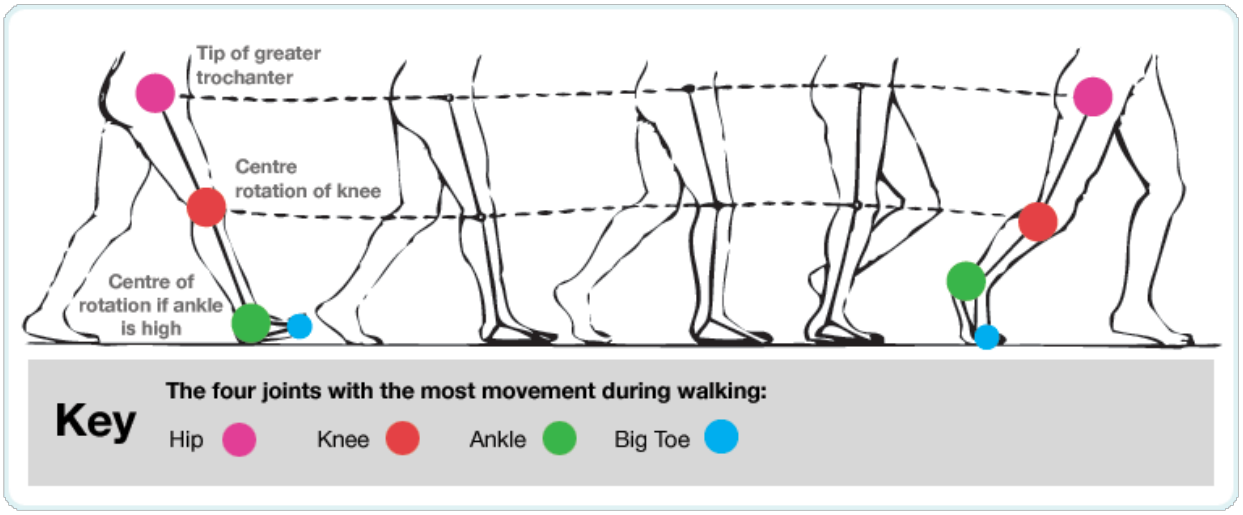


Figure 194 – The Four main joints involved in Locomotion (adapted by Muscle and Joint Pain Clinic).

Gait Phases

Locomotion is defined as the method of moving from one place to another (Birch *et al.*, 2020). Therefore, gait, is known as the manner or style that a person undertakes a locomotor activity, which includes walking or running (*ibid*). The gait cycle is the time between two consecutive occurrences of one repetitive events involved in walking (*ibid*). The four stages within the stance phase includes: [1] Loading response, [2] Mid-stance, [3] Terminal stance, and [4] Pre-swing (Birch *et al.*, 2020). The swing phase comprises three stages: [1] Initial swing, [2] Mid swing and [3] Terminal swing (*ibid*).The body is naturally symmetrical, but contains minor asymmetry, similar to the asymmetry of the face. This is further expressed during gait through upper trunk movement and lower leg rotation, where the legs swing and rotate for advancement. The minor asymmetry relates to intrinsic characteristics of healthy subjects, but major asymmetry is thought to be acquired characteristics consecutive with pathology or

accidents. The existence of asymmetry, therefore, is thought to enhance the observation of features from the body or gait.

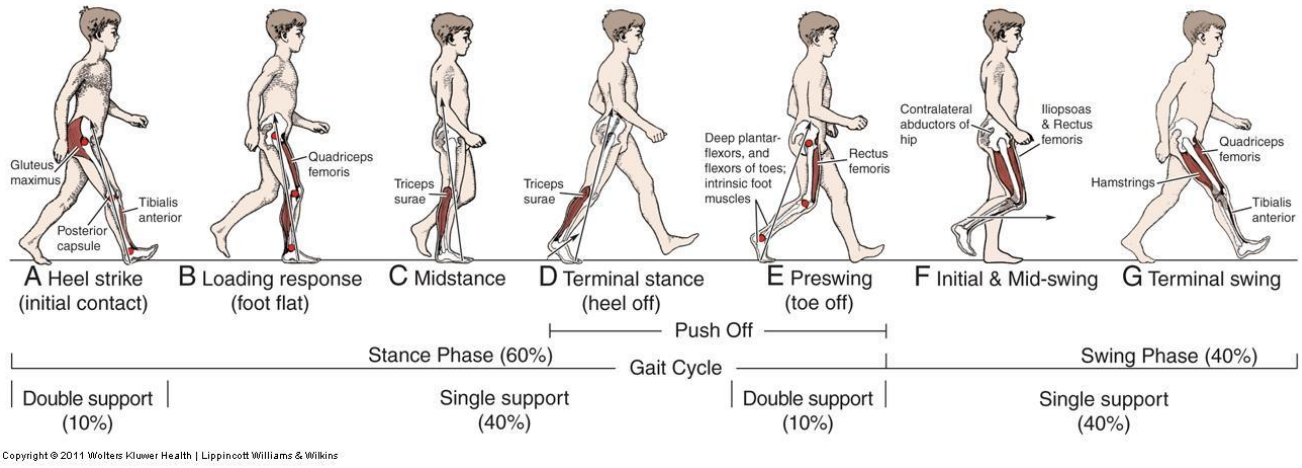


Figure 195 – The Phases within the Gait Cycle for Walking (adapted by Moore et al., 2011).

Static, Dynamic and Angle measurements

The anthropometric measurements of the body (static and dynamic features) are applied for the assessment of gait. Static features are defined as the geometrical measurements of the body, i.e. individual's length of whole leg, length of individual's knee to foot height etc. Dynamic features are measurements related to gait. For instance, the distance between the left and the right toe during gait, distance between knees, stride length etc. The examples of such measurements are represented by the lines. Angle measurements refer the angle degree of gait during flexion.

Anthropometry Landmarks in Gait – Static Assessment

The anthropometric landmarks and measurements determined within Part 1 stance, is identical for the static measurements of gait. However, dynamic measurements include those that are reserved for gait only. For static gait assessment, the anatomical landmarks were taken from the mid-stance phase.

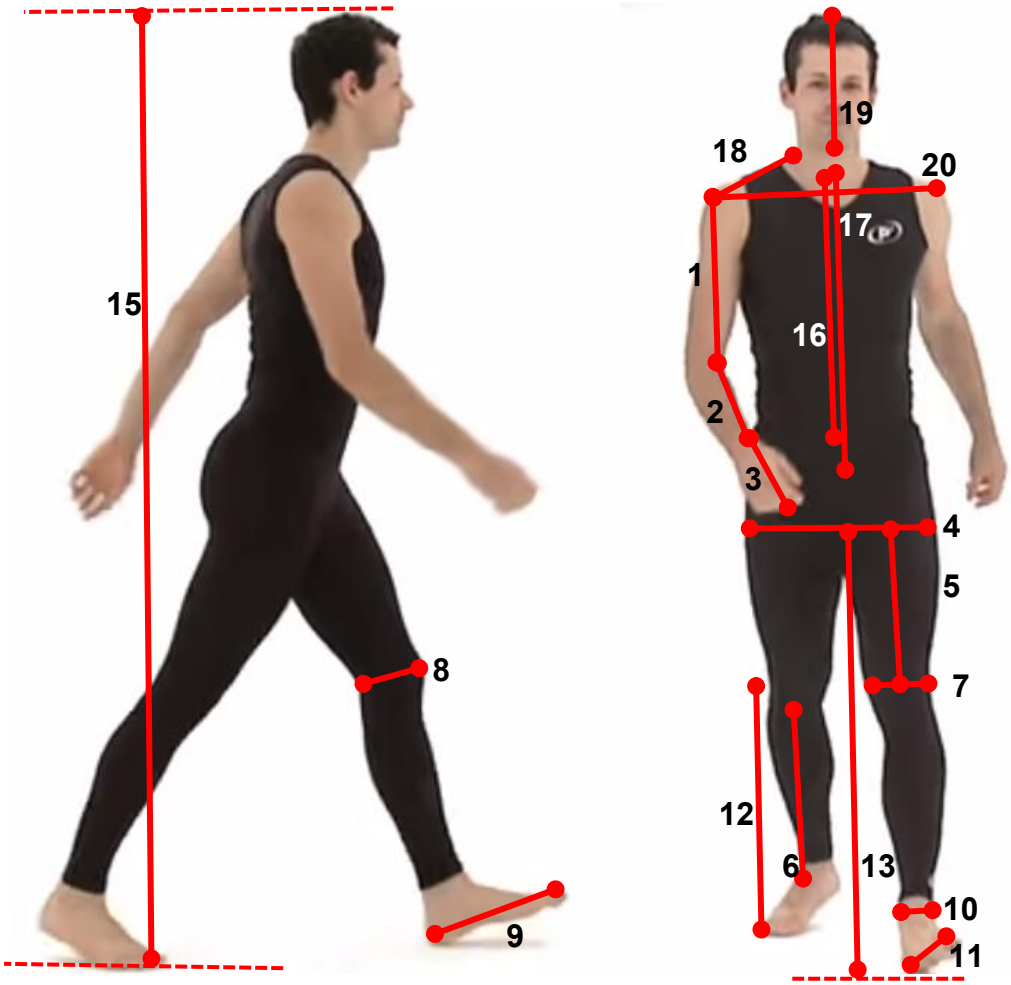


Figure 196 – Static Measurements (as adapted by YouTube, 2011b). The variables that were measured are detailed within Table 4.9 below.

Table 9 – Anatomical Landmarks and Abbreviations for Static Measurements. The anatomical landmarks were first determined prior to measurement as listed within the table.

Anatomical Landmark (Walking) Static	Abbreviations
1. Shoulder – Elbow Length	GHJ - AcF
2. Forearm (elbow-wrist) Length	AcF - StyP
3. Hand length	StyP - D
4. Maximum Hip Width	Gtr/R – Gtr/L
5. Thigh length	Cr - PCen
6. Lower leg length	PI - CMal
7. Knee/Patella width	KJ/R – KJ/L
8. Knee Breadth	PP - PopF
9. Foot length	Ha - Ca
10. Bi Malleolar Width	Mal/R – Mal/L
11. Foot Width	Cu - Phx
12. Mid Patella Height	HaIn - PCen
13. Leg Length-Crotch	HaIn - Cr
14. Leg Length-Trochanter (Posterior)	CaIn - Gtr
15. Total Height (stature)	V - CaIn
16. Torso Length	JugN - LoUmb
17. Jugular to Inguinal Length	JugN - SupIng
18. Trapezius Length	AmT – GHJ
19. Head Height	V - Ch
20. Shoulder Width	GHJ/R – GHJ/L

Anthropometry Landmarks in Gait – Dynamic Assessment

Table 10 – Anthropometric Landmarks for Dynamic Assessment

Abbreviation	Name	Description of Location
PP	Protruding Patella	In profile view, the most protruding and centremost part of the Patella
AMal	Anterior of Mallelous	In profile view, the horizontal line adjacent to the anterior of the malleolus, the dip of the ankle joint where it flexes and extends.
Ha	Hallux	In profile view, can be located as the outermost point of the toe
StyP	Styloid Process	In anterior view, can be located on the distal end of the radius, specifically the side of the hand that contains the smallest finger (5^{th} Phalanx). It is the most protruding point of the wrist and is visualised by a bump. For dynamic gait assessment, the innermost (medial) dip of the wrist

Anthropometric Landmarks

1. Protruding Point of Patella (PP)

Location

In profile view, the most protruding and centremost part of the patella.

Figure 197 – Protruding point of patella

2. Anterior of Malleolus (AMal)

Location

In profile view, the horizontal line adjacent to the anterior of the malleolus, the dip of the ankle joint where it flexes and extends.

Figure 198 – Anterior of malleolus

3. Hallux (Ha)

Location

In profile view, can be located as the outermost point of the toe (or shoe).

Figure 199 – Hallux

4. Styloid Process (StyP)

Location

In anterior view, can be located on the distal end of the radius, specifically the side of the hand that contains the thumb. It is the most protruding point of the wrist and is visualised by a bump. For dynamic gait assessment, the innermost (medial) dip of the wrist.

Figure 200 – Styloid Process

Figure 201 – Dynamic Measurements Revised (as adapted by YouTube, 2011b). The variables that were measured are detailed within Table 4.11 below.

Table 11 – Anatomical Landmarks and Abbreviations for Dynamic Measurements Revised. The anatomical landmarks were revised prior to measurement as listed within the table.

Anatomical Landmark (Walking) Dynamic	Abbreviations
1. Knee Cap – Knee Cap (level)	PP/R – PP/L
2. Lateral Malleolus – Medial Malleolus	LatMal/L – MedMal/R
3. Hallux – Hallux (level)	Ha/R – Ha/L
4. Styloid process – Styloid Process	StyP/R – StyP/L

Anthropometry Landmarks in Gait – Angle Assessment

Table 12 – Anthropometric Landmarks for Angle Assessment

Abbreviation	Name	Description of Location
ElbFlex	Elbow Flexion	Angle of elbow flexion at forward swing. Measurements on Photoshop are taken from GHJ to antecubital fossa, from antecubital fossa to styloid process
KnFlex	Knee Flexion	Angle of knee flexion at leading and trailing limb. Measurements on Photoshop are taken from lowest point of gluteus to popliteal fossa, then from popliteal fossa to posterior of ankle
AnkFlex	Ankle Flexion	Angle of ankle flexion (trailing limb). Measurements on Photoshop are taken from inferior of knee to talocrural joint, from talocrural joint to hallux

Anthropometric Landmarks

1. Elbow Flexion (ElbFlex)

Location

Angle of elbow flexion at forward swing. Measurements on Photoshop are taken from GHJ to antecubital fossa, from antecubital fossa to styloid process (radial side).

2. Knee Flexion (KnFlex)

Location

Angle of knee flexion at leading and trailing limb. Measurements on Photoshop are taken from lowest point of gluteus to popliteal fossa, then from popliteal fossa to posterior of ankle.

3. Ankle Flexion (AnkFlex)

Location

Angle of ankle flexion (trailing limb). Measurements on Photoshop are taken from inferior of knee to talocrural joint (front of ankle), from talocrural joint to hallux (toe).

Figure 202 – Angle Measurements (as adapted by YouTube, 2011b). The variables that were measured are detailed within Table 4.12 below.

Table 13 – Anatomical Landmarks and Abbreviations for Dynamic Measurements. The anatomical landmarks were first determined prior to angle measurement as listed within the table.

Anatomical Landmark (Walking) Angles	Abbreviations
1. Elbow Flexion	ElbFlex
2. Knee Flexion	KnFlex
3. Ankle Flexion	AnkFlex

Morphological Assessment/Classification for Gait

Table 14 – Morphological Variables for Gait

Phase	Gait - Morphological Feature	Definition
Backward Arm Swing	1. Lateral Placement of Upper Arm	The abduction or adduction of the upper arm laterally during backward arm swing
	2. Lateral Placement of Forearm	The abduction or adduction of the lower arm laterally during backward arm swing
	3. Rotation of the Forearm	The rotational direction (medial/lateral) the forearm assumes during backward arm swing
	4. Level of Elbow Flexion	The varying degrees of flexion observed within the elbow during backward arm swing
	5. Rotation of Hand	The rotational direction (medial/lateral) the hand assumes during backward arm swing
	6. Finger Flexion	The flexion or extension of the fingers during backward arm swing
Forward Arm Swing	7. Lateral Placement of Upper Arm	The abduction or adduction of the upper arm laterally during forward arm swing
	8. Lateral Placement of Forearm	The abduction or adduction of the lower arm laterally during forward arm swing
	9. Rotation of the Forearm	The rotational direction (medial/lateral) the forearm assumes during forward arm swing
	10. Level of Elbow Flexion	The varying degrees of flexion observed within the elbow during forward arm swing
	11. Rotation of Hand	The rotational direction (medial/lateral) the hand assumes during forward arm swing
	12. Finger Flexion	The flexion or extension of the fingers during forward arm swing
Complete Cycle	13. Lateral Trunk Sway	The lateral sway of the body (from side to side) observed during multiple gait cycles
	14. Orientation of Lower Extremities	The levels of genu varum and genu valgum as a result of knee rotation
Midstance	15. Head Level	The vertical movement and subsequent positioning of the head during midstance
	16. Lateral Head Tilt	The ‘side-to-side’ tilting of the head during midstance
	17. Shoulder Level	The level of the shoulder in relation to the neck during midstance
	18. Lateral Placement of Upper Arm	The abduction or adduction of the upper arm laterally during midstance
	19. Lateral Placement of Forearm	The abduction or adduction of the lower arm laterally during midstance
	20. Level of Elbow Flexion	The varying degrees of flexion observed within the elbow during midstance
	21. Rotation of Hand	The rotational direction (medial/lateral) the hand assumes during midstance
	22. Finger Flexion	The flexion or extension of the fingers during midstance
	23. Thoracic Projection (bust size)	The levels of thoracic projection during midstance
	24. Abdominal Projection	The levels of abdominal projection during midstance

	25. Upper Thoracic Curvature	The curvature of the upper back within the upper thoracic region during midstance
	26. Thoracic Curvature	The curvature of the back within the thoracic region during midstance
	27. Lumbar Curvature	The curvature of the back within the lumbar region during midstance
	28. Gluteal Shape	The shape of the gluteal region
	32. Lateral Placement of Upper Leg	The abduction or adduction of the upper leg laterally during midstance
	32. Lateral Placement of Lower Leg	The abduction or adduction of the lower leg laterally during midstance
	33. Knee Flexion	The varying degrees of flexion observed within the knee during midstance
	34. Placement of Feet	The placement of feet laterally during midstance
	35. Lateral positioning of the feet	The positioning of the lateral area of the feet
Swing	36. Lateral Placement of Upper Leg	The abduction or adduction of the upper leg laterally during swing
	37. Lateral Placement of Lower Leg	The abduction or adduction of the lower leg laterally during swing
	38. Placement of Feet	The placement of feet laterally during swing
Full Body	39. Somatotype	The general body shape

Backward Arm Swing

1. Lateral Placement of Upper Arm - *Frontal*

The abduction or adduction of the upper arm laterally during backward arm swing

Classification	Number	Description
Abduction	1	The upper arm deviates away from the torso of the body with increased space between body and arms during backward arm swing
Neutral	2	The arms rest naturally by the sides of the torso and neither abducts nor adducts. Space between arms and torso is minimal during backward arm swing
Adduction	3	The upper arm is positioned closely towards the torso of the body, with minimal space visible between body and arms during backward arm swing

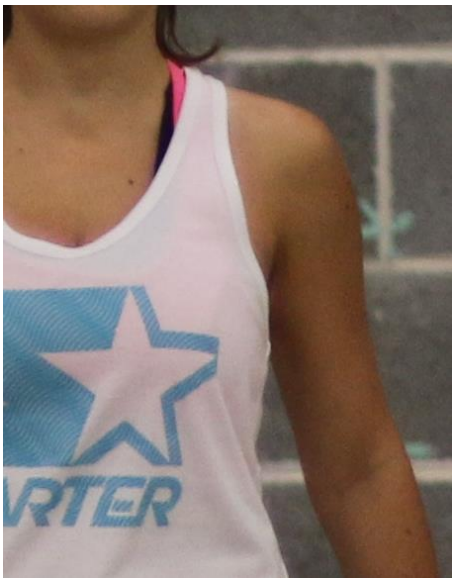


Figure 203 – Abduction

Figure 204 – Neutral

Figure 205 – Adduction

2. Lateral Placement of Forearm - *Frontal*

The abduction or adduction of the lower arm laterally during backward arm swing

Classification	Number	Description
Abduction	1	The forearm deviates away from the torso of the body with increased space between body and arms during backward arm swing
Neutral	2	The forearm rests naturally by the sides of the torso and neither abducts nor adducts. Space between forearm and torso is minimal during backward arm swing
Adduction	3	The forearm is positioned closely towards the torso of the body, with minimal space visible between body and forearm during backward arm swing

Figure 206 – Abduction

Figure 207 – Neutral

Figure 208 – Adduction

3. Rotation of Forearm - *Frontal*

The rotational direction (medial/lateral) the forearm assumes during backward arm swing

Classification	Number	Description
Medial	1	The forearm rotates medially towards the torso (where the ulna and radius are in pronation)
Neutral	2	The forearm does not rotate medially nor laterally
Lateral	3	The forearm rotates laterally away from the torso (where the ulna is in supination)

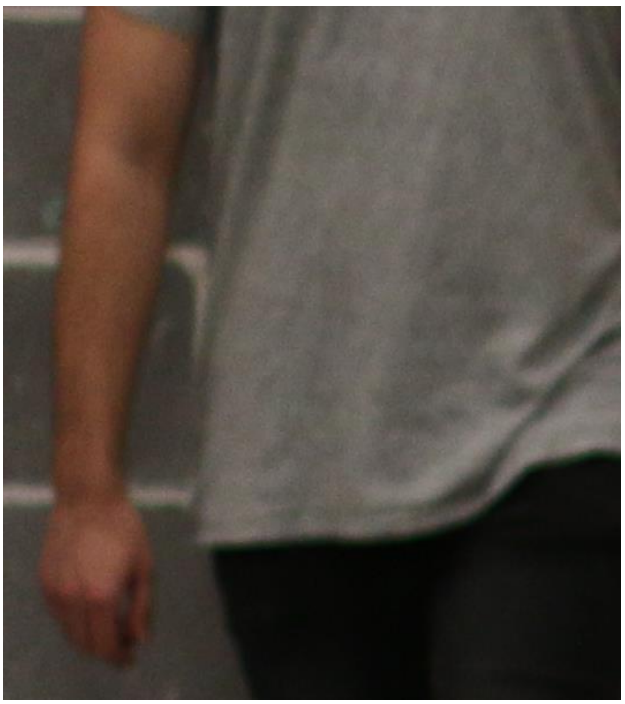


Figure 209 – Medial

Figure 210 – Neutral

Figure 211 – Lateral

4. Level of Elbow Flexion - *Profile*

The varying degrees of flexion observed within the elbow during backward arm swing

Classification	Number	Description
Extended	1	Upon backward arm swing, the arm swings to a straight, extended almost 180-degree angle
Neutral	2	Upon backward arm swing, the arm swings to a slightly bent, relatively straight position, just below a 170-degree angle
Flexed	3	Upon backward arm swing, the arm swings to a more flexed position, assuming more of an obtuse angle
Markedly Flexed	4	Upon backward arm swing, the arm swings to a bent, flexed towards a 90-degree angle

Figure 212 – Extended

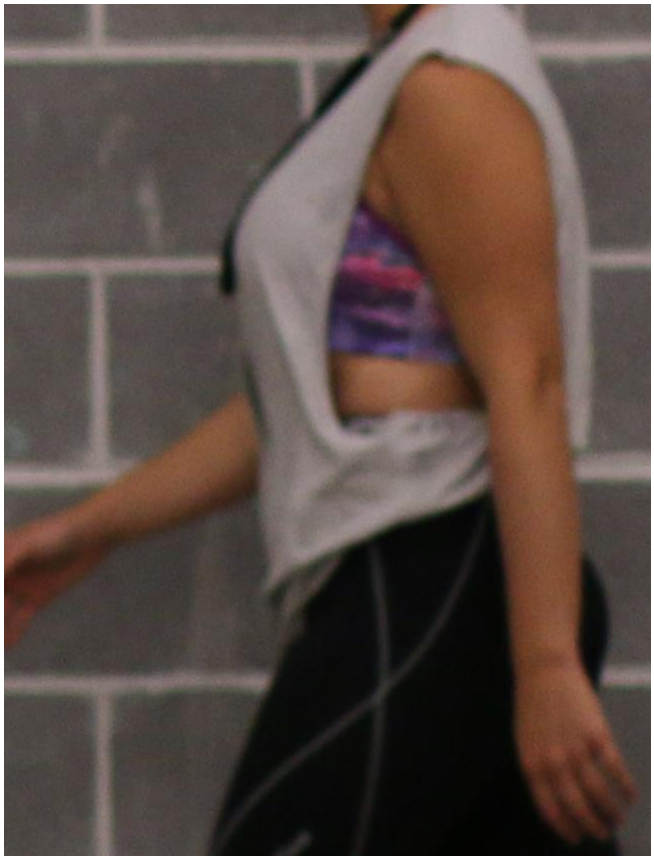


Figure 213 – Neutral

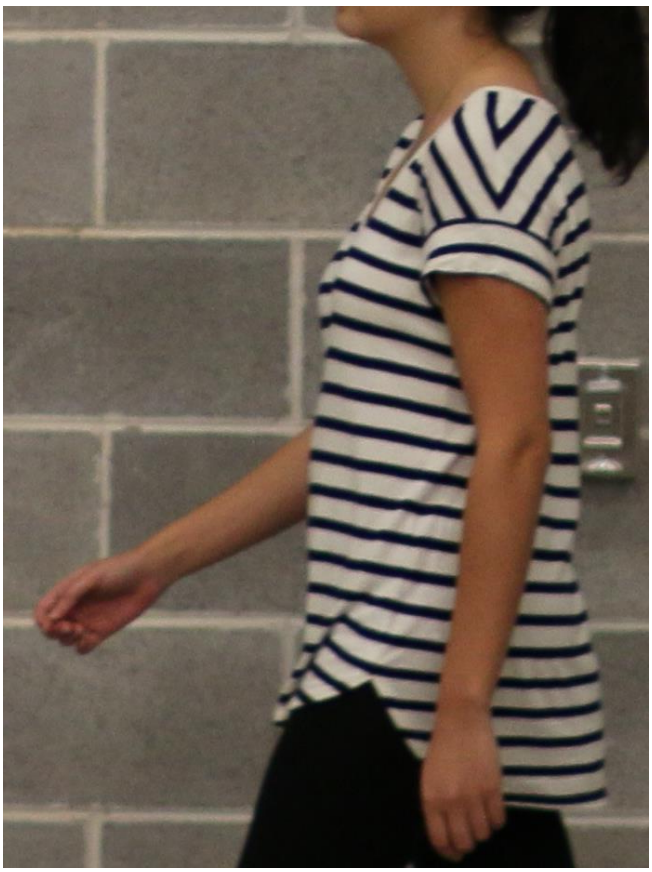


Figure 214 – Flexed

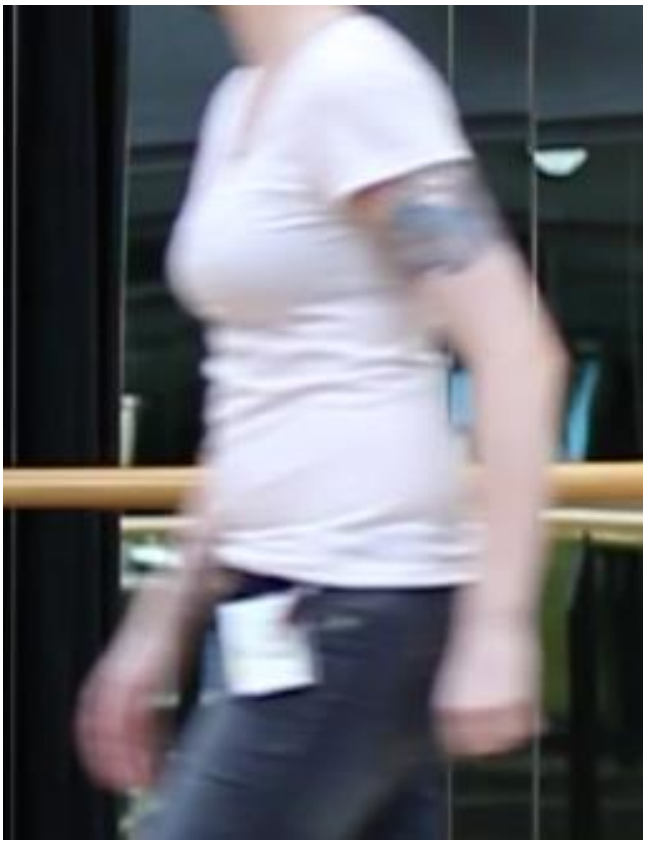


Figure 215 – Markedly Flexed

5. Rotation of Hand - *Frontal*

The rotational direction (medial/lateral) the hand assumes during backward arm swing

Classification	Number	Description
Medial	1	The hand rotates medially towards torso/pelvis where the thumbs are closest to the coronal plane
Neutral	2	The hand does not rotate medially nor laterally where the thumbs are facing the camera or 'observer view'
Lateral	3	The hand rotates laterally away from torso/pelvis where the thumb is furthest from the coronal plane

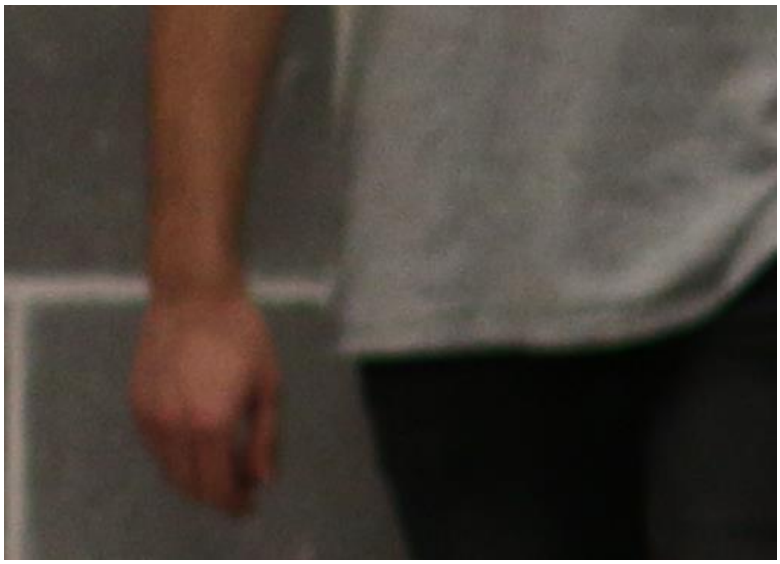


Figure 216 – Medial

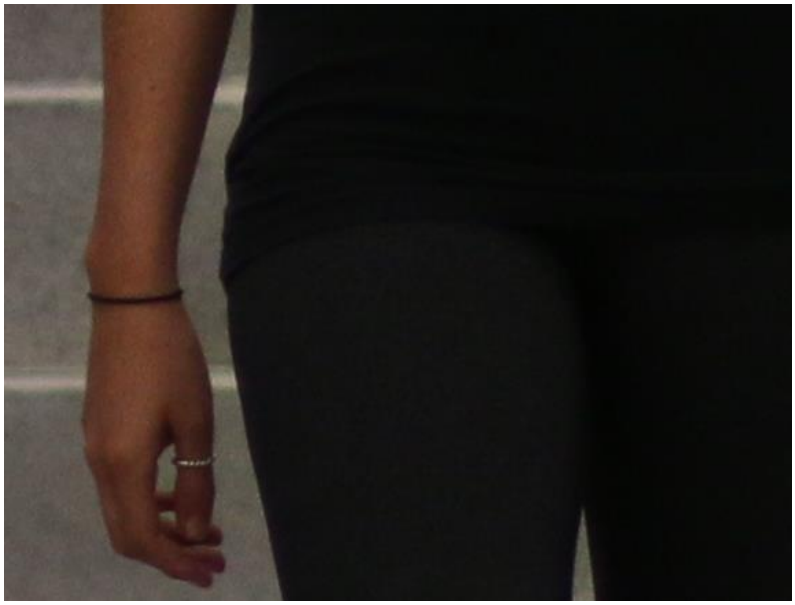


Figure 217 – Neutral

Figure 218 – Lateral

6. Finger Flexion – *Frontal/Profile*

The flexion or extension of the fingers during backward arm swing

Classification	Number	Description
Flexed	1	The fingers are flexed loosely or clenched and fingertips may not be visible
Neutral/Partially Flexed	2	The fingers are slightly flexed in a comfortable position where no visible extension or clenching is visible
Extended	3	The fingers are extended and fingertips are visible

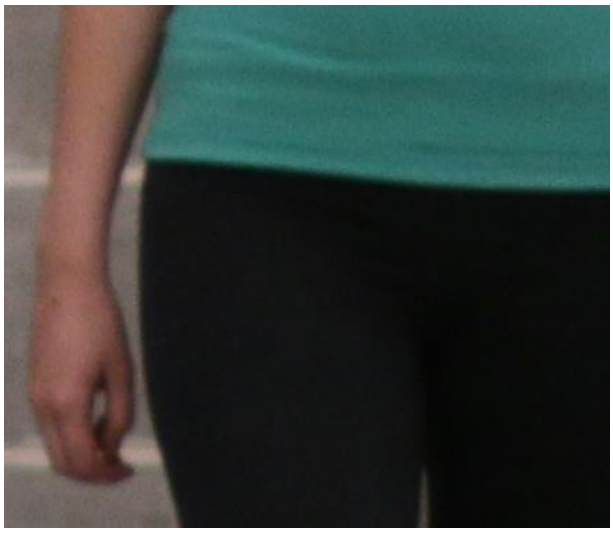


Figure 219 – Flexed

Figure 220 – Neutral/Partially Flexed

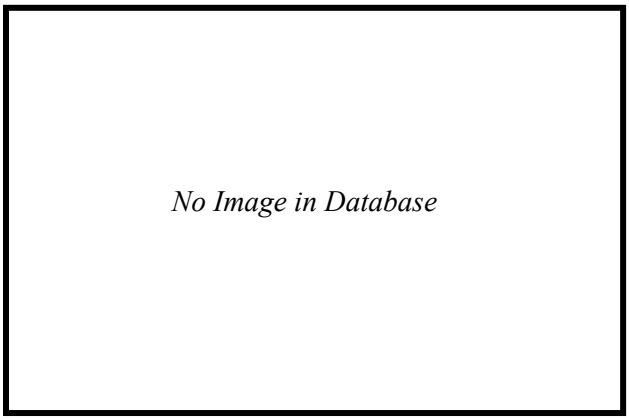


Figure 221 – Extended

Forward Arm Swing

7. Lateral Placement of Upper Arm - *Frontal*

The abduction or adduction of the upper arm laterally during forward arm swing

Classification	Number	Description
Abduction	1	The upper arm deviates away from the torso of the body with increased space between body and arms during forward arm swing
Neutral	2	The arms rest naturally by the sides of the torso and neither abducts nor adducts. Space between arms and torso is minimal during forward arm swing
Adduction	3	The upper arm is positioned closely towards the torso of the body, with minimal space visible between body and arms during forward arm swing

Figure 222 – Abduction

Figure 223 – Neutral

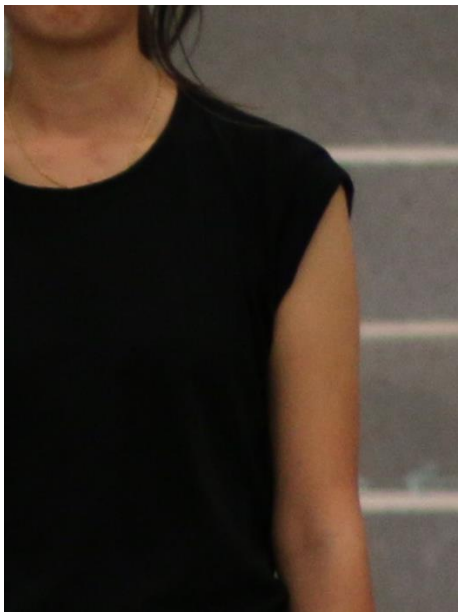


Figure 224 – Adduction

8. Lateral Placement of Forearm - *Frontal*

The abduction or adduction of the lower arm laterally during forward arm swing

Classification	Number	Description
Abduction	1	The forearm deviates away from the torso of the body with increased space between body and arms during forward arm swing
Neutral	2	The forearm rests naturally by the sides of the torso and neither abducts nor adducts. Space between forearm and torso is minimal during forward arm swing
Adduction	3	The forearm is positioned closely towards the torso of the body, with minimal space visible between body and forearm during forward arm swing

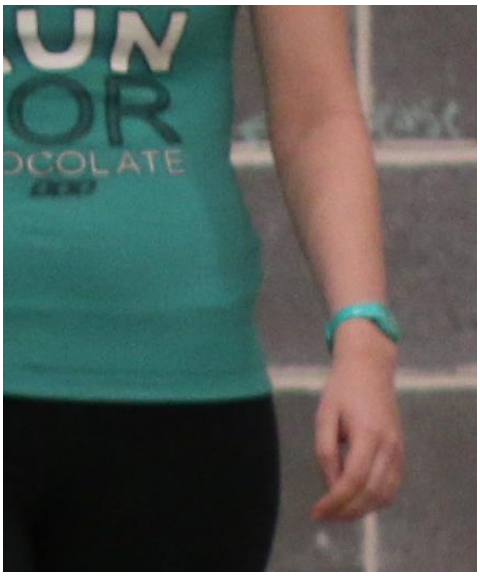


Figure 225 – Abduction

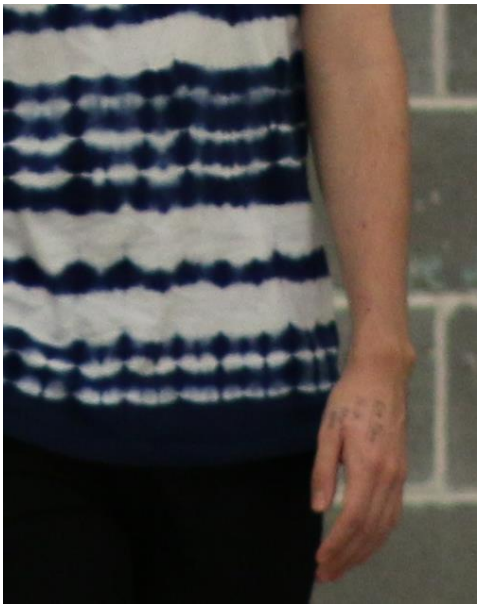


Figure 226 – Neutral

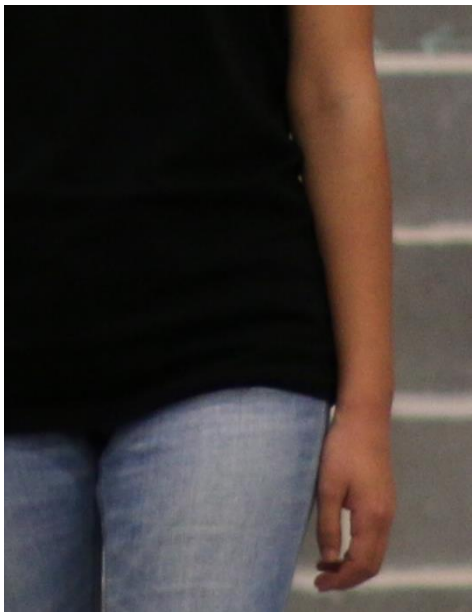


Figure 227 – Adduction

9. Rotation of Forearm - *Frontal*

The rotational direction (medial/lateral) the forearm assumes during forward arm swing

Classification	Number	Description
Medial	1	The forearm rotates medially towards the torso (where the ulna and radius are in pronation)
Neutral	2	The forearm does not rotate medially nor laterally
Lateral	3	The forearm rotates laterally away from the torso (where the ulna is in supination)

Figure 228 – Medial

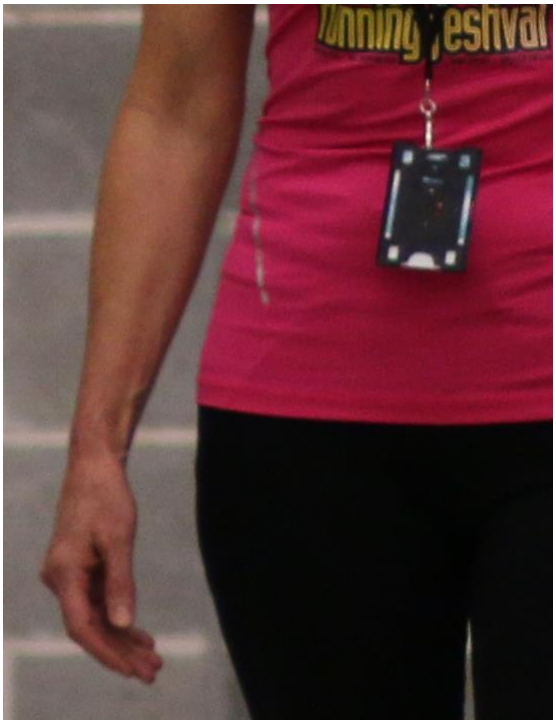


Figure 229 – Neutral

No Image in Database

Figure 230 – Lateral

10. Level of Elbow Flexion - *Profile*

The varying degrees of flexion observed within the elbow during forward arm swing

Classification	Number	Description
Extended	1	Upon forward arm swing, the arm swings to a straight, extended almost 180-degree angle
Neutral	2	Upon forward arm swing, the arm swings to a slightly bent, relatively straight position, just below a 170-degree angle
Flexed	3	Upon forward arm swing, the arm swings to a more flexed position, assuming more of an obtuse angle
Markedly Flexed	4	Upon forward arm swing, the arm swings to a bent, flexed towards a 90-degree angle

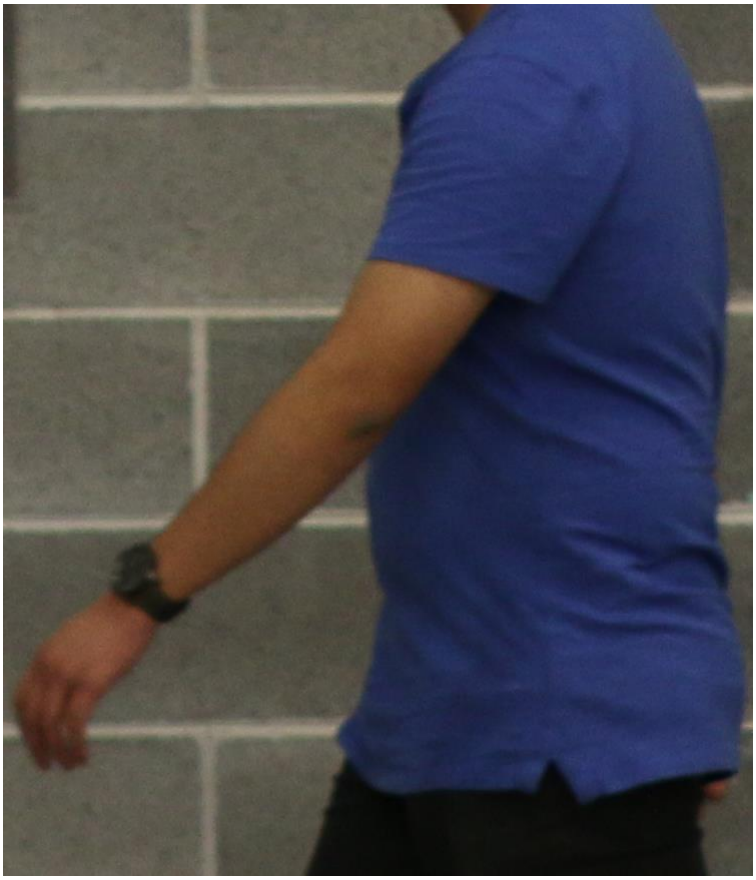


Figure 231 – Extended

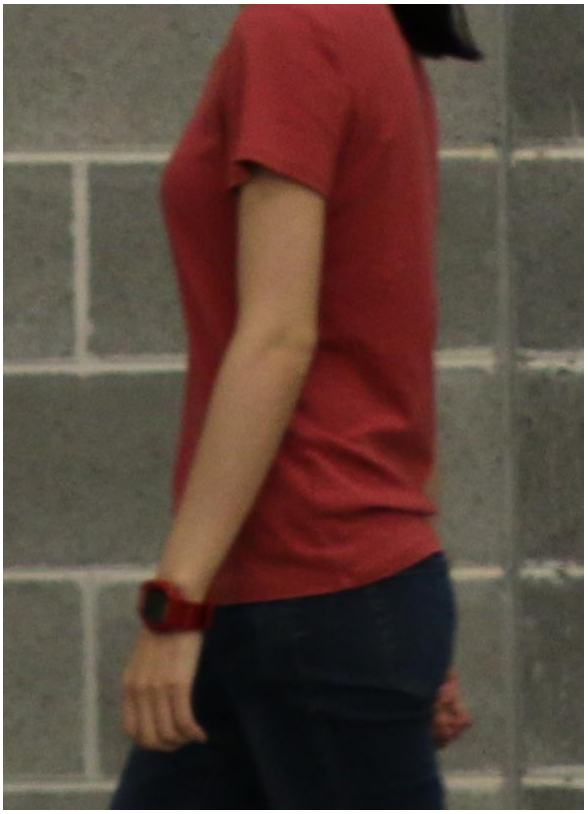


Figure 232 – Neutral

Figure 233 – Flexed

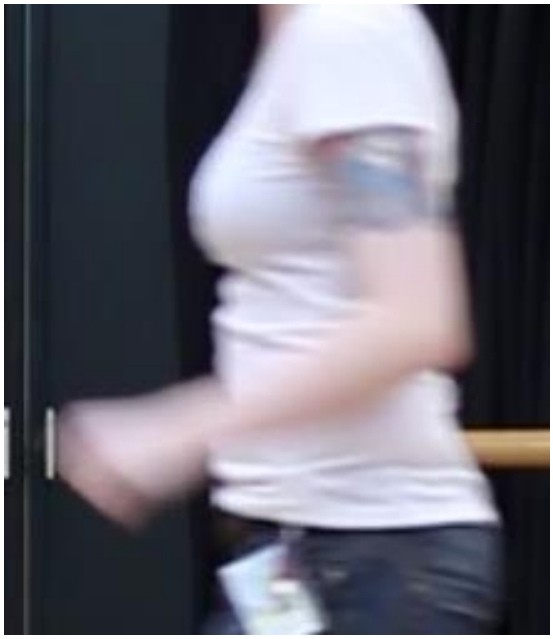


Figure 234 – Markedly Flexed

11. Rotation of Hand - *Frontal*

The rotational direction (medial/lateral) the hand assumes during forward arm swing

Classification	Number	Description
Medial	1	The hand rotates medially towards torso/pelvis where the thumbs are closest to the coronal plane
Neutral	2	The hand does not rotate medially nor laterally where the thumbs are facing the camera or 'observer view'
Lateral	3	The hand rotates laterally away from torso/pelvis where the thumb is furthest from the coronal plane

Figure 235 – Medial

Figure 236 – Neutral

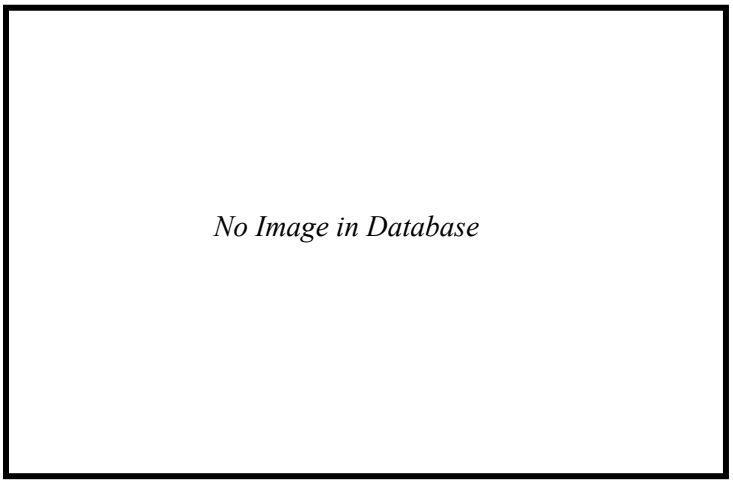


Figure 237 – Lateral

12. Finger Flexion – *Frontal/Profile*

The flexion or extension of the fingers during forward arm swing

Classification	Number	Description
Flexed	1	The fingers are flexed loosely or clenched and fingertips may not be visible
Neutral/Partially Flexed	2	The fingers are slightly flexed in a comfortable position where no visible extension or clenching is visible
Extended	3	The fingers are extended and fingertips are visible

Figure 238 – Flexed

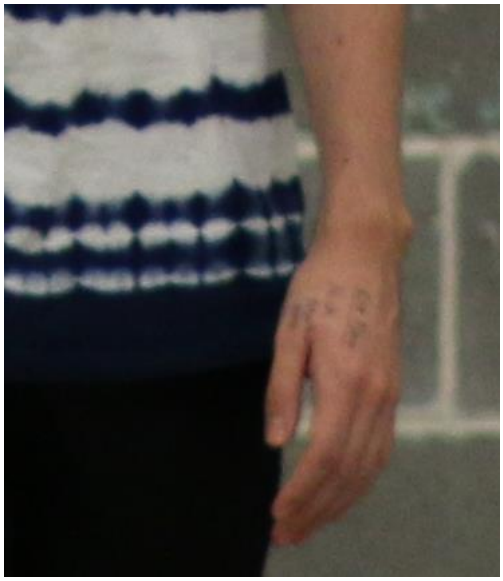


Figure 239 – Neutral/Partially Flexed

Figure 240 – Extended

Complete Cycle

13. Lateral Trunk Sway - *Frontal*

The lateral sway of the body (from side to side) observed during multiple gait cycles

Classification	Number	Description
Rigid	1	No side-to-side lateral sway is observed as the person is walking, but rather a rigidity to the torso is observed
Neutral (minimal Sway)	2	Minimal side-to-side lateral sway is observed as the person is walking, where a relaxed movement is seen
Marked Swaying	3	Marked and exaggerated side-to-side lateral sway is observed as the person is walking, where they appear to sway with each step

Figure 241 – Rigid

Figure 242 – Neutral (minimal sway)

Figure 243 – Marked Swaying

14. Orientation of Lower Extremities Anterior – *Frontal/Posterior*

The levels of genu varum and genu valgum as a result of knee rotation (difficult assessment due to parallax)

Classification	Number	Description
Moderate Bow Legs	1	Moderate bow leg (Genu Varum) is visualised, which results from the leg rotating medially towards the sagittal plane (curved appearance)
Slight Bow Legs	2	Slight bow leg (Genu Varum) is visualised, which results from the leg rotating slightly medially towards the sagittal plane (curved appearance)
Straight	3	There is no medial or lateral rotation of the leg as they are parallel to the sagittal plane
Slight Knock knees	4	Slight lateral rotation of one or both knees results in a 'knock kneed' (Genu Valgum) appearance where there is adduction of the upper leg (towards sagittal plane) and abduction of the lower leg (away from sagittal plane)
Moderate Knock knees	5	Moderate lateral rotation of one or both knees results in a 'knock kneed' (Genu Valgum) appearance where there is adduction of the upper leg (towards sagittal plane) and abduction of the lower leg (away from sagittal plane)

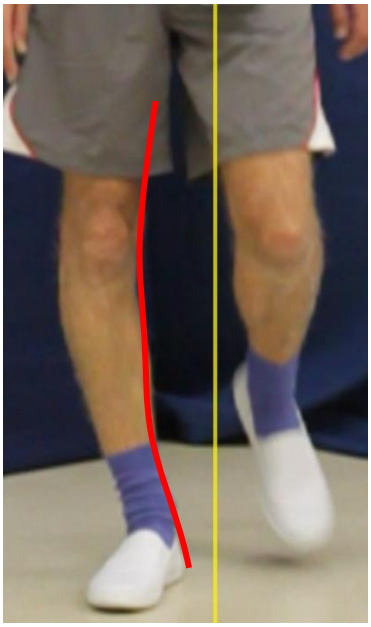


Figure 244 – Moderate bow legs (anterior)

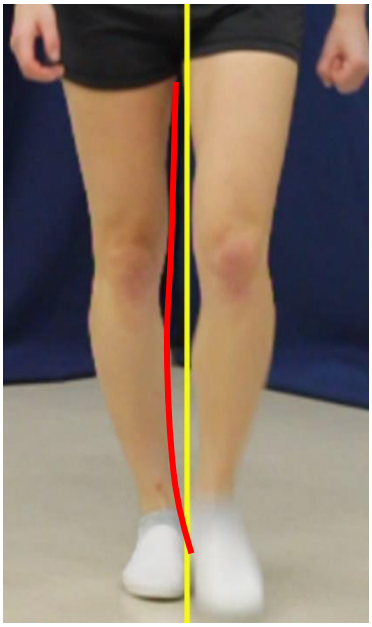


Figure 245 – Slight bow legs (anterior)

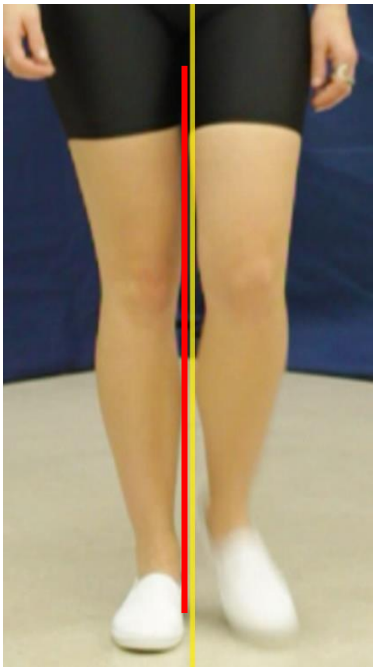


Figure 246 – Straight legs (anterior)

Figure 247 – Slight knock kneed (anterior)

Figure 248 – Moderate knock kneed (anterior)

Midstance

15. Head Level - *Profile*

The vertical movement and subsequent positioning of the head during midstance

Classification	Number	Description
Tilted Down	1	The head gravitates down towards the neck
Facing Ahead	2	The head is facing directly ahead, neither tilted down towards the neck nor upwards away from the neck
Tilted Up	3	The head gravitates up and away from the neck

Figure 249 – Tilted Down

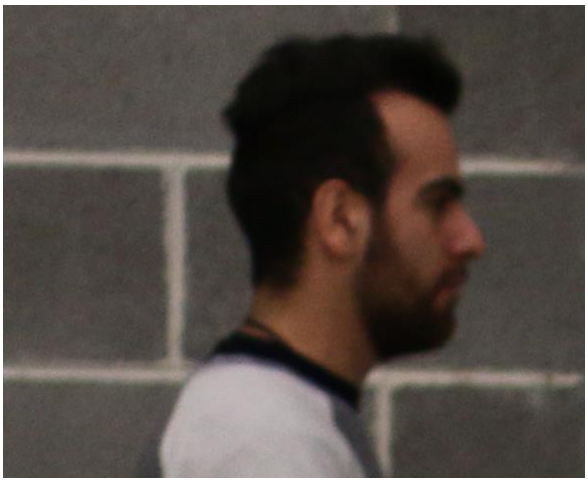


Figure 250 – Facing Ahead

Figure 251 – Tilted Up

16. Lateral head Tilt - *Frontal*

The 'side-to-side' tilting of the head during midstance

Classification	Number	Description
Tilted Left	1	The head visibly tilts to the left
Centered	2	The head is centered
Tilted Right	3	The head visibly tilts to the right

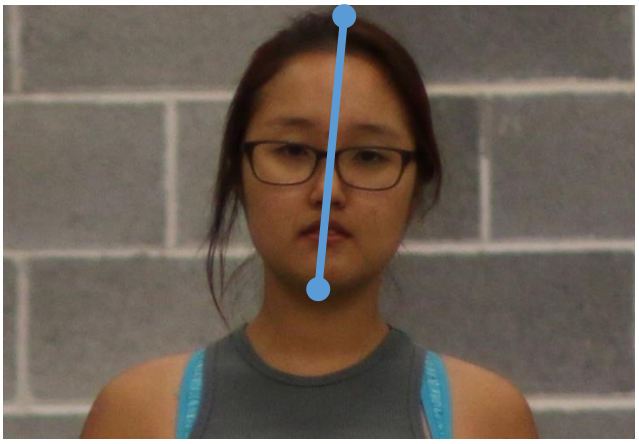


Figure 252 – Tilted Left

Figure 253 – Centered

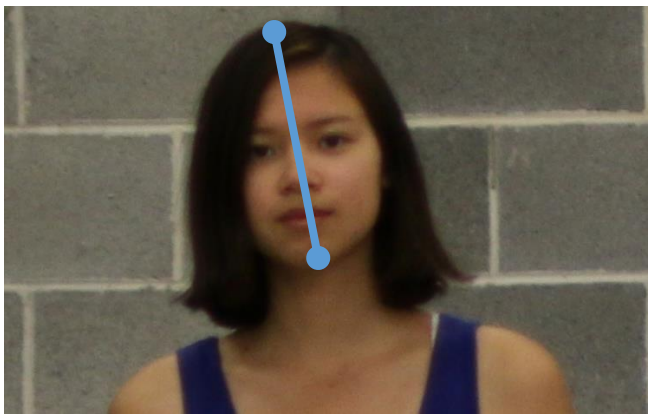


Figure 254 – Tilted Right

17. Shoulder level - *Posterior*

The level of the shoulder in relation to the neck during midstance

Classification	Number	Description
Lowered	1	A markedly visible downward angle (depression) of the shoulder, measured >20 degree angle
Neutral	2	A medium downward angle of the shoulder, measured at approximately 15 - 20 degree angle
Raised	3	A markedly visible elevation of the shoulder, measured <15 degree angle

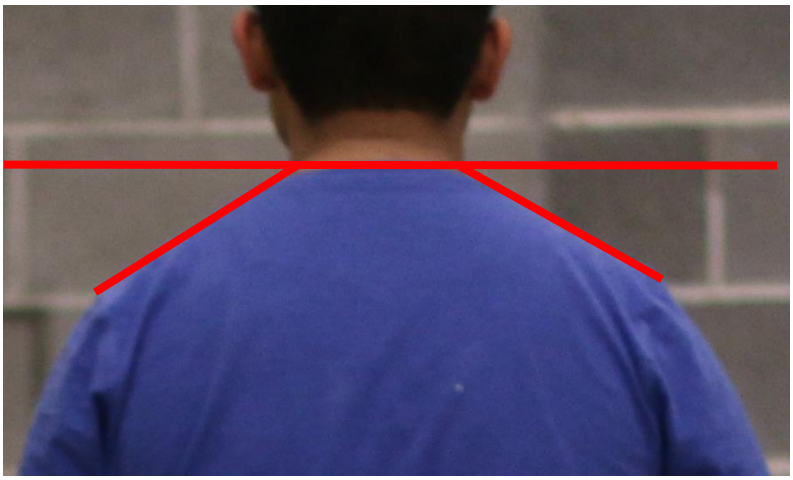


Figure 255 – Lowered

Figure 256 – Neutral

Figure 257 – Raised

18. Lateral Placement of Upper Arm - *Frontal*

The abduction or adduction of the upper arm laterally during midstance

Classification	Number	Description
Abduction	1	The upper arm deviates away from the torso of the body with increased space between body and arms during midstance
Neutral	2	The arms rest naturally by the sides of the torso and neither abducts nor adducts. Space between arms and torso is minimal during midstance
Adduction	3	The upper arm is positioned closely towards the torso of the body, with minimal space visible between body and arms during midstance

Figure 258 – Abduction

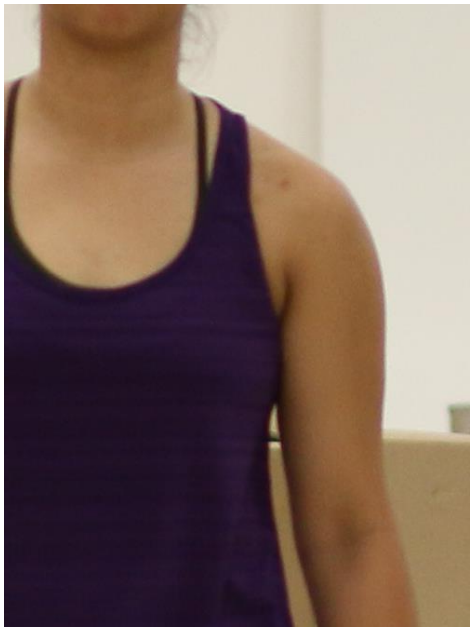


Figure 259 – Neutral

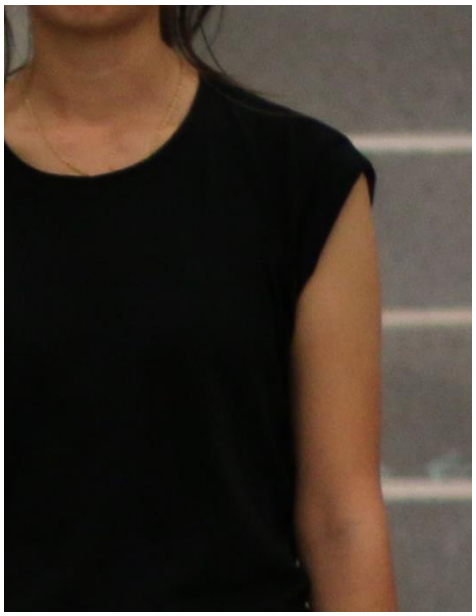


Figure 260 – Adduction

19. Lateral Placement of Forearm - *Frontal*

The abduction or adduction of the lower arm laterally during midstance

Classification	Number	Description
Abduction	1	The forearm deviates away from the torso of the body with increased space between body and arms during midstance
Neutral	2	The forearm rests naturally by the sides of the torso and neither abducts nor adducts. Space between forearm and torso is minimal during midstance
Adduction	3	The forearm is positioned closely towards the torso of the body, with minimal space visible between body and forearm during midstance

Figure 261 – Abduction

Figure 262 – Neutral

Figure 263 – Adduction

20. Level of Elbow Flexion - *Profile*

The varying degrees of flexion observed within the elbow during midstance

Classification	Number	Description
Extended	1	During midstance, the arm swings to a straight, extended almost 180-degree angle
Neutral	2	During midstance, the arm swings to a slightly bent, relatively straight position, just below a 170-degree angle
Flexed	3	During midstance, the arm swings to a more flexed position, assuming more of an obtuse angle
Markedly Flexed	4	During midstance, the arm swings to a bent, flexed almost 90-degree angle

Figure 264 – Extended

Figure 265 – Neutral

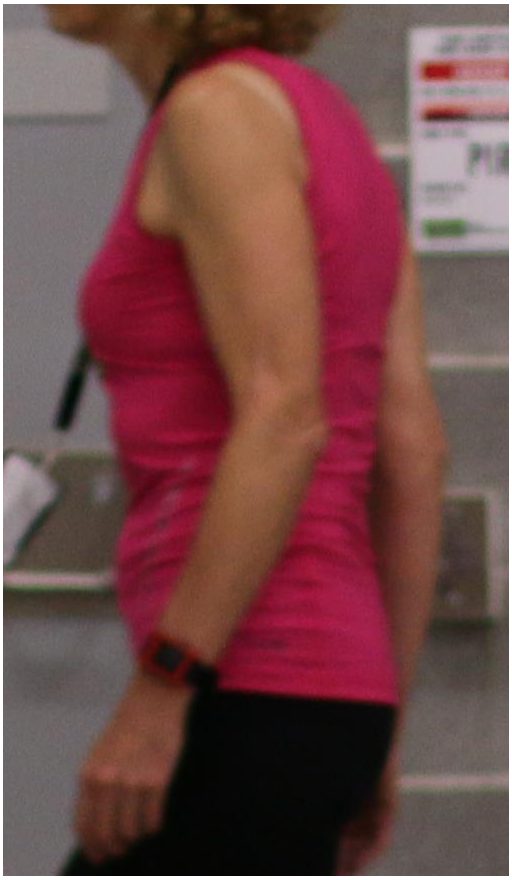


Figure 266 – Flexed

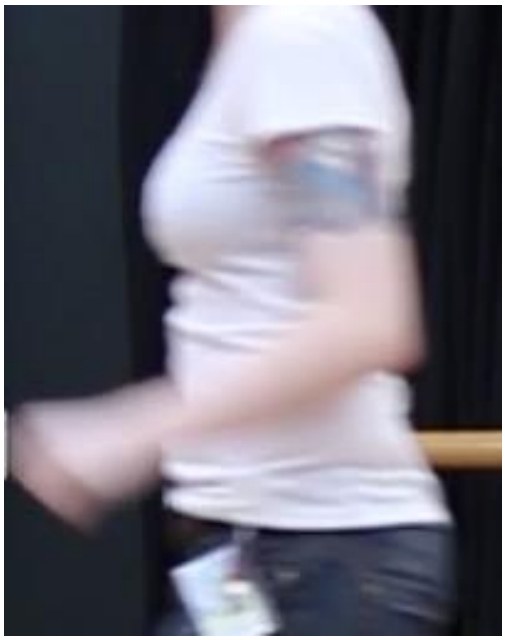


Figure 267 – Markedly Flexed

21. Rotation of Hand - *Frontal*

The rotational direction (medial/lateral) the hand assumes during midstance

Classification	Number	Description
Medial	1	The hand rotates medially towards torso/pelvis where the thumbs are closest to the coronal plane
Neutral	2	The hand does not rotate medially nor laterally where the thumbs are facing the camera or 'observer view'
Lateral	3	The hand rotates laterally away from torso/pelvis where the thumb is furthest from the coronal plane

Figure 268 – Medial

Figure 269 – Neutral

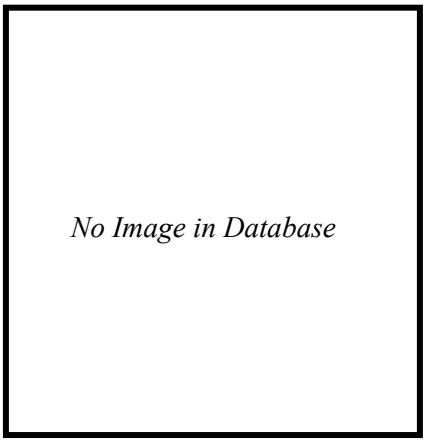


Figure 270 – Lateral

22. Finger Flexion – *Frontal/Profile*

The flexion or extension of the fingers during midstance

Classification	Number	Description
Flexed	1	The fingers are flexed loosely or clenched and fingertips may not be visible
Neutral/Partially Flexed	2	The fingers are slightly flexed in a comfortable position where no visible extension or clenching is visible
Extended	3	The fingers are extended and fingertips are visible

Figure 271 – Flexed

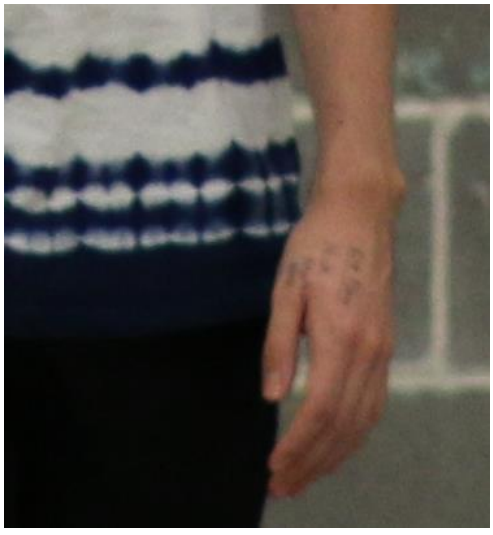


Figure 272 – Neutral/Partially Flexed

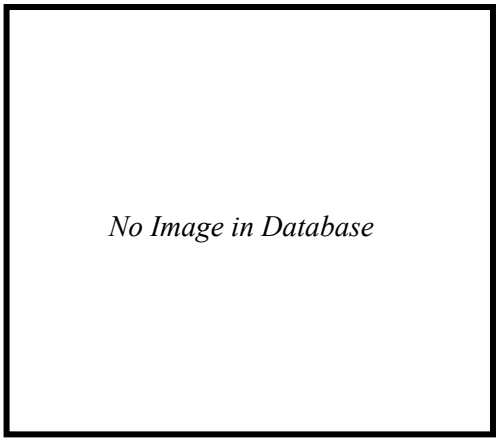


Figure 273 – Extended

23. Thoracic Projection (bust size) - *Profile*

The levels of thoracic projection (bust size) during midstance

Classification	Number	Description
Flat	1	The thoracic region is flat where no/minimal projection is observed relative to the pelvic region
Slightly Projecting	2	The thoracic region projects slightly, past the point of the relative pelvic region
Markedly Projecting	3	The thoracic region projects markedly, past the point of the relative pelvic region

Figure 274 – Flat

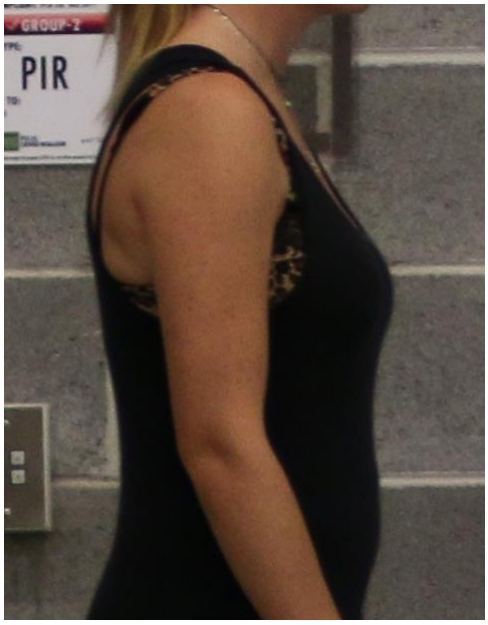


Figure 275 – Slightly Projecting

Figure 276 – Markedly Projecting

24. Abdominal Projection - *Profile*

The levels of abdominal projection during midstance

Classification	Number	Description
Flat	1	The abdominal region is flat where no/minimal projection is observed relative to the pelvic region
Slightly Projecting	2	The abdominal region projects slightly, past the point of the relative pelvic region
Markedly Projecting	3	The abdominal region projects markedly, past the point of the relative pelvic region

Figure 277 – Flat

Figure 278 – Slightly Projecting

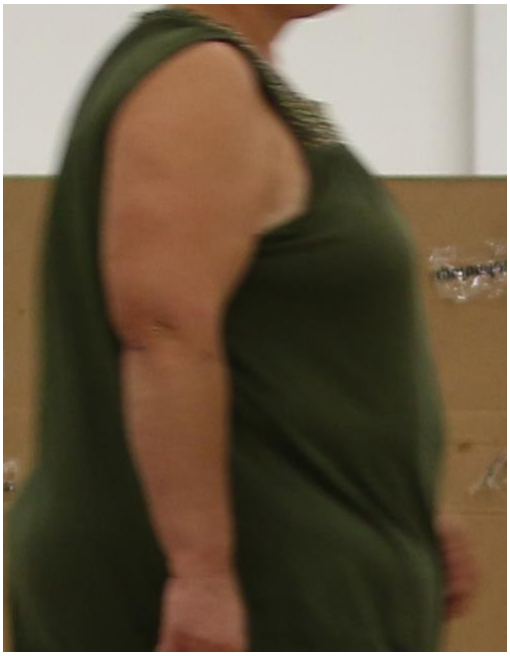


Figure 279 – Markedly Projecting

25. Upper Thoracic Curvature - *Profile*

The curvature of the upper back within the upper thoracic region during midstance

Classification	Number	Description
Curved	1	The posteriorly curved appearance of the upper thoracic region, which can present the appearance of a 'hunch' due to anatomical structure, or overlaying adipose tissue
Neutral	2	The neutral appearance of the upper thoracic region, can be observed to be slightly curved (convex)
Flattened	3	The flattened appearance of the upper thoracic region, can be observed to be straight in structure

Figure 280 – Curved

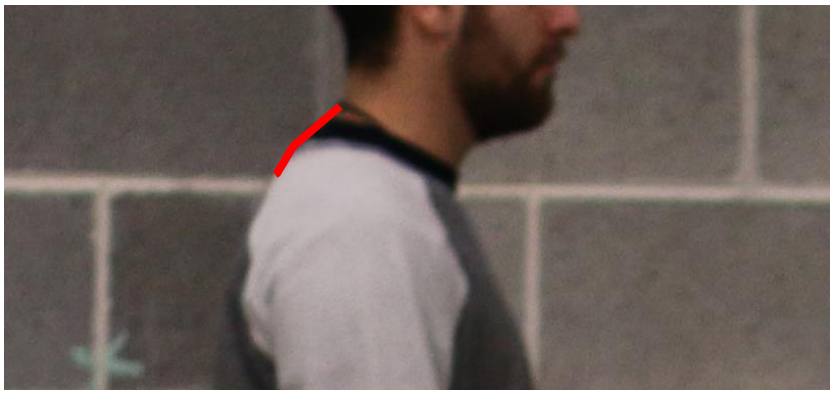


Figure 281 – Neutral

Figure 282 – Flattened

26. Thoracic Curvature - *Profile*

The curvature of the back within the thoracic region during midstance

Classification	Number	Description
Curved	1	The exaggerated posterior curvature of the thoracic spine (kyphosis)
Neutral	2	The neutral appearance of the thoracic region, can be observed to be slightly curved (convex)
Flattened	3	The flattened appearance of the thoracic region, can be observed to be visibly flattened in structure

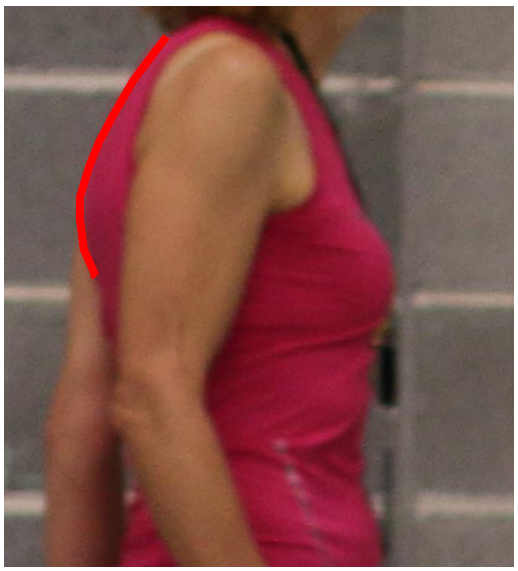


Figure 283 – Curved

Figure 284 – Neutral

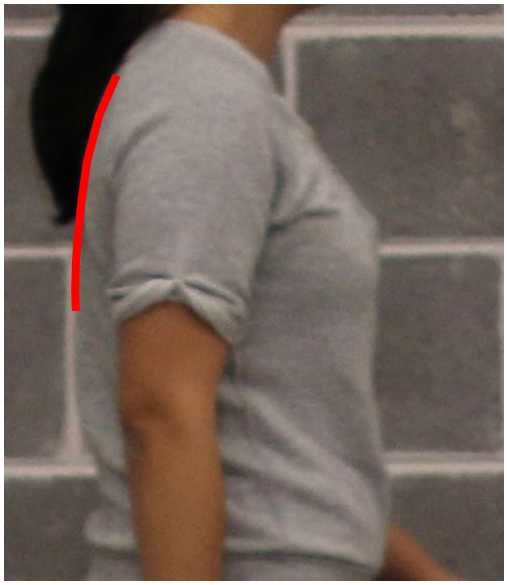


Figure 285 – Flattened

27. Lumbar Curvature - *Profile*

The curvature of the back within the lumbar region during midstance

Classification	Number	Description
Curved	1	The exaggerated anterior curvature (towards midline of torso) of the lumbar spine
Straight	2	The neutral appearance of the lumbar region, can be observed to be slightly curved
Flattened	3	The flattened appearance of the lumbar region, can be observed to be relatively flattened in structure

Figure 286 – Curved

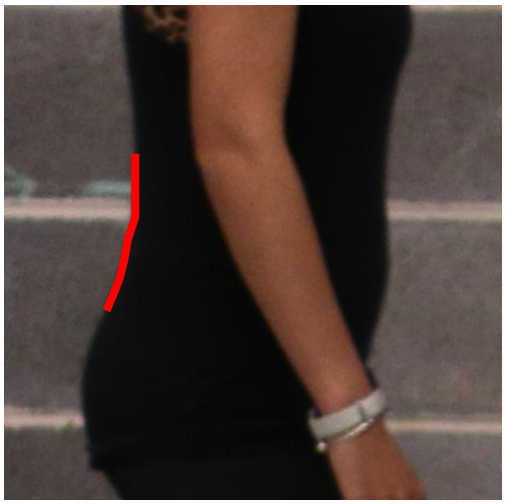


Figure 287 – Neutral

Figure 288 – Flattened

28. Gluteal Shape - *Posterior*

The shape of the gluteal region

Classification	Number	Description
V-Shape	1	The gluteus appears ‘v-like’ in shape where the lateral sides of hips are bowing inwards when moving distally
Square	2	The gluteus appears ‘square-like’ in shape where lateral sides of hips are even when travelling distally
Round	3	The gluteus is rounded or curved
Heart	4	The gluteus is round in shape with a narrow waist, giving the appearance of a ‘heart’ shape

Figure 289 – V Shape

Figure 290 – Square

Figure 291 – Round

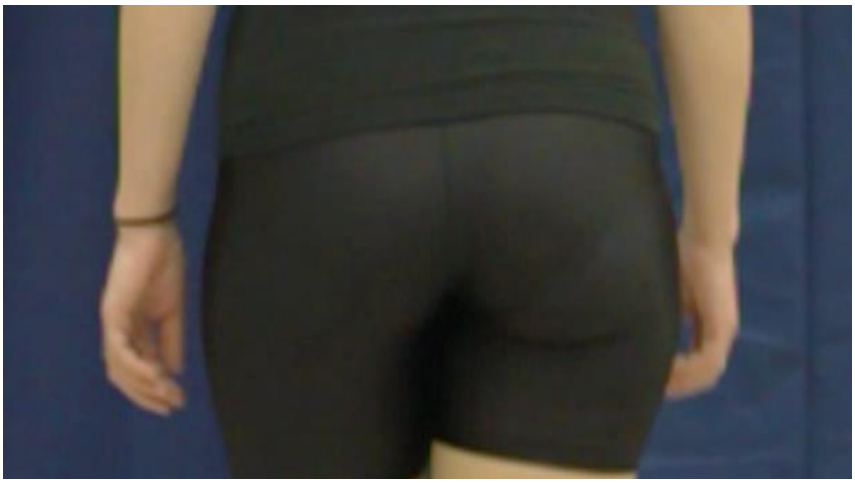


Figure 292 – Heart

29. Lateral Placement of Upper Leg - *Frontal*

For the purpose of this manual, the abduction or adduction of the upper leg laterally during midstance

Classification	Number	Description
Abduction	1	The upper leg deviates away from the sagittal plane of the body with abundant space between both lower limbs
Neutral	2	The upper leg neither abducts nor adducts. Space between both upper legs are minimal
Adduction	3	The upper leg deviates towards the sagittal plane of the body with no space between both upper limbs

Figure 293 – Abduction

Figure 294 – Neutral

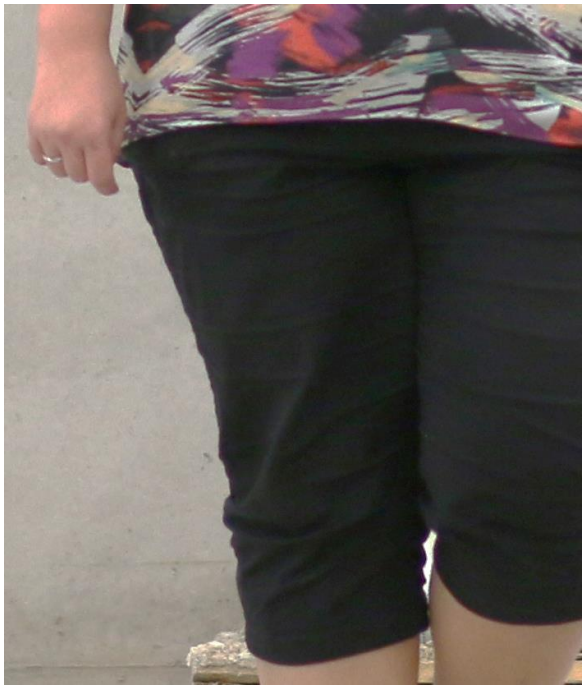


Figure 295 – Adduction

30. Lateral Placement of Lower Leg - *Frontal*

For the purpose of this manual, the abduction or adduction of the lower leg laterally during midstance

Classification	Number	Description
Abduction	1	The lower leg deviates away from the sagittal plane of the body with abundant space between both lower limbs
Neutral	2	The lower leg neither abducts nor adducts. Space between both lower legs are minimal
Adduction	3	The lower leg deviates towards the sagittal plane of the body with no space between both lower limbs

Figure 296 – Abduction

Figure 297 – Neutral

Figure 298 – Adduction

33. Knee Flexion - *Profile*

The varying degrees of flexion observed within the knee during midstance

Classification	Number	Description
Extended	1	During midstance, the leg is straight, extended at a 180-degree angle
Slightly Flexed	2	During midstance, the leg is slightly bent, relatively straight position, just below the 180-degree angle
Flexed	3	During midstance, the leg is more flexed position, assuming more of an ~170-degree angle
Markedly Flexed	4	During midstance, the leg is bent, <170-degree angle

Figure 299 – Extended

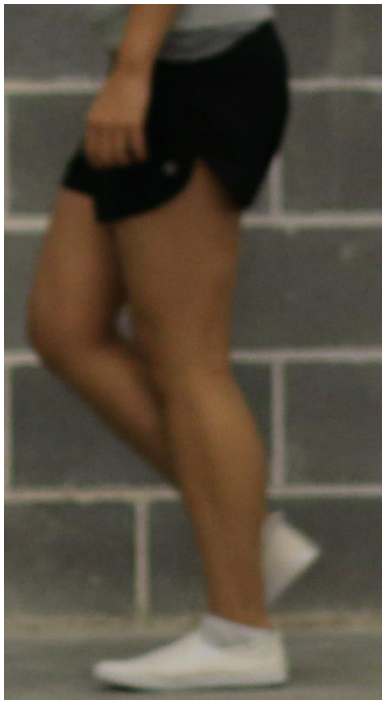


Figure 300 – Slightly Flexed

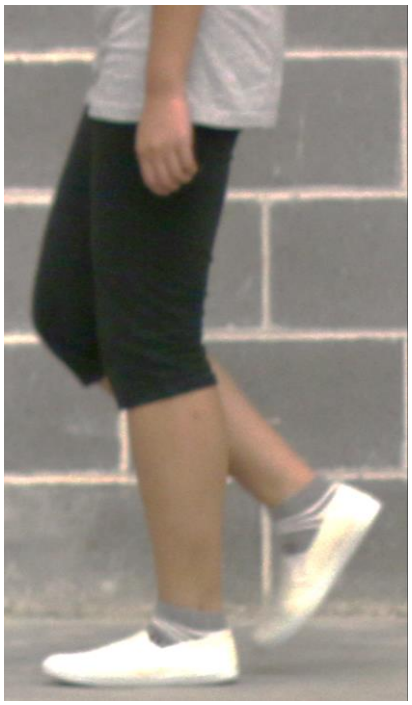


Figure 301 – Flexed

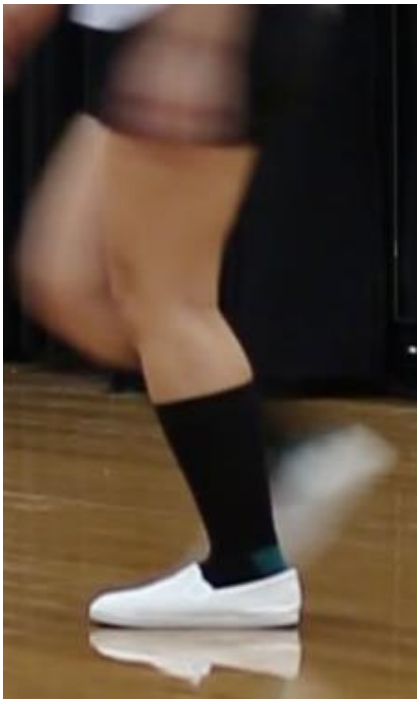


Figure 302 – Markedly Flexed

34. Placement of Feet - *Frontal*

The placement of feet laterally during midstance

Classification	Number	Description
Out-toeing	1	The feet are laterally rotated outwards
Straight	2	The feet are neither laterally nor medially rotated
In-toeing	3	The feet are medially rotated inwards

Figure 303 – Out-toeing

Figure 304 – Straight

Figure 305 – In-toeing

35. Lateral positioning of the feet - *Frontal*

The positioning of the lateral area of the feet

Classification	Number	Description
Inner foot	1	The position appears distributed to the inner sides of the feet
Neutral	2	The position appears evenly distributed on the whole foot
Outer foot	3	The position appears distributed to the outer sides of the feet

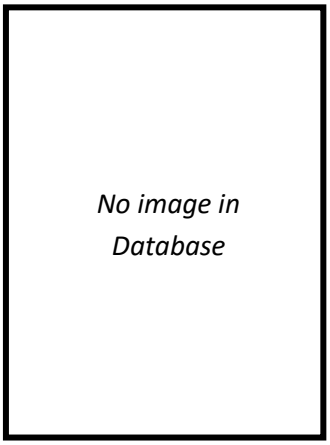


Figure 306 – Inner foot

Figure 307 – Whole foot

Figure 308 – Outer foot

Swing

36. Lateral Placement of Upper Leg - *Frontal*

For the purpose of this manual, the abduction or adduction of the upper leg laterally during swing

Classification	Number	Description
Abduction	1	The upper leg deviates away from the sagittal plane of the body with abundant space between both lower limbs
Neutral	2	The upper leg neither abducts nor adducts. Space between both upper legs are minimal
Adduction	3	The upper leg deviates towards the sagittal plane of the body with no space between both upper limbs

Figure 309 – Abduction

Figure 310 – Neutral

Figure 311 – Adduction

37. Lateral Placement of Lower Leg - *Frontal*

For the purpose of this manual, the abduction or adduction of the lower leg laterally during swing

Classification	Number	Description
Abduction	1	The lower leg deviates away from the sagittal plane of the body with abundant space between both lower limbs
Neutral	2	The lower leg neither abducts nor adducts. Space between both lower legs are minimal
Adduction	3	The lower leg deviates towards the sagittal plane of the body with no space between both lower limbs

Figure 312 – Abduction

Figure 313 – Neutral

Figure 314 – Adduction

38. Placement of Feet - *Frontal*

The placement of feet laterally during swing

Classification	Number	Description
Out-toeing	1	The feet are laterally rotated outwards during forward advancement of the foot
Straight	2	The feet are neither laterally nor medially rotated during forward advancement of the foot
In-toeing	3	The feet are medially rotated inwards during forward advancement of the foot

Figure 315 – Out-toeing

Figure 316 – Straight

Figure 317 – In-toeing

Full Body

39. Somatotype – *Frontal/Posterior*

The general body shape

Classification	Number	Description
Ectomorph	1	An ectomorph shape is observed by long appendicular limbs with a skinny build with delicate muscle build
Mesomorph	2	A mesomorph is characterised by a naturally athletic muscular build with a rectangular shaped body
Endomorph	3	An endomorph is observed by a short, round and wider body with higher levels of adipose tissue

Figure 318 – Ectomorph, Mesomorph, and Endomorph

Datasheets

Gait - Morphology Datasheets						
Subject Number:		Sex:		Age:	Ancestry:	
Gait Phase	Feature	View	Left/Right	Classification	Ordinal	Nominal
Backward Arm Swing	1. Lateral Placement of Upper Arm	Frontal		Abduction	1	
				Neutral	2	
				Adduction	3	
	2. Lateral Placement of Forearm	Frontal		Abduction	1	
				Neutral	2	
				Adduction	3	
	3. Rotation of the Forearm	Frontal		Medial Rotation	1	
				Neutral	2	
				Lateral Rotation	3	
	4. Level of Elbow Flexion	Profile		Extended	1	
				Neutral	2	
				Flexed	3	
				Markedly Flexed	4	
	5. Rotation of Hand	Frontal		Medial Rotation	1	
				Neutral	2	
				Lateral Rotation	3	
	6. Finger Flexion	Frontal / Profile		Flexed	1	
				Neutral/Partially Flexed	2	
				Extended	3	

Gait Phase	Feature	View	Left/Right	Classification	Ordinal	Nominal
Forward Arm Swing	7. Lateral Placement of Upper Arm	Frontal		Abduction	1	
				Neutral	2	
				Adduction	3	
	8. Lateral Placement of Forearm	Frontal		Abduction	1	
				Neutral	2	
				Adduction	3	
	9. Rotation of the Forearm	Frontal		Medial Rotation	1	
				Neutral	2	
				Lateral Rotation	3	
	10. Level of Elbow Flexion	Profile		Extended	1	
				Neutral	2	
				Flexed	3	
				Markedly Flexed	4	
	11. Rotation of Hand	Frontal		Medial Rotation	1	
				Neutral	2	
				Lateral Rotation	3	
	12. Finger Flexion	Frontal / Profile		Flexed	1	
				Neutral/Partially Flexed	2	
				Extended	3	
Complete Cycle	13. Lateral Trunk Sway	Frontal		Rigid	1	
				Neutral (minimal sway)	2	
				Marked Swaying	3	
	14. Orientation of Lower Extremities	Frontal / Posterior		Moderate Bow Legs	1	
				Slight Bow Legs	2	
				Straight	3	
				Slight Knock Knees	4	
				Moderate Knock Knees	5	

Gait Phase	Feature	View	Left/Right	Classification	Ordinal	Nominal
Midstance	15. Head Level	Profile		Tilted Down	1	
				Facing Ahead	2	
				Tilted Up	3	
	16. Lateral Head Tilt	Frontal		Tilted left	1	
				Centered	2	
				Tilted right	3	
	17. Shoulder Level	Posterior		Lowered	1	
				Neutral	2	
				Raised	3	
	18. Lateral Placement of Upper Arm	Frontal		Abduction	1	
				Neutral	2	
				Adduction	3	
	19. Lateral Placement of Forearm	Frontal		Abduction	1	
				Neutral	2	
				Adduction	3	
	20. Level of Elbow Flexion	Profile		Extended	1	
				Neutral	2	
				Flexed	3	
				Markedly Flexed	4	
	21. Rotation of Hand	Frontal		Medial Rotation	1	
				Neutral	2	
				Lateral Rotation	3	
	22. Finger Flexion	Frontal / Profile		Flexed	1	
				Neutral/Partially Flexed	2	
				Extended	3	

Gait Phase	Feature	View	Left/Right	Classification	Ordinal	Nominal
Midstance	23. Thoracic Projection	Profile		Flat	1	
				Slightly Projecting	2	
				Markedly Projecting	3	
	24. Abdominal Projection	Profile		Flat	1	
				Slightly Projecting	2	
				Markedly Projecting	3	
	25. Upper Thoracic Curvature	Profile		Curved	1	
				Neutral	2	
				Flattened	3	
	26. Thoracic Curvature	Profile		Curved	1	
				Neutral	2	
				Flattened	3	
	27. Lumbar Curvature	Profile		Curved	1	
				Neutral	2	
				Flattened	3	
	28. Gluteal Shape	Posterior		V Shape	1	
				Square	2	
				Round	3	
				Heart	4	
	32. Lateral Placement of Upper Leg	Frontal		Abduction	1	
				Neutral	2	
				Adduction	3	
	32. Lateral Placement of Lower Leg	Frontal		Abduction	1	
				Neutral	2	
				Adduction	3	
	33. Knee Flexion	Profile		Extended	1	
				Slightly Flexed	2	
				Flexed	3	
				Markedly Flexed	4	

Gait Phase	Feature	View	Left/Right	Classification	Ordinal	Nominal
Mid Stance	34. Placement of Feet	Frontal		Moderate Out-toeing	1	
				Neutral (facing ahead)	2	
				In-toeing	3	
	35. Lateral positioning of the feet	Frontal		Inner Foot	1	
				Neutral (evenly balanced)	2	
				Outer Foot	3	
Swing	36. Lateral Placement of Upper Leg	Frontal		Abduction	1	
				Neutral	2	
				Adduction	3	
	37. Lateral Placement of Lower Leg	Frontal		Abduction	1	
				Neutral	2	
				Adduction	3	
	38. Placement of Feet	Frontal		Moderate Out-toeing	1	
				Neutral (facing ahead)	2	
				In-toeing	3	
Full Body	39. Somatotype	Frontal		Ectomorph	1	
				Mesomorph	2	
				Endomorph	3	

Gait - Anthropometry Datasheets				
Subject Number:	Sex:	Age:	Ancestry:	
Measurement	Feature	View	Measurement Raw	Proportional Indices
Static	1. Shoulder – Elbow Length Right	Frontal		
	2. Shoulder – Elbow Length Left			
	3. Forearm Length Right			
	4. Forearm Length Left			
	5. Hand Length Right			
	6. Hand Length Left			
	7. Maximum Hip Width	Posterior		
	8. Thigh Length Right	Frontal		
	9. Thigh Length Left			
	10. Lower Leg Length Right			
	11. Lower Leg Length Left			
	12. Knee/Patella Width Right			
	13. Knee/Patella Width Left			
	14. Knee Breadth Right	Profile		
	15. Knee Breadth Left			
	16. Foot Length Right			
	17. Foot Length Left			
	18. Bi-Malleolar Width Right	Frontal		
	19. Bi-Malleolar Width Left			
	20. Foot Width Right			
	21. Foot Width Left			
	22. Mid Patella Height Right			
	23. Mid Patella Height Left			
	24. Leg Length – Crotch Length Right			
	25. Leg Length – Crotch Length Left			
	26. Leg Length – Trochanter Right	Posterior		
	27. Leg Length – Trochanter Left			
	28. Trapezius Length Right	Frontal		
	29. Trapezius Length Left			
	30. Head Height			
	31. Torso Length			
	32. Jugular to Inguinal Length			
	33. Shoulder Width			
	34. Total Height - Stature	Profile		

Dynamic	1. Knee Cap – Knee cap Right			
	2. Knee Cap – Knee cap Left			
	3. Lateral Malleolus – Medial Malleolus Right			
	4. Lateral Malleolus – Medial Malleolus Left			
	5. Hallux – Hallux Right			
	6. Hallux – Hallux Left			
	7. Styloid process – Styloid Process Right	Frontal		
	8. Styloid process – Styloid Process Left			
Angle	1. Elbow Flexion Right	Profile		
	2. Elbow Flexion Left			
	3. Knee Flexion Right			
	4. Knee Flexion Left			
	5. Ankle Flexion Right			
	6. Ankle Flexion Left			

Part 6: Recommendations

Recommendations

A list of the recommendations have been developed for both trace and reference:

1. The use of a control (such as a police officer) within the same footage that the trace was recorded on is imperative for the scientific integrity of the results when assessing both trace and reference.
2. Using standardised protocols, such as this developed CCTV manual, and ensuring that in forensic procedures the camera is roughly level to the umbilicus of the suspected person/s, the full body is in shot and various body views (anterior, posterior, left and right profiles, quarter views) are photographed and recorded.
3. Determination of the CCTV camera at the scene and installing them within certain areas for recording of the suspected person/s will allow a further (and more accurate) analysis of the trace and reference as the same camera with the associated distortion will be present. Also maintaining the same views that the trace was recorded and trying to recreate that with the reference.
4. Matching the speed of the trace recorded on CCTV camera with the reference can add further robustness to the assessment. To achieve this, a police officer accompanying the suspect can walk in corridors (or similar) relatively at the same speed of the trace without the obstruction of other objects or individuals. This in turn, may possibly enhance the technique on a case-by-case basis. Further research is necessary.
5. Repeatability tests are needed to be regularly repeated to ensure that the most updated results are provided for the analyses

Part 7: References

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