TECHNICAL REPORT
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MEASURER'S HANDBOOK: US ARMY AND MARINE CORPS ANTHROPOMETRIC SURVEYS, 2010-2011

by
Jennifer Hotzman*
Claire C. Gordon
Bruce Bradtmiller*
Brian D. Corner
Michael Mucher*
Shirley Kristensen*
Steven Paquette
and
Cynthia L. Blackwell

***Anthrotech**
Yellow Springs, OH 45387

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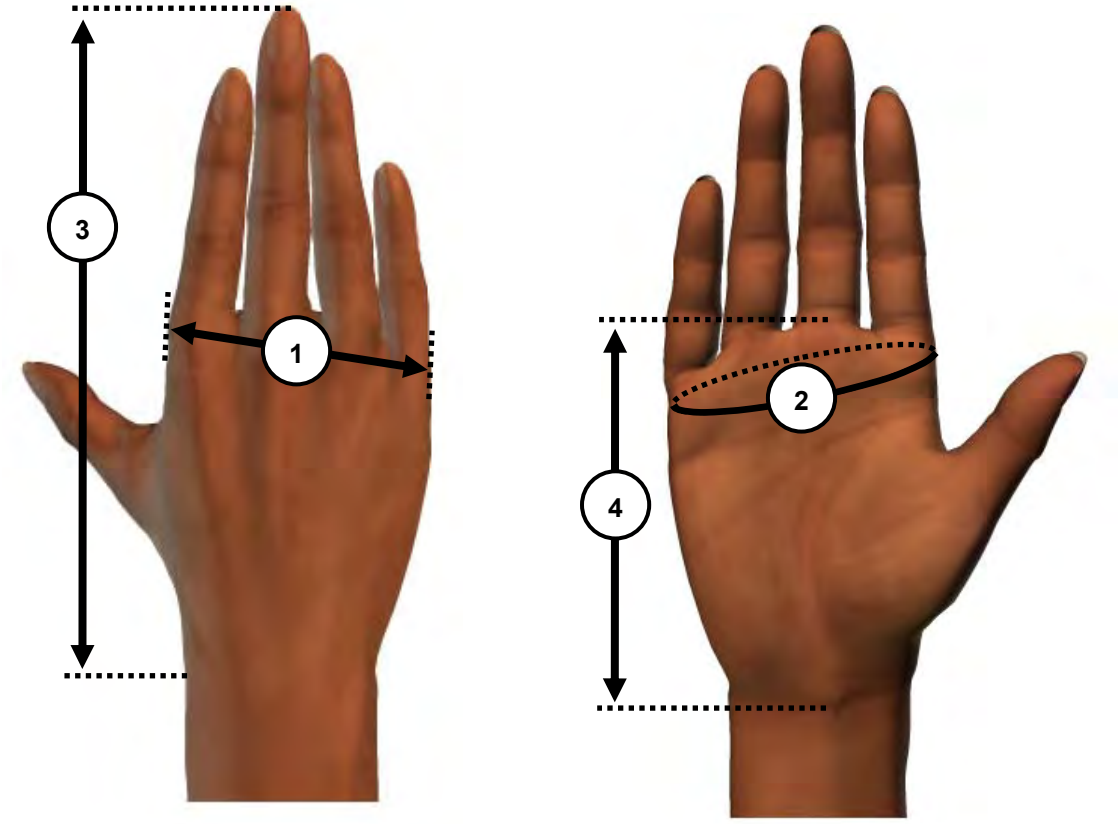
APPENDIX H

VISUAL INDEX OF MEASUREMENTS

Users should note that the body positions represented in the Visual Index are approximate. To confirm exact body positions and measurement procedures, users should consult the specific dimension descriptions found in Section 7.4.

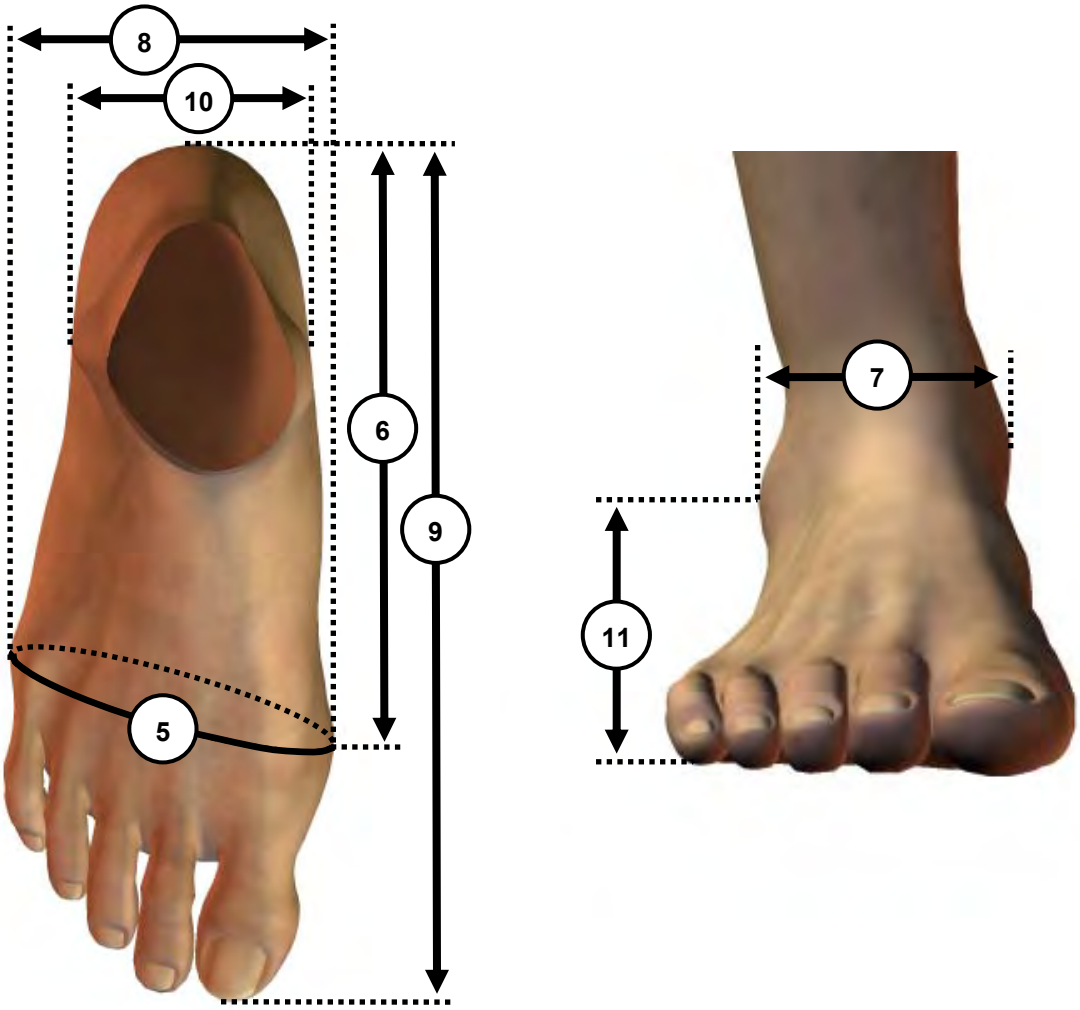


(1) HAND BREADTH

(2) HAND CIRCUMFERENCE

(3) HAND LENGTH

(4) PALM LENGTH



(5) BALL OF FOOT CIRCUMFERENCE

(6) BALL OF FOOT LENGTH

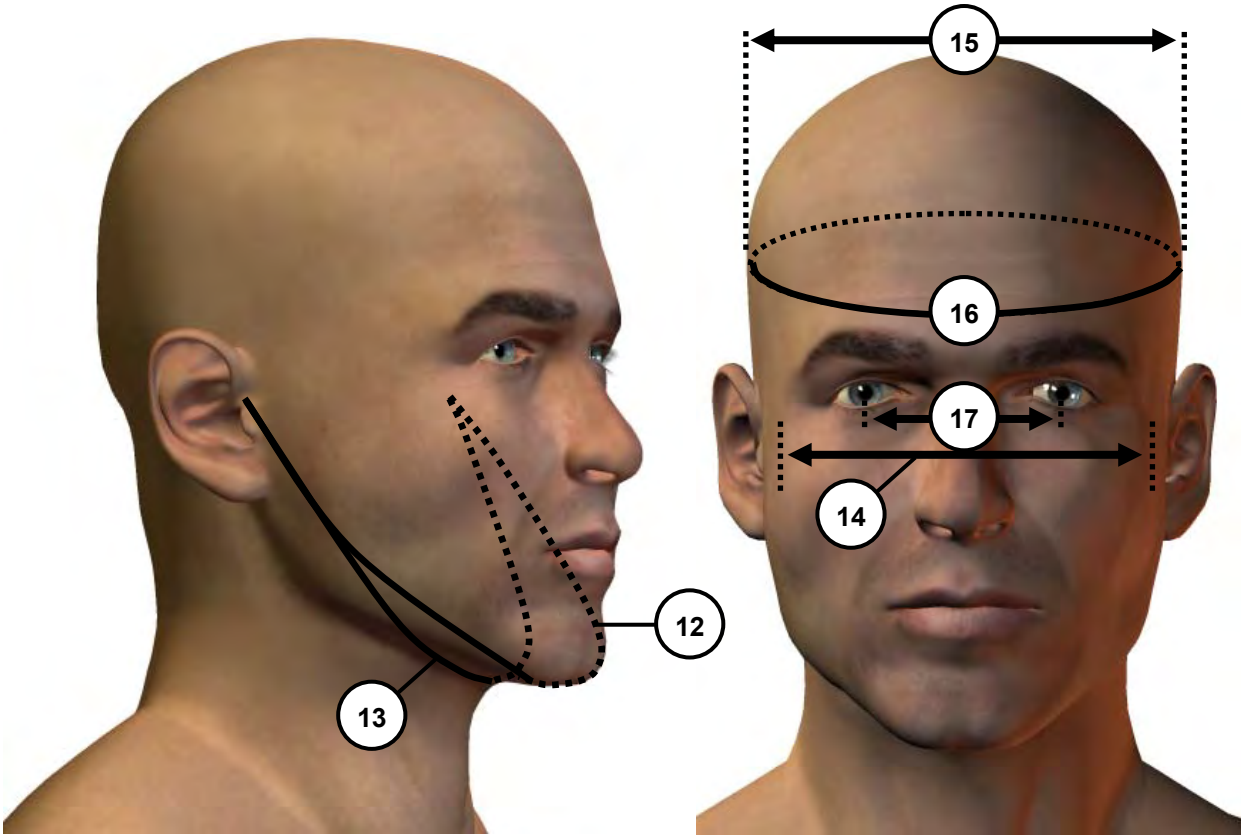
(7) BIMALLEOLAR BREADTH

(8) FOOT BREADTH, HORIZONTAL

(9) FOOT LENGTH

(10) HEEL BREADTH

(11) LATERAL MALLEOLUS HEIGHT



(12) BITRAGION CHIN ARC

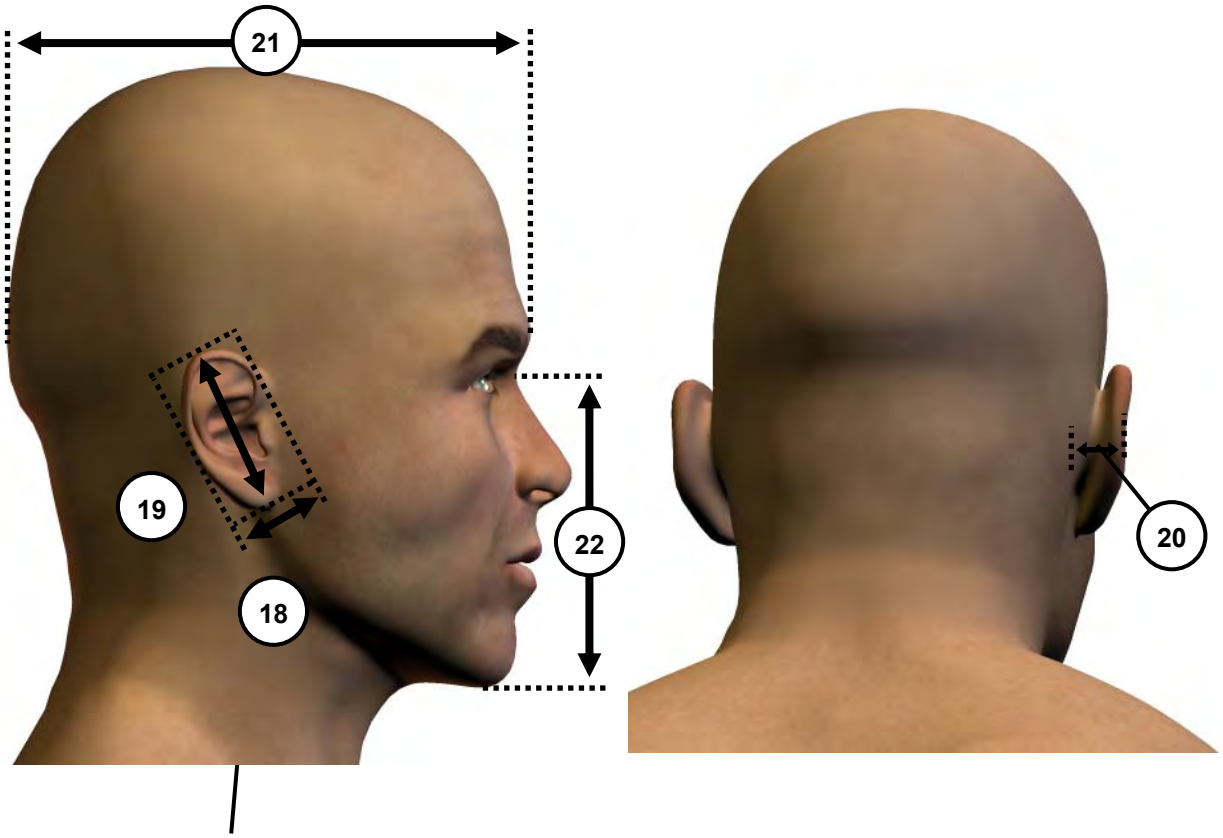
(13) BITRAGION SUBMANDIBULAR ARC

(14) BIZYGOMATIC BREADTH

(15) HEAD BREADTH

(16) HEAD CIRCUMFERENCE

(17) INTERPUPILLARY BREADTH



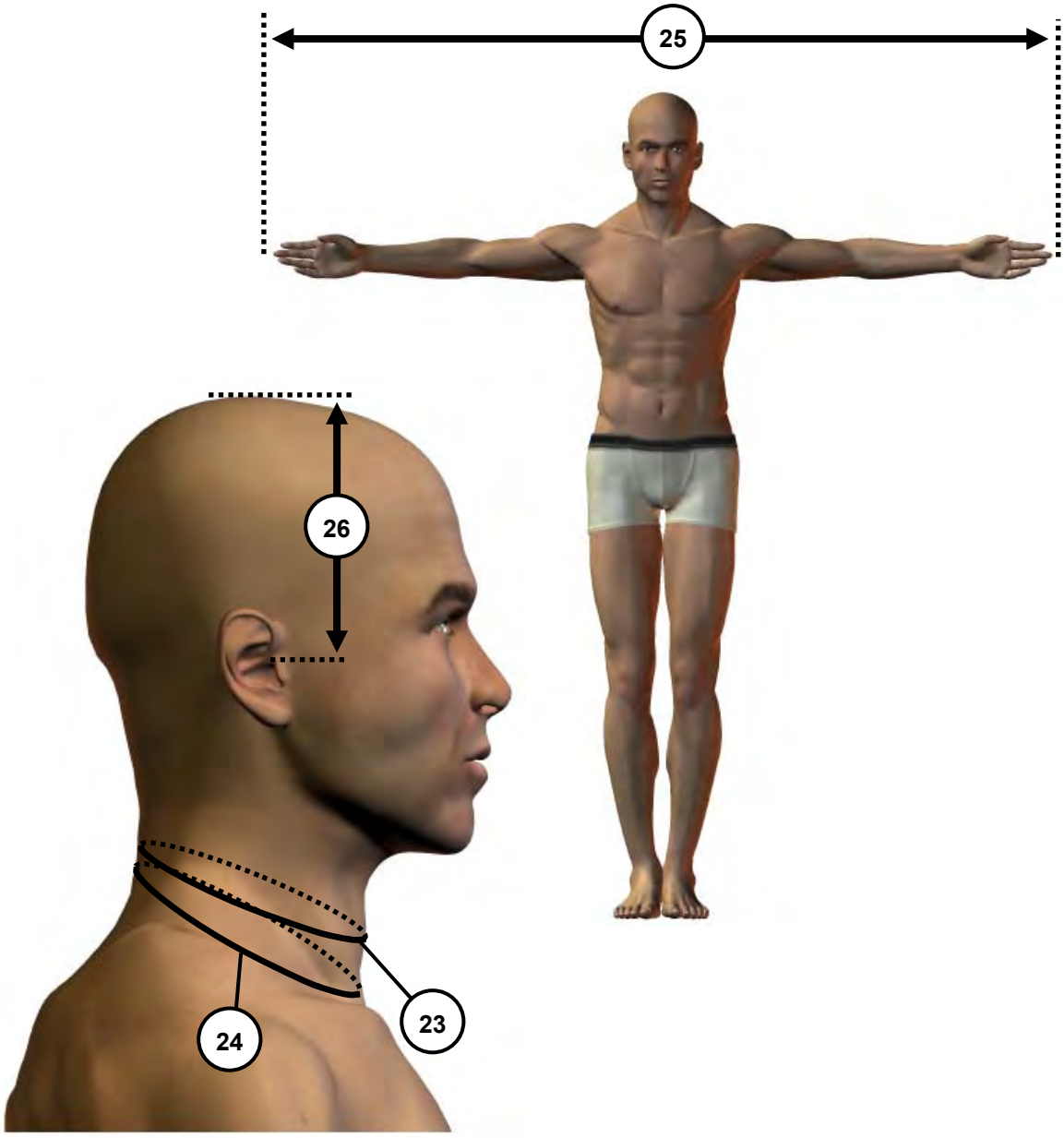
(18) EAR BREADTH

(19) EAR LENGTH

(20) EAR PROTRUSION

(21) HEAD LENGTH

(22) MENTON-SELLION LENGTH

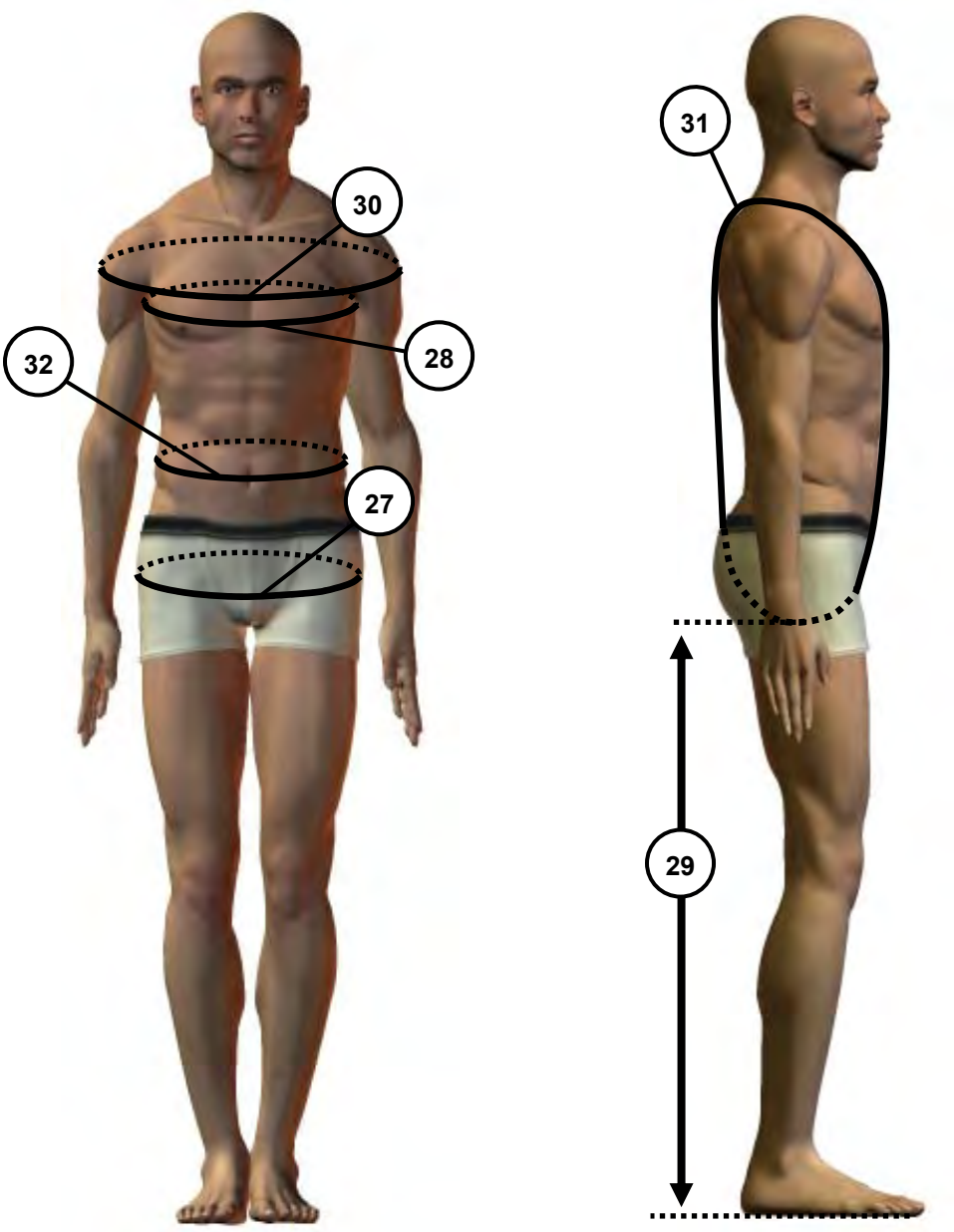


(23) NECK CIRCUMFERENCE

(24) NECK CIRCUMFERENCE, BASE

(25) SPAN

(26) TRAGION–TOP OF HEAD



(27) BUTTOCK CIRCUMFERENCE

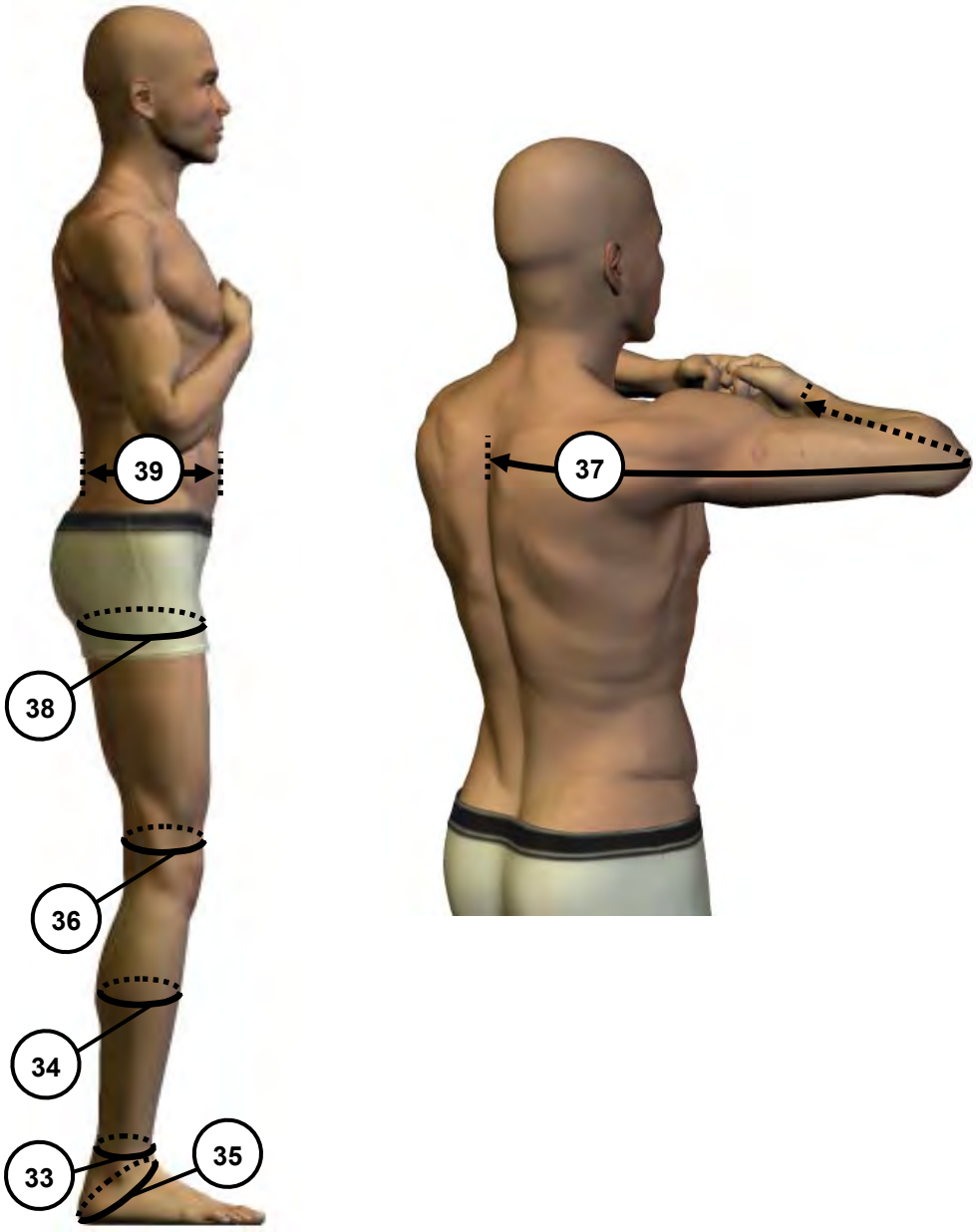
(28) CHEST CIRCUMFERENCE

(29) CROTCH HEIGHT

(30) SHOULDER CIRCUMFERENCE

(31) VERTICAL TRUNK CIRCUMFERENCE (USA)

(32) WAIST CIRCUMFERENCE (OMPHALION)



(33) ANKLE CIRCUMFERENCE

(34) CALF CIRCUMFERENCE

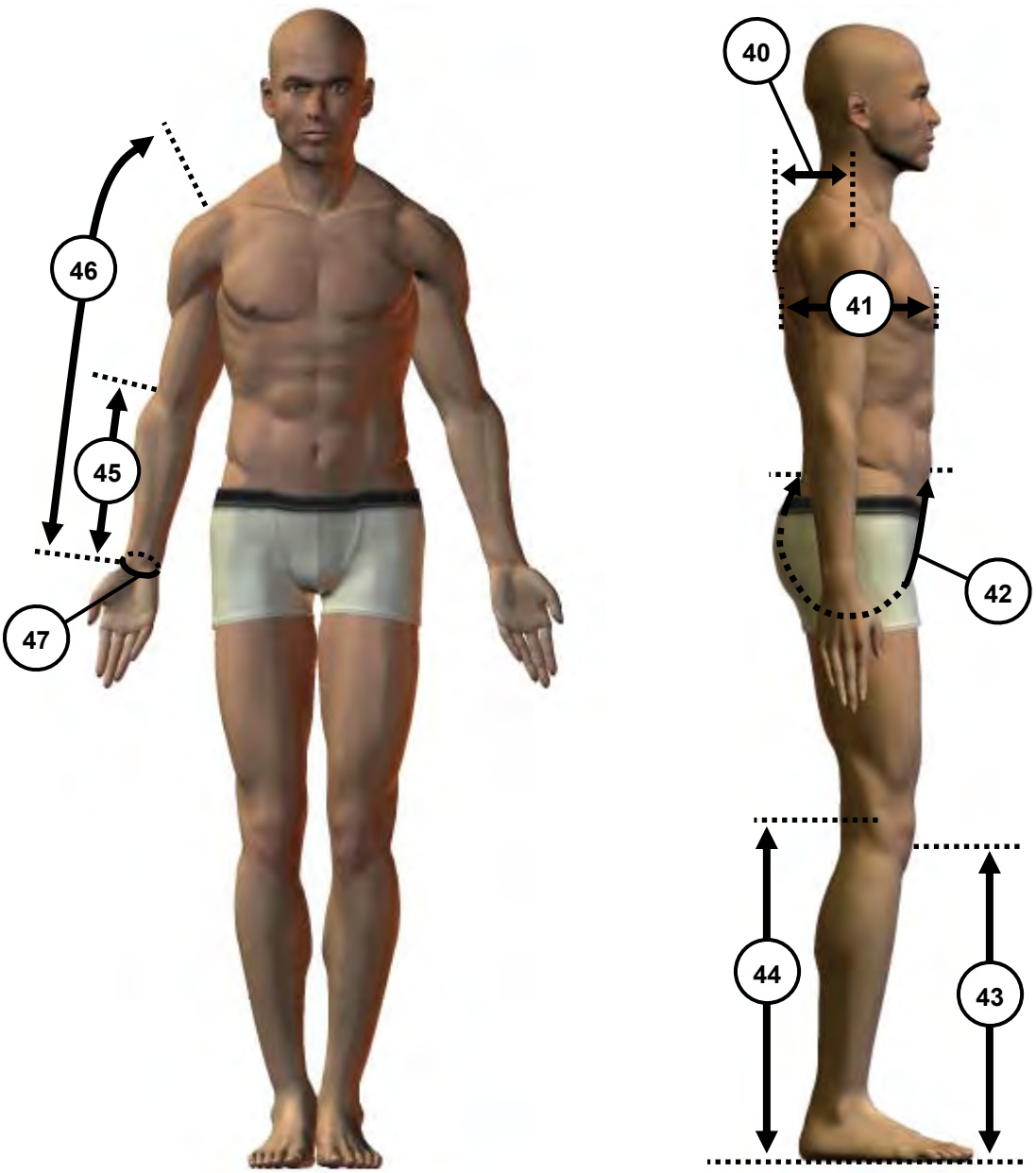
(35) HEEL ANKLE CIRCUMFERENCE

(36) LOWER THIGH CIRCUMFERENCE

(37) SLEEVE LENGTH: SPINE-WRIST

(38) THIGH CIRCUMFERENCE

(39) WAIST DEPTH



(40) ACROMION–WALL DEPTH

(41) CHEST DEPTH

(42) CROTCH LENGTH (OMPHALION)

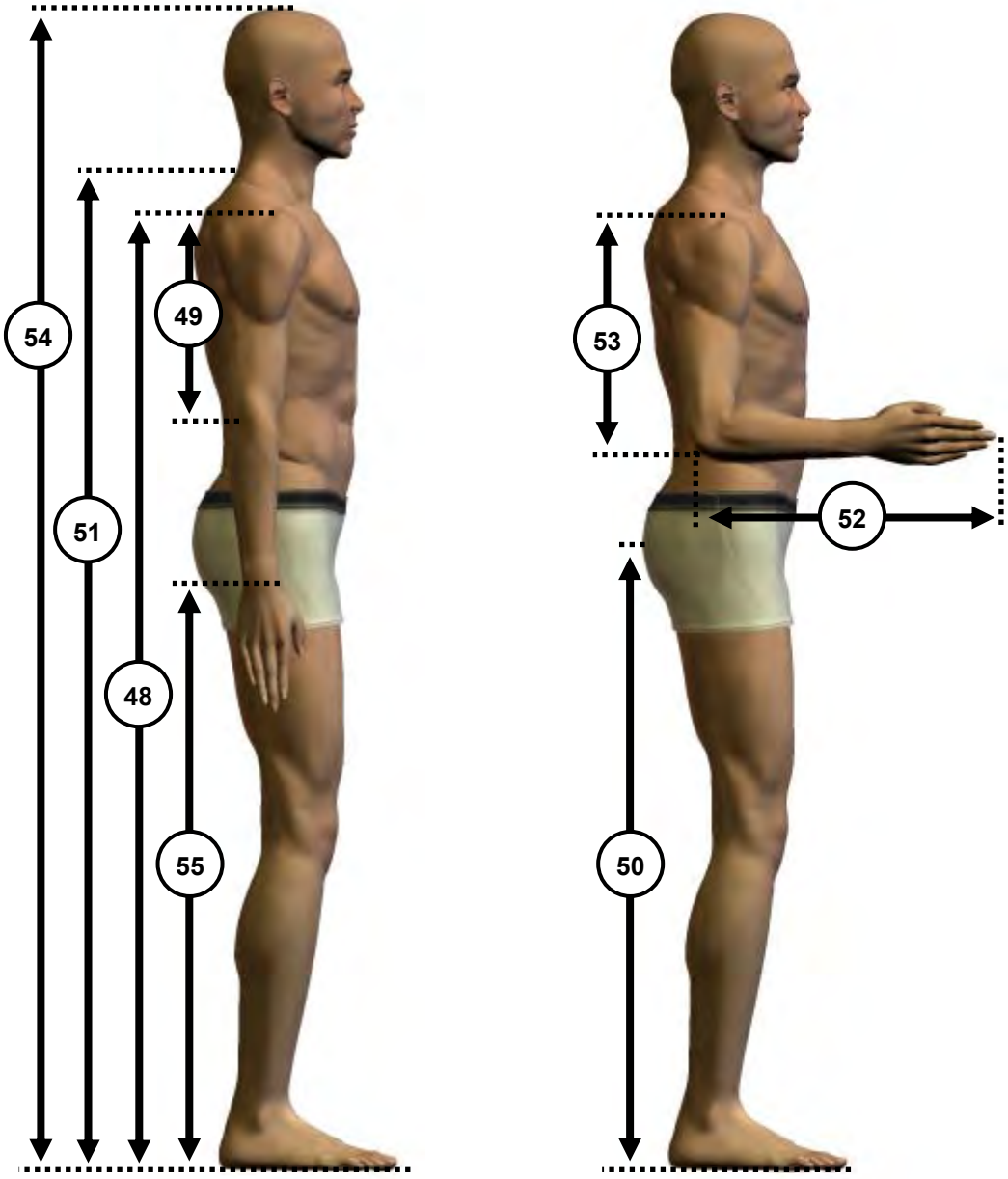
(43) KNEE HEIGHT, MIDPATELLA

(44) LATERAL FEMORAL EPICONDYLE HEIGHT

(45) RADIALE-STYLION LENGTH

(46) SLEEVE OUTSEAM

(47) WRIST CIRCUMFERENCE



(48) ACROMIAL HEIGHT

(49) ACROMION-RADIALE LENGTH

(50) BUTTOCK HEIGHT

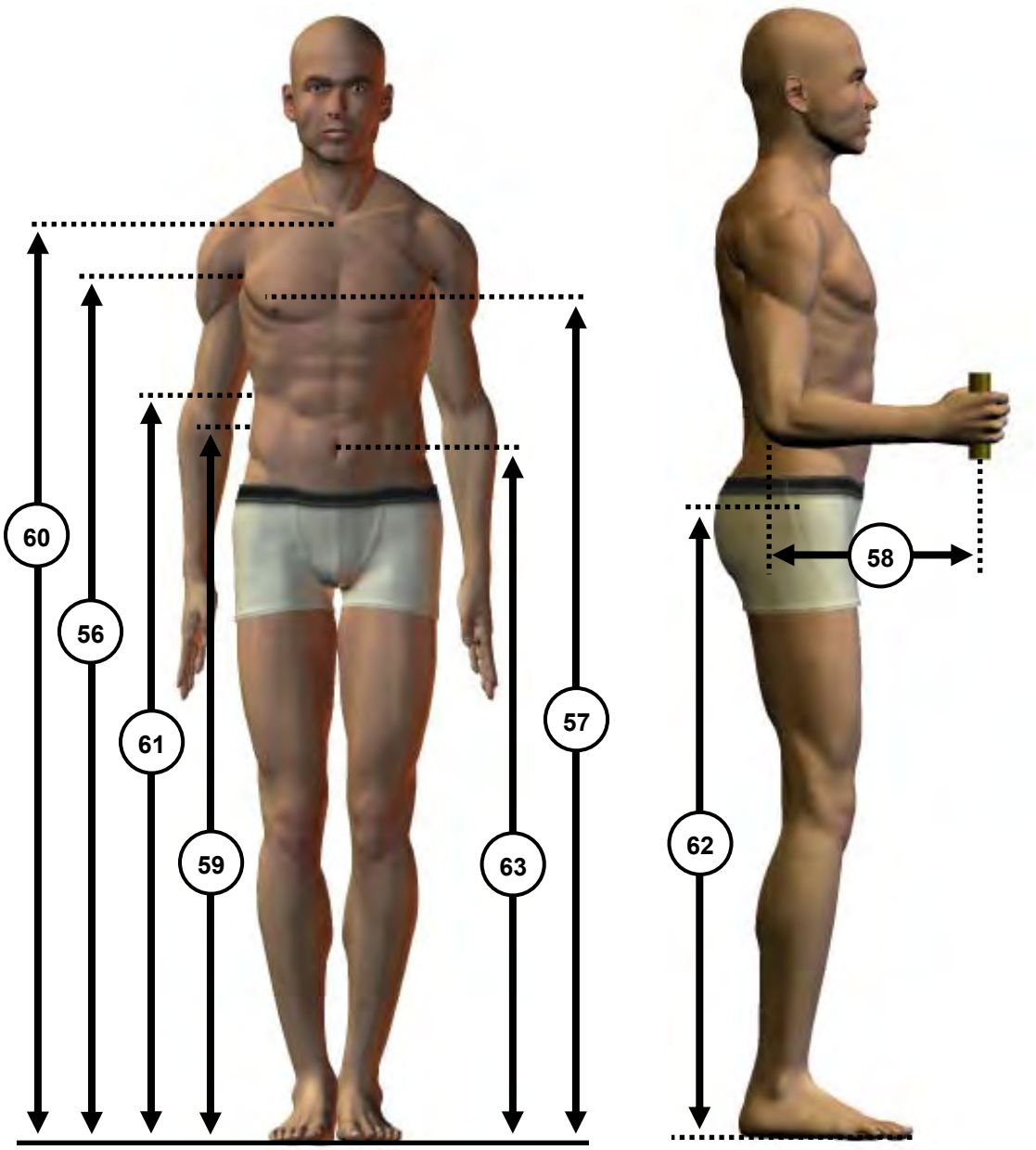
(51) CERVICALE HEIGHT

(52) FOREARM-HAND LENGTH

(53) SHOULDER-ELBOW LENGTH

(54) STATURE

(55) WRIST HEIGHT



(56) AXILLA HEIGHT

(57) CHEST HEIGHT

(58) FOREARM-CENTER OF GRIP LENGTH

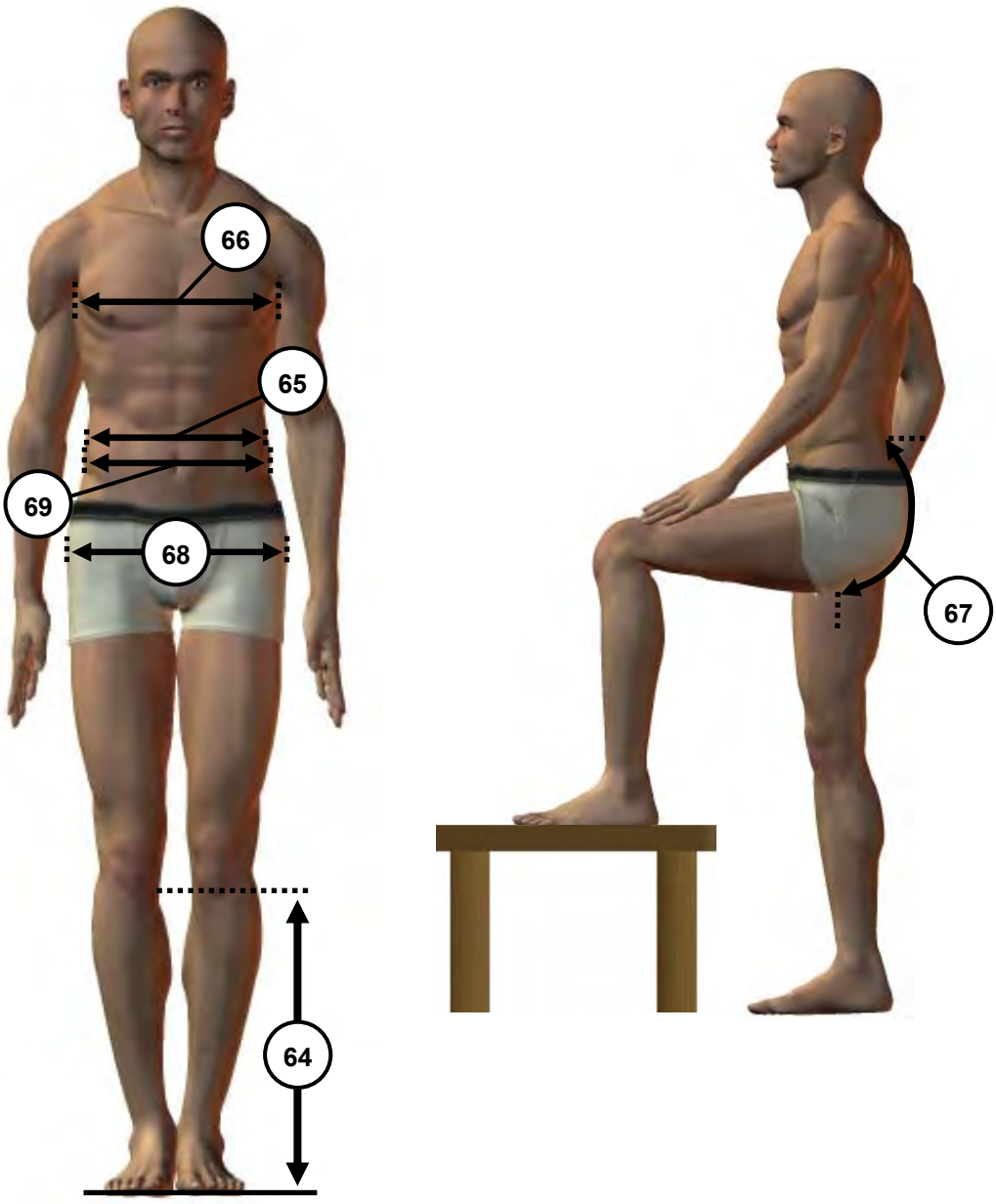
(59) ILIOCRISTALE HEIGHT

(60) SUPRASTERNALE HEIGHT

(61) TENTH RIB HEIGHT

(62) TROCHANTERION HEIGHT

(63) WAIST HEIGHT (OMPHALION)



(64) TIBIAL HEIGHT

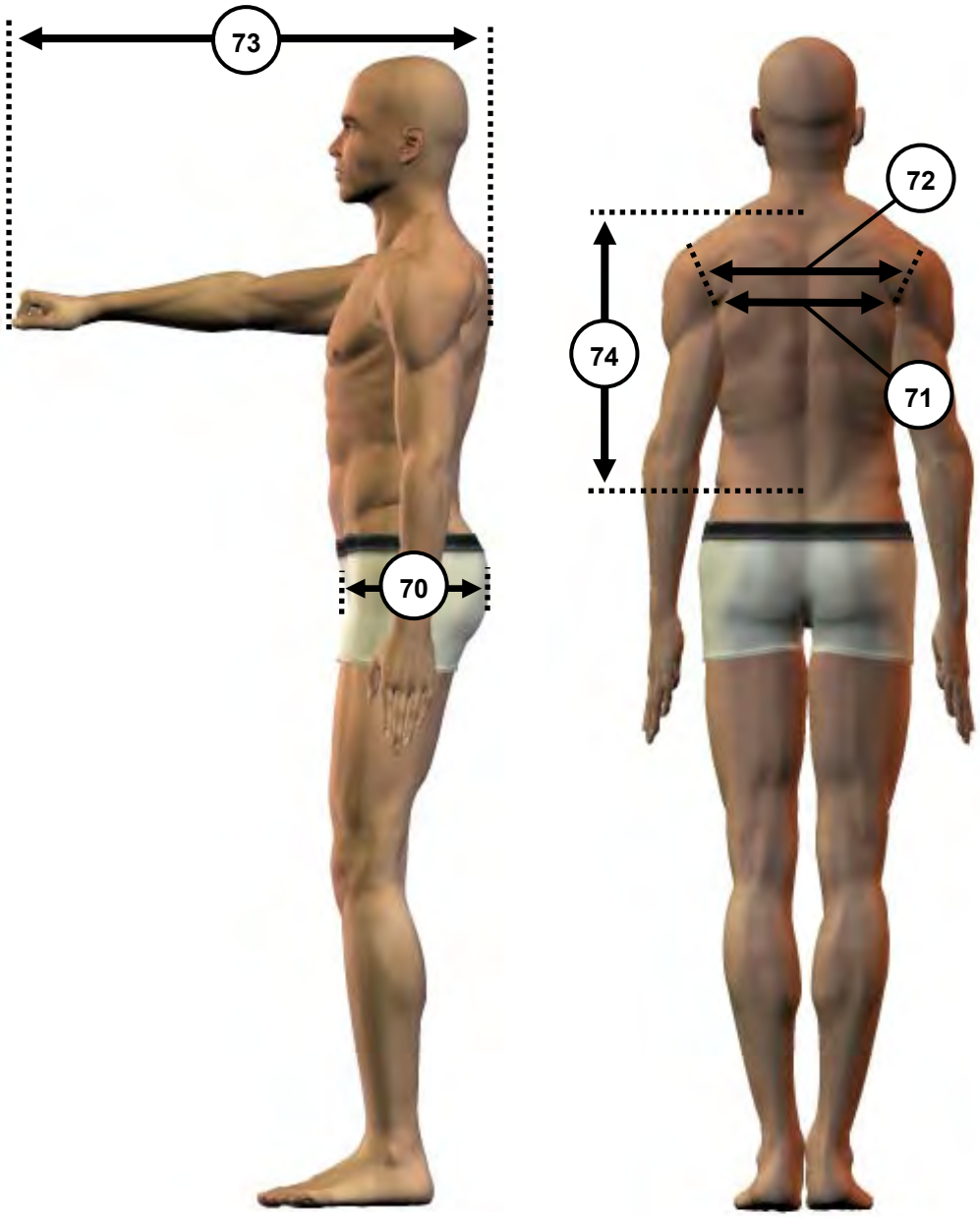
(65) BICRISTAL BREADTH

(66) CHEST BREADTH

(67) CROTCH LENGTH, POSTERIOR (OMPHALION)

(68) HIP BREADTH

(69) WAIST BREADTH



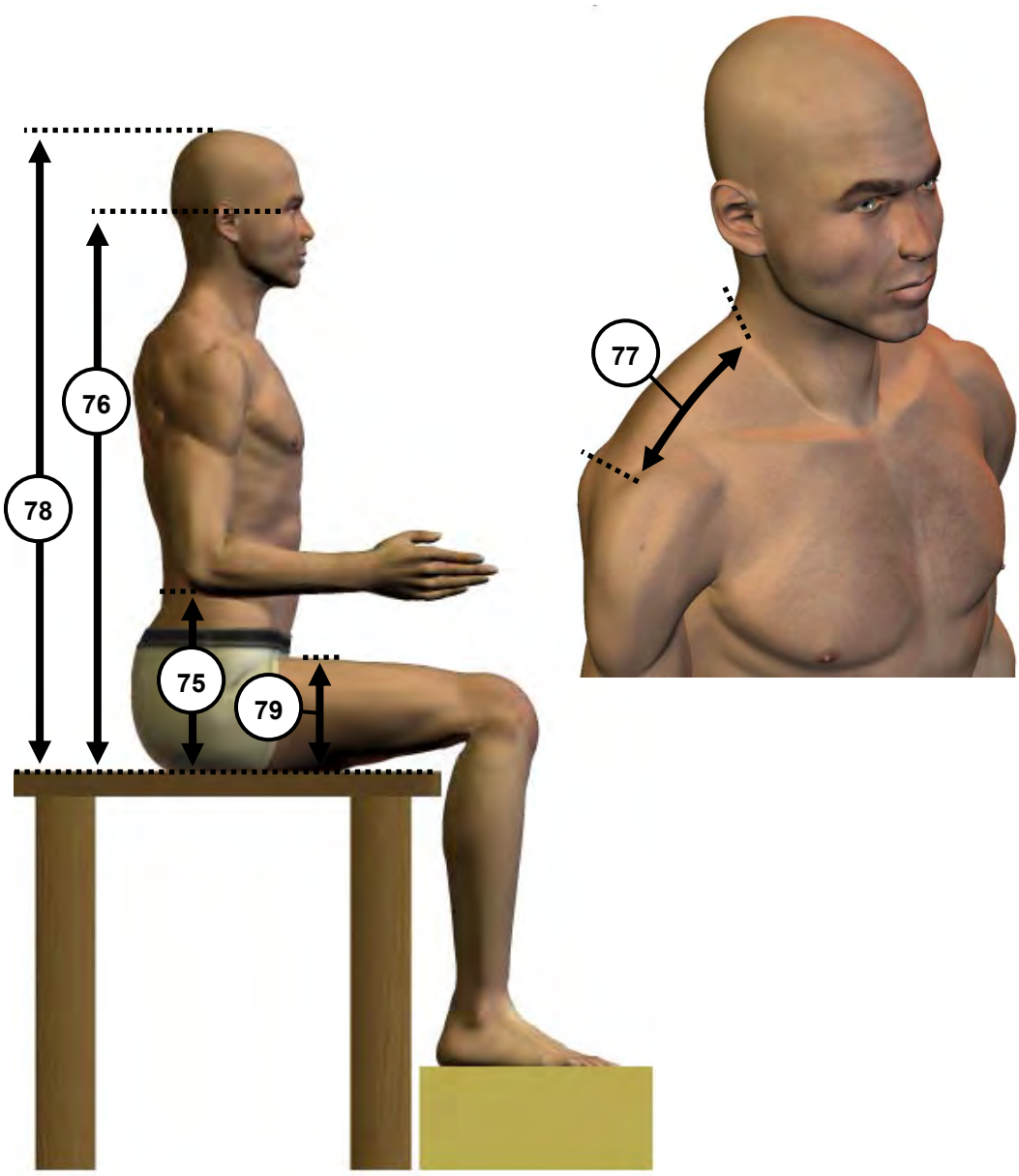
(70) BUTTOCK DEPTH

(71) INTERSCYE I

(72) INTERSCYE II

(73) THUMBTIP REACH

(74) WAIST BACK LENGTH (OMPHALION)



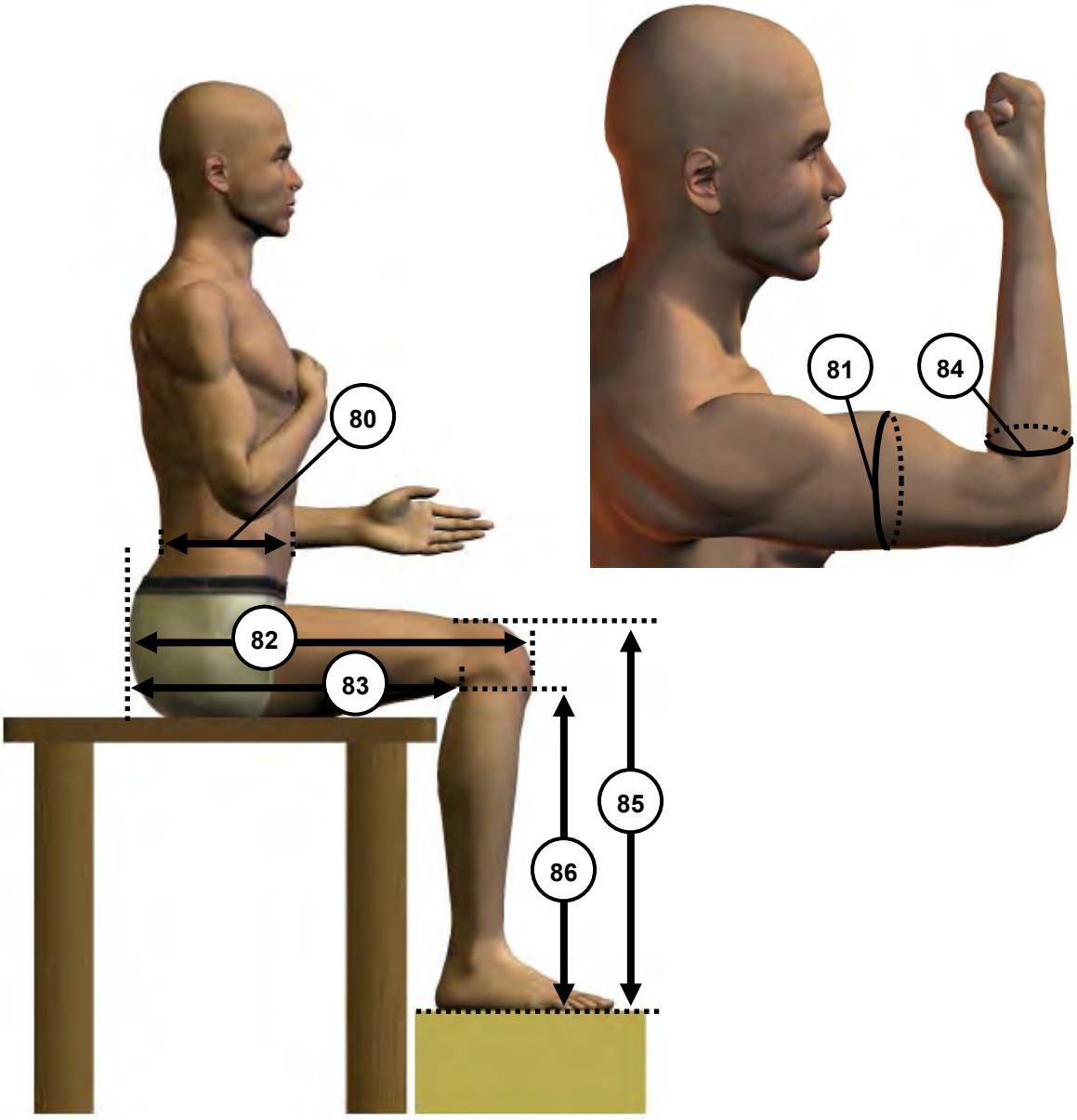
(75) ELBOW REST HEIGHT

(76) EYE HEIGHT, SITTING

(77) SHOULDER LENGTH

(78) SITTING HEIGHT

(79) THIGH CLEARANCE



(80) ABDOMINAL EXTENSION DEPTH, SITTING

(81) BICEPS CIRCUMFERENCE, FLEXED

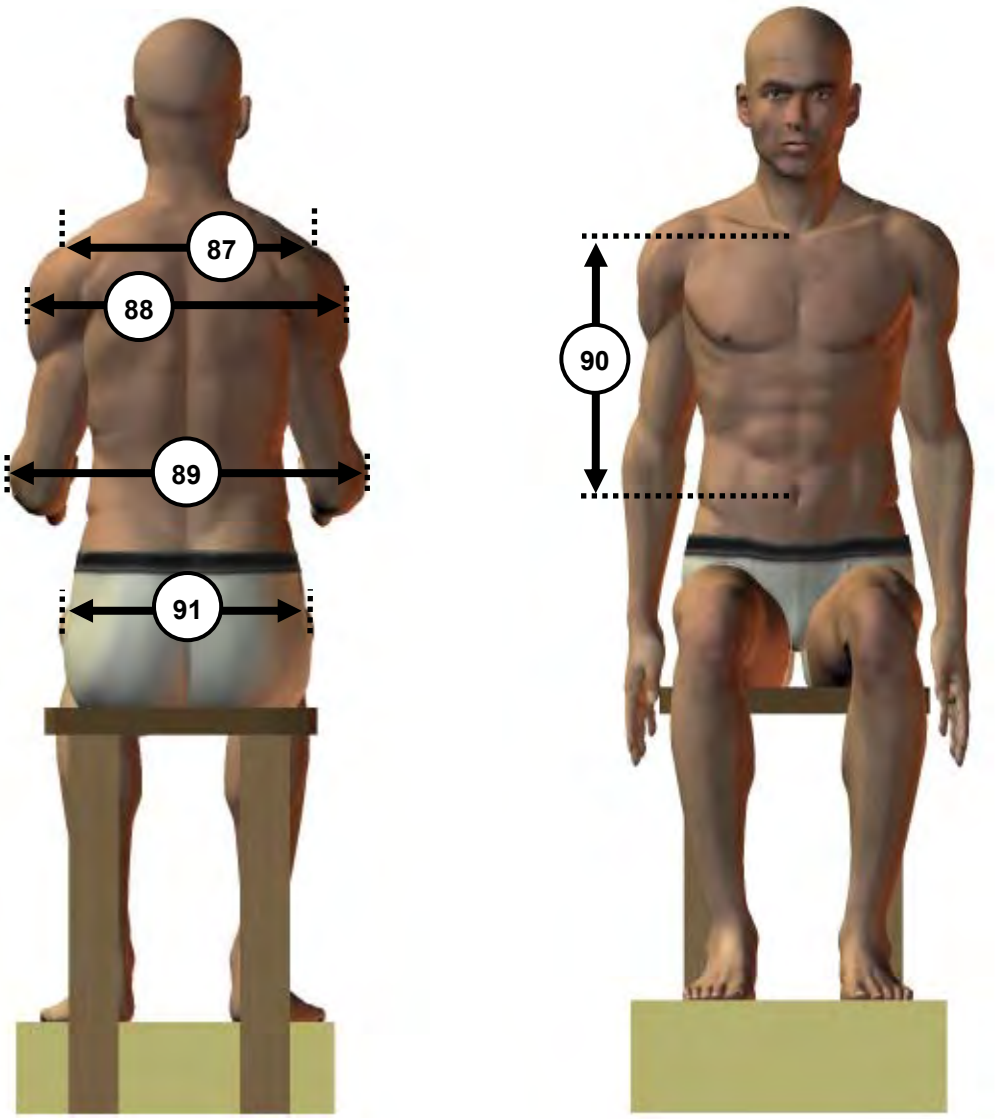
(82) BUTTOCK-KNEE LENGTH

(83) BUTTOCK-POPLITEAL LENGTH

(84) FOREARM CIRCUMFERENCE, FLEXED

(85) KNEE HEIGHT, SITTING

(86) POPLITEAL HEIGHT



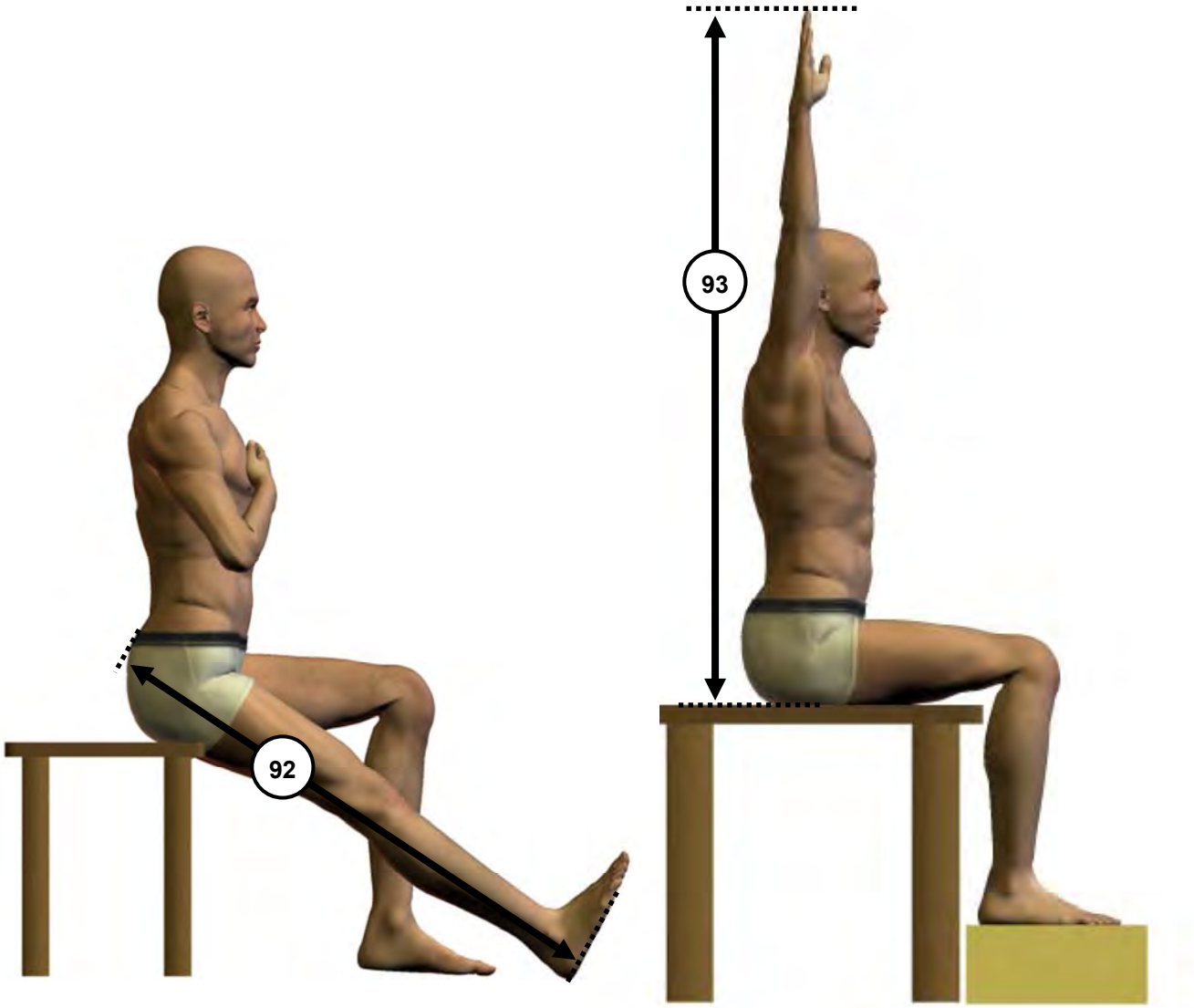
(87) BIACROMIAL BREADTH

(88) BIDELTOID BREADTH

(89) FOREARM-FOREARM BREADTH

(90) WAIST FRONT LENGTH, SITTING

(91) HIP BREADTH, SITTING



(92) FUNCTIONAL LEG LENGTH

(93) OVERHEAD FINGERTIP REACH, SITTING

6. THE MEASUREMENTS

The techniques of measuring each body dimension are described in this chapter. Included in each description is a definition of the measurement, required posture for the participant, recommended positions for the measurer, the name of the relevant instrument, and instructions for taking the measurement. Where there is a choice of right or left, all measurements are taken on the right side unless otherwise specified or in rare cases where an anatomical abnormality makes it necessary to measure on the left side. All measurements are made to the nearest millimeter. Weight is taken to the nearest 0.1 kg.

6.1 PARTICIPANT POSTURE

The purpose of a standardized participant posture is to ensure that measurement differences between individuals are due to body size differences, not variations in body posture. Most body posture descriptions are self-explanatory, but the phrases "anthropometric standing" and "anthropometric sitting," so often used in these descriptions, require clarification.

6.1.1 Anthropometric Standing

For anthropometric standing (Figure 19), participants are asked to stand erect, with their weight evenly distributed on both feet, heels together as much as possible, legs and trunk straight without stiffness, and the head erect and looking straight ahead. The arms are to hang relaxed with the elbows lightly touching the sides with the palms of the hands beside, but not touching, the thighs. On individuals with muscular upper arms, the elbows may not touch the sides. This posture is similar to that of the position of military attention, but without the stiffness and bracing with which it is often associated.

FIGURE 19
Anthropometric Standing Position

6.1.2 Anthropometric Sitting

In the position of anthropometric sitting (Figure 20), the participant sits on a cushionless flat surface with the long axes of the thighs parallel. There is approximately an 8 cm gap (hand width) between the surface edge and the back of the knee at thigh level. The feet are in line with the thighs (apart) and are on an adjustable foot rest, and the knees are flexed 90°. This position is established using a scored plastic right angle and the two seated landmarks on the thigh (trochanter and lateral femoral epicondyle, sitting). Rest one inside edge of the plastic right angle on the table surface beside the right thigh. The other arm of the angle will hang over the front edge of the table. Using Styrofoam pieces of various thicknesses, move the feet up and down until the two landmarks are in line with each other. The lateral femoral epicondyle, sitting and lateral malleolus landmarks are set in line with each other using the other arm of the angle. The trunk is erect without stiffness; the head is also erect, and the participant looks straight ahead. The shoulders are relaxed, and the upper arms are hanging loosely at the sides. The hands rest on the thighs. Before measuring, have the participant flex the elbows 90° with the hands straight, palms facing inward. Deviations from these standardized positions are indicated where appropriate.

FIGURE 20
Anthropometric Sitting Position

A number of dimensions require that the participant's head be in the Frankfurt plane (also known as the Frankfurt horizontal). This head position is quite similar to "head is erect" and "participant looks straight ahead." However, when the Frankfurt plane is called for, the anthropometrist will position the participant's head so that an imaginary line connecting the drawn landmarks at right tragion and right orbitale is horizontal (Figure 21)

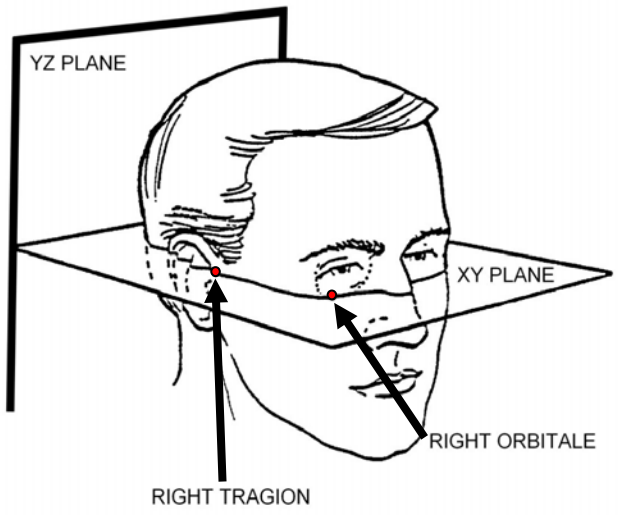


FIGURE 21
Frankfurt Plane

6.2 PARALLAX

Parallax is the apparent displacement of an object owing to the angle from which it is viewed. A common example of this is misreading time when looking at the minute hand of a clock from any position except directly in front of it. Parallax can be a significant source of error in anthropometry and must be avoided. To guard against this kind of error, the anthropometrist must have his or her eyes at the same level as the measurement termination landmark or the level at which the measurement is being taken. For measurements taken on the lower body, participants will be standing on a platform, but it will still be necessary for you to do some bending or stooping to bring your eyes in line with a landmark, the blade of an instrument, or a tape measure. A stool or ladder will be supplied for taking overhead reach measurements.

6.3 MEASUREMENT ACCURACY

It is axiomatic that the data from any anthropometric study are only as good as the reliability with which the body dimensions were measured. However, measuring the body consistently is difficult and often impossible. Body positions, the amount of pressure exerted on the instruments, and breathing cycles are only a few of the sources

of variation which can seriously affect the reliability of the measurement. Some examples are listed below.

Whether a participant is inhaling or exhaling when a measurement is recorded affects many dimensions. Those most affected are circumferences, breadths, and depths of the shoulders and torso, and heights from the floor or sitting surface to the shoulders and points on the torso and arms. The majority of these measurements should be taken at the maximum point of quiet respiration, i.e., just before the individual exhales.

Few individuals can stand or sit erect without swaying. This is because the muscles that hold us in these positions are continuously adjusting to the effects of gravity. Stature, for example, will vary a measurable amount if the participant is slightly tilted when the measurement is made. If someone is visibly swaying take the measurement when he or she is most vertical.

For a number of dimensions there is a caution not to let the participant tense the abdominal muscles. WAIST CIRCUMFERENCE (OMPHALION) is a good example of a dimension whose measurement can be drastically changed by the tension or relaxation of the abdominal muscles. A few dimensions require effort on the part of the participant to achieve the required body position. One example is BICEPS CIRCUMFERENCE, FLEXED in which the participant is asked to "make a muscle" as hard as possible. Variability in the motivation of the participant can be a problem here, and participants should be urged to make a maximum effort.

The same amount of tension is used on the tape when measuring body circumferences and arcs. However, it is more difficult to achieve consistency when measuring dimensions where tissue may often be relatively soft or compressed by an adjacent body segment than when measuring dimensions where tissue is usually firm.

It is the object of the handbook instructions, and the goal of the practical training, to standardize the way these dimensions will be measured and to minimize the effect of these and other variations.

A table listing allowable interobserver error for the measurements in the surveys, and a description of how the values were determined, appears in Appendix G.

6.4 DIMENSION DESCRIPTIONS

Illustrated measurement descriptions for one of the 94 dimensions appear in each of the following sections. Each section includes the following categories, when applicable: description, undrawn landmark, drawn landmark, procedure, instrument, and caution. A visual index, designed to help the reader identify the anthropometric term(s) used for a particular dimension or dimensions of interest, appears in Appendix H. Many of these descriptions are from Clauser et al. (1988) and Gordon et al. (1989).

6.4.1 Abdominal Extension Depth, Sitting

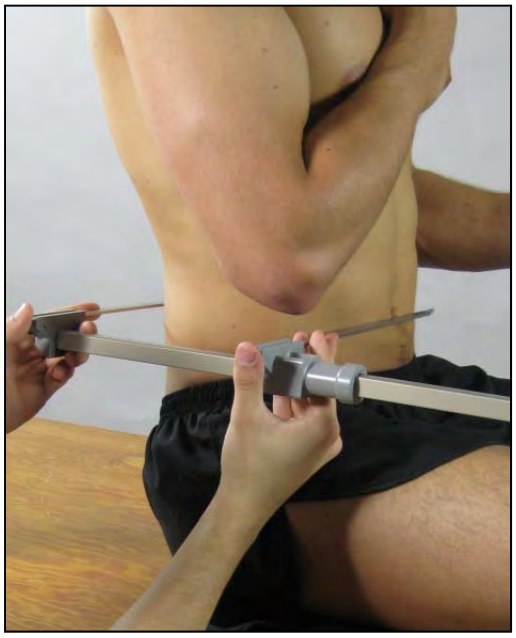
DESCRIPTION: The maximum depth of the abdomen when participant is sitting.

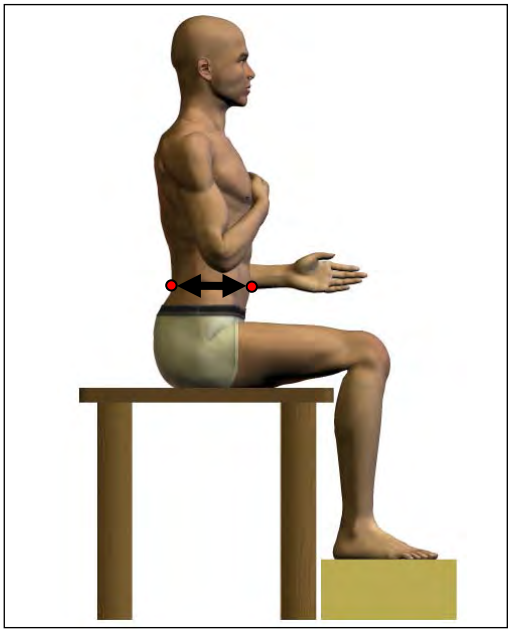
UNDRAWN LANDMARK: Abdominal point, anterior.

PROCEDURE: Participant is in the anthropometric sitting position, but the right hand is placed on the chest. Stand at the participant's right and use a beam caliper to measure the horizontal distance between the anterior point of the abdomen and the back at the same level. The fixed blade of the caliper is placed on the back. The measurement is made at the maximum point of quiet respiration, with the blades of the instrument just touching the skin.

INSTRUMENT: Beam caliper.

CAUTION: Make sure the participant does not tense the abdominal muscles.





6.4.2 Acromial Height

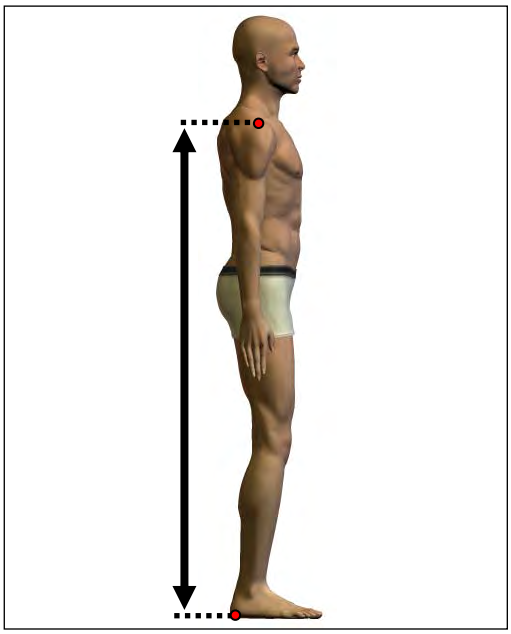
DESCRIPTION: Vertical distance from the floor to the right acromion landmark.

DRAWN LANDMARK: Acromion, right.

PROCEDURE: Participant is in the anthropometric standing position. Stand to the right of the participant, and use an anthropometer to measure the vertical distance between the standing surface and the drawn acromion landmark on the tip of the right shoulder. The measurement is made at the maximum point of quiet respiration.

INSTRUMENT: Anthropometer.

CAUTION: The participant must not be allowed to change the position of the shoulders.



6.4.3 Acromion-Radiale Length

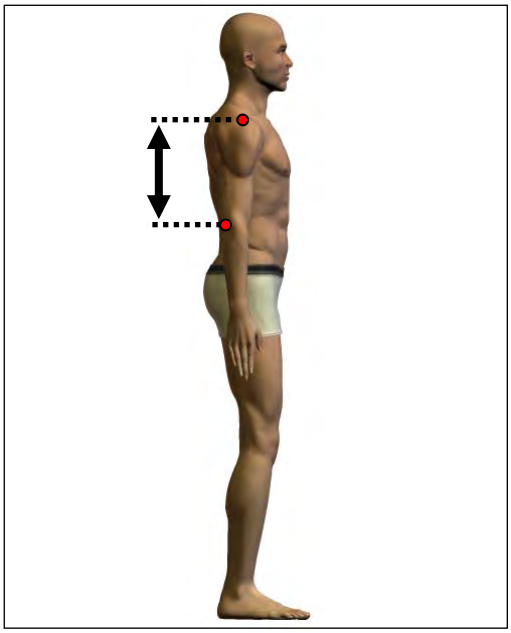
DESCRIPTION: The distance between the acromion landmark on the right shoulder and the radiale landmark on the right elbow.

DRAWN LANDMARKS: Acromion, right; Radiale, right.

PROCEDURE: Participant is in the anthropometric standing position. Stand to the right of the participant, and use a beam caliper to measure the distance between the drawn acromion landmark on the tip of the right shoulder and the drawn radiale landmark on the elbow. It is important that the beam of the caliper be parallel to the long axis of the arm, and that the fixed blade of the caliper remain on the acromion landmark during this measurement. Both blades of the instrument just touch the body.

INSTRUMENT: Beam caliper.

CAUTION: Care should be taken not to distort the skin.



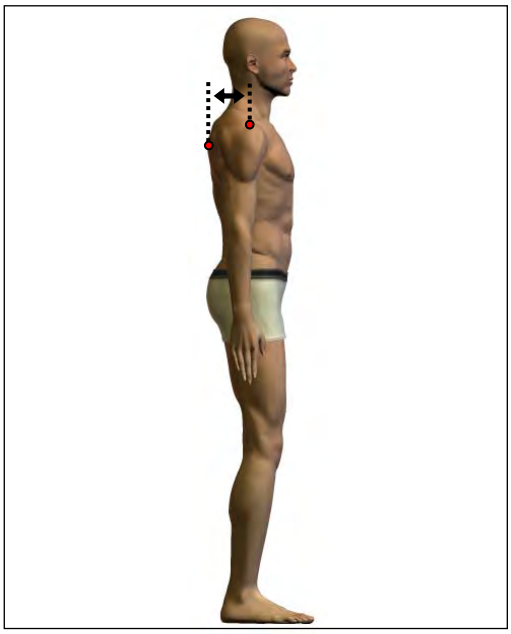
6.4.4 Acromion–Wall Depth

DESCRIPTION: The horizontal distance from a vertical surface to the acromion.

DRAWN LANDMARK: Acromion, right.

PROCEDURE: Participant stands fully erect with shoulder blades and buttocks firmly against a vertical surface with equal pressure exerted by the shoulders against the vertical surface. The feet are together and the heels are on a marked line 20 cm from the wall. The arms are relaxed at the sides. Stand to the right of the participant, and measure the horizontal distance from the vertical surface to the acromion landmark with a height gauge. The base of the height gauge is placed firmly against the vertical surface, and the blade is on the acromion landmark.

INSTRUMENT: Height gauge.



6.4.5 Ankle Circumference

DESCRIPTION: Minimum horizontal circumference of the ankle.

PROCEDURE: Participant stands on a table with the feet about 10 cm apart and the weight distributed equally on both feet. Stand at the right of the participant and, with a tape, measure the minimum horizontal circumference of the ankle. Exert only enough tape tension to maintain contact between the tape and the skin.

INSTRUMENT: Steel tape.

6.4.6 Axilla Height

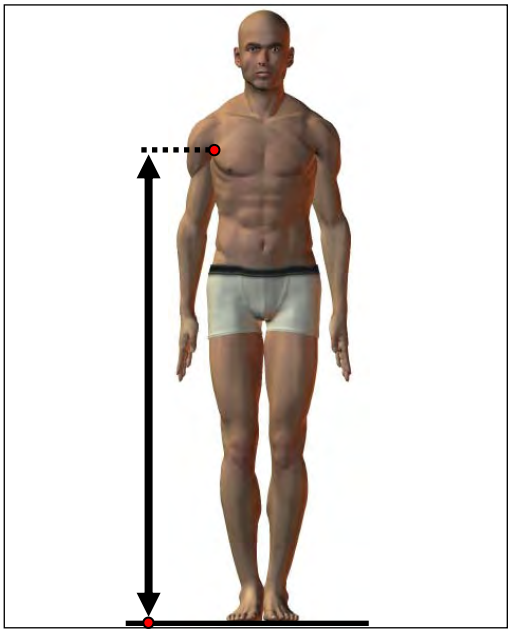
DESCRIPTION: The vertical distance between a standing surface and the right axillary fold, as designated by the anterior scye on the torso landmark.

DRAWN LANDMARK: Anterior scye on the torso, right.

PROCEDURE: Participant is in the anthropometric standing position. Stand in front of the participant, and use an anthropometer to measure the vertical distance between the standing surface and the axillary fold as designated by the drawn anterior scye on the torso landmark. The measurement is taken at the maximum point of quiet respiration.

INSTRUMENT: Anthropometer.

CAUTION: The participant must not be allowed to change the position of the shoulders.



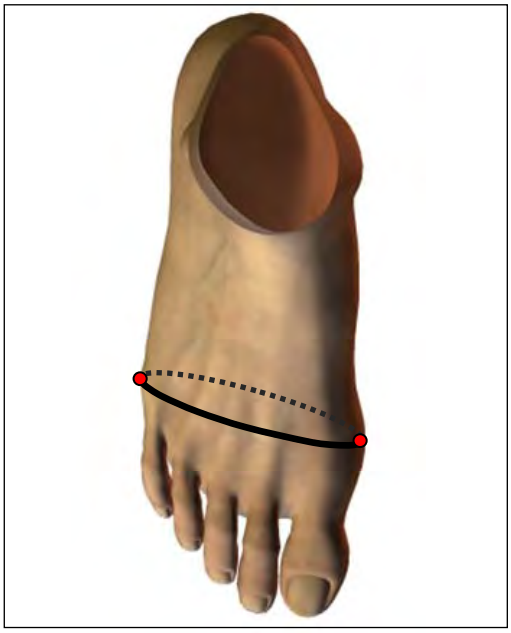
6.4.7 Ball of Foot Circumference

DESCRIPTION: The circumference of the ball of the right foot encompassing the first and fifth metatarsophalangeal landmarks.

DRAWN LANDMARKS: First metatarsophalangeal protrusion, right; fifth metatarsophalangeal protrusion, right.

PROCEDURE: Participant stands on a table with the feet about 10 cm apart and the weight distributed equally on both feet. Stand in front of the participant, and use a tape to measure the circumference of the foot at the drawn first and fifth metatarsophalangeal landmarks on the ball of the foot. Exert only enough tension on the tape to maintain contact between the tape and the skin.

INSTRUMENT: Steel tape.



6.4.8 Ball of Foot Length

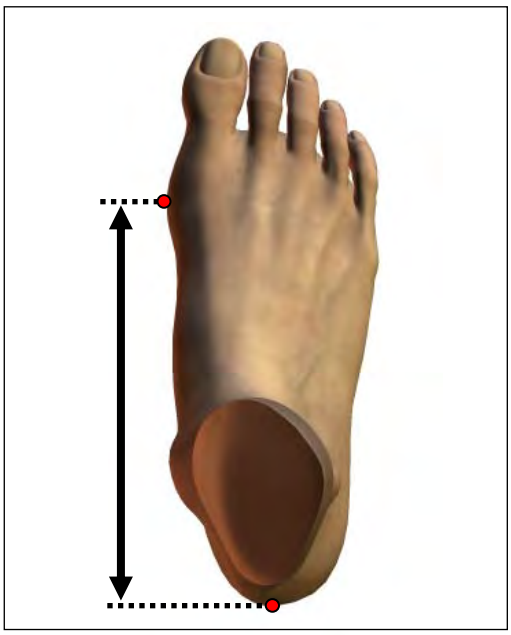
DESCRIPTION: The distance from the back of the heel (pternion) to the landmark at the first metatarsophalangeal protrusion on the ball of the right foot.

DRAWN LANDMARK: First metatarsophalangeal protrusion, right.

UNDRAWN LANDMARK: Pternion.

PROCEDURE: Participant stands erect on a table with the right foot on the Brannock device and the left foot on a board of equal height. The weight is distributed equally on both feet. Stand to the right side of the participant, and make sure the back of the heel (pternion) is lightly touching the back of the device and that the long axis of the foot is in line with the long axis of the device. When the foot is correctly positioned, move to the front of the participant. Measure the distance between the back of the heel and the ball of the foot by moving the pointer of the "vertical" slide to the level of the drawn landmark at the first metatarsophalangeal protrusion. Read the measurement at that point from the device scale.

INSTRUMENTS: Brannock device.



6.4.9 Biacromial Breadth

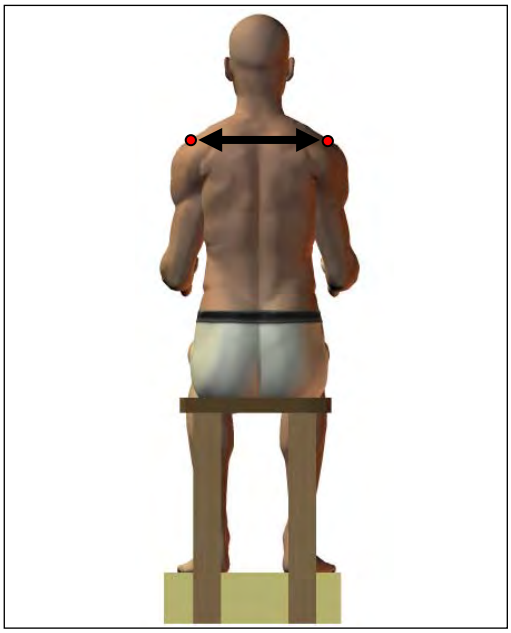
DESCRIPTION: The distance between the right and left acromion landmarks on the tips of the shoulder.

DRAWN LANDMARKS: Acromion, right and left.

PROCEDURE: Participant is in the anthropometric sitting position. Stand behind the participant, and use a beam caliper to measure the distance between the drawn right and left acromion landmarks at the tips of the shoulders. The beam should be parallel to the coronal plane. If the acromial landmarks cannot be seen from behind, stand in front of the participant. The measurement is taken at the maximum point of quiet respiration. Use sufficient pressure to maintain firm contact with the skin.

INSTRUMENT: Beam caliper.

CAUTION: The participant must not be allowed to change the position of the shoulders.



6.4.10 Biceps Circumference, Flexed

DESCRIPTION: The circumference of the right upper arm at the biceps point landmark

DRAWN LANDMARK: Biceps point, right.

PROCEDURE: Participant stands. The right upper arm is extended forward horizontally and the elbow is flexed about 90°. Place a tape around the upper arm at the level of the drawn biceps point landmark. The fist is clenched and held facing the head. The participant is urged to exert maximum effort in “making a muscle.” Stand at the right of the participant, and use a tape to measure the circumference of the upper arm. The tape should be in a plane perpendicular to the long axis of the upper arm. Exert only enough tension on the tape to maintain contact between the tape and the skin.

INSTRUMENT: Steel tape.

6.4.11 Bicristal Breadth

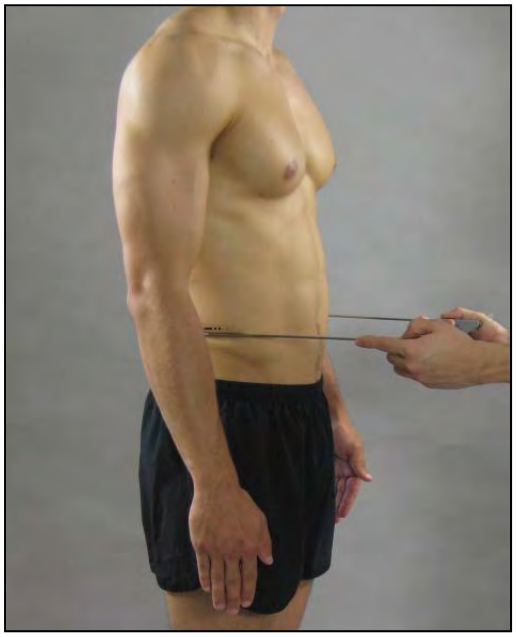
DESCRIPTION: The straight-line distance between the right and left iliocristale landmarks on the iliac crests.

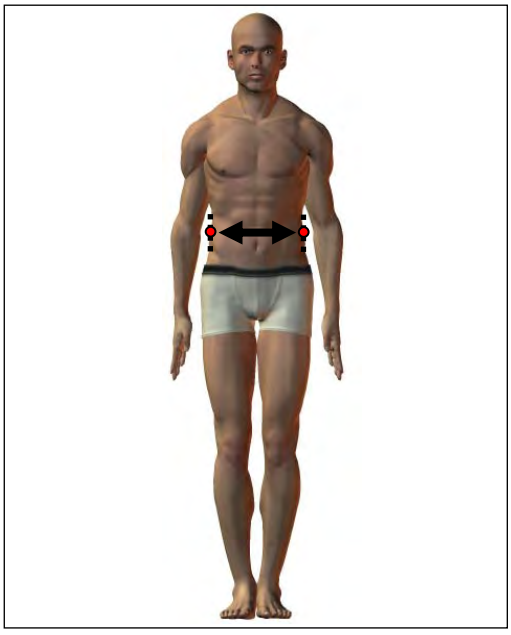
DRAWN LANDMARKS: Iliocristale, right and left.

PROCEDURE: Participant stands on a table in the anthropometric standing position. Stand in front of the participant, and use a beam caliper to measure the distance between the drawn right and left iliocristale landmarks. Compress the tissue firmly to ensure you are on the bony landmarks. Due to rolling on top of the pelvis, it may be necessary to position the blades slightly inferior to the iliocristale landmarks.

INSTRUMENT: Beam caliper.

NOTE: The beam will not necessarily be parallel to the floor, since the two iliac crests are not always located directly across from each other, but it must be parallel to the coronal plane.





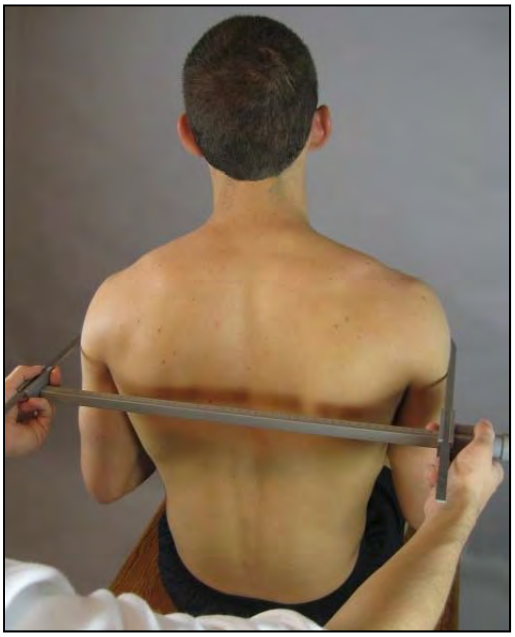
6.4.12 Bideltoid Breadth

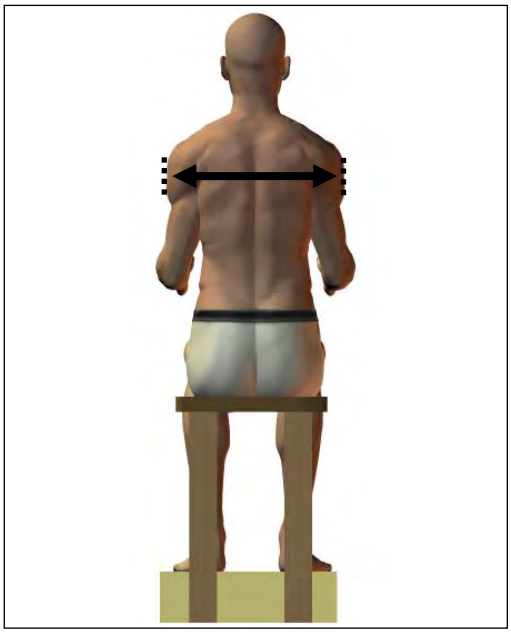
DESCRIPTION: The maximum horizontal distance between the lateral margins of the upper arms on the deltoid muscles.

PROCEDURE: Participant is in the anthropometric sitting position. Stand behind the participant, and use a beam caliper to locate the greatest horizontal distance between the outside edges of the deltoid muscles on the upper arms. This is done by brushing the caliper blades up and down the upper arms. When the blades lightly touch the skin on both sides, withdraw the instrument to read off the measurement. The measurement is made at the maximum point of quiet respiration. Note that the deltoid landmarks are NOT used for this dimension.

INSTRUMENT: Beam caliper.

CAUTION: The participant must not be allowed to change the position of the shoulders. This measurement should never be taken lower than the bottom of the deltoid muscles.





6.4.13 Bimalleolar Breadth

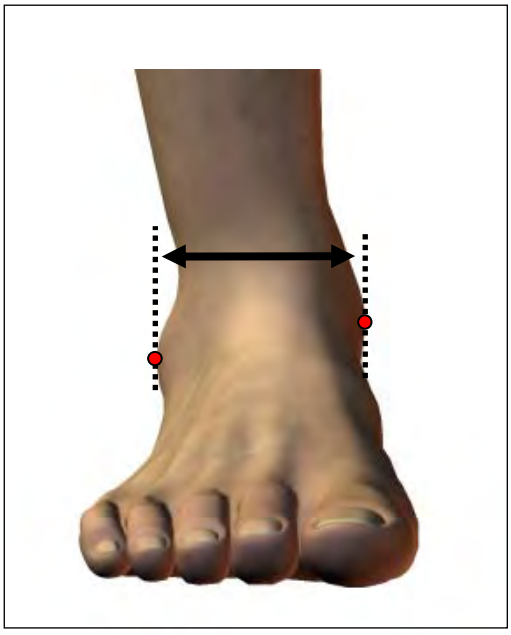
DESCRIPTION: The horizontal distance between the maximum protrusions of the ankle bones (lateral and medial malleoli) on the right foot.

DRAWN LANDMARK: Lateral malleolus, right.

UNDRAWN LANDMARK: Medial malleolus.

PROCEDURE: Participant stands on a table with the weight distributed equally on both feet. The feet are about 10 cm apart with the toes pointing forward. Stand behind the participant, and use a Holtain caliper to measure the horizontal distance between the maximum protrusions of the ankle bones (lateral and medial malleoli) of the right foot. Holding the fixed blade of the caliper parallel to the long axis of the foot, place it on the medial malleolus. Hold the beam of the caliper parallel to the floor. Both blades of the instrument should just touch the skin.

INSTRUMENT: Holtain caliper.



6.4.14 Bitragion Chin Arc

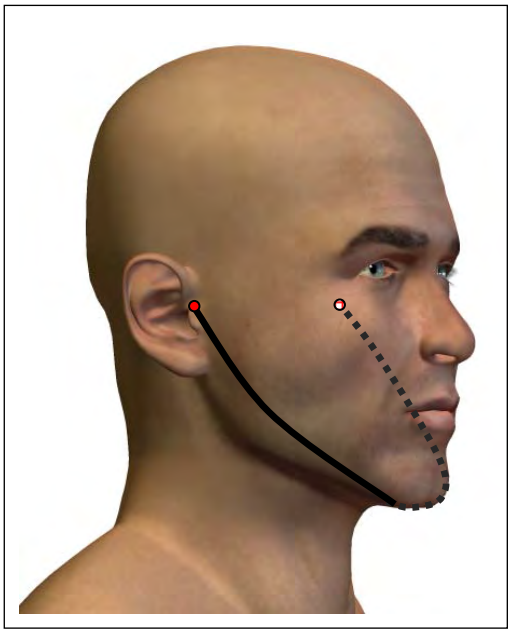
DESCRIPTION: The surface distance between the right and left tragion across the anterior point of the chin.

DRAWN LANDMARKS: Tragion, right and left.

UNDRAWN LANDMARK: Chin.

PROCEDURE: Participant sits with the teeth together (lightly occluded). Stand in front of the participant, and use a tape to measure the surface distance from the drawn right tragion landmark to the drawn left tragion landmark across the tip of the chin (chin landmark). Exert enough tension on the tape to maintain contact between the tape and the skin, and be sure that the zero point of the tape remains on the tragion landmark. The chin will be slightly compressed.

INSTRUMENT: Steel tape.



6.4.15 Bitragion Submandibular Arc

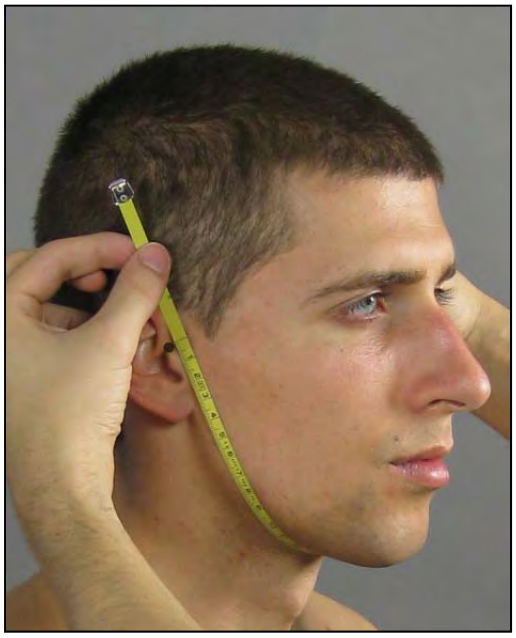
DESCRIPTION: The surface distance between the right and left tragion across the submandibular landmark at the juncture of the jaw and the neck.

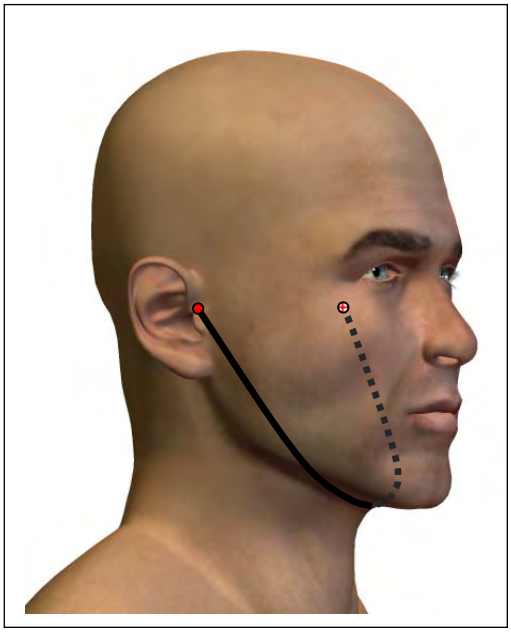
DRAWN LANDMARKS: Tragion, right and left; Submandibular.

PROCEDURE: Participant sits with the head in the Frankfurt plane. Stand in front of the participant, and use a tape to measure the surface distance from the drawn right tragion landmark to the drawn left tragion landmark across the submandibular landmark. Be sure the zero point of the tape is on the tragion landmark, and exert only enough tension on the tape to maintain light contact between the tape and the skin.

INSTRUMENT: Steel tape.

CAUTION: Take care not to compress the soft tissue of the lower jaw.





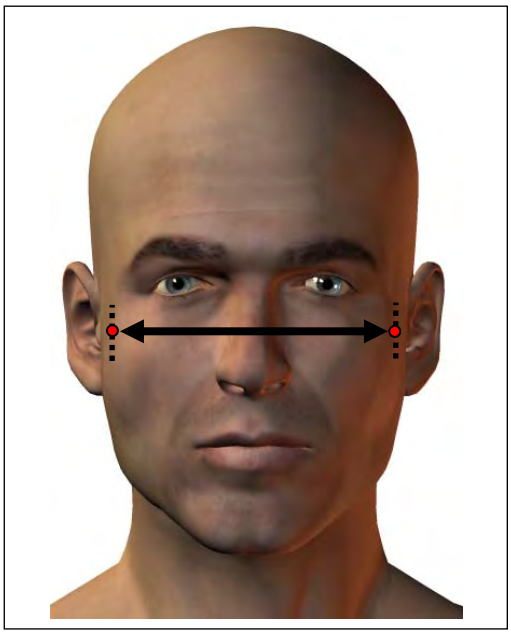
6.4.16 Bizygomatic Breadth

DESCRIPTION: The maximum horizontal breadth of the face between the zygomatic arches.

DRAWN LANDMARKS: Zygion, right and left.

PROCEDURE: Participant sits. Stand in front of the participant, and use a spreading caliper to measure the maximum horizontal breadth of the face between the cheekbones (zygomatic arches). Exert only enough pressure to ensure that the caliper tips are on the zygomatic arches.

INSTRUMENT: Spreading caliper.



6.4.17 Buttock Circumference

DESCRIPTION: The horizontal circumference of the trunk at the level of the maximum protrusion of the right buttock.

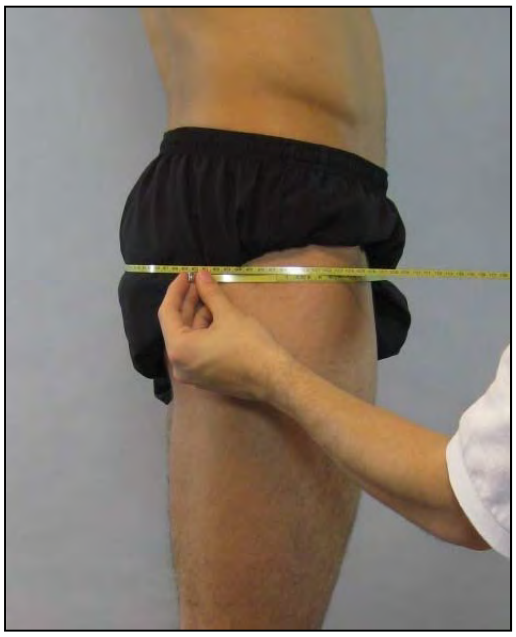
DRAWN LANDMARKS: Buttock point, right lateral and left lateral.

UNDRAWN LANDMARK: Buttock point, posterior.

PROCEDURE: Participant stands erect on a table with heels together. Ask the participant to hold up the right leg of the shorts to expose the landmark. Stand at the participant's right, and use a tape to measure the horizontal circumference of the trunk at the level of the maximum protrusion of the right buttock. The tape should pass over the posterior buttock point (not drawn) and the buttock point landmarks drawn on the right and left hips. If necessary, ask male participants to adjust the genitalia so as to interfere as little as possible with the tape. Exert only enough tension on the tape to maintain contact between the tape and the skin.

INSTRUMENT: Steel tape.

CAUTION: The tape must be maintained in a horizontal plane.



6.4.18 Buttock Depth

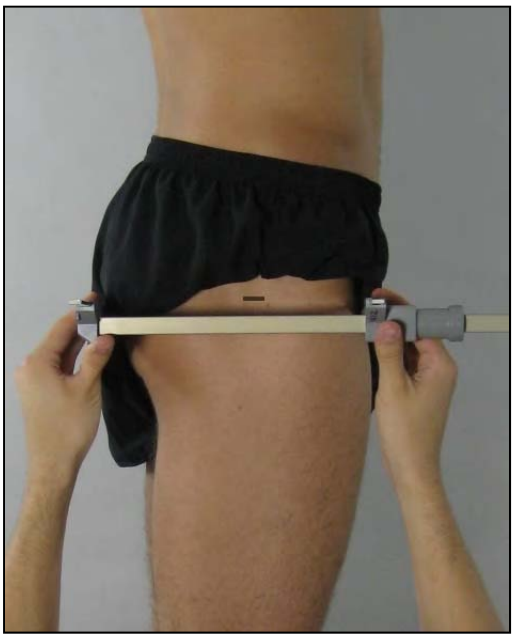
DESCRIPTION: The horizontal depth of the torso at the level of the maximum protrusion of the right buttock.

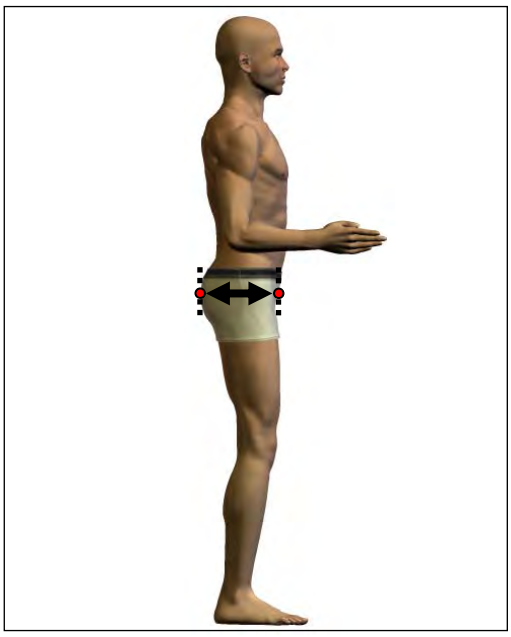
DRAWN LANDMARK: Buttock point, right lateral.

UNDRAWN LANDMARK: Buttock point, posterior.

PROCEDURE: Participant stands on a table with heels together. Ask the participant to hold up the right side of the measuring shorts so the measurer can see the right lateral buttock point. Stand at the participant's right, and use a beam caliper to measure the horizontal depth of the torso at the level of the maximum protrusion of the right buttock. The fixed blade is placed on the posterior buttock point; the other blade is placed on the abdomen so that it crosses the midsagittal plane at the same level. The blades should be at the level of the right lateral buttock point. If necessary, ask male participants to adjust genitalia so as to interfere as little as possible with the caliper blade. Exert only enough pressure on the instrument to attain contact between the caliper blades and the skin.

INSTRUMENT: Beam caliper.





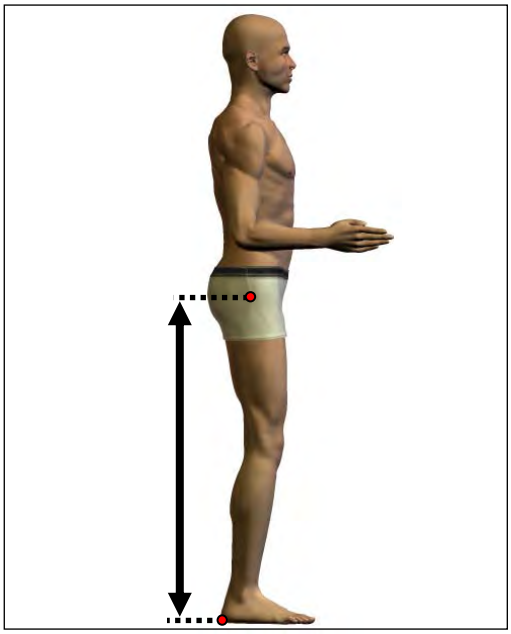
6.4.19 Buttock Height

DESCRIPTION: The vertical distance between a standing surface and the level of the maximum protrusion of the right buttock.

DRAWN LANDMARK: Buttock point, right lateral.

PROCEDURE: Participant stands on a table in the anthropometric standing position, but with the right elbow flexed. In some cases the participant will have to hold up the right leg of the shorts to expose the landmark. Stand at the right of the participant, and use an anthropometer to measure the vertical distance between the standing surface and the level of the maximum protrusion of the buttock as drawn on the right side of the right thigh.

INSTRUMENT: Anthropometer.



6.4.20 Buttock-Knee Length

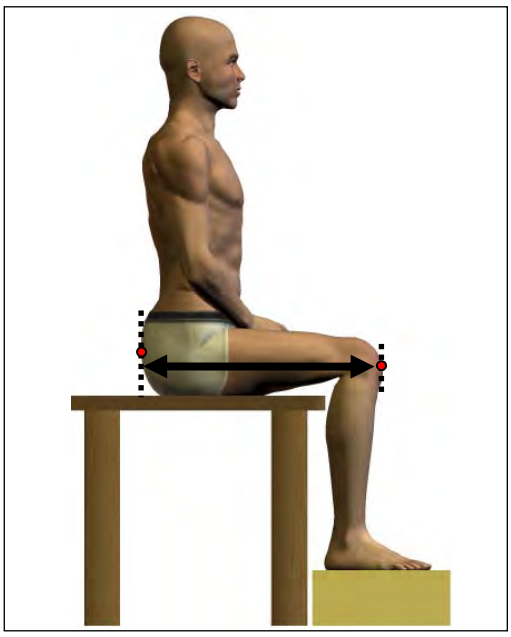
DESCRIPTION: The horizontal distance between a buttock plate placed at the most posterior point of either buttock and the anterior point of the right knee.

UNDRAWN LANDMARK: Knee point, anterior.

PROCEDURE: Participant is in the anthropometric sitting position, but with arms relaxed on the lap. Stand at the right of the participant, and slide the buttock plate toward the participant until it makes light contact with the most posterior point on either buttock. When the plate is in position lock it in place. Use an anthropometer to measure the horizontal distance between the buttock plate and the front of the knee (knee point, anterior). The base of the anthropometer is anchored on the buttock plate. Exert only enough pressure on the instrument to attain contact between the anthropometer blade and the knee.

INSTRUMENTS: Anthropometer, Buttock plate.

CAUTION: To ensure that the anthropometer is horizontal, be sure that the base of the anthropometer is fully against the buttock plate.



6.4.21 Buttock-Popliteal Length

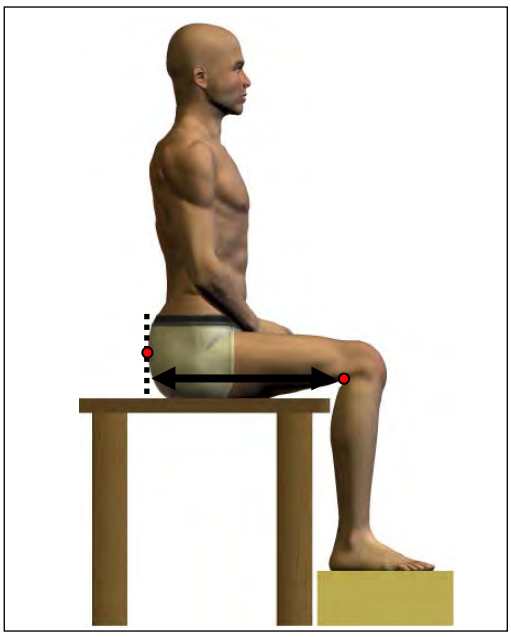
DESCRIPTION: The horizontal distance between a buttock plate placed at the most posterior point of either buttock and the back of the right knee (the popliteal fossa at the dorsal juncture of the calf and thigh).

UNDRAWN LANDMARK: Popliteal fossa at the dorsal juncture of the calf and thigh.

PROCEDURE: Participant is in the anthropometric sitting position with the arms relaxed on the lap. Stand at the right of the participant, and slide the buttock plate toward the participant until it makes light contact with the most posterior point on either buttock. When the plate is in position, lock it in place. Use an anthropometer to measure the horizontal distance from the buttock plate to the back of the knee. This is done in such a way that the blade of the anthropometer is placed as high and as far forward as possible in the popliteal fossa behind the knee (dorsal juncture of the calf and thigh) without compressing tissue. Exert only enough pressure on the instrument to attain contact between the anthropometer blade and the skin.

INSTRUMENTS: Anthropometer, Buttock plate.

CAUTION: To ensure that the anthropometer is horizontal, be sure that the base of the anthropometer is fully against the buttock plate. The computer will add 1 cm to the recorded dimension to account for the width of the anthropometer blade.

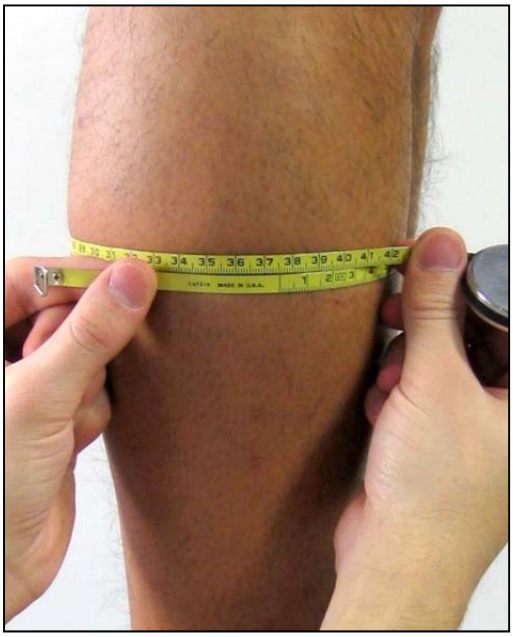


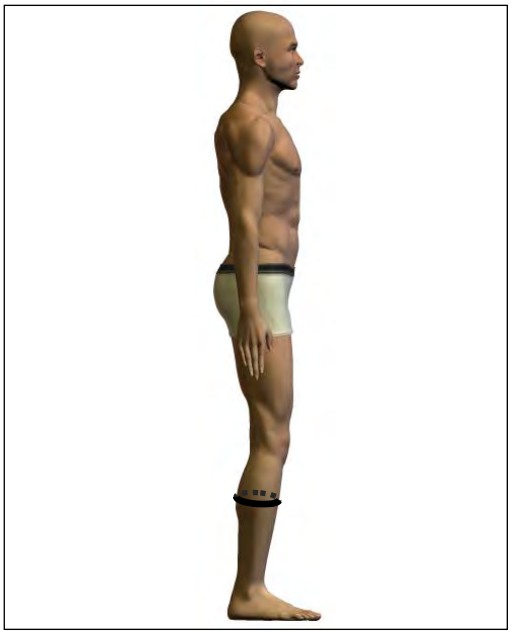
6.4.22 Calf Circumference

DESCRIPTION: The maximum horizontal circumference of the right calf.

PROCEDURE[5]: Participant stands erect on a table with the heels approximately 10 cm apart, and the weight distributed equally on both feet. Stand at the right of the participant. With a tape held in the horizontal plane measure the circumference of the calf at three locations in the area of observed maximum circumference. Record all three values. Exert only enough tension on the tape to maintain contact between the tape and the skin.

INSTRUMENT: Steel tape.





[5] In ANSUR, the level of the circumference was found by sliding the horizontal tape up and down the thigh until the maximum was achieved. The current procedure is faster and produces equivalent results (Hotzman et al., 2010).

6.4.23 Cervicale Height

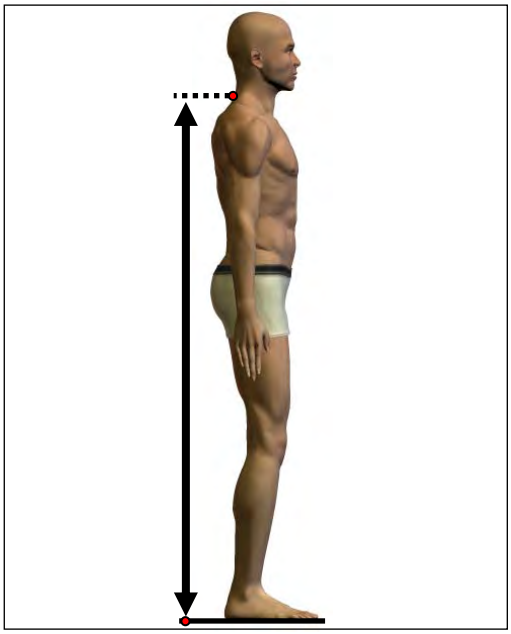
DESCRIPTION: The vertical distance between a standing surface and the cervicale landmark at the base of the neck.

DRAWN LANDMARK: Cervicale.

PROCEDURE: Participant is in the anthropometric standing position with the head held in the Frankfurt plane. Stand behind the participant and use an anthropometer to measure the vertical distance between the standing surface and the drawn cervicale landmark. The measurement is taken at the maximum point of quiet respiration.

INSTRUMENT: Anthropometer.

CAUTION: Be sure the participant's head remains in the Frankfurt plane while the measurement is taken.



6.4.24 Chest Breadth

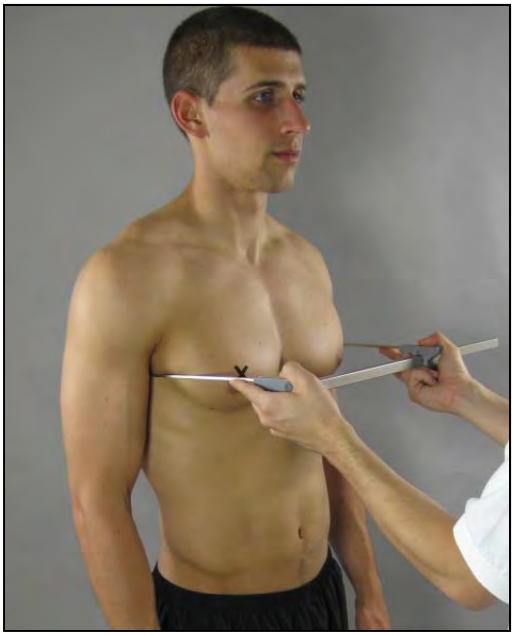
DESCRIPTION: The maximum horizontal breadth of the chest at the level of the chest point anterior landmark[6].

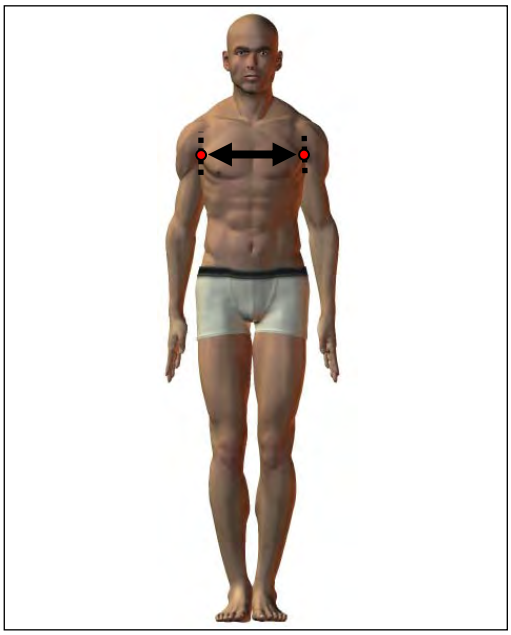
DRAWN LANDMARK: Chest point, anterior, right.

PROCEDURE: Participant stands erect looking straight ahead with the heels together and the weight distributed evenly on both feet. The participant places both hands on the hips. Stand in front of the participant, and ready the beam caliper by lining up the blades at the level of chest point anterior. Ask the participant to take a deep breath and hold it. Compress the tissue firmly to ensure contact with the rib cage, ask the participant to lower the arms, and take the measurement. The measurement is taken at maximum inspiration of the chest at the level of the chest point anterior landmark. On women, the landmark will be an adhesive dot on the bra. Before taking the measurement verify that this landmark has not shifted.

INSTRUMENT: Beam caliper.

CAUTION: Breast tissue should NOT be included in this measurement. This can be avoided, when necessary, by tilting the blades of the caliper upwards and approaching the bony sides of the chest from below the breasts. Additionally, unlike most other dimensions, which are measured at the maximum point of quiet respiration, this dimension is measured at full inspiration.





[6] In ANSUR this measurement was taken (in males) at the level of Thelion (nipple). This change was made in order to capture the breadth of the chest at its maximum. It is unchanged for females.

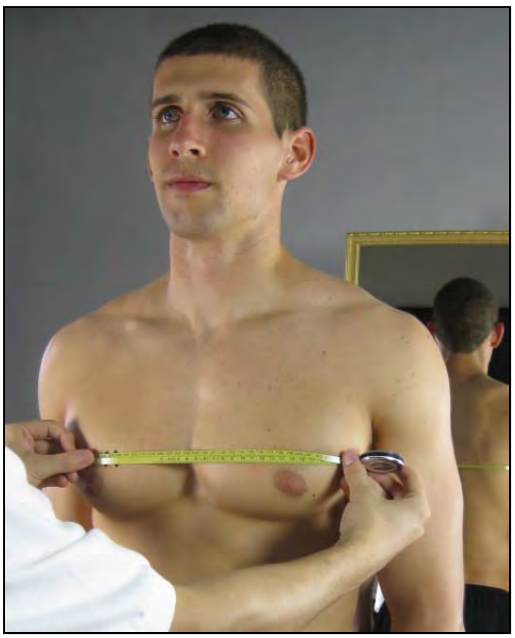
6.4.25 Chest Circumference

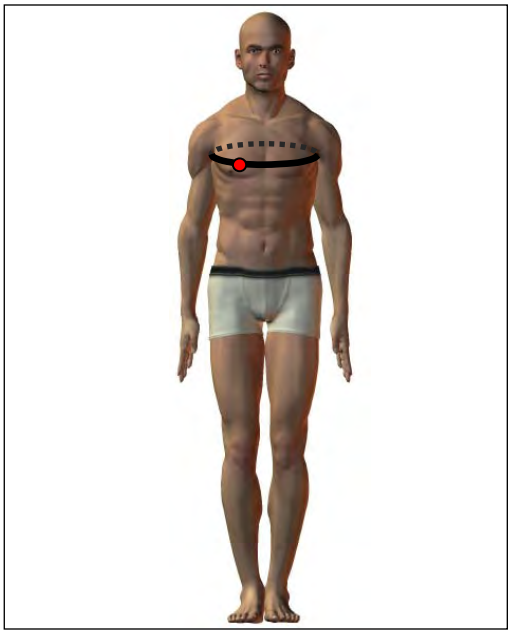
DESCRIPTION: The maximum circumference of the chest at the fullest part of the breast[7].

DRAWN LANDMARK: Chest point, anterior, right.

PROCEDURE: Participant is in the anthropometric standing position in front of a mirror. Stand in front of the participant, and use a tape to measure the horizontal circumference of the chest at the level of the right chest point anterior landmark. On women, the landmark will be an adhesive dot on the bra. Before taking the measurement verify that this landmark has not shifted. Use the mirror to check the position of the tape as it crosses the participant's back. This dimension will cross very soft tissue at the armpit and bust, and some compression of the tissue will inevitably occur. Be sure, however, to keep this to a minimum. Exert only enough tension on the tape to maintain contact between the tape and the skin. The tape will span body hollows in this measurement. The measurement is taken at the maximum point of quiet respiration.

INSTRUMENT: Steel tape.





[7] In ANSUR this measurement was taken (in males) at the level of Thelion (nipple). This change was made in order to capture the circumference of the chest at its maximum. It is unchanged for females.

6.4.26 Chest Depth

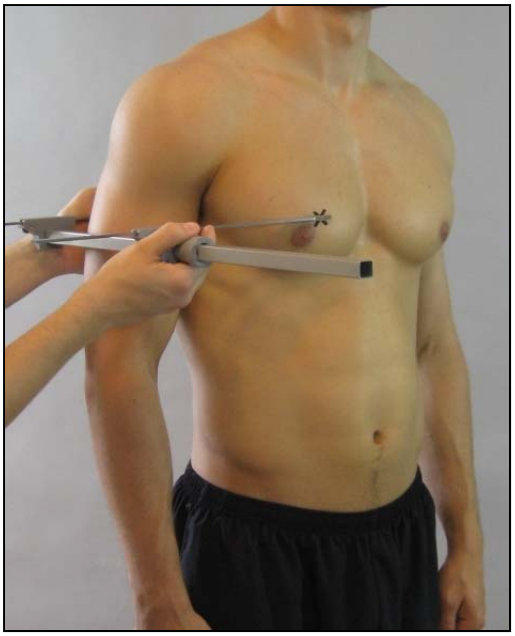
DESCRIPTION: The horizontal distance between the right chest point anterior landmark and the back at the same level[8].

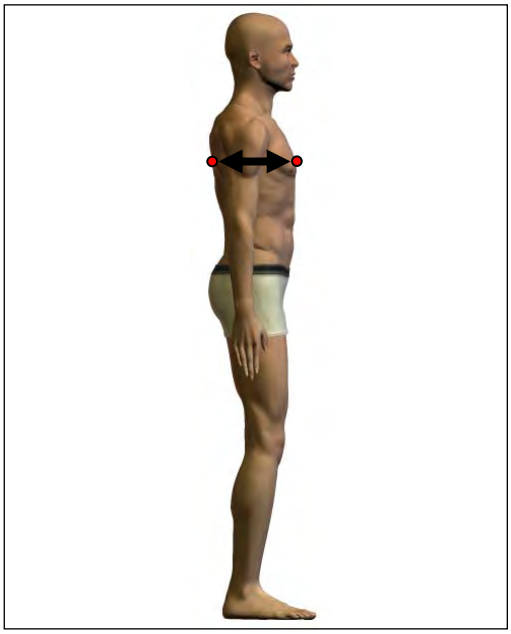
DRAWN LANDMARK: Chest point, anterior, right.

PROCEDURE: Participant is in the anthropometric standing position. Stand at the right of the participant, and use a beam caliper to measure the horizontal distance between the chest at the level of the right chest point anterior landmark and the back at the same level. Place the fixed blade of the caliper on the back. On women, the landmark will be an adhesive dot on the bra. Before taking the measurement verify that this landmark has not shifted. This measurement is taken at the maximum point of quiet respiration. Exert only enough pressure to maintain contact between the caliper and the skin (or bra).

INSTRUMENT: Beam caliper.

CAUTION: Participant must not be allowed to change the position of the shoulders.





[8] In ANSUR this measurement was taken (in males) at the level of Thelion (nipple). This change was made in order to capture the depth of the chest at its maximum. It is unchanged for females.

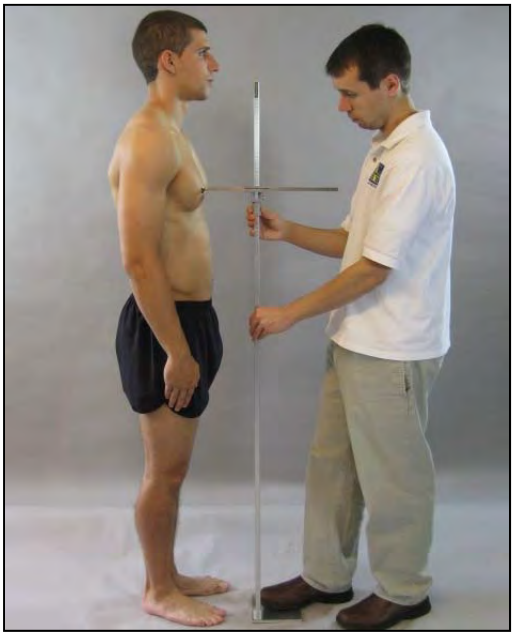
6.4.27 Chest Height

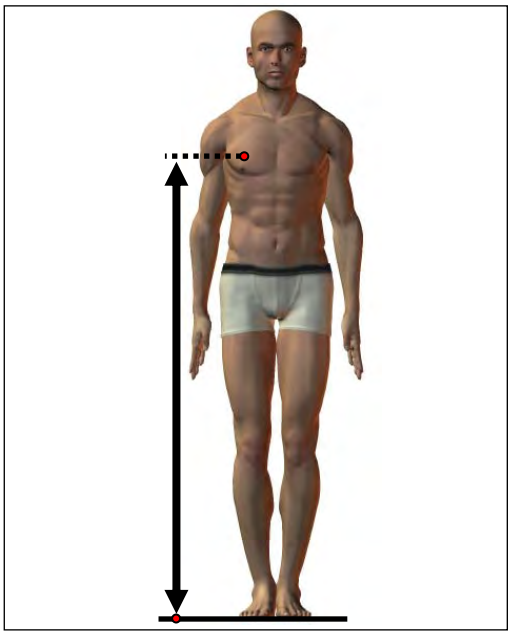
DESCRIPTION: The vertical distance between a standing surface and the right chest point anterior landmark[9].

DRAWN LANDMARK: Chest point, anterior, right.

PROCEDURE: Participant is in the anthropometric standing position. Stand in front of the participant, and use an anthropometer to measure the vertical distance between the standing surface and the right chest point anterior landmark. On women, the landmark will be an adhesive dot on the bra. Before taking the measurement verify that this landmark has not shifted. The measurement is taken at the maximum point of quiet respiration.

INSTRUMENT: Anthropometer.





[9] In ANSUR this measurement was taken (in males) at the level of Thelion (nipple). This change was made in order to capture the height of the chest at its maximum fullness. It is unchanged for females.

6.4.28 Crotch Height

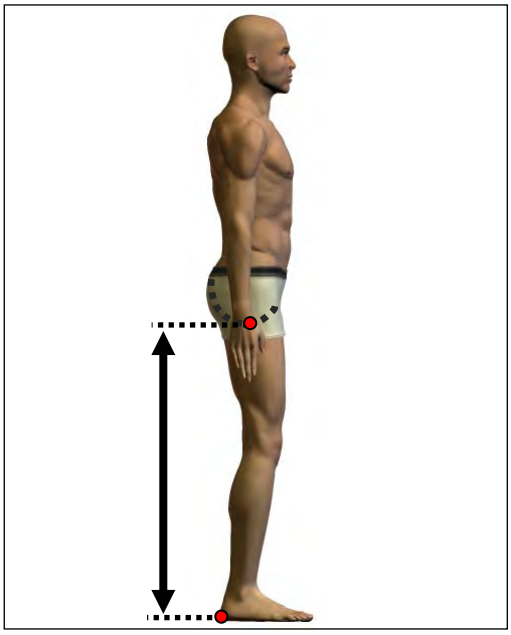
DESCRIPTION: The vertical distance between the standing surface and the crotch.

UNDRAWN LANDMARK: Crotch.

PROCEDURE: Participant stands on a table in the anthropometric standing position. Stand in front of the participant. Ask the participant to spread the legs apart enough to allow placement of the blade of an anthropometer near the crotch. The participant then brings the heels back together and raises the blade until it is in firm contact with the crotch. (Place the blade to the right of the genitalia.) The measurer then exerts additional upward pressure on the slide of the anthropometer to achieve firm and uniform placement. Measure the vertical distance between the standing surface and the crotch.

INSTRUMENT: Anthropometer.

CAUTION: The computer will add 1 cm to the recorded dimension to account for the width of the anthropometer blade.



6.4.29 Crotch Length (Omphalion)

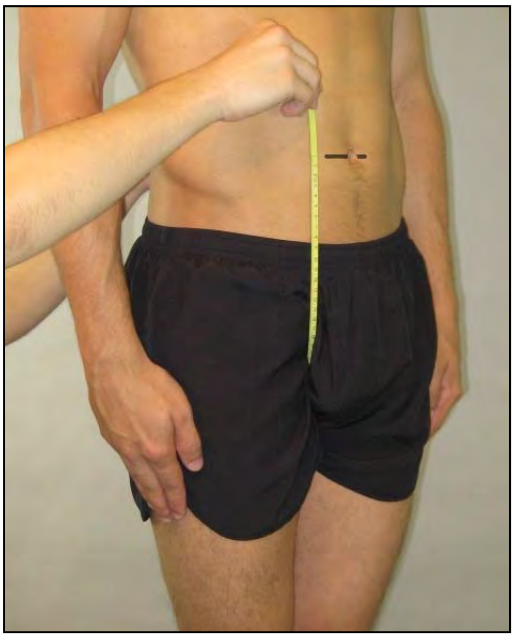
DESCRIPTION: The distance between the abdomen at the level of the center of the navel (omphalion) to the same level on the back.

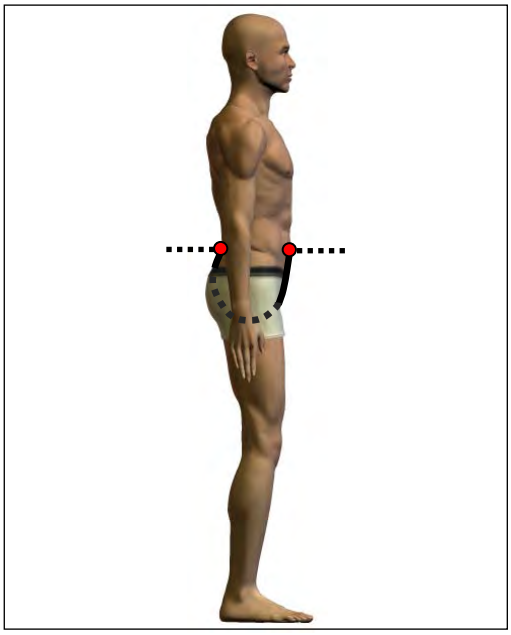
DRAWN LANDMARKS: Waist (omphalion), anterior and posterior.

PROCEDURE: Participant stands erect looking straight ahead with the feet sufficiently apart to allow passing a tape through the crotch. When the tape is in place, the participant brings the heels together for the measurement. Stand at the right of the participant ,and measure the distance between the drawn landmarks on the navel [waist (omphalion), anterior] and at the same waist level in back [waist (omphalion), posterior]. The tape passes through the crotch (on males to the right of the scrotum) and between the buttocks. The zero point of the tape is placed on the posterior waist landmark. After passing through the crotch, the tape should be brought vertically to the anterior waist landmark. On men this will be somewhat to the right of the navel. Exert only enough tension on the tape to maintain contact between the tape and the surface of the body. The measurement is taken at the maximum point of quiet respiration.

INSTRUMENT: Steel tape.

CAUTION: Be sure the participant does not tense the abdominal muscles and that the tape lies on the skin.





6.4.30 Crotch Length, Posterior (Omphalion)

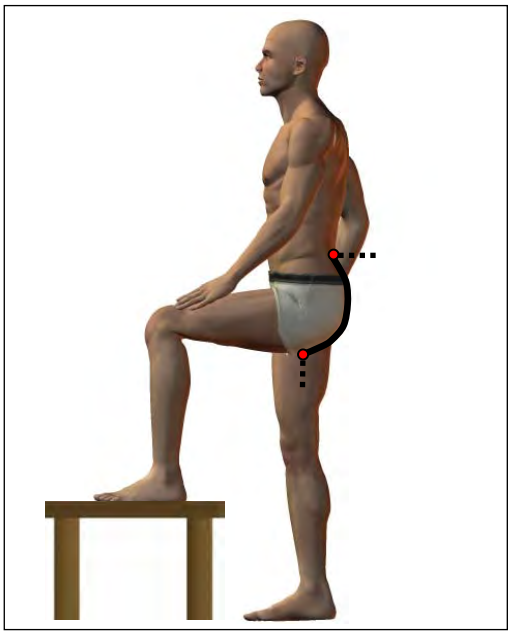
DESCRIPTION: The surface distance from the crotch at the inner thigh landmark to the back of the waist at the level of the center of the navel (omphalion).

DRAWN LANDMARKS: Inner thigh, right; Waist (omphalion), posterior.

PROCEDURE: Participant stands erect with the left foot on a platform so that the knee is flexed. Stand to the left rear of the participant, and use a specially modified tape to measure the surface distance from the crotch at the drawn inner thigh landmark to the back of the waist at the drawn waist (omphalion), posterior landmark. To take the measurement, grasp the zero end of the tape by the dowel, place the leading edge of the pennant on the inner thigh landmark, and bring the tape up between the buttocks to the back of the waist, exerting only enough pressure to maintain contact between the tape and the body. The measurement is taken at the maximum point of quiet respiration.

INSTRUMENT: Modified tape.

CAUTION: Do not let the participant tense the abdominal muscles and be sure that the tape lies on the surface of the body.



6.4.31 Ear Breadth

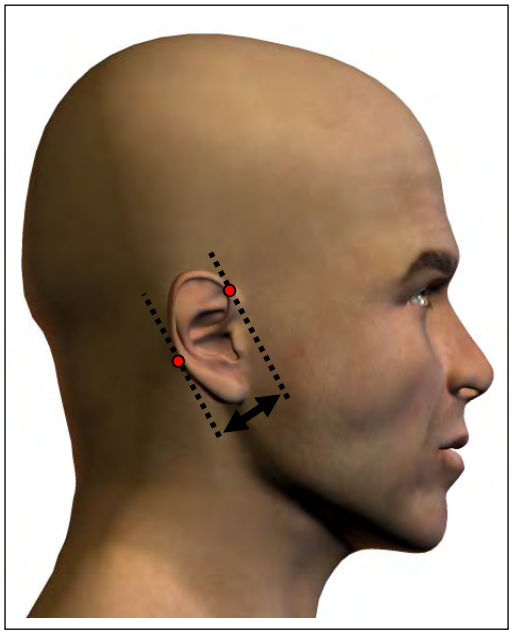
DESCRIPTION: The maximum breadth of the ear between otobasion, superior, and a point on the outside edge of the ear in a line perpendicular to the long axis of the ear.

UNDRAWN LANDMARK: Otobasion, superior.

PROCEDURE: Participant sits looking straight ahead. Stand at the participant's right, and use a sliding caliper to measure the maximum breadth of the ear perpendicular to its long axis. The fixed blade of the caliper is placed in front of the ear at the juncture of the top of the ear with the head (otobasion, superior), and oriented in a line parallel to the long axis of the ear. The other blade of the instrument is touching the outer edge of the ear at its widest point. Exert only enough pressure to attain contact between the caliper and the skin.

INSTRUMENT: Sliding caliper.

CAUTION: Care must be taken not to distort the soft tissue of the ear.



6.4.32 Ear Length

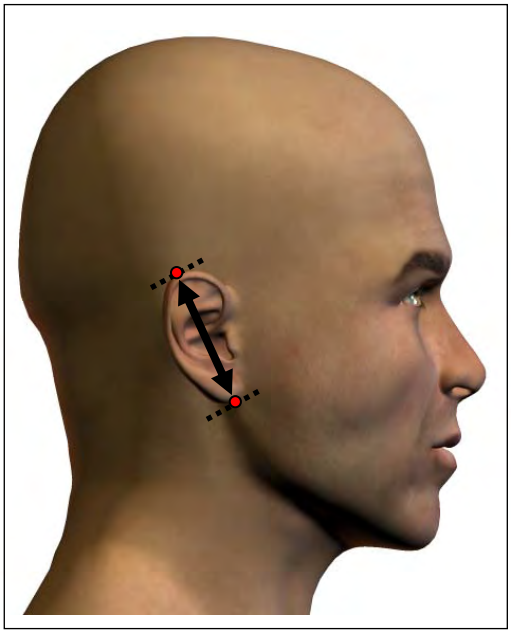
DESCRIPTION: The length of the right ear from its highest to lowest points on a line parallel to the long axis of the ear.

UNDRAWN LANDMARKS: Ear, top and bottom.

PROCEDURE: Participant sits looking straight ahead. Stand at the right of the participant, and use a sliding caliper to measure the length of the ear from its highest to lowest points on a line parallel to the long axis of the ear. The fixed blade of the caliper is placed on the bottom of the earlobe. Exert only enough pressure to attain contact between the caliper and the skin.

INSTRUMENT: Sliding caliper.

CAUTION: Care must be taken not to distort the ear with the caliper.



6.4.33 Ear Protrusion

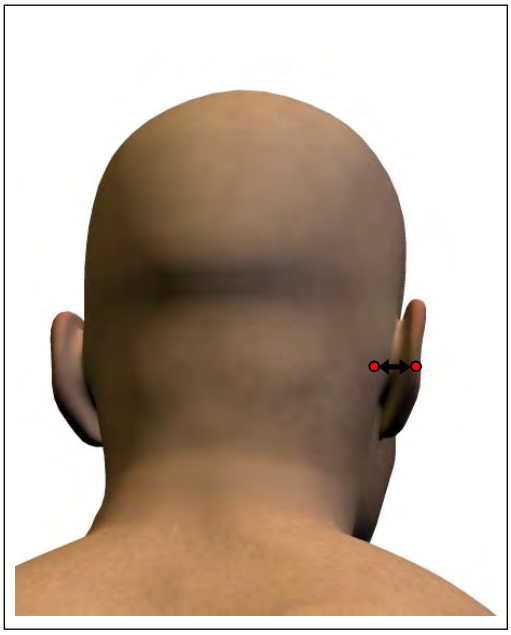
DESCRIPTION: The horizontal distance between the mastoid process and the outside edge of the right ear at its most lateral point (ear point).

UNDRAWN LANDMARK: Ear point.

PROCEDURE: Participant sits looking straight ahead. Stand at the right of the participant, and use a sliding caliper with the slide reversed to measure the horizontal distance between the mastoid process (the bony area behind the ear) and the outside edge of the ear at its most lateral point (ear point). The base of the caliper is placed on the mastoid process. Exert only enough pressure to ensure that the caliper blade is on the lateral point of the ear.

INSTRUMENT: Sliding caliper.

CAUTION: Care must be taken not to distort the ear and that the beam of the caliper is perpendicular to the head.



6.4.34 Elbow Rest Height

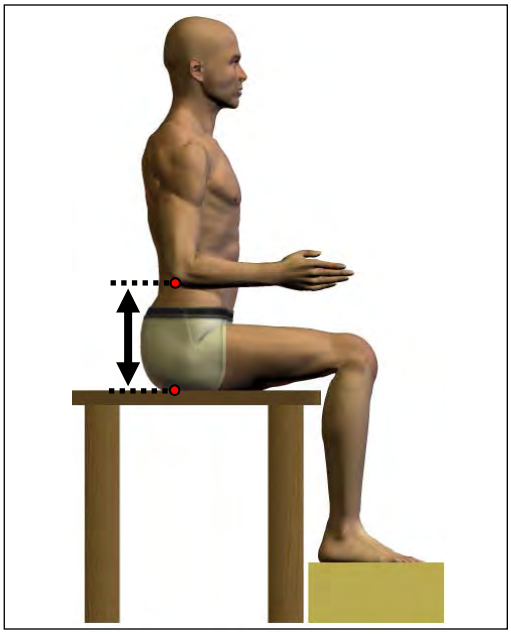
DESCRIPTION: The vertical distance between a sitting surface and the olecranon landmark on the bottom of the flexed right elbow.

UNDRAWN LANDMARK: Olecranon, bottom.

PROCEDURE: Participant is in the anthropometric sitting position. Stand behind the participant, and use an anthropometer to measure the vertical distance between the sitting surface and the bottom of the flexed elbow (olecranon, bottom). The measurement is taken at the maximum point of quiet respiration.

INSTRUMENT: Anthropometer.

CAUTION: This dimension is difficult to measure with a high degree of reliability. Check the participant's posture, position of the shoulders, upper arms, and forearms, and be sure to make the measurement at the required point of respiration. The computer will add 1 cm to the recorded dimension to account for the width of the anthropometer blade.



6.4.35 Eye Height, Sitting

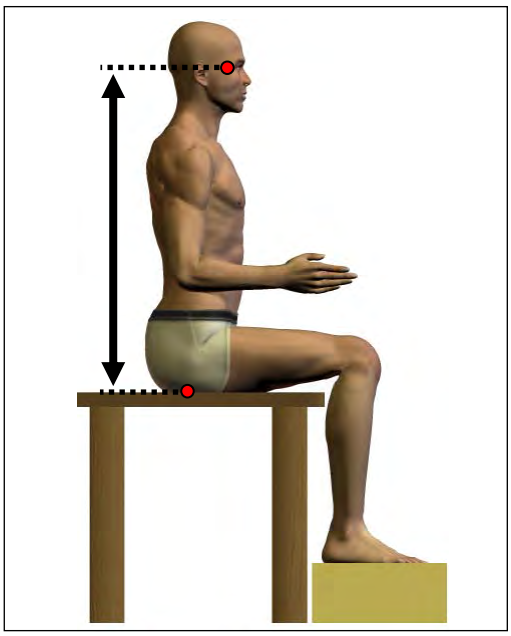
DESCRIPTION: The vertical distance between a sitting surface and the ectocanthus landmark on the outer corner of the right eye.

UNDRAWN LANDMARK: Ectocanthus.

PROCEDURE: Participant is in the anthropometric sitting position with the head in the Frankfurt plane. Use an anthropometer to measure the vertical distance between the sitting surface and the outer corner of the eye (ectocanthus, right). Begin by placing the anthropometer on the sitting surface just behind and somewhat to the right of the participant with the blade directed away from the participant. Move the blade to a position approximately level with the participant's eyes. Then swivel it around toward the participant bringing it close to the corner of the eye without actually touching it. On some larger and heavier participants, the anthropometer may have to be brought around to the side or even to the front of the participant in order for the blade to reach the area close to the corner of the eye. Align along the *bottom* of the blade at the level of ectocanthus. The measurement is taken at the maximum point of quiet respiration.

INSTRUMENT: Anthropometer.

CAUTION: The point of the anthropometer blade must never be directed toward the participant's eye. Be sure the participant's head is in the Frankfurt plane and that your eye is at the same level as the bottom of the blade of the anthropometer.



6.4.36 Foot Breadth, Horizontal

DESCRIPTION: The maximum breadth of the right foot.

DRAWN LANDMARKS: First metatarsophalangeal protrusion, right; fifth metatarsophalangeal protrusion, right.

PROCEDURE: Participant stands erect on a table with the right foot on the Brannock device and the left foot on a board of equal height. The weight is distributed equally on both feet. Stand to the right side of the participant and make sure the back of the heel (pternion) is lightly touching the back of the device and that the long axis of the foot is in line with the long axis of the device. Move the point of the “vertical” slide to the level of the drawn landmark on the first metatarsophalangeal protrusion. When the foot is correctly positioned, measure the maximum breadth of the foot by moving the ‘horizontal’ slide until it is just touching the side of the foot. Read the measurement at that point from the device scale.

INSTRUMENTS: Brannock device.

CAUTION: Be sure the foot is correctly positioned before taking the measurement.

6.4.37 Foot Length

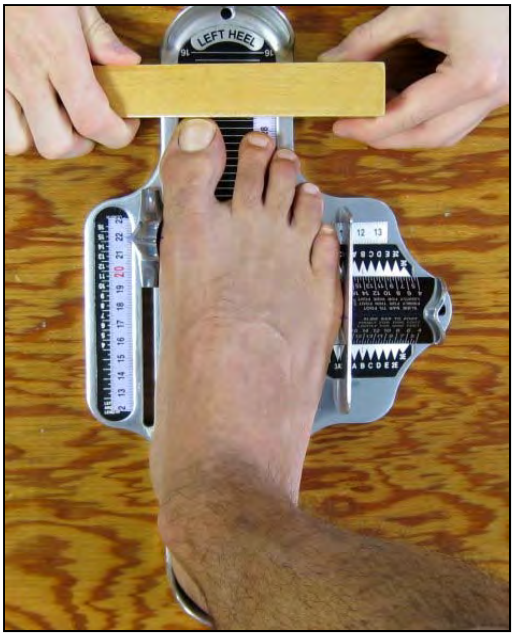
DESCRIPTION: The maximum length of the right foot.

UNDRAWN LANDMARKS: Acropodion; Pternion.

PROCEDURE: Participant stands erect on a table with the right foot on the Brannock device and the left foot on a board of equal height. The weight is distributed equally on both feet. Stand to the right side of the participant, and make sure the back of the heel (pternion) is lightly touching the back of the device and that the long axis of the foot is in line with the long axis of the device. When the foot is correctly positioned, measure the length of the foot by placing a block against the tip of the longest toe (acropodion) to establish the length of the foot. Use only enough pressure to ensure that the block touches the toe. Read the measurement at that point from the device scale.

INSTRUMENTS: Brannock device; block.

CAUTION: Be sure the foot is correctly positioned before taking the measurement.



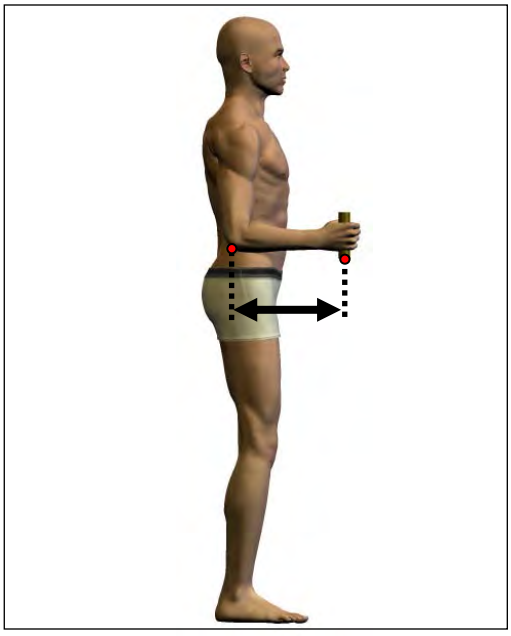
6.4.38 Forearm-Center of Grip Length

DESCRIPTION: The horizontal distance between the back of the tip of the right elbow (olecranon, rear) to the center of a 1-1/4” diameter dowel gripped in the right hand.

UNDRAWN LANDMARK: Olecranon, rear.

PROCEDURE: Participant stands erect with the upper arms hanging at the side and the right elbow flexed 90°. The hand grips a 1-1/4” diameter dowel placed on the fixed blade of a beam caliper. The hand gripping the dowel should be in line with the long axis of the arm; typically this requires gripping the dowel at the bottom. Stand to the right of the participant and use the beam caliper to measure the horizontal distance between the back of the tip of the elbow (olecranon, rear) to center of the dowel. Place the movable blade on olecranon, rear. Exert only enough pressure to attain contact between the caliper and the skin. Be sure that the dowel remains vertical.

INSTRUMENT: Beam caliper; 1-1/4” diameter dowel.



6.4.39 Forearm Circumference, Flexed

DESCRIPTION: The circumference at the elbow crease of the flexed right forearm.

UNDRAWN LANDMARK: Elbow crease.

PROCEDURE: Participant stands with the upper arm extended forward horizontally, the elbow flexed 90°, and the fist tightly clenched. Stand at the right of the participant, and use a tape to measure the circumference of the forearm at the level where the bottom edge of the tape passes across the crease at the juncture between the upper arm and forearm (elbow crease). The measurement is made in a plane perpendicular to the long axis of the forearm. Exert only enough tension on the tape to maintain contact between the tape and the skin.

INSTRUMENT: Steel tape.

CAUTION: Urge the participant to clench the fist tightly.

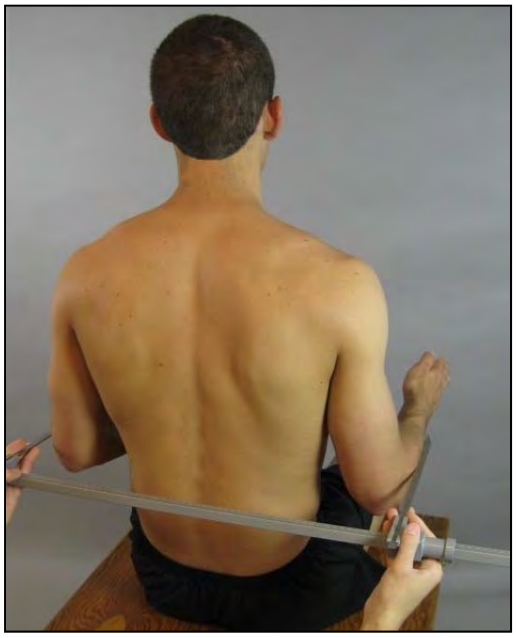
6.4.40 Forearm-Forearm Breadth

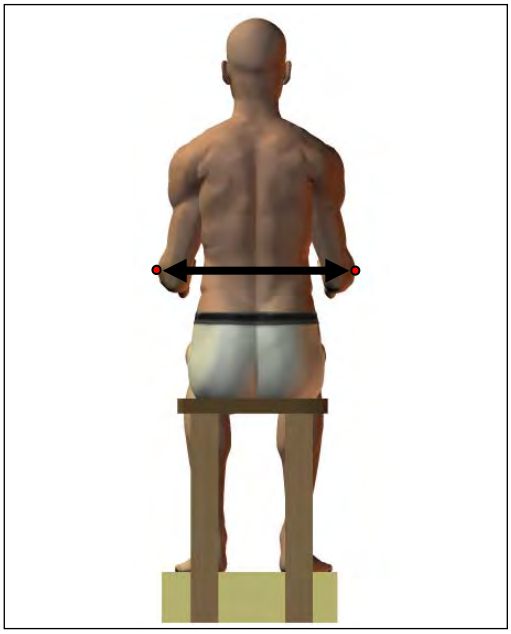
DESCRIPTION: The maximum horizontal distance between the outer sides of the forearms.

PROCEDURE: Participant is in the anthropometric sitting position. Stand behind the participant, and use a beam caliper to measure the maximum horizontal distance across the upper body between the outsides of the forearms. Brush the blades back and forth to ensure that the maximum breadth is attained. Exert only enough pressure to ensure that the caliper blades are on the lateral points of the forearms. The measurement is taken at the maximum point of quiet respiration.

INSTRUMENT: Beam caliper.

CAUTION: Be sure that the arms are in the required position and the participant is at the maximum point of quiet respiration.





6.4.41 Forearm-Hand Length

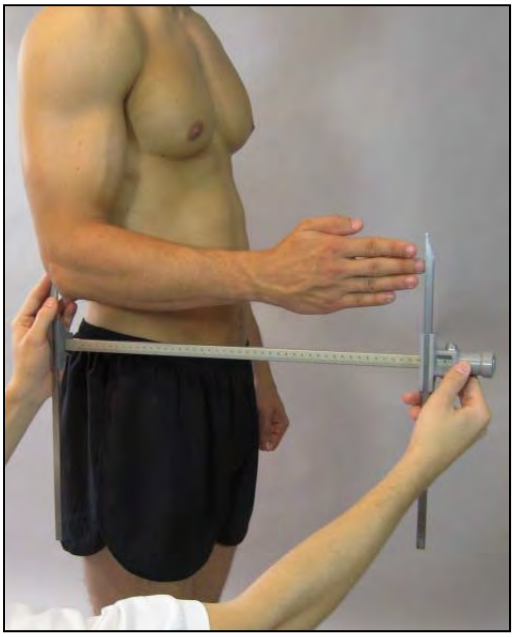
DESCRIPTION: The horizontal distance between the back of the tip of the right elbow to the tip of the right middle finger.

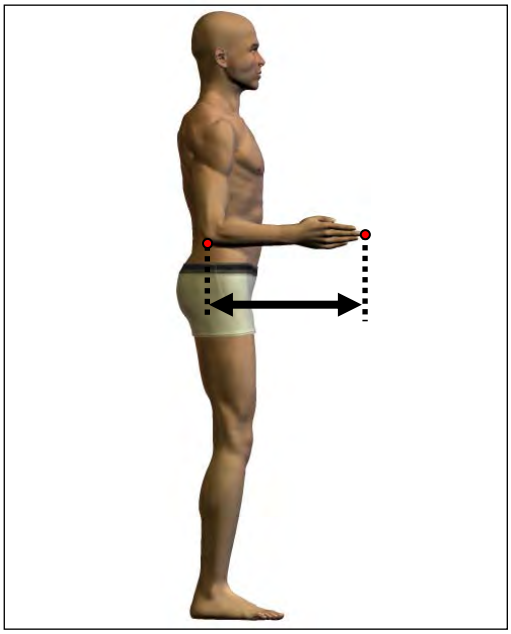
UNDRAWN LANDMARKS: Olecranon, rear; Dactylion III, right.

PROCEDURE: Participant stands erect with the upper arms hanging at the side and the right elbow flexed 90°. The hand is held out straight with the palm facing inward. Stand to the right of the participant, and use a beam caliper to measure the horizontal distance between the back of the tip of the elbow (olecranon, rear) to the tip of the middle finger (dactylion III). Place the fixed blade on olecranon, rear. Exert only enough pressure to attain contact between the caliper and the skin.

INSTRUMENT: Beam caliper.

CAUTION: Measure to the tip of the finger, not the fingernail.





6.4.42 Functional Leg Length

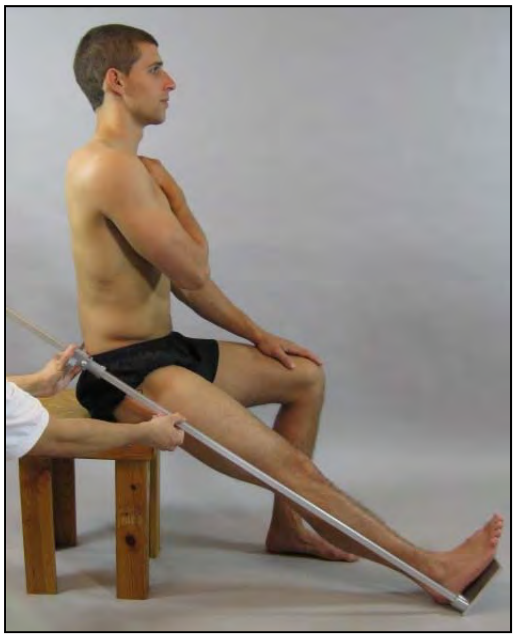
DESCRIPTION: The straight-line distance between the plane of the bottom of the right foot with the leg extended and the back of the body of a seated participant.

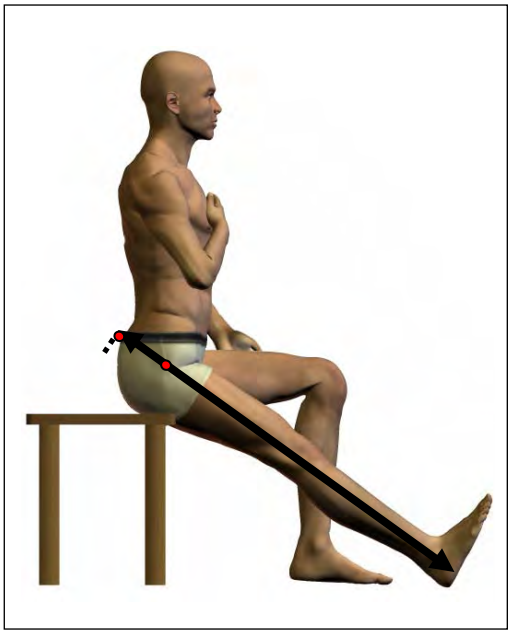
DRAWN LANDMARK: Trochanter.

PROCEDURE: Participant sits erect on the edge of a seat that is approximately 45.8 cm tall with the trochanter 10 cm from the front of the seat, the right leg extended, and the foot on the base plate of an anthropometer, which rests on the floor. The participant bends the left leg approximately 90° to enhance stability. Stand at the right of the participant and measure the straight-line distance between the footrest surface of the base of the anthropometer and the back surface of the body. The shaft of the anthropometer passes over the drawn trochanter landmark. The foot should be in firm contact with the base plate of the anthropometer; the blade should be in light contact with the back.

INSTRUMENT: Anthropometer.

CAUTION: Urge the participant to fully extend the knee. Be sure that the anthropometer is properly aligned with the trochanter landmark. Be sure the participant has his or her hips parallel to the edge of the bench. The computer will subtract 10 mm to eliminate the thickness of the anthropometer base.





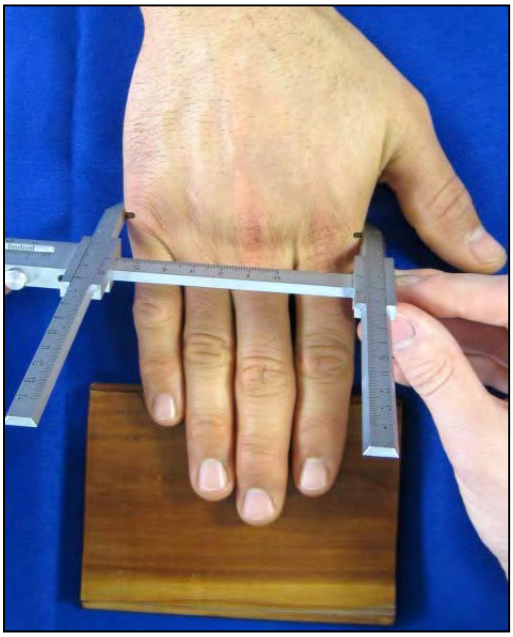
6.4.43 Hand Breadth

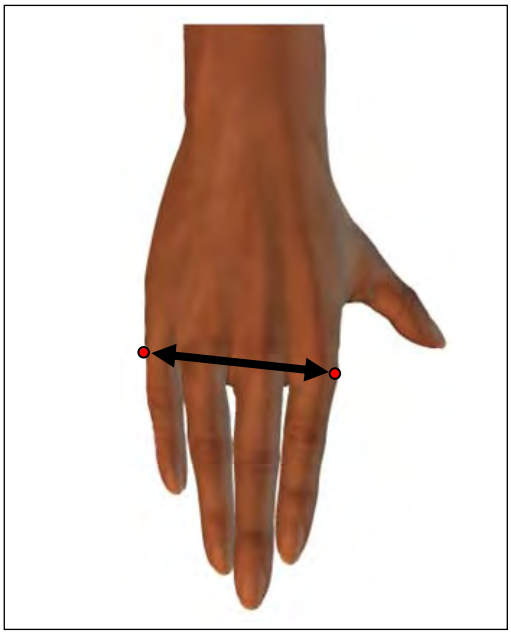
DESCRIPTION: The breadth of the right hand between the landmarks at metacarpale II and metacarpale V.

DRAWN LANDMARKS: Metacarpale II, right; Metacarpale V, right.

PROCEDURE: Participant sits with the palm on a table and the distal phalanges on a flat surface 8 mm higher. The fingers are together, and the thumb is held away from the hand at about a 45° angle. The measurer presses the hand into firm contact with the table and instructs the participant to hold this position. The middle finger is parallel to the long axis of the forearm. Stand in front of the participant, and use a sliding caliper to measure the breadth of the hand between the drawn landmarks at metacarpale II and metacarpale V. Exert only enough pressure to ensure that the caliper blades are on the landmarks.

INSTRUMENT: Sliding caliper.





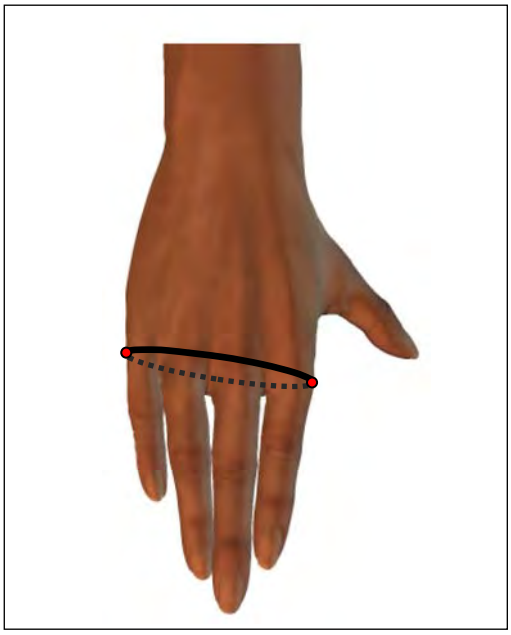
6.4.44 Hand Circumference

DESCRIPTION: The circumference of the right hand encompassing the landmarks metacarpale II and metacarpale V.

DRAWN LANDMARKS: Metacarpale II, right; Metacarpale V, right.

PROCEDURE: Participant sits with the palm on a table and the distal phalanges on a flat surface 8 mm higher. The fingers are together, and the thumb is held away from the hand at about a 45° angle. The measurer presses the hand into firm contact with the table and instructs the participant to hold this position. The middle finger is parallel to the long axis of the forearm. Place the tape under the hand before positioning the participant. Stand in front of the participant, and pass the tape over the drawn landmarks at metacarpale II and metacarpale V to measure the circumference of the hand. Exert only enough tension on the tape to maintain contact between the tape and the skin.

INSTRUMENT: Steel tape.



6.4.45 Hand Length

DESCRIPTION: The length of the right hand between the stylion landmark on the wrist and the tip of the middle finger (dactylion III).

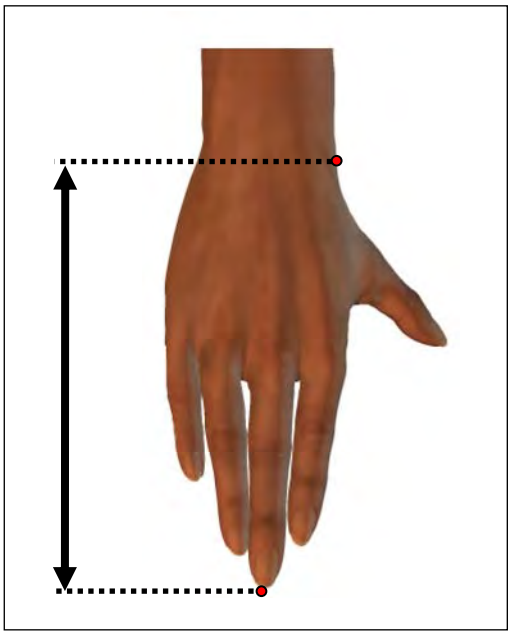
DRAWN LANDMARK: Stylion.

UNDRAWN LANDMARK: Dactylion III, right.

PROCEDURE: Participant sits with the palm on a table and the distal phalanges on a flat surface 8 mm higher. The fingers are together and the thumb is held away from the hand at about a 45° angle. The measurer presses the hand into firm contact with the table and instructs the participant to hold this position. The middle finger is parallel to the long axis of the forearm. Stand at the left of the participant, and use a Poech sliding caliper to measure the length of the hand between the drawn stylion landmark on the wrist and the tip of the middle finger (dactylion III). Place the fixed blade of the caliper on stylion. The beam of the caliper is parallel to the long axis of the arm. Exert only enough pressure to ensure that the tips of the caliper are on the landmarks.

INSTRUMENT: Poech sliding caliper.

CAUTION: Participant must not be allowed to flex or hyperextend. Be sure the measurement is taken at the tip of the finger and not the nail.



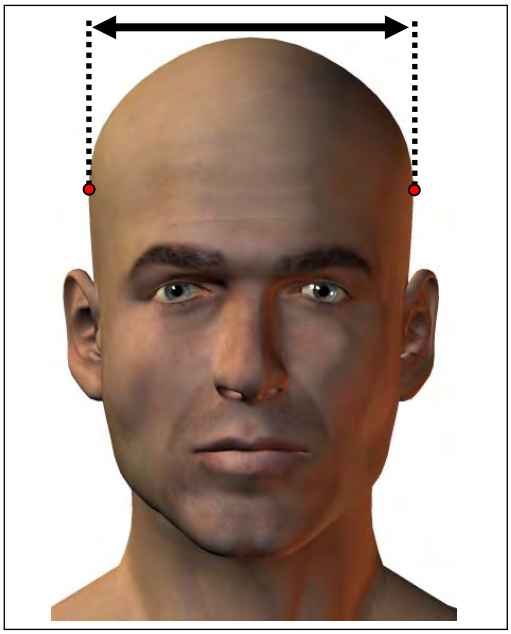
6.4.46 Head Breadth

DESCRIPTION: The maximum horizontal breadth of the head above the ears.

UNDRAWN LANDMARKS: Euryon, right and left.

PROCEDURE: Participant sits. Stand behind the participant, and use a spreading caliper to measure the maximum horizontal breadth of the head above the ears (euryon, right and left). Exert sufficient pressure to obtain contact between the caliper and the skin.

INSTRUMENT: Spreading caliper.



6.4.47 Head Circumference

DESCRIPTION: The maximum circumference of the head above the supraorbital ridges and ears.

PROCEDURE: Participant sits. Stand to the right of the participant, and use a tape to measure the maximum circumference of the head above the attachment of the ears to the head. The bottom of the tape should pass just above the ridges of the eyebrows (supraorbital ridges) and around the back of the head. Use enough tension to compress the hair.

INSTRUMENT: Steel tape.

CAUTION: The plane of the tape will be higher in front than it is in the back but it should not be tilted to either side.

6.4.48 Head Length

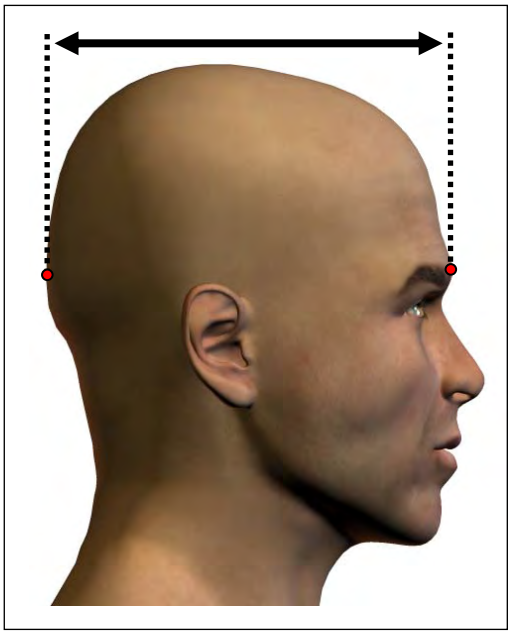
DESCRIPTION: The distance from the glabella landmark between the brow ridges to opisthocranion.

DRAWN LANDMARK: Glabella.

UNDRAWN LANDMARK: Opisthocranion.

PROCEDURE: Participant sits. Stand at the right of the participant. Use a spreading caliper to measure in the midsagittal plane, the distance between the glabella landmark and opisthocranion. Place one tip of the caliper on glabella, and move the other tip up and down on the back of the head in the midsagittal plane until the maximum measurement is obtained. Use light pressure on glabella and enough pressure on opisthocranion to compress the hair.

INSTRUMENT: Spreading caliper.



6.4.49 Heel-Ankle Circumference

DESCRIPTION: The circumference of the right foot encompassing the right ankle and base of the heel.

DRAWN LANDMARK: Dorsal juncture of the foot and leg, right.

PROCEDURE: Participant stands on a table with the feet about 10 cm apart and the weight distributed equally on both feet. Stand in front of the participant, and use a tape to measure the circumference of the foot at the ankle and base of the heel. The tape passes over the point at which the heel first contacts the table and over the drawn landmark at the front of the ankle (dorsal juncture of the foot and leg). The tape spans hollows of the foot. Exert only enough tension to maintain contact between the tape and the skin.

INSTRUMENT: Steel tape.

CAUTION: The tape may be held at the base of the heel to prevent its slipping during the measurement.

6.4.50 Heel Breadth

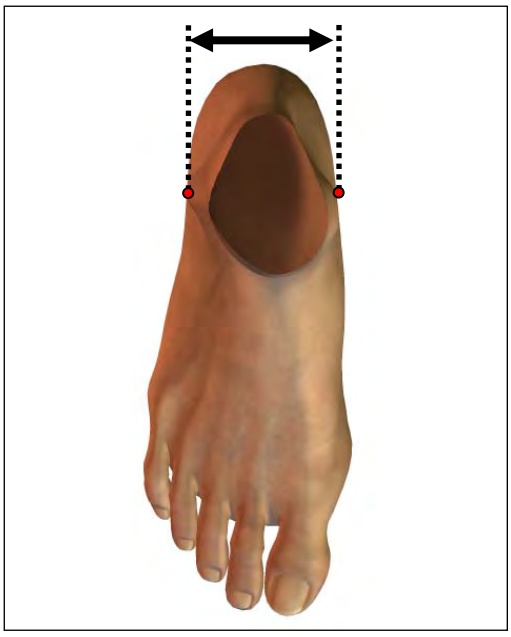
DESCRIPTION: The maximum horizontal distance between the medial and lateral points on the inside and outside of the right heel, at or posterior to the lateral malleolus landmark.

UNDRAWN LANDMARKS: Heel point, lateral and medial.

PROCEDURE: Participant stands on a table with the weight distributed equally on both feet. The feet are spread apart about 10 cm and are parallel. Stand behind the participant, and use a Holtain caliper to measure the maximum horizontal distance between the medial and lateral points on the inside and outside of the heel. The measurement is taken just above the level of the table at the most protruding points of the curvature of the heel. Hold the caliper so that the fixed blade is on the medial heel point on the inside of the heel and parallel to the medial side of the foot. Exert only enough pressure to ensure that the caliper blades are on the heel points.

INSTRUMENT: Holtain caliper.

CAUTION: Some participants will not exhibit medial and lateral heel points. For these participants, measure the breadth of the heel at the level of the most protruding point of the lateral malleolus.



6.4.51 Hip Breadth

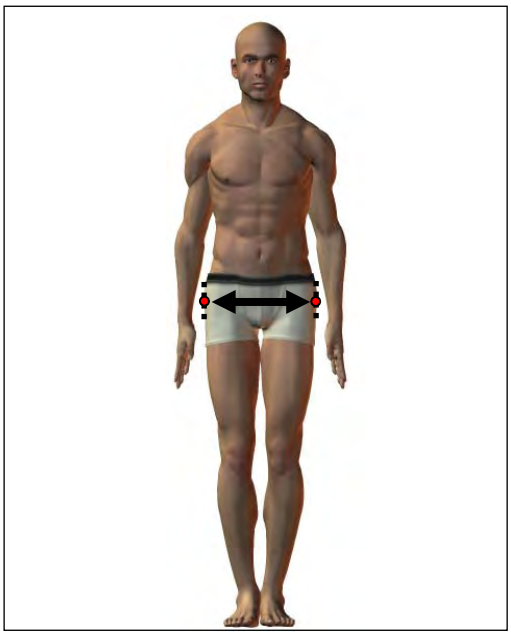
DESCRIPTION: The horizontal distance between the lateral buttock landmarks on the sides of the hips.

DRAWN LANDMARKS: Buttock point, right lateral and left lateral.

PROCEDURE: Participant is in the anthropometric standing position with the arms held slightly away from the body. Stand in front of the participant, and use a beam caliper to measure the horizontal distance between the drawn lateral buttock landmarks. If necessary, have the participant hold the sides of the shorts above the landmarks. Exert only enough pressure to ensure that the caliper blades are on the hips.

INSTRUMENT: Beam caliper.

CAUTION: Make sure participants do not pull soft tissue when they hold up their shorts.



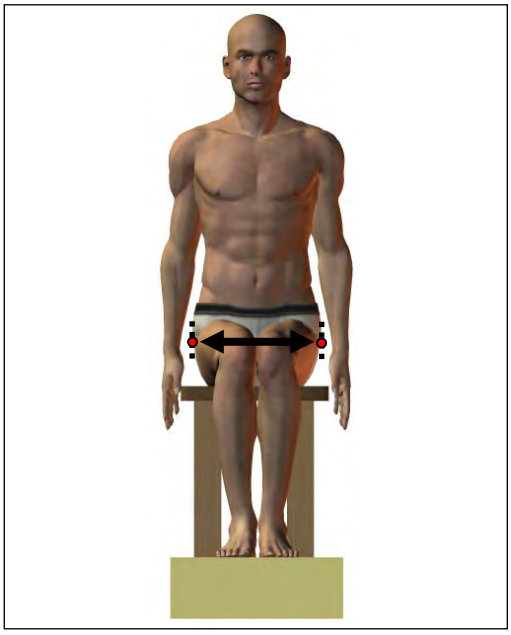
6.4.52 Hip Breadth, Sitting

DESCRIPTION: Maximum hip (or thigh) breadth of a seated participant.

PROCEDURE: Participant sits erect with the feet and knees together and the arms relaxed at the sides. Stand in front of the participant, and use a beam caliper to measure the most lateral points on the hips or thighs (whichever are broader). The blades of the caliper are kept at approximately a 45° angle to the horizontal and moved up and down to locate the maximum breadth. Exert only enough pressure to ensure that the caliper blades are on the body.

INSTRUMENT: Beam caliper.

CAUTION: The recorder should help the participant hold the knees together. Make sure the participant's torso is still erect immediately prior to taking the measurement.



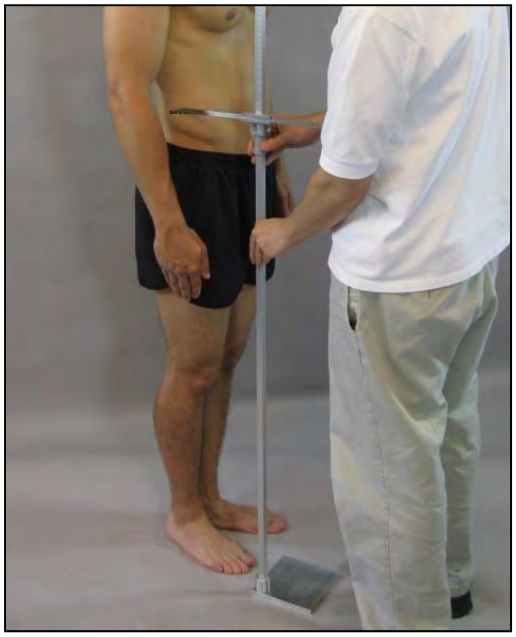
6.4.53 Iliocristale Height

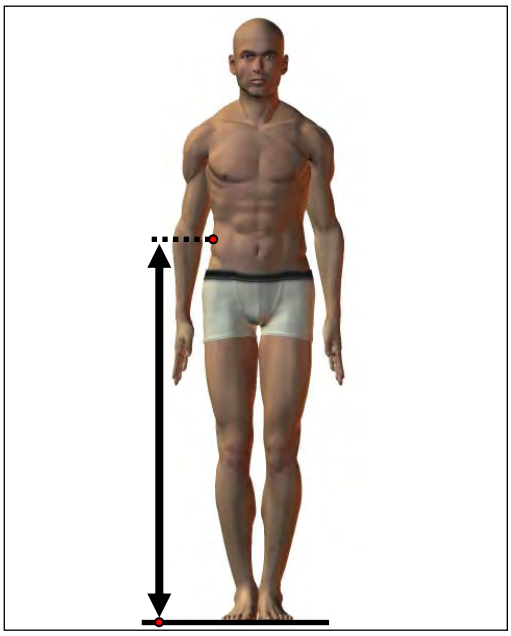
DESCRIPTION: The vertical distance between a standing surface and the iliocristale landmark on the right side of the pelvis.

DRAWN LANDMARK: Iliocristale, right.

PROCEDURE: Participant is in the anthropometric standing position. Stand in front of the participant, and use an anthropometer to measure the vertical distance between the standing surface and the drawn iliocristale landmark on the right side of the pelvis.

INSTRUMENT: Anthropometer.





6.4.54 Interpupillary Breadth

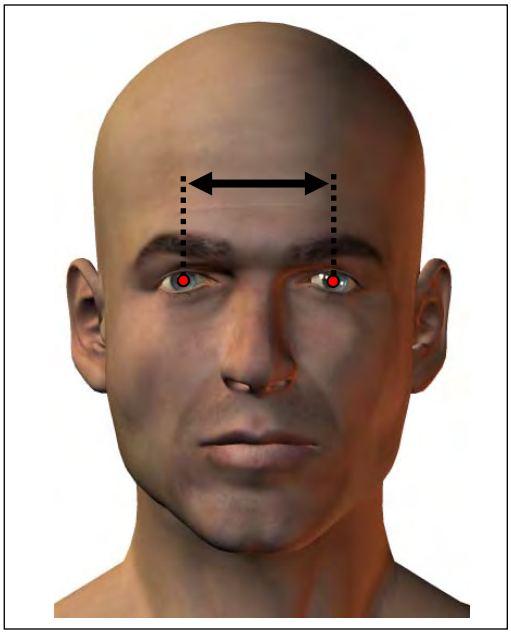
DESCRIPTION: The distance between the centers of the right and left pupils.

UNDRAWN LANDMARKS: Center of pupil, right and left.

PROCEDURE: Participant sits. Stand in front of the participant, and use a pupillometer to measure the distance between the two pupils. Move the lever on the top of the device all the way to the right. Ask the participant to look into the pupillometer, and focus on the light. Look into the other end of the device, and move the right vertical hairline to the point at which it passes through the center of the pupil of the right eye. Move the lever all the way to the left, and repeat the process for the other pupil. Remove the device from the participant's face, and read the measurement from the middle of the three scales on the bottom of the pupillometer.

INSTRUMENT: Pupillometer.

CAUTION: Be certain that the dial is always set on infinity (∞).



6.4.55 Interscye l

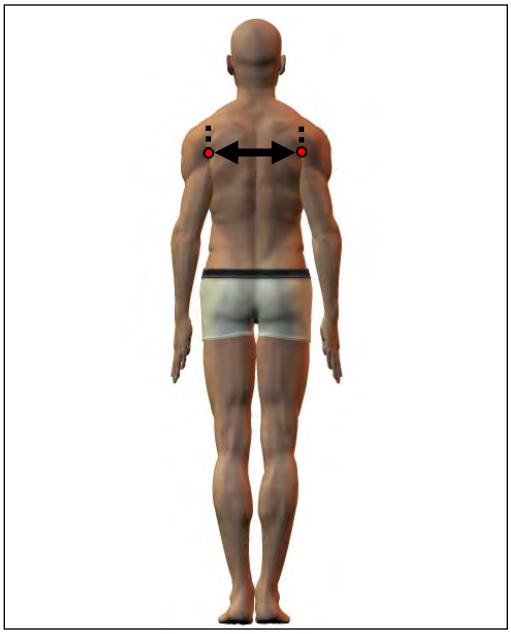
DESCRIPTION: The distance across the back between the right and left posterior axillary fold landmarks.

DRAWN LANDMARKS: Axillary fold, right posterior and left posterior.

PROCEDURE: Participant is in the anthropometric standing position. Stand behind the participant, and use a tape to measure the distance between the top of the right posterior axillary fold and the top of the left posterior axillary fold (where the arms join the torso). The tape is held on the skin surface except where it spans the hollow of the back. Be sure the tape goes across the back in a straight line and does not arch up over the shoulder blades. The measurement is taken at the maximum point of quiet respiration.

INSTRUMENT: Steel tape.

CAUTION: The participant must not be allowed to change the position of the shoulders.



6.4.56 Interscye II

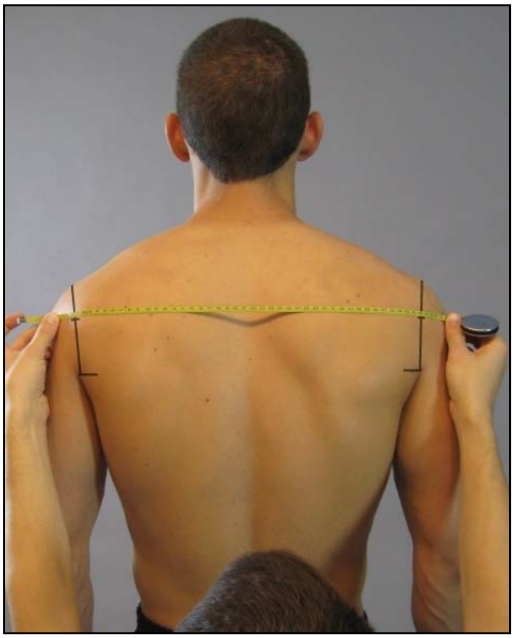
DESCRIPTION: The distance across the back between the right and left midscye landmarks.

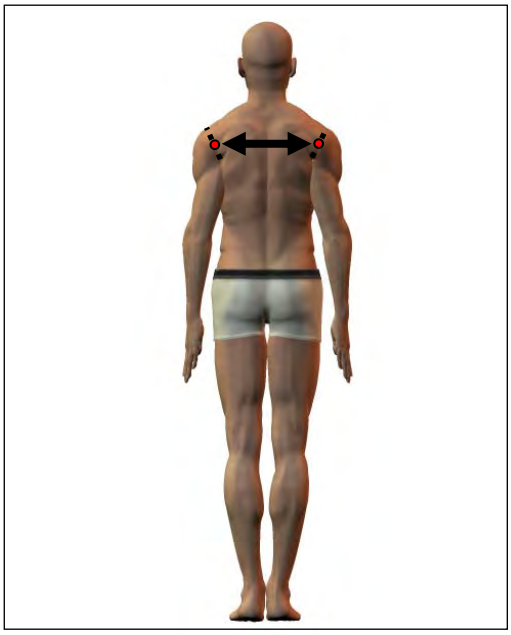
DRAWN LANDMARKS: Midscye, right and left.

PROCEDURE: Participant is in the anthropometric standing position. Stand behind the participant, and use a tape to measure the distance between the drawn right and left midscye landmarks**.** The tape is held on the skin except where it spans the hollows of the back. Be sure the tape goes across the back in a straight line and does not arch up over the shoulder blades. The measurement is taken at the maximum point of quiet respiration.

INSTRUMENT: Steel tape.

CAUTION: The participant must not be allowed to change the position of the shoulders.





6.4.57 Knee Height, Midpatella

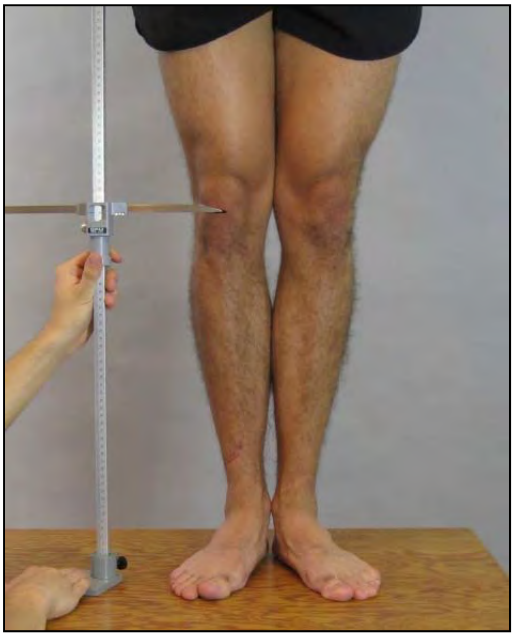
DESCRIPTION: The vertical distance between a standing surface and the midpatella landmark.

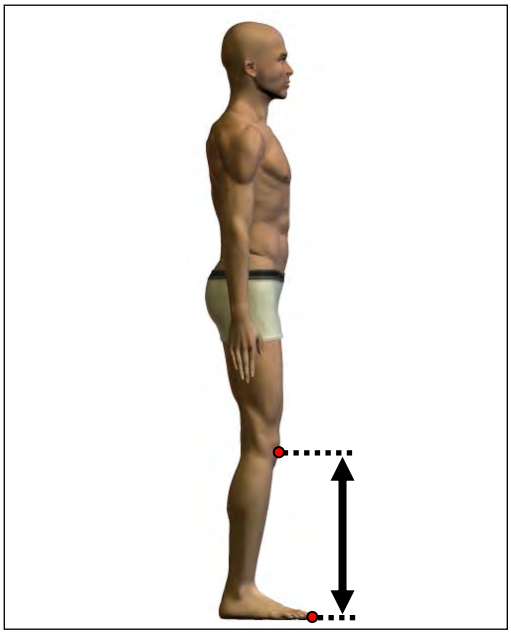
DRAWN LANDMARK: Midpatella, right.

PROCEDURE: Participant stands erect on a table with the heels together and the weight distributed equally on both feet. Stand at the right of the participant, and use an anthropometer to measure the vertical distance between the standing surface and the drawn midpatella landmark at the center of the knee.

INSTRUMENT: Anthropometer.

CAUTION: Participants will tend to lock their knees. If participants have difficulty keeping the knee loose, firmly grasp the thigh a few inches above the knee for a moment. This will induce relaxation of the patella, which is necessary for this measurement.





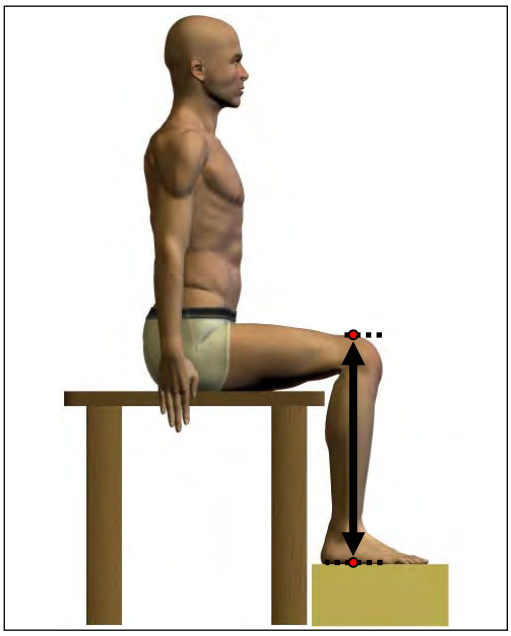
6.4.58 Knee Height, Sitting

DESCRIPTION: The vertical distance between a footrest surface and the suprapatella landmark.

DRAWN LANDMARK: Suprapatella, right.

PROCEDURE: Participant sits with the thighs parallel, the knees flexed 90°, and the feet in line with the thighs. The arms are relaxed at the sides. Stand at the right of the participant, and use an anthropometer to measure the vertical distance between the footrest and the drawn suprapatella landmark at the top of the knee.

INSTRUMENT: Anthropometer.



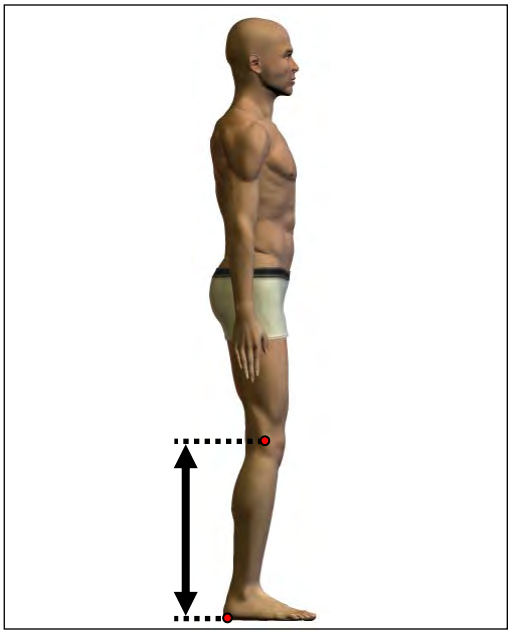
6.4.59 Lateral Femoral Epicondyle Height

DESCRIPTION: The vertical distance between a standing surface and the standing lateral femoral epicondyle landmark.

DRAWN LANDMARK: Lateral femoral epicondyle, standing, right.

PROCEDURE: Participant stands erect on a table with the heels together and the weight distributed equally on both feet. Stand at the right side of the participant, and use an anthropometer to measure the vertical distance between the standing surface and the marked standing lateral femoral epicondyle landmark on the outside of the knee.

INSTRUMENT: Anthropometer.



6.4.60 Lateral Malleolus Height

DESCRIPTION: The vertical distance between a standing surface and the lateral malleolus landmark.

DRAWN LANDMARK: Lateral malleolus, right.

PROCEDURE: Participant stands erect on a table with the heels together and the weight distributed equally on both feet. Stand at the right of the participant, and use a height gauge to measure the vertical distance between the standing surface and the drawn lateral malleolus landmark on the outside of the right ankle.

INSTRUMENT: Modified height gauge.

CAUTION: The measurer's eyes must be at the level of the blade or the gauge.

6.4.61 Lower Thigh Circumference

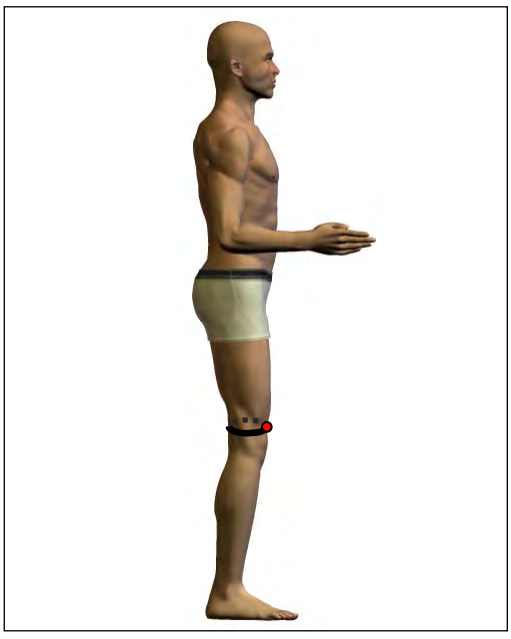
DESCRIPTION: The horizontal circumference of the right thigh at the level of the suprapatella landmark.

DRAWN LANDMARK: Suprapatella, right.

PROCEDURE: Participant stands erect on a table with the feet about 10 cm apart and the weight distributed equally on both feet. Stand at the right of the participant, and use a tape to measure the horizontal circumference of the thigh at the level of the suprapatella landmark at the top of the knee. The bottom of the tape follows the top of the landmark. Exert only enough tension on the tape to maintain contact between the tape and the skin.

INSTRUMENT: Steel tape.

CAUTION: Participants will tend to lock their knees. If participants have difficulty keeping the knee loose, firmly grasp the thigh a few inches above the knee for a moment. This will induce relaxation of the patella which is necessary for this measurement.



6.4.62 Menton-Sellion Length

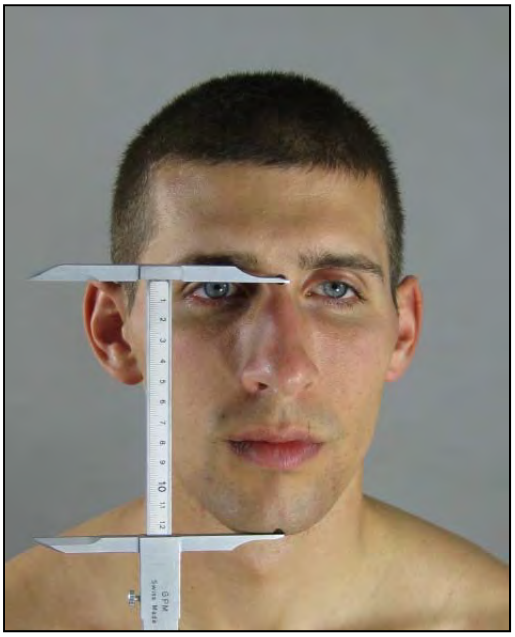
DESCRIPTION: The distance between the menton landmark and the sellion landmark in the midsagittal plane.

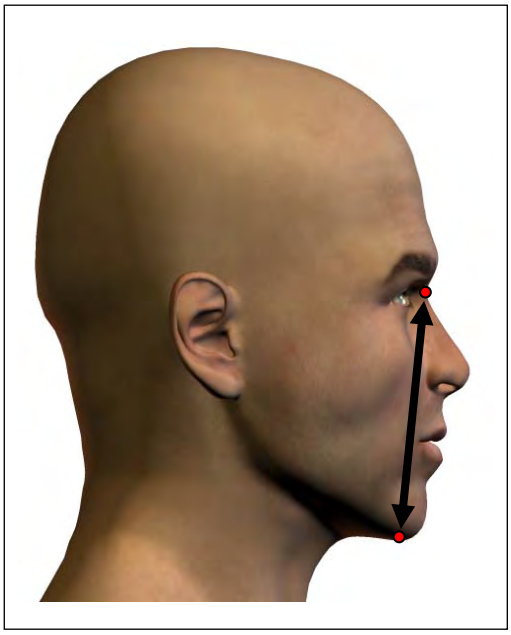
DRAWN LANDMARKS: Menton; Sellion.

PROCEDURE: Participant sits. The teeth are together, but not clenched. Stand toward the right of the participant, and use a sliding caliper to measure, in the midsagittal plane, the distance between the drawn menton landmark at the bottom of the chin and the drawn sellion landmark at the deepest point of the nasal root depression. Place the fixed blade of the caliper on sellion**.** Exert only enough pressure to attain contact between the caliper and the skin.

INSTRUMENT: Sliding caliper.

CAUTION: Be sure that the participant's teeth are together (lightly occluded) during the measurement.





6.4.63 Neck Circumference

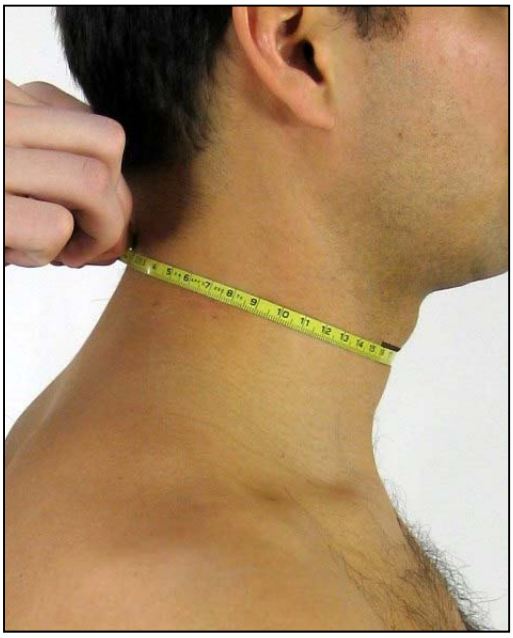
DESCRIPTION: The circumference of the neck at the level of the infrathyroid landmark (Adam's apple).

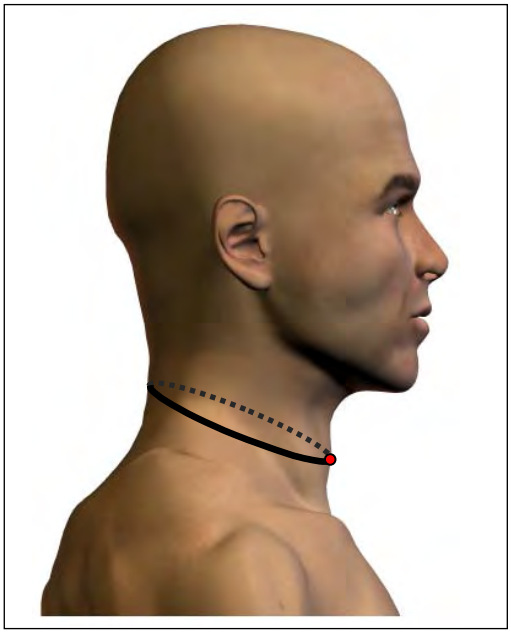
DRAWN LANDMARK: Infrathyroid.

PROCEDURE: Participant is in the anthropometric standing position with the head in the Frankfurt plane. Stand at the right of the participant, and use a tape to measure the circumference of the neck at the level of the drawn infrathyroid landmark. The plane of the measurement is perpendicular to the long axis of the neck. Exert only enough tension on the tape to maintain contact between the tape and the skin.

INSTRUMENT: Steel tape.

CAUTION: Be sure that the participant's head is in the Frankfurt plane.





6.4.64 Neck Circumference, Base

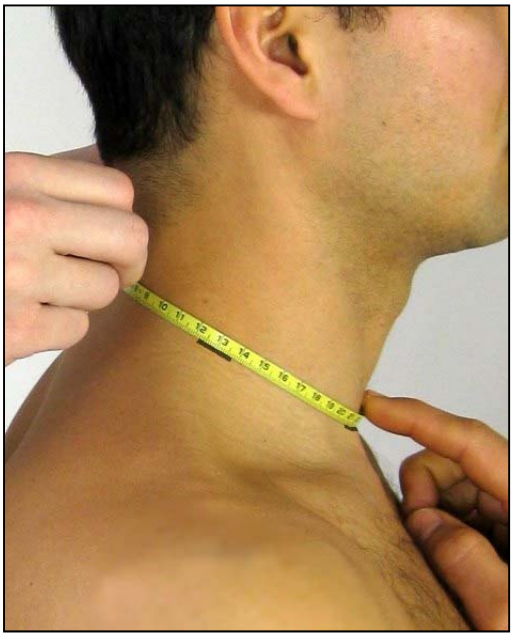
DESCRIPTION: The circumference of the base of the neck encompassing the lateral neck and anterior neck landmarks.

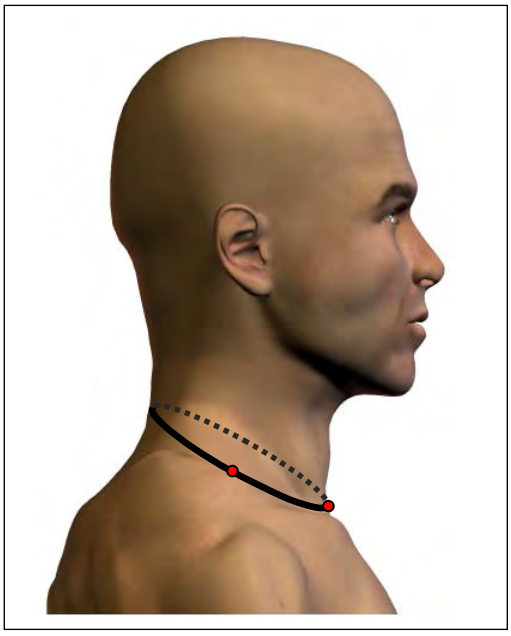
DRAWN LANDMARKS: Neck, anterior, right lateral, and left lateral.

PROCEDURE: Participant is in the anthropometric standing position with the head in the Frankfurt plane. Stand behind the participant, and use a tape to measure the circumference of the base of the neck. The tape passes over the drawn lateral and anterior neck landmarks. Exert only enough tension on the tape to maintain contact between the tape and the skin. The participant will hold the tape on the anterior neck landmark.

INSTRUMENT: Steel tape.

CAUTION: Be sure that the participant's head is in the Frankfurt plane.





6.4.65 Overhead Fingertip Reach, Sitting

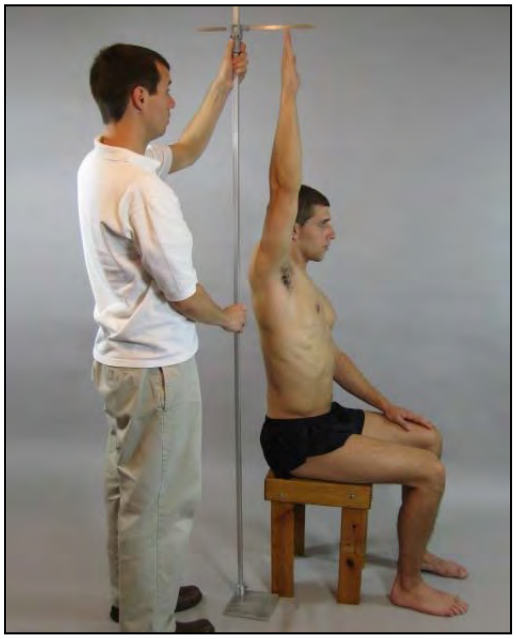
DESCRIPTION: The vertical distance between a sitting surface and the tip of the right middle finger of a seated participant whose arm is extended overhead.

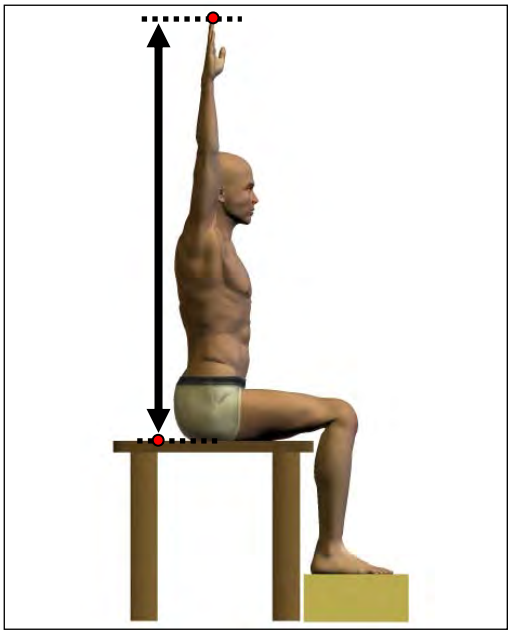
UNDRAWN LANDMARK: Dactylion III, right.

PROCEDURE: Participant sits erect on a flat surface with the right arm, hand extended vertically overhead as far as possible, and the palm of the hand facing forward. Grasp the participant's wrist to guide the arm into a vertical position. Some participants will not be able to fully extend the arm into this position without discomfort. In these cases, do not force the arm any higher than it can comfortably go without changing the position of the torso. Stand at the right of the participant, and use an anthropometer to measure the distance between the floor and the tip of the middle finger (dactylion III). The computer will subtract the height of the seat from this measurement. The measurement is made at the maximum point of quiet respiration.

INSTRUMENT: Anthropometer.

CAUTION: Do not permit the participant to hyperextend the wrist. Women, in particular, will tend to do this.





6.4.66 Palm Length

DESCRIPTION: The distance between the center of the crease at the base of the middle finger (digit III, base) and the ventral stylion landmark on the right wrist.

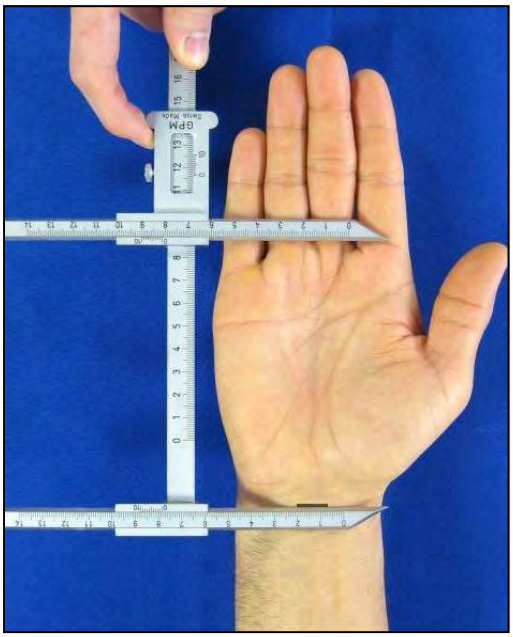
DRAWN LANDMARK: Ventral stylion.

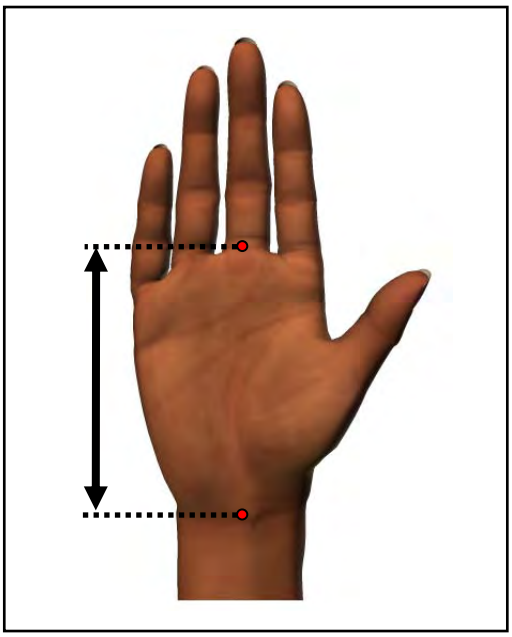
UNDRAWN LANDMARK: Digit III, base.

PROCEDURE: The participant holds the right forearm horizontal with the hand straight, palm up. The fingers are together, and the thumb is abducted approximately 45°. The middle finger is parallel to the long axis of the forearm. Stand at the left of the participant, and use a Poech sliding caliper to measure the perpendicular distance between the center of the crease at the base of the finger (digit III, base) and the ventral stylion landmark on the wrist. Place the fixed blade of the caliper at the base of the finger. The beam of the caliper is parallel to the long axis of the arm.

INSTRUMENT: Poech sliding caliper.

CAUTION: Participant must not be allowed to flex or hyperextend the fingers or the hand. If there are multiple creases at the base of digit III, choose the most proximal crease.





6.4.67 Popliteal Height

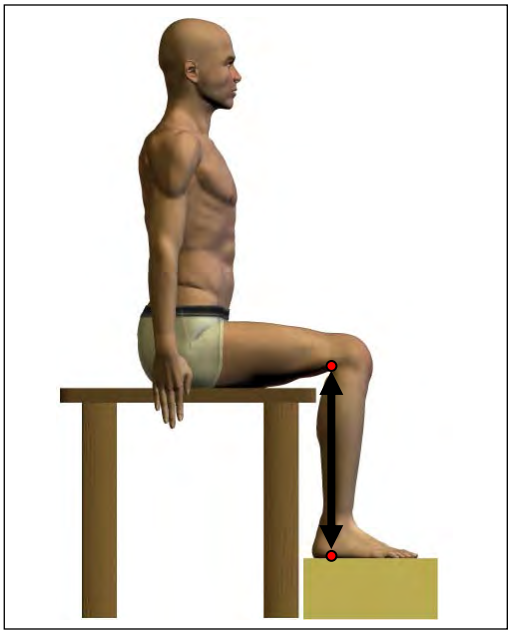
DESCRIPTION: The vertical distance from a footrest to the back of the right knee (the popliteal fossa at the dorsal juncture of the calf and thigh).

UNDRAWN LANDMARK: Popliteal fossa at the dorsal juncture of the calf and thigh.

PROCEDURE: Participant sits with the thighs parallel, the knees flexed 90°. The feet are in line with the thighs, and the arms are relaxed at the sides. Stand to the right of the participant, and use an anthropometer to measure the distance between the footrest surface and the bottom surface of the thigh just behind the knee (dorsal juncture of the calf and thigh).

INSTRUMENT: Anthropometer.

CAUTION: Take care that the blade of the anthropometer does not compress the thigh tissue (compressing the calf is OK). Be sure the knees are in the proper position. The computer will add 1 cm to this measurement to account for the width of the anthropometer blade.



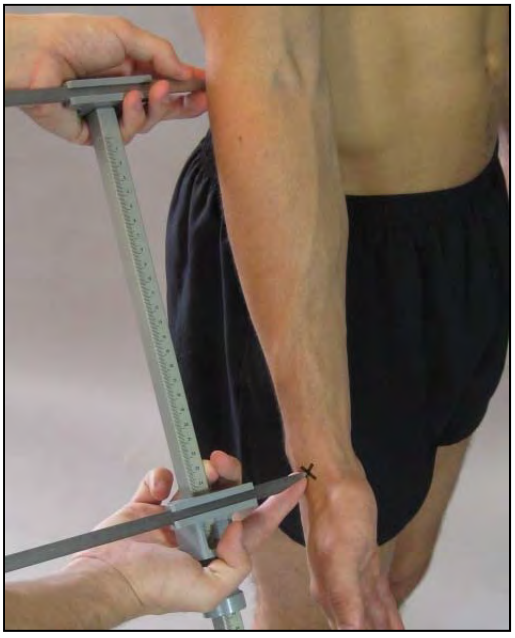
6.4.68 Radiale-Stylion Length

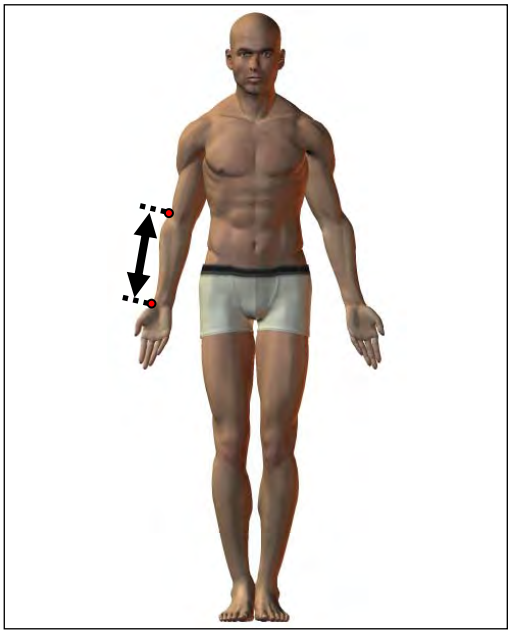
DESCRIPTION: The distance between the radiale landmark on the right elbow and the stylion landmark on the right wrist.

DRAWN LANDMARKS: Radiale; Stylion.

PROCEDURE: Participant stands with the arms relaxed at the sides and the right palm facing forward. Stand at the right of the participant and use a beam caliper to measure the distance between the drawn radiale landmark on the elbow and the drawn stylion landmark on the wrist. Be sure that the beam of the caliper is parallel to the long axis of the arm. Place the fixed blade on radiale**.** Exert only enough pressure to attain contact between the caliper and the skin.

INSTRUMENT: Beam caliper.





6.4.69 Shoulder Circumference

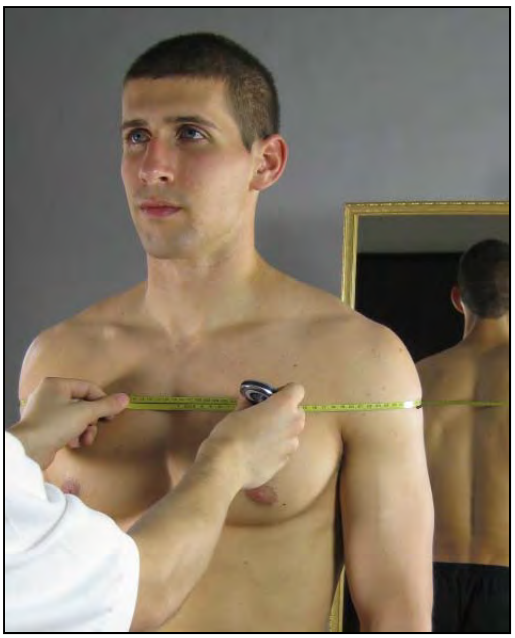
DESCRIPTION: The circumference of the shoulders at the level of the midpoints of the right and left deltoid muscles.

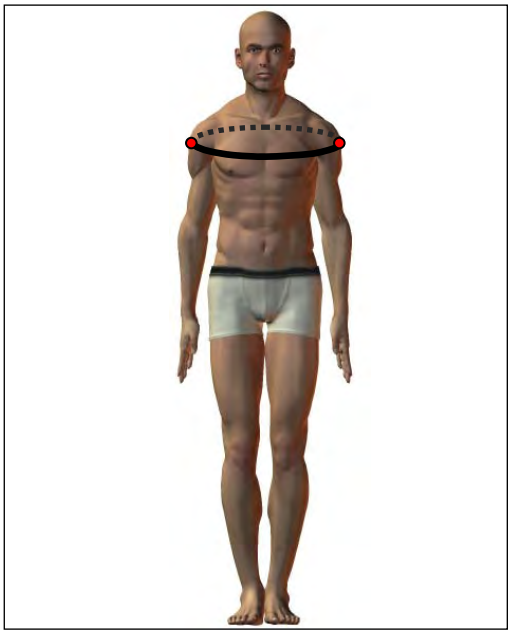
DRAWN LANDMARKS: Deltoid point, right and left.

PROCEDURE: Participant is in the anthropometric standing position with his/her back to a mirror. Stand in front of the participant, and use a tape to measure the circumference of the shoulders at the level of deltoid landmarks. Use the mirror to check the position of the tape as it crosses the participant's back. The tape will pass over the drawn right and left deltoid point landmarks. Exert only enough tension on the tape to maintain contact between the tape and the skin. The measurement is taken at the maximum point of quiet respiration.

INSTRUMENT: Steel tape.

CAUTION: As the level of the two shoulders is often slightly different, this measurement may not always be horizontal.





6.4.70 Shoulder-Elbow Length

DESCRIPTION: The distance between the right acromion landmark and the olecranon landmark on the bottom of the right elbow.

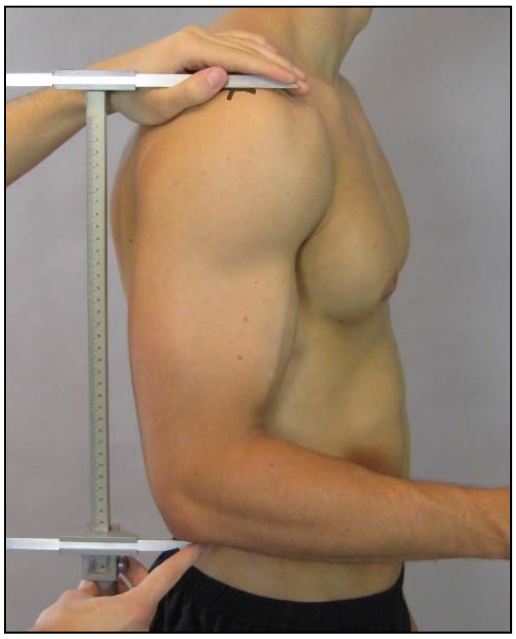
DRAWN LANDMARK: Acromion, right

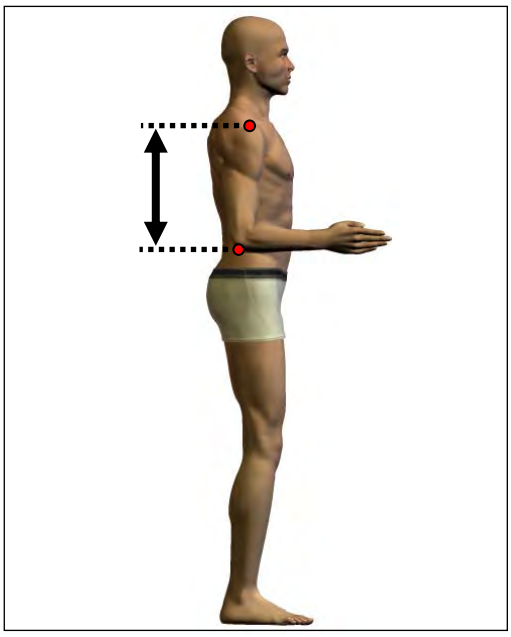
UNDRAWN LANDMARK: Olecranon, bottom.

PROCEDURE: Participant stands erect with the upper arm hanging at the side and the elbow flexed 90°. The hand is straight, and the palm faces inward (medially). Stand at the right of the participant, and use a beam caliper to measure the distance between the drawn acromion landmark on the tip of the shoulder and the bottom of the elbow (olecranon, bottom). The measurement is made parallel to the long axis of the upper arm. Place the fixed blade of the caliper on acromion. Exert only enough pressure to attain contact between the caliper and the skin.

INSTRUMENT: Beam caliper.

CAUTION: Be sure that the zero edge of the blade of the caliper is on acromion when the measurement is made and that the skin is not distorted.





6.4.71 Shoulder Length

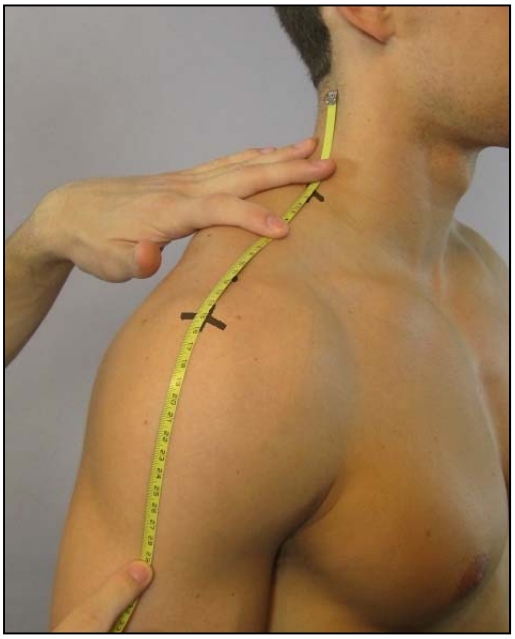
DESCRIPTION: The surface distance between the trapezius landmark and the acromion landmark on the right shoulder.

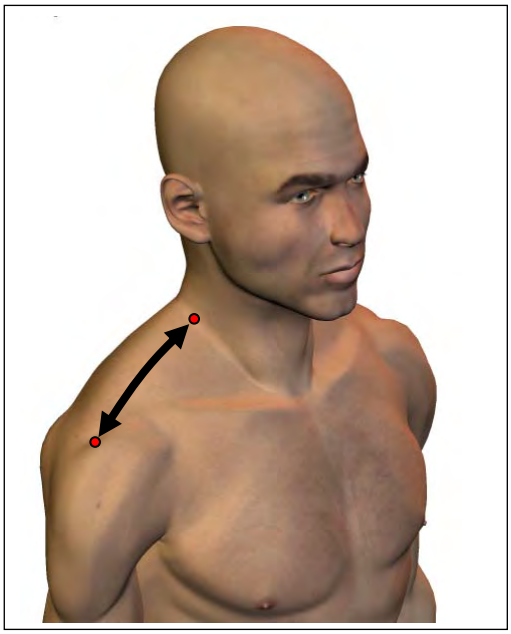
DRAWN LANDMARKS: Trapezius point, right; Acromion, right.

PROCEDURE: Participant is in the anthropometric standing position. Stand at the right of the participant, and use a tape to measure the surface distance between the drawn trapezius point landmark at the base of the neck and the drawn acromion landmark on the outer border of the shoulder. The zero end of the tape is on the trapezius point**.**

INSTRUMENT: Steel tape.

CAUTION: The participant must not be allowed to change the position of the shoulders.





6.4.72 Sitting Height

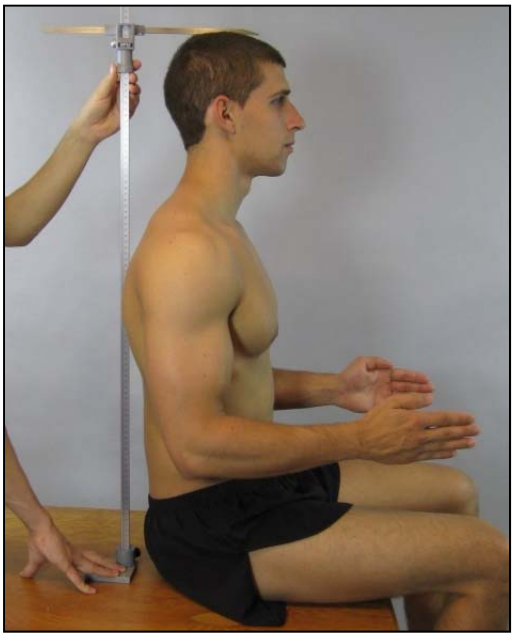
DESCRIPTION: The vertical distance between a sitting surface and the top of the head.

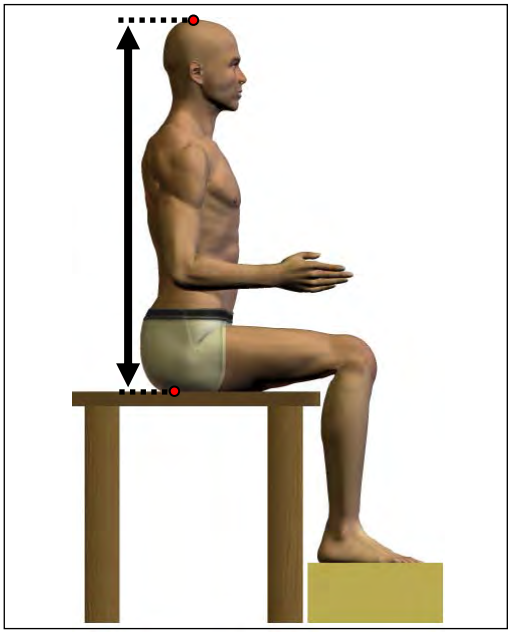
UNDRAWN LANDMARK: Top of head (vertex).

PROCEDURE: Participant is in the anthropometric sitting position with the head in the Frankfurt plane. Stand at the right rear of the participant, and use an anthropometer to measure the vertical distance between the sitting surface and the top of the head. Use sufficient pressure to compress the hair. The measurement is made at the maximum point of quiet respiration.

INSTRUMENT: Anthropometer.

CAUTION: Be sure the head is in the Frankfurt plane.





6.4.73 Sleeve Length: Spine-Wrist

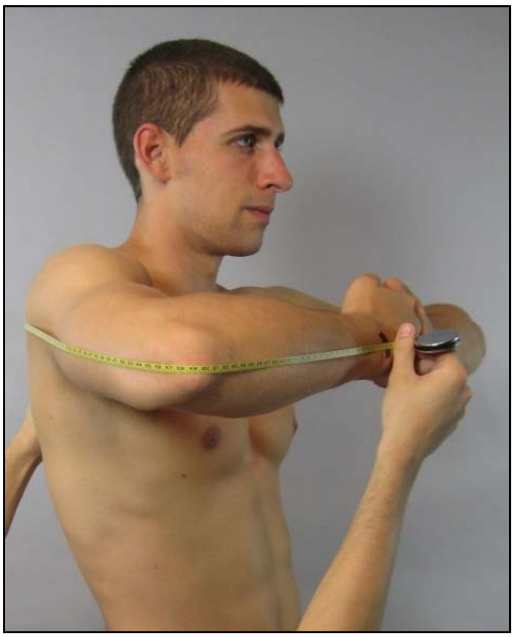
DESCRIPTION: The horizontal distance from the midspine landmark, across the olecranon, center, landmark to the dorsal wrist landmark.

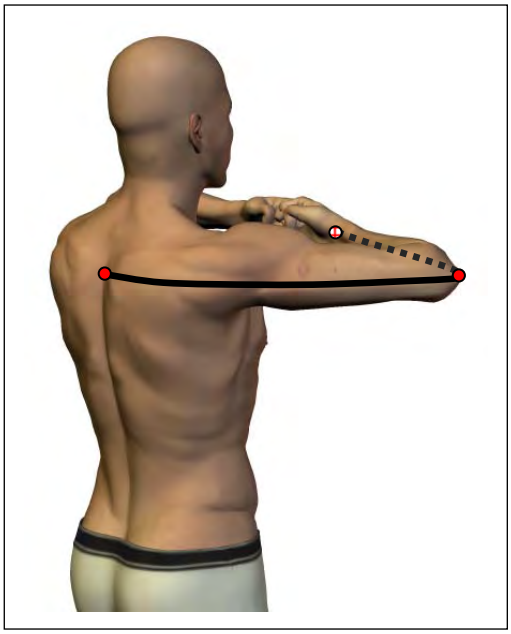
DRAWN LANDMARKS: Midspine; Dorsal stylion; Olecranon, center.

PROCEDURE: Participant makes fists and brings them together in such a way that the metacarpophalangeal and proximal interphalangeal knuckles are touching. With the dorsal surfaces of the joined hands facing outward and the palmar sides facing inwards, the participant raises the arms until they are in a horizontal position parallel to the standing surface. The forearms and fists are in a straight line. Stand at the right of the participant, and use a tape to measure the horizontal surface distance between the midpoint of the spine (drawn midspine landmark) and the drawn dorsal stylion landmark. The tape passes over the olecranon, center landmark at the tip of the elbow. Place the zero point of the tape on the midspine landmark, and be sure the tape lies on the surface of the skin for the measurement.

INSTRUMENT: Steel tape.

CAUTION: The shoulders are relaxed, and the participant must not be allowed to change the position of the shoulders and arms. Be sure the zero point of the tape is on the midspine landmark when the measurement is made.





6.4.74 Sleeve Outseam

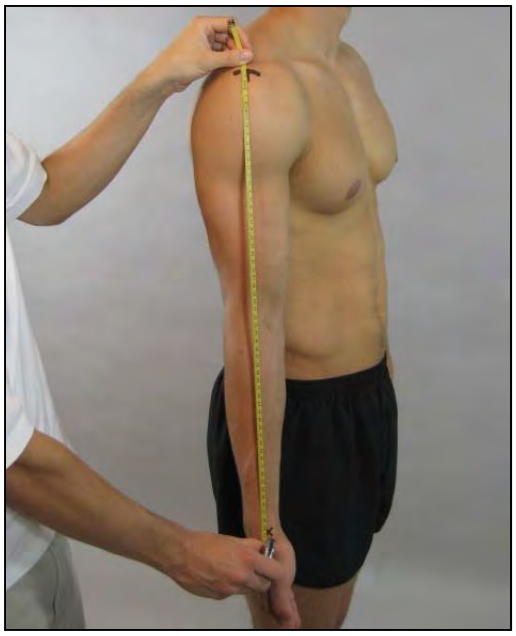
DESCRIPTION: The distance between the acromion landmark on the tip of the right shoulder and the stylion landmark.

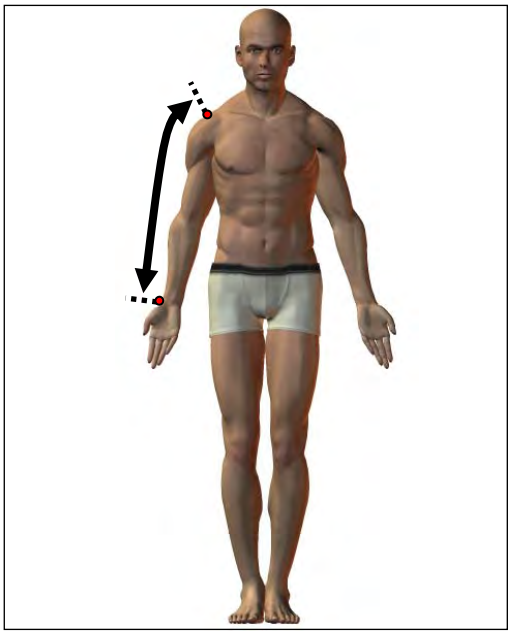
DRAWN LANDMARKS: Acromion, right; Stylion.

PROCEDURE: Participant stands erect with both arms straight and the palms facing forward. The elbows lightly touch the sides of the body. Stand at the right of the participant, and use a tape to measure the straight-line distance between the acromion landmark and the stylion landmark. The tape follows the surface of the shoulder and deltoid muscle, but will span body hollows as it moves down the arm. Be sure the zero point of the tape is on the acromion landmark.

INSTRUMENT: Tape.

CAUTION: Take care not to distort the skin at the shoulder.





6.4.75 Span

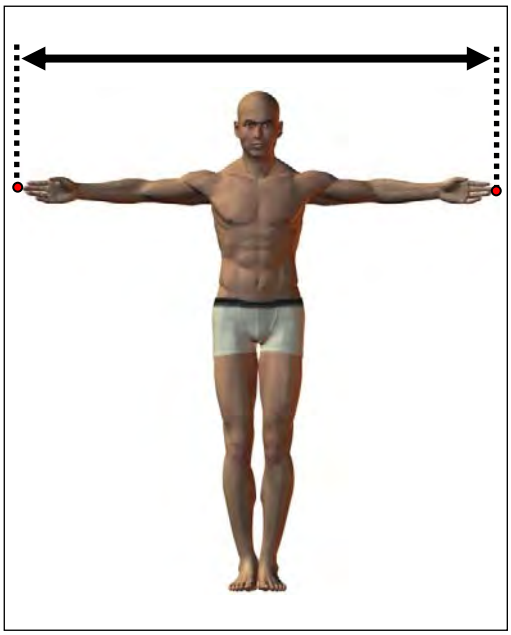
DESCRIPTION: The distance between the tips of the middle fingers of horizontally outstretched arms.

UNDRAWN LANDMARKS: Dactylion III, right and left.

PROCEDURE: Participant stands erect with the back against a wall-mounted scale and the feet together. Both arms and hands are stretched horizontally against the back wall with the palms facing outward and the tip of the third finger of one hand just touching a side wall. Stand near the hand of the participant opposite the side wall. Use a block to establish, on the wall-mounted scale, the distance between the side wall and the tip of the middle finger (dactylion III). The participant's middle fingers are in light contact with the side wall on one side and the block on the other. The measurement is taken at the maximum point of quiet respiration.

INSTRUMENTS: Wall chart; Block.

CAUTION: Urge the participant to stretch the arms laterally as much as possible. Check that the arms remain in the required position. On very muscular individuals or individuals with a larger upper torso, the arms may not necessarily be against the wall.



6.4.76 Stature

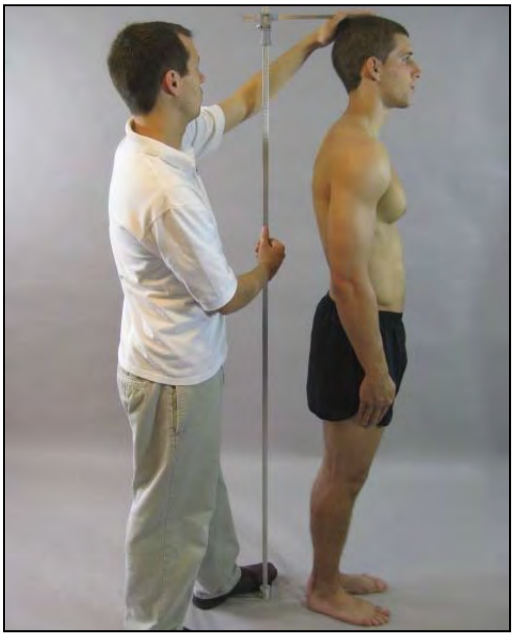
DESCRIPTION: The vertical distance from a standing surface to the top of the head.

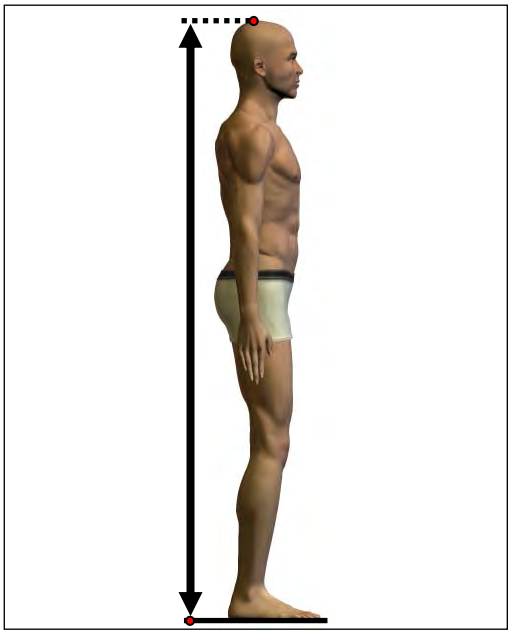
UNDRAWN LANDMARK: Top of head (vertex).

PROCEDURE: Participant is in the anthropometric standing position with the head in the Frankfurt plane. Stand at one side of the participant, and use an anthropometer to measure the vertical distance between the standing surface and the top of the head. Move the blade of the anthropometer across the top of the head to ensure measurement of the maximum distance. Use firm pressure to compress the participant's hair. The measurement is taken at the maximum point of quiet respiration.

INSTRUMENT: Anthropometer.

CAUTION: Be sure that the head is in the Frankfurt plane.





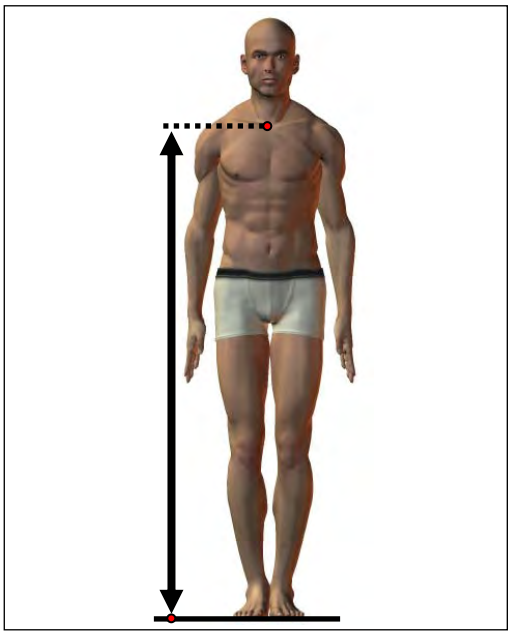
6.4.77 Suprasternale Height

DESCRIPTION: The vertical distance between a standing surface and the suprasternale landmark.

DRAWN LANDMARK: Suprasternale, right.

PROCEDURE: Participant is in the anthropometric standing position. Stand in front of the participant, and use an anthropometer to measure the vertical distance between the standing surface and the drawn suprasternale landmark at the lowest point of the notch at the top of the breastbone. The measurement is made at the maximum point of quiet respiration. Measurer may wish to place one foot on the anthropometer base to stabilize.

INSTRUMENT: Anthropometer.



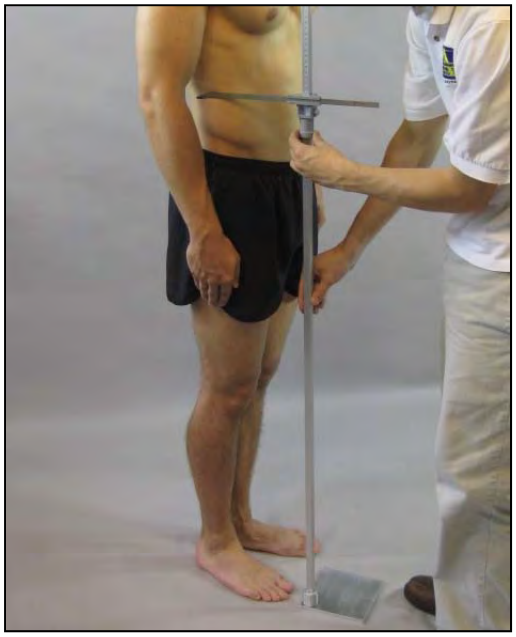
6.4.78 Tenth Rib Height

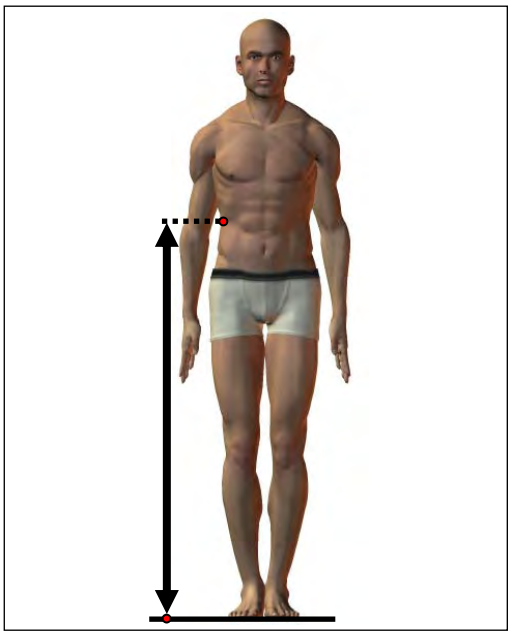
DESCRIPTION: The vertical distance between a standing surface and the tenth rib landmark.

DRAWN LANDMARK: Tenth rib, right.

PROCEDURE: Participant is in the anthropometric standing position. Stand in front of the participant, and use an anthropometer to measure the vertical distance between the standing surface and the drawn tenth rib landmark at the bottom of the rib cage. The measurement is made at the maximum point of quiet respiration.

INSTRUMENT: Anthropometer.





6.4.79 Thigh Circumference

DESCRIPTION: The circumference of the thigh at its juncture with the buttock.

DRAWN LANDMARK: Gluteal furrow point, right.

PROCEDURE: Participant stands erect on a table with the weight distributed equally on both feet. The legs are spread apart just enough so that the thighs do not touch, and the right hand is on the chest. Stand at the right of the participant, and use a tape to measure the circumference of the thigh at its juncture with the buttock (gluteal furrow point). The measurement is made perpendicular to the long axis of the thigh. Exert only enough tension on the tape to maintain contact between the tape and the skin.

INSTRUMENT: Steel tape.

CAUTION: The participant must not tense the thigh muscles. The tape must not be placed in a furrow.

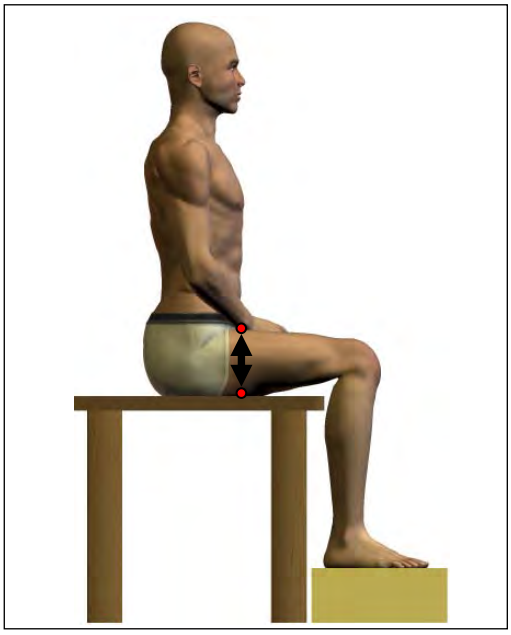
6.4.80 Thigh Clearance

DESCRIPTION: The vertical distance between a sitting surface and the highest point on top of the right thigh.

UNDRAWN LANDMARK: Thigh point, top.

PROCEDURE: Participant sits with the thighs parallel, knees flexed 90°, and the feet in line with the thighs. The arms are relaxed on the lap. Stand at the right of the participant, and use an anthropometer to measure the vertical distance between the sitting surface and the highest point on the top of the thigh (thigh point, top). Brush the blade of the anthropometer back and forth across the top of the thigh to locate its highest point.

INSTRUMENT: Anthropometer.



6.4.81 Thumbtip Reach

DESCRIPTION: The horizontal distance from a back wall to the tip of the right thumb.

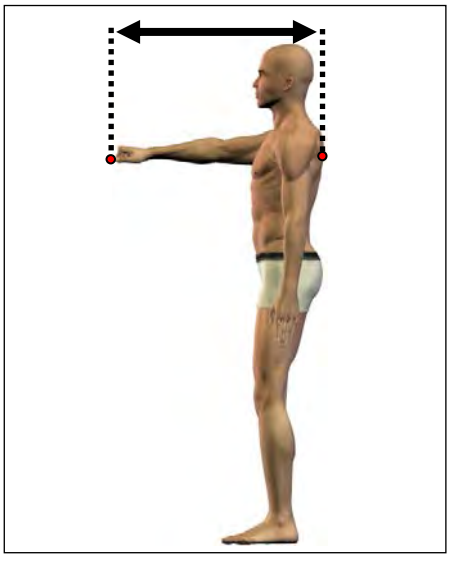
UNDRAWN LANDMARK: Thumbtip, right.

PROCEDURE: Participant stands erect in a corner looking straight ahead with the feet together and the heels on a marked line 20 cm from the wall. The buttocks and shoulders are against a back wall. The right arm and hand are stretched forward horizontally against the side wall, palm down. The thumb continues the horizontal line of the arm and the remaining fingers are curled into a fist. Stand in front of the participant, and hold the participant's right shoulder against the rear wall (not shown in photo). Place a block at the thumbtip to establish, on the wall scale, the horizontal distance between the back wall and the tip of the thumb. The measurement is taken three times, repositioning the arm each time.*

INSTRUMENT: Wall chart; Block.

CAUTION: Measurer should continue to hold the right shoulder while taking the measurement. The participant’s arm should extend forward and may not have contact with the wall.

* The computer selects the final value by calculating the smallest two and the largest two values and comparing the differences to the allowable observer error. It then exercises one of three options: (1) If both differences are smaller than or equal to the allowable error, the middle value is retained; (2) if only the smallest or only the largest value is distant from the middle value by more than the allowable error, the mean of the other two values is used; and (3) if both differences are greater than the allowable error, all three measurements are made again.



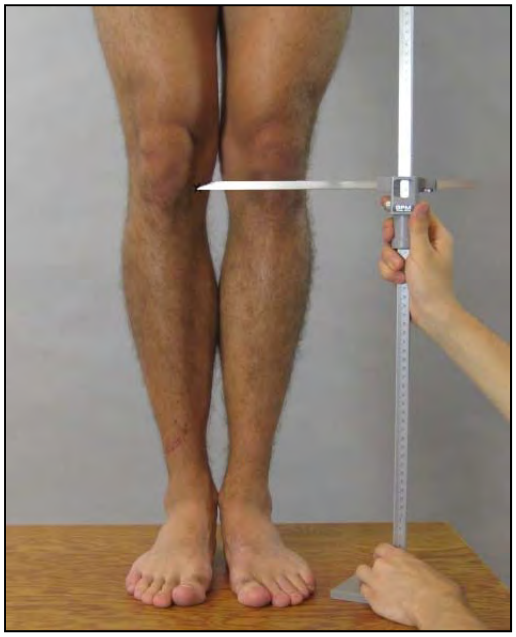
6.4.82 Tibial Height

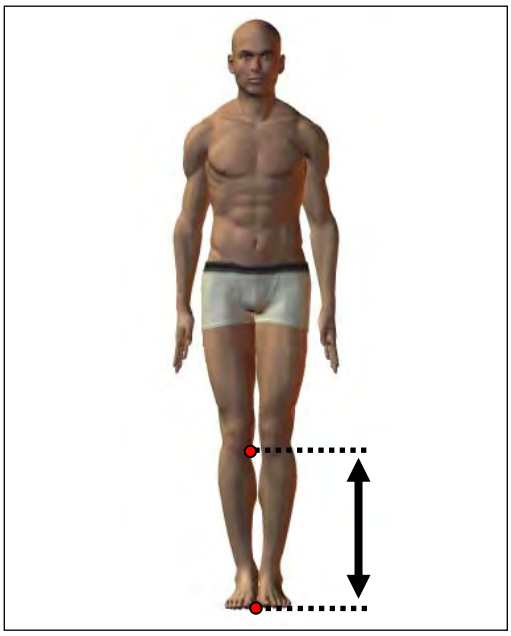
DESCRIPTION: The vertical distance between a standing surface and the tibiale landmark.

DRAWN LANDMARK: Tibiale, right.

PROCEDURE: Participant stands erect on a table with the feet together and the weight distributed equally on both feet. Stand in front of the participant, and use an anthropometer to measure the vertical distance between the standing surface and the tibiale landmark below the knee on the medial side.

INSTRUMENT: Anthropometer.





6.4.83 Tragion-Top of Head

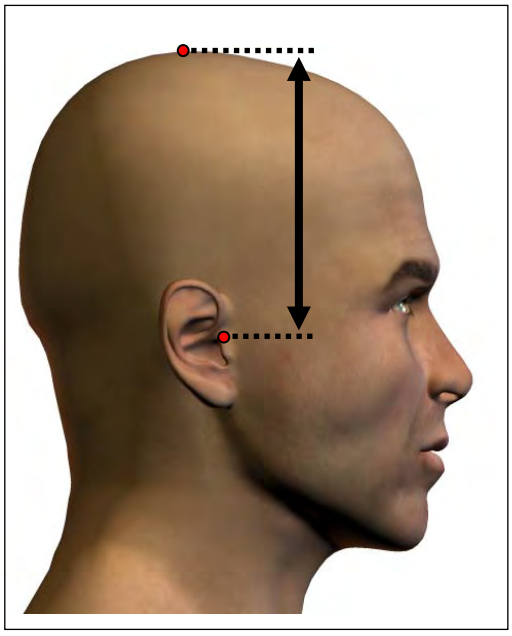
DESCRIPTION: The vertical distance between the right tragion landmark on the cartilaginous flap in front of the earhole and the horizontal plane tangent to the top of the head.

DRAWN LANDMARK: Tragion, right.

UNDRAWN LANDMARK: Top of head (vertex).

PROCEDURE: Participant sits with the head in the Frankfurt plane. Stand to the right of the participant, and use a beam caliper with paddle blade to measure the vertical distance between the right tragion landmark and the top of the head. The fixed blade is on tragion. Be sure the beam is parallel to the long axis of the head. Exert sufficient pressure to obtain contact between the paddle blade and the skin.

INSTRUMENT: Beam caliper with paddle blade.



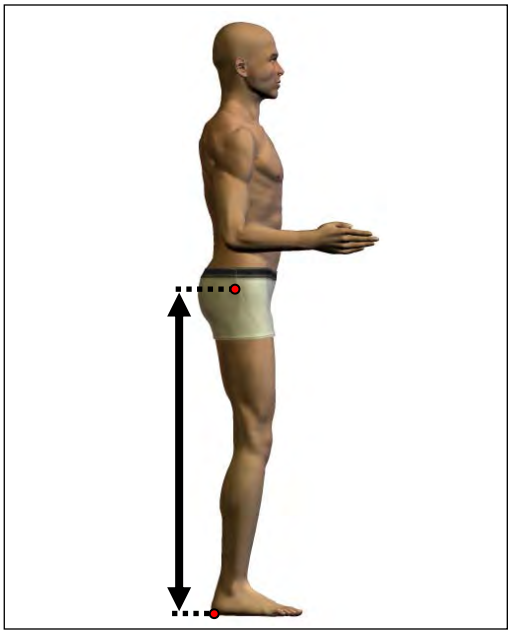
6.4.84 Trochanterion Height

DESCRIPTION: The vertical distance between a standing surface and the trochanterion landmark on the upper side of the right thigh.

DRAWN LANDMARK: Trochanterion, right.

PROCEDURE: Participant stands on a table in the anthropometric standing position. Ask the participant to hold up the right leg of the shorts to expose the landmark. Stand at the right of the participant, and use an anthropometer to measure the vertical distance between the standing surface and the drawn trochanterion landmark.

INSTRUMENT: Anthropometer.



6.4.85 Vertical Trunk Circumference (USA)

DESCRIPTION: The vertical circumference of the trunk on a line passing through the crotch and over the fullest part of the chest, midshoulder, and buttock point, posterior.

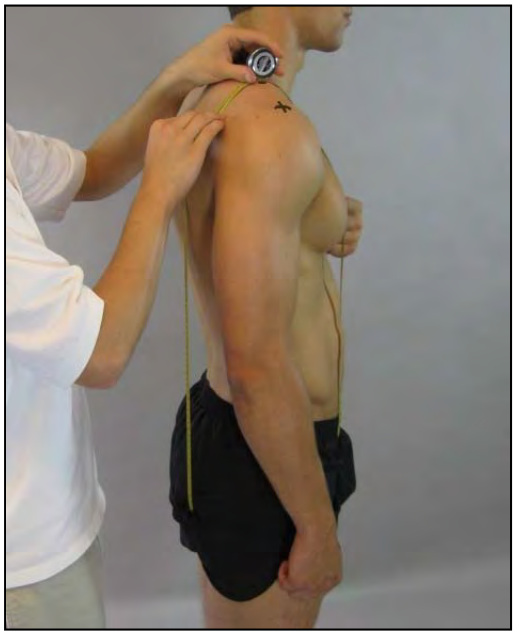
DRAWN LANDMARK: Midshoulder, right.

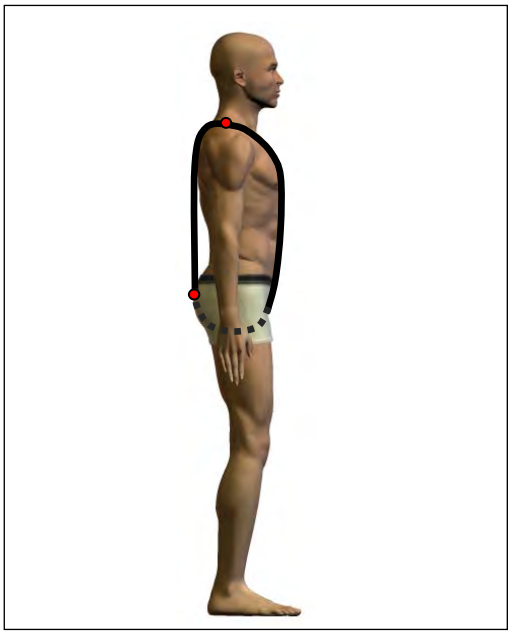
UNDRAWN LANDMARK: Buttock point, posterior.

PROCEDURE: The participant stands in the anthropometric standing position with the feet about 10 cm apart to allow the placement of a tape in the crotch, and then brings the heels together. (On men, the tape passes to the right of the scrotum.) Stand at the right of the participant. The zero end of the tape is brought upward to pass midway between the sternum and the anterior axillary fold and over the midshoulder landmark. The other side of the tape is brought up the back and to the midshoulder landmark crossing the maximum protrusion of the right buttock. Hold the case of the tape on the upper chest to help keep the tape in place, and ask the participant to hold the tape over the right upper breast with the left hand. Exert only enough tension on the tape to maintain contact between the tape and the skin. The tape will span body hollows. The measurement is taken at the maximum point of quiet respiration.

INSTRUMENT: Steel tape.

CAUTION: The participant must not change the position of the shoulders.





6.4.86 Waist Back Length (Omphalion)

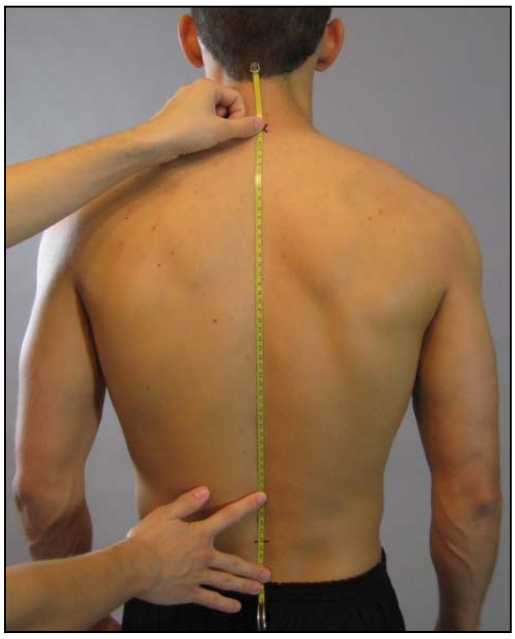
DESCRIPTION: The surface distance between the cervicale landmark at the back of the neck and the waist (omphalion), posterior landmark.

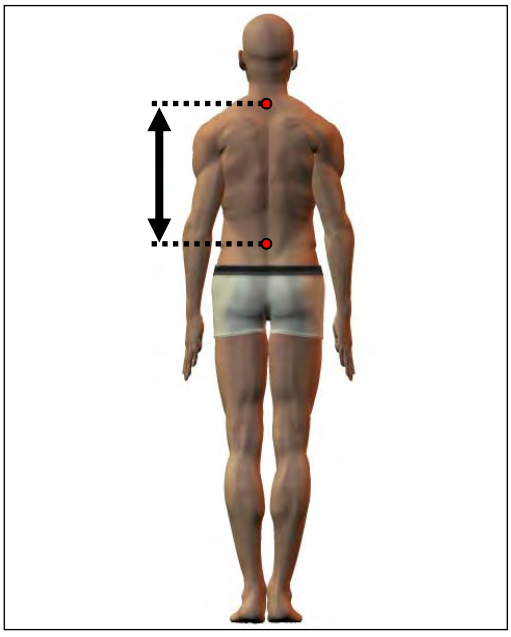
DRAWN LANDMARKS: Cervicale; Waist (omphalion), posterior.

PROCEDURE: Participant is in the anthropometric standing position with the head in the Frankfurt plane. Stand behind the participant, and use a tape to measure the vertical surface distance between the landmarks at cervicale and waist (omphalion), posterior. The tape follows body contours. For women the tape passes underneath the bra. Place the zero point of the tape on cervicale. Exert only enough pressure to prevent slack in the tape. The measurement is taken at the maximum point of quiet respiration.

INSTRUMENT: Steel tape.

CAUTION: Be sure that the head is in the Frankfurt plane and that the zero point of the tape is on the cervicale landmark when the measurement is made. The measurer will often have to hold the tape against the participant's back to maintain skin contact.





6.4.87 Waist Breadth

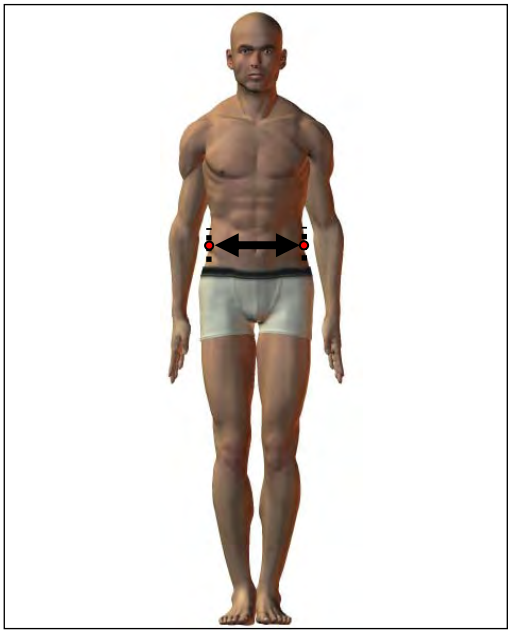
DESCRIPTION: The horizontal breadth of the waist at the level of omphalion.

DRAWN LANDMARKS: Waist (omphalion), right and left.

PROCEDURE: Participant is in the anthropometric standing position. Stand in front of the participant, and use a beam caliper to measure the horizontal breadth of the waist from the drawn landmark at right waist (omphalion) to the drawn landmark at left waist (omphalion). Exert only enough pressure to attain contact between the caliper and the skin. The measurement is taken at the maximum point of quiet respiration.

INSTRUMENT: Beam caliper.

CAUTION: Care must be taken not to compress the soft tissue.



6.4.88 Waist Circumference (Omphalion)

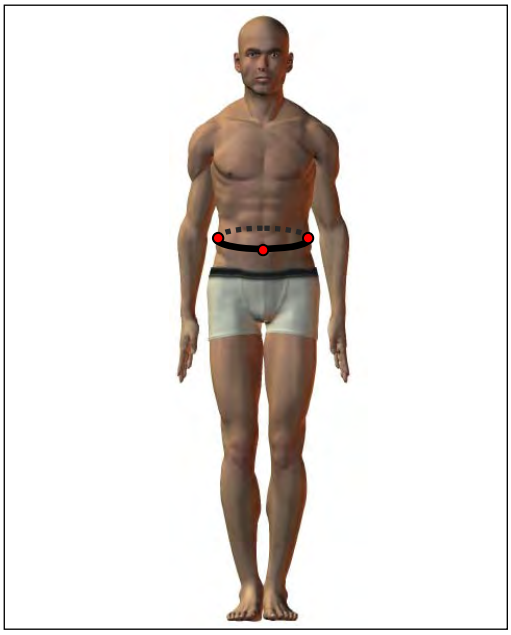
DESCRIPTION: The horizontal circumference of the waist at the level of omphalion encompassing the waist (omphalion) landmarks.

DRAWN LANDMARKS: Waist (omphalion), right, left, anterior and posterior.

PROCEDURE: Participant is in the anthropometric standing position in front of a mirror. Stand in front of the participant, and use a tape to measure the horizontal distance around the torso at the level of the center of the navel. The tape will pass over the drawn waist (omphalion) landmarks at the front, back and sides. Use the mirror to check the position of the tape as it crosses the participant's back. Exert only enough tension on the tape to maintain contact between the tape and the body. The measurement is made at the maximum point of quiet respiration.

INSTRUMENT: Steel tape.

CAUTION: The participant must not tense the abdominal muscles.



6.4.89 Waist Depth

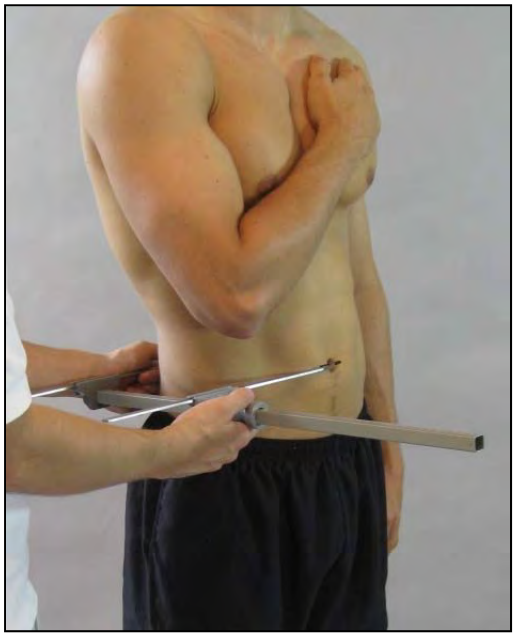
DESCRIPTION: The horizontal distance between the front and the back of the waist at the level of omphalion.

DRAWN LANDMARKS: Waist (omphalion), anterior and posterior.

PROCEDURE: Participant is in the anthropometric standing position, but with the right hand on the chest. Stand at the right of the participant, and use a beam caliper to measure the horizontal distance between the drawn landmarks at waist (omphalion), posterior and waist (omphalion), anterior. The fixed blade of the caliper is on the back. Exert only enough pressure to attain contact between the caliper and the skin. The measurement is taken at the maximum point of quiet respiration.

INSTRUMENT: Beam caliper.

CAUTION: The participant must not tense the abdominal muscles.



6.4.90 Waist Front Length, Sitting

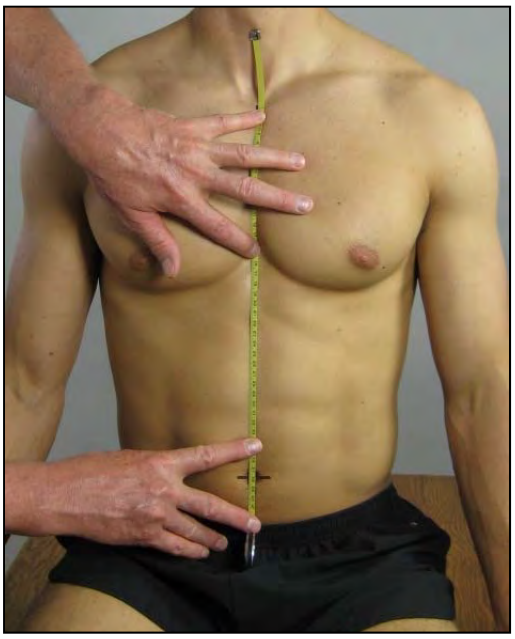
DESCRIPTION: The surface distance between the suprasternale landmark at the lowest point of the notch at the top of the breastbone and omphalion.

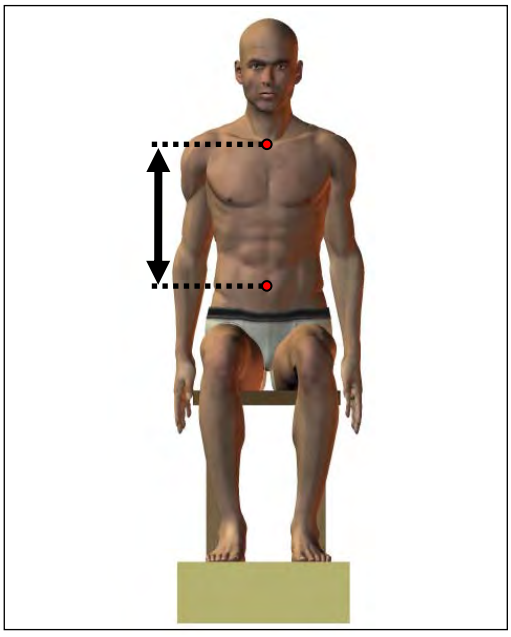
DRAWN LANDMARKS: Suprasternale, right; Waist (omphalion), anterior.

PROCEDURE: Participant is in the anthropometric sitting position with the head in the Frankfurt plane, but with the arms relaxed at the sides. Stand in front of the participant, and use a tape to measure the surface distance between the drawn suprasternale landmark and the drawn anterior waist (omphalion) landmark. For females, ask the participant to pass the tape underneath the bra. The zero point of the tape is placed on the suprasternale landmark. Exert only enough tension to prevent slack in the tape. The measurement is made at the maximum point of quiet respiration.

INSTRUMENT: Steel tape.

CAUTION: Be sure that the participant's head is in the Frankfurt plane and that the zero point of the tape is on the suprasternale landmark when the measurement is taken. The participant must not tense the abdominal muscles.





6.4.91 Waist Height (Omphalion)

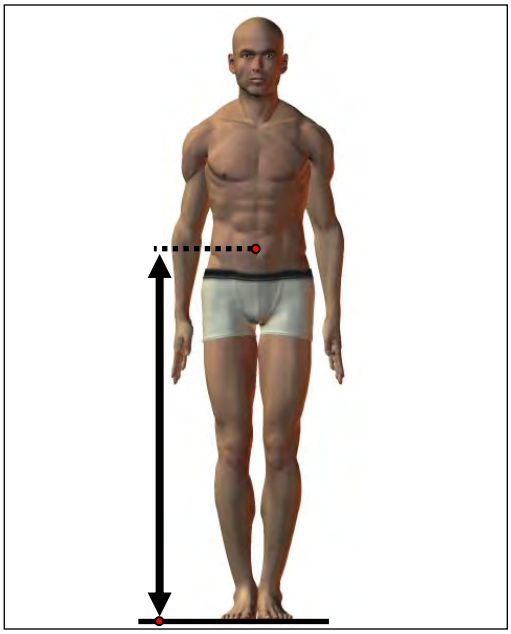
DESCRIPTION: The vertical distance between a standing surface and omphalion.

DRAWN LANDMARKS: Waist (omphalion), anterior.

PROCEDURE: Participant is in the anthropometric standing position. Stand in front of the participant, and use an anthropometer to measure the vertical distance between the standing surface and the center of the navel [waist (omphalion), anterior, landmark]. The measurement is made at the maximum point of quiet respiration.

INSTRUMENT: Anthropometer.

CAUTION: The participant must not be allowed to tense the abdominal muscles.



6.4.92 Weight

PROCEDURE: Participant stands on the platform of the scale with weight distributed evenly on both legs. Stand in front of the participant, and take the weight of the participant to the nearest tenth of a kilogram.

INSTRUMENT: Scale.

6.4.93 Wrist Circumference

DESCRIPTION: The circumference of the wrist at the level of stylion and perpendicular to the long axis of the forearm.

DRAWN LANDMARK: Stylion.

PROCEDURE: Participant stands with the upper arm relaxed and the elbow flexed 90° with the palm up. Stand in front of the participant, and use a tape to measure the circumference of the wrist perpendicular to the long axis of the forearm. When correctly placed, the upper edge of the tape will run just below the bony prominence at stylion, and the lower edge of the tape will run just above the pisiform bone at the bottom of the little finger side of the hand. Exert only enough tension on the tape to maintain contact between the tape and the skin.

INSTRUMENT: Steel tape.

6.4.94 Wrist Height

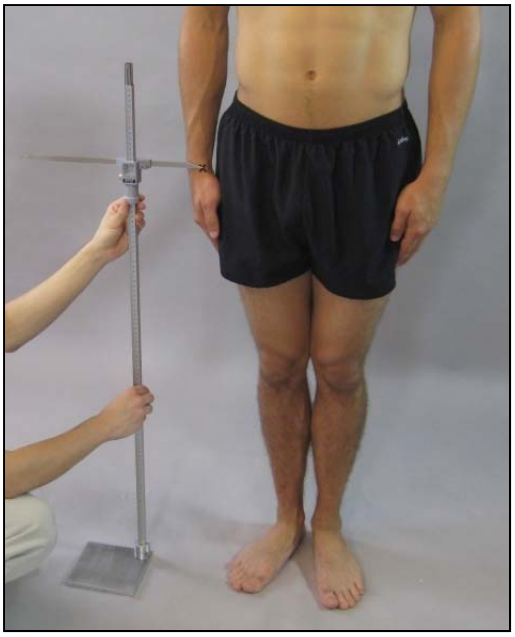
DESCRIPTION: The vertical distance between a standing surface and the stylion landmark.

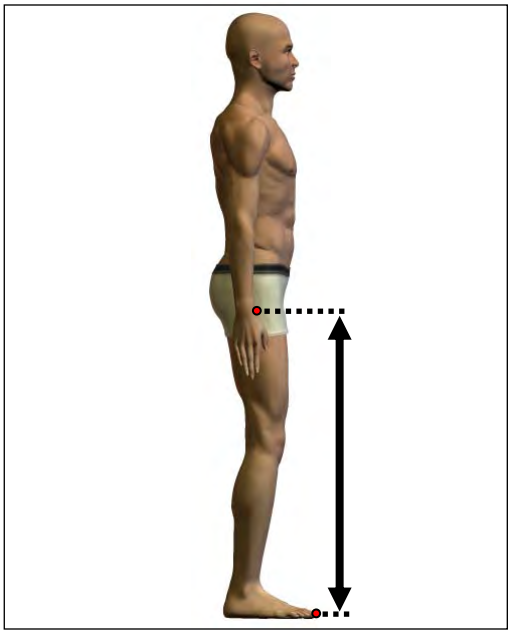
DRAWN LANDMARK: Stylion.

PROCEDURE: Participant stands erect looking straight ahead with the heels together and the weight distributed equally on both feet. The shoulders are relaxed, and the arms are extended downwards with the elbow, wrist, and fingers held rigidly straight. The arms lightly touch the sides. The palms face inward (medially). Stand in front of the participant, and use an anthropometer to measure the vertical distance between the standing surface and the drawn stylion landmark at the wrist. The measurement is taken at the maximum point of quiet respiration.

INSTRUMENT: Anthropometer.

CAUTION: The participant must not be allowed to change the position of the shoulders.



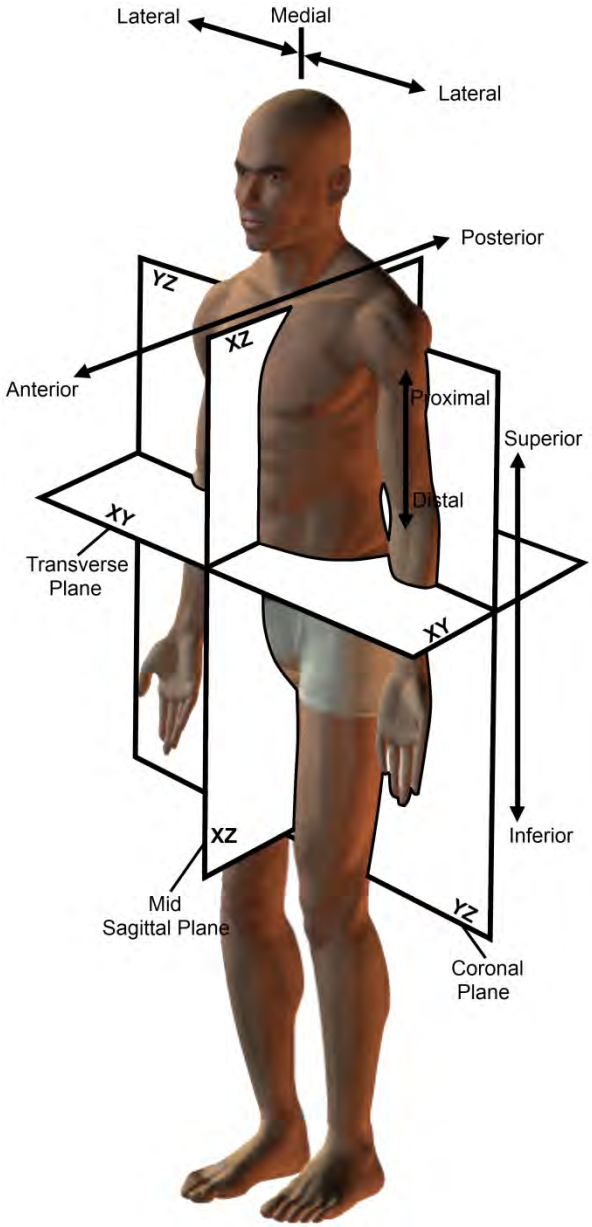


GLOSSARY OF ANATOMICAL AND ANTHROPOMETRIC TERMS

acromion – tip of the shoulder

acromial process – an oblong portion of the shoulder blade at the top of the shoulder

anatomical position - a standard position of the body to which all anatomical directions (e.g., superior, medial, anterior) are referenced, as follows



anterior - pertaining to the front of the body; as opposed to posterior

anthropometric standing position – described in Section 6.1.1 and shown in Figure 19

anthropometric sitting position –described in Section 6.1.2 and shown in Figure 20

axilla - armpit

bi - a prefix denoting connection with or relation to each of two symmetrically paired parts

biceps – used to refer to the two heads of a muscle; the term is most commonly used to refer to the large muscle on the anterior surface of the upper arm (biceps brachii).

canthus - a corner or angle formed by the meeting of the eyelids

coronal plane - any vertical plane at right angles to the midsagittal plane; divides the body into anterior and posterior divisions (see anatomical position diagram on previous page)

deltoid muscle - the muscle that forms the flesh of the lateral side of the upper third of the upper arm

distal - farther from the trunk of the body, as opposed to proximal (see anatomical position diagram on previous page)

dorsal - pertaining to the back of the body or one of its parts (on the hand, its top surface as opposed to its palmar surface and on the foot, its top surface as opposed to plantar).

epicondyle - the bony prominence at the distal end of the humerus and femur (bones)

extend - to move adjacent segments of limbs so that the angle between them is increased, as when the leg is straightened; as opposed to flex

femoral epicondyle – the bony projections on either side of the distal end of the femur

femur - the thigh bone

flex - to move limbs in such a direction as to bring the two parts together, as when the elbow is bent; as opposed to extend

Frankfurt plane - the standard horizontal plane orientation of the head; the plane is established by a line passing through the right tragion (approximate earhole) and the lowest point of the right orbit (eye socket); see Figure 21

gluteal furrow – the crease at the juncture of the buttock and the thigh

hyperextend - to overextend a limb or other part of the body

iliac - pertaining to an ilium, one of the three fused bones that form one side of the pelvis

iliac crest – the superior rim of a pelvic bone

inferior - below, in relation to another structure; lower (see anatomical position diagram on first page of Glossary)

lateral - away from the midline of the body; as opposed to medial (see anatomical position diagram on first page of Glossary)

malleoli - rounded bony projection on either side of the ankle; the lateral malleolus, on the outside of the ankle, is at the distal end of the fibula (one of the two bones of the calf) ; the medial malleolus, on the inside of the ankle, is at the distal end of the tibia (the shin bone)

mandible -- the lower jawbone

mastoid process - lowest bony projection behind and below the ear. It can best be felt immediately behind the earlobe

medial - lying near or toward the midline of the body; as opposed to lateral (see anatomical position diagram on first page of Glossary)

metacarpophalangeal joint - a joint (knuckle) formed by the juncture of a finger bone (phalanx) with the palm bone (metacarpal)

metatarsophalangeal joint - a joint formed by the juncture of a toe bone (phalanx) with the foot bone (metatarsal)

midsagittal - the vertical plane that divides the body into equal right and left halves (see anatomical position diagram on first page of Glossary)

olecranon - the proximal end of the ulna (the elbow)

omphalion - the navel

palmar - pertaining to the palm side of the hand; as opposed to its dorsal surface.

patella - the kneecap

phalanx - a finger or toe bone.

pisiform - a wrist bone on the little finger side of the hand at the base of the palm; it can be felt as a bony protuberance just below the fleshy pad at the base of the palm

popliteal fossa – dorsal juncture of the calf and thigh; back of the knee

posterior – pertaining to the back of the body; as opposed to anterior (see anatomical position diagram on first page of Glossary)

proximal - closer to the trunk of the body; as opposed to distal (see anatomical position diagram on first page of Glossary)

radius - the bone of the forearm on the thumb side of the arm

scye – a tailoring term referring to the armhole of a garment

sternum – breast bone

stylion – the lowest point at the bottom of the radius (bone)

superior - above, in relation to another structure (see anatomical position diagram on first page of Glossary)

supra – prefix designating above or on.

supraorbital ridges – the brow ridges above the eye sockets at the bottom of the forehead

tibia - shin bone

tragion – the juncture of the top of the cartilaginous flap of the ear with the head

tragus – the cartilaginous flap of the ear near the earhole

trapezius – the large muscle that originates on the neck and the upper half of the back and converges on the shoulder between midshoulder and acromion

trochanter – a point in the center of the lateral side of the large prominence at the top of the thigh bone (femur), located on a sitting subject

ventral – front or inside surface

vertebra – a bone of the spine; in humans there are 7 cervical (neck), 12 thoracic (chest), 5 lumbar (lower back), 5 sacral (fused), and 4 caudal (tail) vertebrae

zygomatic arch – the bony arch below and to the side of the orbit of the skull extending horizontally along the side of the head from the cheekbone (the zygomatic bone) nearly to the external ear

zygomatic bone - a bone of the face underlying the upper part of the cheek