

Data recording

Participant: _____ Date: _____ Age: _____ y Sex: M / F

Right ankle:

Trial 1: _____ cm Trial 2: _____ cm Best: _____ cm

Restricted (<9–10 cm): Y / N

Left ankle:

Trial 1: _____ cm Trial 2: _____ cm Best: _____ cm

Restricted (<9–10 cm): Y / N

INTERPRETATION

Consider the four steps of interpretation located in the 'interpretation, feedback and discussion' section at the start of this manual. This test provides an indication of the length of the posterior structures (calf muscles and joint structures) that cross the talocrural joint. When measuring the weight bearing lunge test, a result <9–10 cm is considered restricted. It is important to note that this test may provide false negative results for participants of above average height; that is, tall participants often achieve >9–10 cm due to the length of their tibia, and not necessarily because their talocrural dorsiflexion is within the normal ranges. Advanced testing procedures using goniometers which assist in reducing false negative results can be found in Hoch et al.[24]

Activity 4 Goniometer and inclinometer joint ROM measurements

AIM: conduct joint ROM tests with a goniometer and inclinometer, interpret the results and provide feedback to a participant.

BACKGROUND

There are numerous instruments available to measure joint ROM. One of the most commonly used and cost effective devices is the lever arm goniometer. The following descriptions focus on the two most common devices; lever arm goniometer and inclinometer as shown in the Figure 8.5. The goniometer has intra-tester reliability and measurement errors of ± 4 degrees[12] which includes ± 2 degrees instrument error.[16] The inclinometer has intra-tester reliability of 0.6–1.5 degrees;[25, 26, 27] with measurement errors of ± 2 degrees due to instrument error.

Lever-arm goniometer

The lever-arm goniometer has two arms joined together at a pivot point (Figure 8.5). Around the pivot point on one of the arms a 360° scale is visible. The pivot point is placed at the axis of rotation, otherwise referred to as the fulcrum point, which is usually positioned over the joint line. The original angle is determined by then aligning the stationary lever arm with the closest proximal bony landmark and the moveable lever arm with the closest distal bony landmark (Figure 8.6a). The participant is then instructed to move their limb through a particular motion and, once complete, the lever arms are repositioned to the same bony landmarks to determine the end range angle (Figure 8.6b).

The total ROM at this joint is calculated as:

Total joint ROM = end range angle – original angle

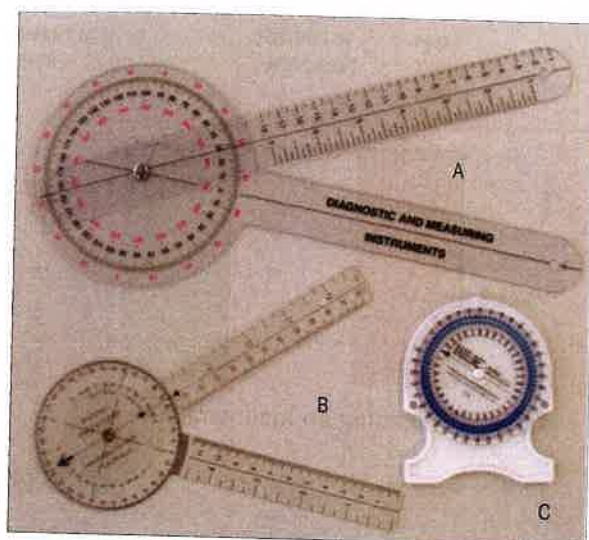


Figure 8.5 Lever arm goniometers (A and B) and an inclinometer (C)

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Figure 8.6a Positioning of goniometer for original angle



Figure 8.6b Positioning of goniometer for end range angle

For the example provided in Figures 8.6a and 8.6b, the total joint ROM for the knee is calculated as:

$$\begin{aligned}\text{Total joint ROM} &= \text{end range angle} - \text{original angle} \\ &= 135^\circ - 0^\circ \\ &= 135^\circ\end{aligned}$$

Inclinometer

The bubble inclinometer is a circular column of coloured fluid contained between two discs of plastic (Figure 8.7a). The top piece of plastic is moveable, circular and imprinted with a 360° scale. It is connected at the centre point to a shaped base which is ideal for placement on either curved or flat surfaces. The simplicity of using the inclinometer is that the fluid level is always set on zero degrees in the neutral position, so the ROM can be read directly from the angle to which the fluid moves (Figure 8.7b). The inclinometer is situated on the limb itself, therefore it is not necessary to align over the joint line with the proximal or distal bony landmarks (Figure 8.8). Note: it is not possible to measure rotation with the inclinometer in the transverse plane.

PROTOCOL SUMMARY

These joint ROM tests involve measuring body and limb ROM in various positions using goniometers and inclinometers.



Figure 8.7a Start inclinometer dial at zero

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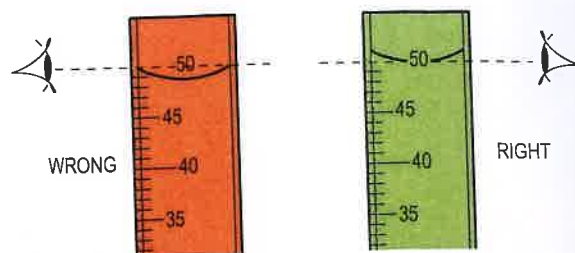


Figure 8.7b Reading an inclinometer



Figure 8.8 Knee flexion with an inclinometer

PROTOCOL

Knowledge of surface anatomy and proficiency in the use of the measuring devices are required to ensure these tests are conducted accurately and with clinically reliable results.

- 1 Follow the pre-test requirements described in Appendix A and general methods for flexibility tests described in Table 8.1.
- 2 Planes of movement listed in Figures 8.9–8.15 are described relative to the standing neutral position [i.e. standard plane of movement for the limb, unless stated otherwise].
- 3 Ensure seated measurements start with good upright posture.
- 4 For standing measurements ensure the participant is standing in the anatomical position.
- 5 The joint to be measured should be isolated to avoid the use of ancillary muscles.
- 6 All joint ROM measurements outlined in Figures 8.9–8.15 are carried out with the standard lever arm goniometer and inclinometer.
- 7 Align the central pivot point of the goniometer over the axis of rotation / joint line and align the arms with the distal joint bony landmarks.
- 8 Hold the inclinometer using the thumb and forefinger spanning across the base of the instrument; hold it securely against the body part / limb to be measured.
- 9 Ensure the inclinometer is set to zero at the start of the movement and that the final ROM measure is read from the bottom of the meniscus at eye level to minimise parallax error (Figure 8.7b).
- 10 When the measuring device is positioned, ask the participant to move their limb in the desired direction.

MEASUREMENT WITH GONIOMETER	POSITION OF PARTICIPANT	PLANE AND JOINT MOVEMENT	GONIOMETER PIVOT POINT ALIGNMENT	PROXIMAL ARM ALIGNMENT	DISTAL ARM ALIGNMENT	MEASUREMENT WITH INCLINOMETER
Flexion 	Seated	Sagittal plane Chin to chest without slumping the shoulders forward	Centre of the ear	Parallel to the floor (0–180° axis line)	Inferior nasal border	At the vertex (crown) of the head in the direction of movement 
Extension 	Seated	Sagittal plane Tip head back without arching the back	Centre of the ear	Parallel to the floor (0–180° axis line)	Inferior nasal border	At the vertex (crown) of the head in the direction of movement 
Lateral flexion 	Seated	Frontal plane Move ear towards the shoulder, take care not to raise the shoulder or rotate the head	C6-C7	Centrally down the spine (perpendicular with the floor)	Occipital protuberance ffC1	At the vertex (crown) of the head in the direction of head movement 
Rotation 	Seated; Supine for inclinometer	Transverse plane Turn and look over the shoulder, take care not to move the upper torso	Vertex of the head	Acromion process	Centre of the nose	On the forehead in the direction of movement 

Figure 8.9 Cervical ranges of joint motion

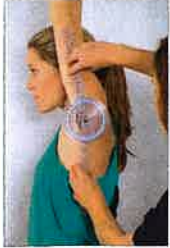
MEASUREMENT WITH GONIOMETER	POSITION OF PARTICIPANT	PLANE AND JOINT MOVEMENT	GONIOMETER PIVOT POINT ALIGNMENT	PROXIMAL ARM ALIGNMENT	DISTAL ARM ALIGNMENT	MEASUREMENT WITH INCLINOMETER
Flexion 	Standing or seated	Sagittal plane Thumb facing forward raise the arm anteriorly	The centre of the head of the humerus on the lateral aspect of the body	Mid-axilla line	Midline of humerus	Longitudinally at the mid-point of the humerus in the direction of movement 
Extension 	Standing or seated	Sagittal plane Thumb facing forward raise the arm posteriorly	The centre of the head of the humerus on the lateral aspect of the body	Mid-axilla line	Midline of humerus	Longitudinally at the mid-point of the humerus in the direction of movement 
Abduction 	Standing or seated	Frontal plane Thumb facing upward abduct the arm	The centre of the head of the humerus on the posterior aspect of the body	Vertically, perpendicular to the floor	Centre of the olecranon	Longitudinally at the mid-point of the humerus in the direction of movement 
Medial rotation (internal rotation) 	Supine	Transverse plane Abducted 90° and elbow bent to 90° (perpendicular to the floor) Lower the forearm and palmar surface of the hand towards the floor	Olecranon	Vertically, perpendicular to the floor	Along the ulnar	Longitudinally on the midline of the dorsal surface of the forearm 

Figure 8.10 Shoulder ranges of joint motion

MEASUREMENT WITH GONIOMETER	POSITION OF PARTICIPANT	PLANE AND JOINT MOVEMENT	GONIOMETER PIVOT POINT ALIGNMENT	PROXIMAL ARM ALIGNMENT	DISTAL ARM ALIGNMENT	MEASUREMENT WITH INCLINOMETER
Lateral rotation (external rotation) 	Supine	Transverse plane Abducted 90° and elbow bent to 90° (perpendicular to the floor) Lower the forearm and dorsal surface of the hand towards the floor	Olecranon	Vertically, perpendicular to the floor	Along the ulnar	Longitudinally on the midline of the palmar surface of the forearm 
Horizontal adduction 	Seated	Transverse plane Arm is abducted 90° and thumbs are pointed up Move the straight arm anteriorly	Superior aspect of the acromion	Coronal plane in line with the acromion processes	Aligned along the humerus to the head of the radius	Can be measured in the supine position. Inclinometer is placed longitudinally on the lateral aspect of the mid-line of the upper arm in the direction of movement 
Horizontal abduction 	Seated	Transverse plane Arm is abducted 90° and thumbs are pointed up Move the straight arm posteriorly	Superior aspect of the acromion	Coronal plane in line with the acromion processes	Aligned along the humerus to the head of the radius	Can be measured in the supine position. Inclinometer is placed longitudinally on the medial mid-line of the upper arm in the direction of movement 

Figure 8.10, cont'd

MEASUREMENT WITH GONIOMETER	POSITION OF PARTICIPANT	PLANE AND JOINT MOVEMENT	GONIOMETER PIVOT POINT ALIGNMENT	PROXIMAL ARM ALIGNMENT	DISTAL ARM ALIGNMENT	MEASUREMENT WITH INCLINOMETER
Flexion 	Seated or standing	Sagittal plane Move palmar surface towards the shoulder	Lateral epicondyle	Lateral aspect of the humerus towards the acromiale	Lateral aspect of the radius	Longitudinally on the midline of the dorsal surface of the forearm in the direction of movement 
Extension 	Seated or standing	Sagittal plane Arm in 90° shoulder flexion, palmar surface facing up, allowing elbow to relax into full extension	Lateral epicondyle	Lateral aspect of the humerus towards the acromiale	Lateral aspect of the radius	Longitudinally on the midline of the palmar surface of the forearm in the direction of movement 
Supination 	Seated or standing	Transverse plane Elbow is flexed to 90°, fingers making a light fist, thumb extended and palmar surface facing medially Move the dorsal surface of the hand inferiorly so palm is facing up	Base of third metacarpal	Vertically, perpendicular to the floor	Parallel to the phalange (thumb)	Horizontally across the palmar surface of the hand and is perpendicular to the floor in the direction of movement 
Pronation 	Seated or standing	Transverse plane Elbow is flexed to 90°, fingers making a light fist, thumb extended, and palmar surface facing medially Move the palmar surface inferiorly so the palm faces the floor	Base of third metacarpal	Vertically, perpendicular to the floor	Parallel to the first phalange (thumb)	Horizontally across the dorsal surface of the hand and is perpendicular to the floor in the direction of movement 

Figure 8.11 Elbow ranges of joint motion

MEASUREMENT WITH GONIOMETER	POSITION OF PARTICIPANT	PLANE AND JOINT MOVEMENT	GONIOMETER PIVOT POINT ALIGNMENT	PROXIMAL ARM ALIGNMENT	DISTAL ARM ALIGNMENT	MEASUREMENT WITH INCLINOMETER
Flexion 	Seated or standing	Sagittal or transverse plane with elbow flexed to 90° Keeping the hand flat and digits together, flex the wrist towards the forearm	Styloid process of the ulna	Along the ulna	Toward the dactylion (tip of middle finger)	Longitudinally on the palmer surface of the hand in the direction of movement. Flex the wrist towards the elbow 
Extension 	Seated or Standing	Sagittal or transverse plane Keeping the hand flat and digits together, flex the wrist towards the floor	Styloid process of the ulna	Along the ulna	Toward the dactylion (tip of middle finger)	Longitudinally on the dorsum of the hand in the direction of movement 
Ulnar deviation 	Seated or Standing	Transverse plane Keeping the hand flat and fingers together, flex the wrist laterally	Centre of the wrist joint	Along the mid-line of the forearm	Along the middle finger	Position the forearm vertically in neutral pronation/supination. Dial positioned along midline of the third metacarpal in the direction of movement 
Radial deviation 	Seated or standing	Transverse plane Keeping the hand flat and fingers together, flex the wrist medially	Centre of the wrist joint	Along the mid-line of the forearm	Along the middle finger	Position the forearm vertically in neutral pronation/supination. Dial positioned along midline of the third metacarpal in the direction of movement 

Figure 8.12 Wrist ranges of joint motion

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MEASUREMENT WITH GONIOMETER	POSITION OF PARTICIPANT	PLANE AND JOINT MOVEMENT	GONIOMETER PIVOT POINT ALIGNMENT	PROXIMAL ARM ALIGNMENT	DISTAL ARM ALIGNMENT	MEASUREMENT WITH INCLINOMETER
Medial rotation 	Prone, knee flexed to 90°	Transverse plane Move the lower limb and foot laterally	Mid-patella	Vertically, perpendicular to the floor	Anterior aspect of the tibial shaft	Longitudinally at the mid-point of the lateral aspect of the fibula in the direction of movement 
Lateral rotation 	Prone, knee flexed to 90°	Transverse plane Move the lower limb and foot medially	Mid-patella	Vertically, perpendicular to the floor	Anterior aspect of the tibial shaft	Longitudinally at the mid-point of the lateral aspect of the fibula in the direction of movement 

Figure 8.13, cont'd

MEASUREMENT WITH GONIOMETER	POSITION OF PARTICIPANT	PLANE AND JOINT MOVEMENT	GONIOMETER PIVOT POINT ALIGNMENT	PROXIMAL ARM ALIGNMENT	DISTAL ARM ALIGNMENT	MEASUREMENT WITH INCLINOMETER
Flexion 	Prone	Sagittal plane Move the foot and lower leg towards the buttocks	Lateral epicondyle of the femur	Lateral aspect of greater trochanter	Lateral malleolus	Longitudinally at the mid-point of the anterior aspect of the tibia in the direction of movement 
Extension 	Supine	Sagittal plane Support the leg distally, allowing knee to relax into full extension	Lateral epicondyle of the femur	Lateral aspect of greater trochanter	Lateral malleolus	Longitudinally at the mid-point of the anterior aspect of the tibia in the direction of movement 

Figure 8.14 Knee ranges of joint motion

MEASUREMENT WITH GONIOMETER	POSITION OF PARTICIPANT	PLANE AND JOINT MOVEMENT	GONIOMETER PIVOT POINT ALIGNMENT	PROXIMAL ARM ALIGNMENT	DISTAL ARM ALIGNMENT	MEASUREMENT WITH INCLINOMETER
Dorsiflexion 	Supine, ankle flexed to 90°	Sagittal plane Flex the foot upwards towards the knee	Lateral malleolus	Lateral aspect of the fibula	On the lateral foot surface parallel to the fifth metatarsal	Longitudinally on the dorsal surface of the foot in the direction of movement 
Plantar flexion 	Supine, ankle flexed to 90°	Sagittal plane Flex the foot downwards towards the floor	Lateral malleolus	Lateral aspect of the fibula	On the lateral foot surface parallel to the fifth metatarsal	Longitudinally on the dorsal surface of the foot in the direction of movement 
Inversion 	Supine, foot in relaxed, plantar-flexed position	Transverse plane Invert the foot medially	Anterior aspect of the talocrural joint between the medial and lateral malleoli	Anterior aspect of the tibia	On the dorsal surface of the second metatarsal	Horizontally across the cuneiforms of the foot
Eversion 	Supine, foot in relaxed, plantar-flexed position	Transverse plane Evert the foot laterally	Anterior aspect of the talocrural joint between the medial and lateral malleoli	Anterior aspect of the tibia	On the dorsal surface of the second metatarsal	Horizontally across the cuneiforms of the foot

Figure 8.15 Ankle ranges of joint motion

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- When full AROM has been achieved by the participant, ensure the placement of the measuring device remains correct, then measure and record the degrees of movement observed.

The wrist is not measured from the anatomical neutral stance. The starting position for testing wrist/hand ROM is with the elbow flexed 90°, hand and wrist flat with the palmar surface face down.

INTERPRETATION

Consider the four steps of interpretation located in the 'interpretation, feedback and discussion' section at the start of this manual. 'Normal' values for ROM of each joint have been described in Table 8.5 for most joints or body segments.

Table 8.5 Ranges of joint motion normative data

JOINT	ACTION	ROM	RECORDED ROM	INTERPRETATION
Neck	Flexion	0–50		
	Extension	0–70		
	Lateral flexion	0–45		
	Rotation	0–70		
Shoulder	Flexion	0–180		
	Extension	0–45		
	Abduction	0–180		
	Medial rotation	0–90		
	Lateral rotation	0–90		
	Horizontal abduction	0–30		
	Horizontal adduction	0–135		
Elbow	Flexion	0–145		
	Extension	0–5		
Forearm	Pronation	0–80		
	Supination	0–90		
Wrist	Flexion	0–90		
	Extension	0–70		
	Abduction	0–25		
	Adduction	0–65		
Hip	Flexion	0–120		
	Extension	0–15		
	Abduction	0–45		
	Adduction	0–20		
	Medial rotation	0–35		
	Lateral rotation	0–45		
Knee	Flexion	0–135		
	Hyper-extension	0–5		
Ankle	Plantar flexion	0–45		
	Dorsiflexion	0–15		
Foot	Inversion	0–30		
	Eversion	0–15		

Source: adapted from: Schultz et al. [2] and Capuano-Pucci et al. [28]