



Musculoskeletal Neurological Examination

Telehealth Examination Proforma

As performed for the study titled *“Addressing safety and comprehensiveness concerns for neurological examination via telehealth in patients with low back pain”*.



Metro North Health acknowledges the Traditional Custodians of the Land upon which we live, work and walk, and pay our respects to Elders both past and present.

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Summary:

The following (telehealth) neurological examination proforma was developed for the purposes of the study titled “Addressing safety and comprehensiveness concerns for neurological examination via telehealth in patients with low back pain” following the development of its in-person counterpart. Both proformas were developed through collaboration between the RBWH Physiotherapy and Neurosurgery Departments and were underpinned by the ‘Neurological exam in musculoskeletal physiotherapy’ (Farmer et al., 2021) document, prepared by representatives of relevant Queensland Health Physiotherapy Clinic Networks. Further extensive clinical input was provided by both Specialist Musculoskeletal Physiotherapists (as awarded by the Australian College of Physiotherapists) and a Consultant Neurosurgeon.

We acknowledge that there is variation in how individual tests can be performed, measured, and interpreted (regardless of delivery medium), and therefore this proforma was developed to ensure consensus between these two professions, as well as drawing on existing literature wherever relevant. Wherever possible, the telehealth examination mimicked the participant set-up and testing procedure of an in-person examination. Assistive devices (e.g. seatbelt) were used to facilitate self-examination, and where necessary participant set-up was altered to enable test performance to take place.

For the purposes of this study, the telehealth examination was completed using an iPad affixed to an adjustable stand and positioned on a movable table. The telehealth platform used for this study was eHab® (NeoRehab, Brisbane, Australia), a web-based video-conferencing software program that is clinically validated for rehabilitation consultations. All assessments took place within the Royal Brisbane and Women’s Hospital (Brisbane, Australia) Physiotherapy Department, where the participant was located in a room on their own with the iPad. The assessor was in a separate clinic room and stationed in front of a standard desktop computer. Basic equipment (e.g., plinth, tissues, towels, pillow, seatbelt, reflex hammer) was made available to the participant within the room).

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Special Tests:

Test: Gait	
Patient starting position/stance	Standing in open space (+/- usual mobility aid) with adequate space to mobilise away from computer device
iPad position relevant to patient start position	Stationed in corner of room, with patient standing in opposite corner of room, facing iPad.
Clinician Instructions AND Test Procedure	<ul style="list-style-type: none"> - <i>I would now like to watch you walk normally. Please stand in the corner of the room facing me, and then walk normally towards the iPad.</i> - <i>And turn around and walk back towards the corner of the room.</i> <p>Additional cues:</p> <ul style="list-style-type: none"> - <i>Can you do that again?</i> - <i>Can you now walk a little faster / slower?</i> - <i>Does that feel like your normal walking?</i> <p>Ask regarding any changes of any specific problem/symptom</p>
Maximum repetition allowance	5 metres or 3 times
Assessment Responses	<p>Normal = regular synchronous gait</p> <p>Abnormal may include foot slap, high steppage, base of support, ataxic, shuffling, festinating, antalgic (Pirker & Katzenschlager, 2017).</p>
Link to video performance	Royal Brisbane & Women's Hospital Physiotherapy Department – Clinician Resources

Test: Toe Walk	
Patient starting position/stance	Standing in open space (+/- usual mobility aid) with adequate space to mobilise away from examiner
iPad position relevant to patient start position	Stationed in corner of room, with patient standing in front, with back towards camera.
Clinician Instructions AND Test Procedure	<p>Ensure examiner can observe heels - posterior view</p> <ul style="list-style-type: none"> - <i>Can you stand on your toes?</i> - <i>If you feel safe to walk forward on your toes, walk towards the iPad.</i> - <i>And now turn around and standing up on your toes, can you walk away from me towards the opposite corner of the room.</i> <p>Additional cues:</p> <ul style="list-style-type: none"> - May need to demonstrate to patient prior to commencement of test. - <i>Right up on your toes</i> - <i>As high as you can go</i> - <i>(Does that feel the same?)</i> <p>Ask regarding any changes of any specific problem/symptom</p>

Maximum repetition allowance	5 metres or 3 times
Assessment Responses	<ul style="list-style-type: none"> - Observe for minimal heel drop from bilateral to single leg stance. - Difference reported by the patient (e.g., reported effort or pain) - Coordination of gait (see gait abnormalities listed under 'Gait').
Link to video performance	Royal Brisbane & Women's Hospital Physiotherapy Department – Clinician Resources

Test: Heel Walk	
Patient starting position/stance	Standing in open space (+/- usual mobility aid), facing the examiner with adequate space to walk towards them.
iPad position relevant to patient start position	Stationed in corner of room, with patient standing in opposite corner of room, facing iPad.
Clinician Instructions AND Test Procedure	<p>Ensure examiner can observe anterior view of feet while walking. Consider the need to assess for passive ankle DF ROM prior to commencing test to ensure full available range is being achieved.</p> <ul style="list-style-type: none"> - <i>Please stand in the corner diagonally opposite the iPad and walk on your heels, on the spot.</i> - <i>If you feel safe to walk forward on your heels, please walk towards the iPad.</i> <p>Additional cues:</p> <ul style="list-style-type: none"> - May prompt for arms/elbows extended for balance. - May need to demonstrate to patient prior to commencement of test. - <i>(Does that feel the same on both legs?)</i> <p>Ask regarding any changes of any specific problem/symptom</p>
Maximum repetition allowance	5 metres or 3 times
Assessment Responses	<ul style="list-style-type: none"> - Observe for equal and adequate dorsiflexion of toes and ankles through gait. - Observe for prominence of tendons, specifically EHL and tibialis anterior - Coordination of gait (see gait abnormalities listed under 'Gait')
Link to video performance	Royal Brisbane & Women's Hospital Physiotherapy Department – Clinician Resources

Test: Romberg's Sign	
Patient starting position/stance	Standing (without aid or lower limb support) in corner of room, side-on to iPad with shoulder facing corner of room (Corner of room provides possible support in three directions).
iPad position relevant to patient start position	Stationed in corner of room, with patient standing in opposite corner of room, as described above.
Clinician Instructions AND Test Procedure	<ul style="list-style-type: none"> - <i>This is a test of balance. Before we start, if at any time you don't feel safe or steady, please reach for the wall.</i>

	<ul style="list-style-type: none"> - <i>Start by bringing your feet close together, keeping your eyes open and hands by your side; try and hold still in this position for 10 seconds.</i> - <i>Keeping your feet and arms in the same position, now close your eyes; try and hold still in this position for 10 seconds.</i> - <i>Now cross your arms against your chest and keep standing with your eyes closed; try and hold still in this position for 30 seconds.</i> <p>Progressive test* of balance applied (Centres for Disease Control and Prevention, 2020):</p> <ol style="list-style-type: none"> 1. Feet close, eyes open (FCEO) – aim for maximum 10 seconds 2. Feet close, eyes close (FCEC) – aim for maximum 10 seconds 3. Feet close, eyes close (FCEC) + hands crossed – aim for maximum 30 seconds <ul style="list-style-type: none"> - Assessor count seconds out aloud. - Assessor prepared to cease test if fall is considered imminent. <p>* Progressive testing was applied as it was deemed appropriate for safety netting.</p>
Maximum repetition allowance	1 attempt per position
Assessment Responses	<p>Positive = participant opens eyes AND/OR requires to step to prevent fall AND/OR arm swing AND/OR fall likely imminent without assessor assistance or ceasing test (Centres for Disease Control and Prevention, 2020).</p> <p>Positive = also included inability to sustain balance at any of the earlier staged postures.</p> <p>Postural sway alone does not constitute a positive response.</p>
Link to video performance	Royal Brisbane & Women's Hospital Physiotherapy Department – Clinician Resources

Test: Triceps Surae (Ankle) Clonus	
Patient starting position/stance	Supine on plinth with single pillow under head, single-leg crook lying for comfort and to ensure visualisation of ankle/leg furthest from iPad.
iPad position relevant to patient start position	Stationed perpendicular (90° to side) to plinth, to visualise whole plinth (and patient lying supine).
Assistive Devices	Seatbelt
Clinician Instructions AND Test Procedure	<ul style="list-style-type: none"> - <i>Please pick up the belt on the trolley and lie down on the bed.</i> - <i>Now loop the belt over the ball of the foot closest to the camera, and then straighten out your leg. By pulling on the belt, comfortably and slowly pull you ankle back towards your head.</i> - (check passive ankle dorsiflexion ROM for available range and any pain response prior to commencing formal test): <i>“Is that OK?”</i> - <i>Relax, but keep the belt there. Now I want you to pull back your ankle quickly and hold the pressure until I ask you to let it go.</i>

	<p>Testing procedure:</p> <ul style="list-style-type: none"> - Check passive ankle dorsiflexion ROM is comfortable (as described above). - If pain response apply test to less painful side first. - Maintain pressure at end of range until any beats cease; or, if not fatiguing for approx. 10+ beats; or cease after 3 sec if no beats. - Ensure that brisk ankle dorsiflexion is achieved.
Maximum repetition allowance	Up to 3 times per side
Assessment Responses	<p>Assess for the number of beats seen on each side.</p> <p>Positive = >3 beats on any one attempt (Suri, 2021)</p>
Link to video performance	Royal Brisbane & Women's Hospital Physiotherapy Department – Clinician Resources

Test: Babinski Sign (Plantar response)	
Patient starting position/stance	<p>Seated in hard-back chair (with armrests), with feet supported. A pillow may be placed at the back of the chair to ensure feet supported on the ground.</p> <p>Consideration of skin integrity; if concerned, do not proceed with test.</p>
iPad position relevant to patient start position	Directly in front of seated participant, able to visualise tested foot/lower limb for anticipated toe movement.
Assistive Device	Reflex hammer
Clinician Instructions AND Test Procedure	<ul style="list-style-type: none"> - <i>Pick up the tendon hammer and sit back in the chair.</i> - <i>Rest the outside of your (left/right) foot onto your opposite knee.</i> - <i>Holding the handle-end of the tendon hammer, scrape the pointy end firmly along the outside of the sole of your (left/right) foot.</i> - <i>Now repeat on the other side.</i> <p>Testing procedure:</p> <ul style="list-style-type: none"> - Assessor to demonstrate direction of applied pressure on palm of hand prior to test commencing. - Repeat with more firm pressure as required. <p>Once a positive response is identified, the test can cease.</p>
Maximum repetition allowance	Up to 3 times per side
Assessment Responses (Farmer et al., 2021)	<ul style="list-style-type: none"> - Positive = dorsiflexion of first toe, and may include dorsiflexion / abduction of other toes; and/or flexor synergy of leg (care to not elicit foot grasp or other primitive reflexes) - Negative = plantar flexion/down-going or no response elicited
Link to video performance	Royal Brisbane & Women's Hospital Physiotherapy Department – Clinician Resources

Test: Hoffman's Sign	
Patient starting position/stance	Seated in hard-back chair (with armrests), with feet supported. A pillow may be placed at the back of the chair to ensure feet supported on the ground.
iPad position relevant to patient start position	Directly in front of seated participant, able to visualise tested hand/lower arm for anticipated thumb/finger movements.
Assistive Device	Reflex hammer +/- pillow/s
Clinician Instructions AND Test Procedure	<ul style="list-style-type: none"> - <i>Rest your (left/right) hand on your thigh, palm facing upwards. Relax your fingers and use the fingernail of your (right/left) hand to flex/bend the index/middle finger fingernail. Let the fingernails grip release to allow the index/middle finger to snap backwards.</i> - <i>Repeat this movement three times in front of the camera so that I can observe for any thumb movement.</i> - <i>Now I want you to do the same thing but with your (left/right) arm turned inwards so that the hand is side on the camera and I am able to observe any index/middle finger movement.</i> - <i>Now repeat on the other side.</i> <p>Testing procedure:</p> <ul style="list-style-type: none"> - Lower arm is placed into supination to optimise muscle relaxation. - Able to place pillow between thigh and forearm (with wrist relaxed over edge of pillow) if required. - Assessor to demonstrate movement prior to test commencement.
Maximum repetition allowance	Up to 3 times per side
Assessment Responses (Cook et al., 2009)	<p>Observe thumb and fingers throughout test procedure.</p> <ul style="list-style-type: none"> - Positive = flexion of the distal phalanx of the thumb / Adduction and flexion of the thumb AND/OR exaggerated finger flexion <p>Care that the strength of the stimulus does not cause overflow movement of fingers.</p>
Link to video performance	Royal Brisbane & Women's Hospital Physiotherapy Department – Clinician Resources

Dermatomal (light touch sensation) tests

Test: Sensation testing (L2 – S2)	
Patient starting position/stance	Seated in hard-back chair (with armrests), with feet supported. A pillow may be placed at the back of the chair to ensure feet supported on the ground.
iPad position relevant to patient start position	Directly in front of seated patient, able to visualise whole body.
Assistive Device	Tissues +/- picture card of ASIA Key Sensory Points +/- tongs
Clinician Instructions AND Test Procedure	<ul style="list-style-type: none"> - <i>Now we are going to check your sensation on different parts of your legs.</i> - <i>Pick up a tissue from the trolley and gently roll it up so that you have a fairly specific tip, like this one [show example].</i> <p>Start with Forehead test (assuming no altered sensation) as baseline.</p> <ul style="list-style-type: none"> - <i>If you gently brush your face with the tissue:</i> - <i>Can you feel the tissue clearly?</i> - <i>Does that feel normal to you?</i> - <i>Now you are going to test the sensation in your legs by gently sweeping the pointed end of the tissue over specific points on each leg. Each time I will ask you if they feel the same side to side and if they feel 'normal' like your forehead. Make sure that your eyes remain closed.</i> <p>Additional clinician instructions/questions for testing at each level bilaterally:</p> <ul style="list-style-type: none"> - <i>Does that feel the same?</i> - <i>Does that feel equal between sides?</i> - <i>And does that feel normal (compared to your forehead)?</i> <p>Test Procedure:</p> <ul style="list-style-type: none"> - Each dermatomal level (L2-S2) is tested bilaterally. - If patient is unable to bend forward and touch their ankle/toes (e.g. restricted hip movement), instruct them to hold the tissue in the tongs prior to proceeding with relevant sensory point. - Key sensory points (Rupp et al., 2021), include: <ul style="list-style-type: none"> • L2: anterior-medial thigh at the midpoint drawn connecting midpoint of inguinal ligament & medial femoral condyle • L3: Medial femoral condyle above the knee • L4: Medial malleolus • L5: Dorsal foot at third metatarsal phalangeal (MTP) joint • S1: Lateral heel (calcaneus) • S2: Midpoint of popliteal fossa.
Maximum repetition allowance	Up to 3 times per dermatomal test side, per side.
Assessment Responses	Grading as per ASIA Impairment Scale (Rupp et al., 2021): <ul style="list-style-type: none"> - 0 = absent - 1 = altered - 2 = normal / intact
Link to video performance	Royal Brisbane & Women's Hospital Physiotherapy Department – Clinician Resources

Strength tests (Myotomes) – Against Gravity (Grade 3 – 5)

Test: Hip Flexion (ASIA L2)	
Patient starting position/stance	Seated in hard-back chair (with armrests), with feet supported. A pillow may be placed at the back of the chair to ensure feet supported on the ground.
iPad position relevant to patient start position	Directly to the side of the seated patient, able to visualise whole body.
Clinician Instructions & Testing Procedure based on Grade	<p>Prior to commencement of muscle tests:</p> <ul style="list-style-type: none"> - <i>I am now going to assess the strength of some of your leg muscles. We will first look at your ability to use these muscles against gravity. If you can hold against gravity, I will then ask you to apply a small amount of pressure and see if you can hold the position. I will then ask you to apply a lot of pressure and again see if you can hold the position. Please let me know if pain stops you from being able to apply sufficient force.</i> <p>Grade 3:</p> <ul style="list-style-type: none"> - <i>Can you lift your (left/right) knee up towards the ceiling by bending your hip as much as possible so that your foot also comes off the floor?</i> - <i>Can you do the same with the other side?</i> - <i>Does one side feel stronger than the other, or are they the same?</i> - Observe for hip flexion ROM and note any differences between sides. <p>Grade 4 & 5:</p> <ul style="list-style-type: none"> - <i>Now I want you to lift your knee up towards the ceiling so that it is higher than your hip. Holding that position, I want you to push down on your knee with one hand but do not allow the knee to move. So I want you to match/resist the downward force.</i> - (Grade 4): <i>Just apply a small amount of pressure with your hand. Okay, push down.</i> - <i>Can you do the same with the other side? Does one side feel stronger than the other, or are they the same?</i> - (Grade 5): <i>Now apply a lot of pressure with your hand. Okay, push push.</i> - <i>Can you do the same with the other side? Does one side feel stronger than the other, or are they the same?</i> <p>To visualise the leg/side furthest from the iPad, ask patient to slightly extend the hip / knee closest to iPad while not being tested.</p>
Maximum repetition allowance	Up to 3 times each side, per grade of strength (as applicable).
Assessment Responses	<p>Grading as per Oxford Manual Muscle Test (Rupp et al., 2021; Medical Research Council, 1943):</p> <ul style="list-style-type: none"> - 3 = Full range of motion against gravity - 4 = Full range of motion against gravity, moderate resistance in a muscle specific position - 5 = Full range of motion against gravity, maximal resistance in a muscle-specific position expected from an otherwise unimpaired person
Link to video performance	Royal Brisbane & Women's Hospital Physiotherapy Department – Clinician Resources

Test: Knee Extension (ASIA L3)	
Patient starting position/stance	Seated in hard-back chair (with armrests), with feet supported. A pillow may be placed at the back of the chair to ensure feet supported on the ground.
iPad position relevant to patient start position	Directly to the side of the seated patient, able to visualise whole body.
Clinician Instructions & Testing Procedure based on Grade	<p>Prior to commencement of muscle tests:</p> <ul style="list-style-type: none"> - <i>I am now going to assess the strength of some of your leg muscles. We will first look at your ability to use these muscles against gravity. If you can hold against gravity, I will then ask you to apply a small amount of pressure and see if you can hold the position. I will then ask you to apply a lot of pressure and again see if you can hold the position. Please let me know if pain stops you from being able to apply sufficient force.</i> <p>Grade 3:</p> <ul style="list-style-type: none"> - <i>Sit leaning back in the armchair with both feet on the ground. Slowly straighten your (left/right) knee by lifting your foot into the air.</i> - <i>Now please do the same movement with your other leg</i> - <i>Does one side feel stronger than the other, or are they the same?</i> - <i>Observe for knee extension ROM and note any differences between sides; if unable to achieved active ROM to 0°, determine if limited by pain or weakness.</i> <p>Grade 4 & 5:</p> <ul style="list-style-type: none"> - (Grade 4): <i>Now I want you cross your (right/left) ankle on top of the leg that we are testing and just rest the leg there. Now straighten the bottom (tested) knee by lifting your feet in the air.</i> - <i>Now do the same movement with your other leg. Does one side feel strong than the other, or are they the same?</i> - (Grade 5): <i>Now do that again but I want you to push down with the top leg as much as you can, while you push up with the other leg. So I want you to match/resist the force. Okay, push push push.</i> - <i>Now do the same with your other leg. Does one side feel strong than the other, or are they the same?</i>
Maximum repetition allowance	Up to 3 times each side, per grade of strength (as applicable).
Assessment Responses	<p>Grading as per Oxford Manual Muscle Test (Rupp et al., 2021; Medical Research Council, 1943):</p> <ul style="list-style-type: none"> - 3 = Full range of motion against gravity - 4 = Full range of motion against gravity, moderate resistance - 5 = Full range of motion against gravity, maximal resistance
Link to video performance	Royal Brisbane & Women's Hospital Physiotherapy Department – Clinician Resources

Test: Ankle dorsiflexion/inversion (ASIA L4)	
Patient starting position/stance	Seated in hard-back chair (with armrests), with feet supported. A pillow may be placed at the back of the chair to ensure feet supported on the ground.
iPad position relevant to patient start position	Directly to the side of the seated patient, able to visualise whole body.
Clinician Instructions & Testing Procedure based on Grade	<p>Prior to commencement of muscle tests:</p> <ul style="list-style-type: none"> - <i>I am now going to assess the strength of some of your leg muscles. We will first look at your ability to use these muscles against gravity. If you can hold against gravity, I will then ask you to apply a small amount of pressure and see if you can hold the position. I will then ask you to apply a lot of pressure and again see if you can hold the position. Please let me know if pain stops you from being able to apply sufficient force.</i> <p>Grade 3:</p> <ul style="list-style-type: none"> - <i>Sitting in the armchair, lean forward slightly to be able to look at both feet on the ground. Have your feet a bit forward of the chair ensuring that they are flat on the floor.</i> - <i>Keeping your heels on the floor, lift the front of your (left/right) foot off the floor as high as you can.</i> - <i>Now do the same with your other foot.</i> <p>To visualise the foot/side furthest from the iPad, ask patient to slide foot closest to iPad underneath chair for the tested ankle to be clearly visualised.</p> <ul style="list-style-type: none"> - <i>Does one side feel stronger than the other, or are they the same?</i> - <i>Observe for ankle DF ROM and note any differences between sides; if there is a difference, determine if this is due to pain, weakness, or a passive restriction.</i> <p>Grade 4 & 5:</p> <ul style="list-style-type: none"> - (Grade 4): <i>Now can you lift the front of your (left/right) foot off the floor and hold it there. Now rest your other heel on top of your (left/right) midfoot.</i> - <i>Now do the same movement with the other side. Does one side feel strong than the other, or are they the same?</i> - (Grade 5): <i>Now lift the front of your (left/right) foot off the floor and hold again. Resting your other heel on top of your (left/right) foot, now apply a downward pressure, but don't let your (left/right) ankle move. Okay, push push push.</i> - <i>Now do the same with the other side. Does one side feel strong than the other, or are they the same?</i>
Maximum repetition allowance	Up to 3 times each side, per grade of strength (as applicable).
Assessment Responses	<p>Grading as per Oxford Manual Muscle Test (Rupp et al., 2021; Medical Research Council, 1943):</p> <ul style="list-style-type: none"> - 3 = Full range of motion against gravity - 4 = Full range of motion against gravity, moderate resistance - 5 = Full range of motion against gravity, maximal resistance
Link to video performance	Royal Brisbane & Women's Hospital Physiotherapy Department – Clinician Resources

Test: Extensor Hallucis Longus (EHL) (ASIA L5)	
Patient starting position/stance	Seated in hard-back chair (with armrests), with feet supported. A pillow may be placed at the back of the chair to ensure feet supported on the ground.
iPad position relevant to patient start position	Directly to the side of the seated patient, able to visualise whole body.
Clinician Instructions & Testing Procedure based on Grade	<p>Prior to commencement of muscle tests:</p> <ul style="list-style-type: none"> - <i>I am now going to assess the strength of some of your leg muscles. We will first look at your ability to use these muscles against gravity. If you can hold against gravity, I will then ask you to apply a small amount of pressure and see if you can hold the position. I will then ask you to apply a lot of pressure and again see if you can hold the position. Please let me know if pain stops you from being able to apply sufficient force.</i> <p>Grade 3:</p> <ul style="list-style-type: none"> - <i>Sitting in the armchair can you lean forward slightly to be able to look at both feet on the ground. Have your feet a bit forward of the chair ensuring that they are flat on the floor.</i> - <i>Without lifting your foot, lift just your big toe off the floor as high as possible.</i> - <i>Now do the same movement with your other big toe.</i> <p>To visualise the first toe/side furthest from the iPad, ask patient to slide foot closest to iPad underneath chair for the tested foot/toe to be clearly visualised.</p> <ul style="list-style-type: none"> - <i>Does one side feel stronger than the other, or are they the same?</i> - <i>Observe for first toe extension ROM and note any differences between sides; if there is a difference, determine if this is due to pain, weakness, or a passive restriction.</i> <p>Grade 4 & 5:</p> <ul style="list-style-type: none"> - (Grade 4): <i>Now keeping your foot flat, lift your (left/right) big toe as high off the ground as possible again. Gently rest the big toe from your other foot on top of your (left/right) toenail). Can you keep the toe up if you apply minimal downward pressure?</i> - <i>Can you do the same with the other side? Does one side feel strong than the other, or are they the same?</i> - (Grade 5): <i>Now keeping your foot flat, lift your (left/right) big toe as high off the ground as possible again. Gently rest the big toe from your other foot on top of your (left/right) toenail). Can you keep the toe up if you apply small-moderate downward pressure?</i> - <i>Can you do the same with the other side? Does one side feel strong than the other, or are they the same?</i>
Maximum repetition allowance	Up to 3 times each side, per grade of strength (as applicable).
Assessment Responses	<p>Grading as per Oxford Manual Muscle Test (Rupp et al., 2021; Medical Research Council, 1943):</p> <ul style="list-style-type: none"> - 3 = Full range of motion against gravity - 4 = Full range of motion against gravity, moderate resistance - 5 = Full range of motion against gravity, maximal resistance
Link to video performance	Royal Brisbane & Women's Hospital Physiotherapy Department – Clinician Resources

Test: Ankle plantar flexion (ASIA S1)	
Patient starting position/stance	<p>Grade 3: Standing facing armchair, leaning forwards with arms on armrests for balance/support and knee of tested limb resting on chair (only to be attempted if Romberg's sign negative).</p> <p>Grade 4-5: Standing facing corner of room, with hands on wall for light balance/support only.</p>
iPad position relevant to patient start position	<p>Grade 3: Directly to the side of the seated patient, able to visualise whole body.</p> <p>Grade 4-5: Stationed in corner of room, with patient standing in opposite corner of room, as described above. Ensure posterior view of the ankles/feet.</p>
Clinician Instructions & Testing Procedure based on Grade	<p>Prior to commencement of muscle tests:</p> <ul style="list-style-type: none"> - <i>I am now going to assess the strength of some of your leg muscles. We will first look at your ability to use these muscles against gravity. If you can hold against gravity, I will then ask you to apply a small amount of pressure and see if you can hold the position. I will then ask you to apply a lot of pressure and again see if you can hold the position. Please let me know if pain stops you from being able to apply sufficient force.</i> <p>Grade 3:</p> <ul style="list-style-type: none"> - <i>Using the armrests for balance, rest your (left/right) knee up onto the chair so that foot is unsupported. From this position, point your toes up towards the ceiling, as far as you can go.</i> - Observe for ability to move through available ROM against gravity. If unable to achieve full PF ROM, determine if this is due to pain, weakness or a passive restriction. - Be aware of safety with respect to single-leg balance with chair. - **Should be tested on all patients to assess available ankle PF ROM for the purposes of Achilles Reflex. <p>Grade 4 & 5:</p> <ul style="list-style-type: none"> - <i>Using the wall for balance only, rise up on both feet as high as you can go.</i> - Observe bilateral heel raises (x 3 reps) for safety, capability and ROM. - If unable to achieve 3 reps of bilateral heel raises (with full available ROM), determine whether due to pain or weakness. - <i>Now standing on your (left/right) foot can you come all the way up onto your toes, and do that 10 times in a row, without a break.</i> - <i>Now do the same with the other side. Does one side feel stronger than the other, or are they the same?</i> - Make sure any upper limb support is for balance only. <p>Repeat test on opposite (unaffected) side.</p>
Maximum repetition allowance	Up to 3 times each side, per grade of strength (as applicable).
Assessment Responses	<p>Grading as per Oxford Manual Muscle Test (Rupp et al., 2021; Medical Research Council, 1943):</p> <ul style="list-style-type: none"> - 3 = Full range of motion against gravity - 4 = Full range of motion against gravity, between 1-9 repetitions achieved. - 5 = Full range of motion against gravity, 10 repetitions achieved.
Link to video performance	Royal Brisbane & Women's Hospital Physiotherapy Department – Clinician Resources

Strength tests (Myotomes) – Gravity minimised (Grade 0 - 2)

Test: Hip Flexion (ASIA L2)	
Patient starting position/stance	Side-lying on non-test side, pillow placed between legs to ensure neutral abduction/adduction of uppermost hip. Hip and knee both at 45* flexion (other ranges of hip flexion allowed as required).
iPad position relevant to patient start position	Stationed perpendicular to plinth, to visualise whole plinth (and patient in side-lying).
Clinician Instructions & Testing Procedure based on Grade	Gravity-minimised tests only to be performed if patient unable to achieve Grade 3 strength for equivalent muscle group. <ul style="list-style-type: none"> - <i>Lying on your side with both of your legs in a comfortable amount of hip and knee bend, and with the pillow between your legs. Keeping your pelvis still, now bring your uppermost knee towards your chest by bending at the knee and hip.</i> - Observe for any hip flexion movement. - <i>Is it pain or weakness that is restricting you?</i> <p>Muscle palpation point for Grade 0-1 (as appropriate & relevant): Psoas Major – place fingers halfway between the umbilicus and the anterior superior iliac spine (ASIS), gently pushing toward the posterior abdominal wall.</p> <p>Repeat test on opposite side by asking patient to place head at opposite head of the bed, still facing the iPad.</p>
Maximum repetition allowance	Up to 3 times each side.
Assessment Responses	Grading as per Oxford Manual Muscle Test (Rupp et al., 2021; Medical Research Council, 1943): <ul style="list-style-type: none"> - 0 = No visible or palpable contraction - 1 = Visible or palpable contraction with no motion - 2 = Full range of motion with gravity eliminated
Link to video performance	Royal Brisbane & Women's Hospital Physiotherapy Department – Clinician Resources

Test: Knee Extension (ASIA L3)	
Patient starting position/stance	Side-lying on non-test side, pillow placed between legs to ensure neutral abduction/adduction of uppermost hip. Hip at 45* flexion and knee in 90* flexion (other ranges of knee extension allowed as required).
iPad position relevant to patient start position	Stationed perpendicular to plinth, to visualise whole plinth (and patient in side-lying).
Clinician Instructions & Testing Procedure based on Grade	Gravity-minimised tests only to be performed if patient unable to achieve Grade 3 strength for equivalent muscle group.

	<ul style="list-style-type: none"> - <i>Lying on your side, start with both of your legs in a comfortable amount of hip and knee bend. From this position, please straighten your knee.</i> - Observe for any knee extension movement. - <i>Is it pain or weakness that is restricting you?</i> <p>Muscle palpation point for Grade 0-1 (as appropriate & relevant): Rectus Femoris – palpate RF on distal third of anterior thigh.</p> <p>Repeat test on opposite side by asking patient to place head at opposite head of the bed, still facing the iPad.</p>
Maximum repetition allowance	Up to 3 times each side.
Assessment Responses	<p>Grading as per Oxford Manual Muscle Test (Rupp et al., 2021; Medical Research Council, 1943):</p> <ul style="list-style-type: none"> - 0 = No visible or palpable contraction - 1 = Visible or palpable contraction with no motion - 2 = Full range of motion with gravity eliminated
Link to video performance	Royal Brisbane & Women's Hospital Physiotherapy Department – Clinician Resources

Test: Ankle dorsiflexion/inversion (ASIA L4)	
Patient starting position/stance	<p>Side-lying on non-test side, pillow placed between legs to ensure neutral abduction/adduction of uppermost hip, and ankles separated/supported by pillow.</p> <p>Hip and knee both at 45* flexion; ankle can be placed into various ranges of dorsiflexion as required.</p>
iPad position relevant to patient start position	Stationed perpendicular to plinth, to visualise whole plinth (and patient in side-lye) +/- ability to zoom in to patient's lower limbs throughout movement.
Clinician Instructions & Testing Procedure based on Grade	<p>Gravity-minimised tests only to be performed if patient unable to achieve Grade 3 strength for equivalent muscle group.</p> <ul style="list-style-type: none"> - <i>Lying on your side in a comfortable position with a pillow between your ankles, gently point your top foot downwards (or point your toes). Now from this position, bend your ankle so that your toes come up towards you.</i> - Observe for any ankle dorsiflexor movement. - <i>Is it pain or weakness that is restricting you?</i> <p>Muscle palpation point for Grade 0-1 (as appropriate & relevant): Tibialis Anterior – anterolateral upper third of shin (if able to self-palpate from test position).</p> <p>Repeat test on opposite side by asking patient to place head at opposite head of the bed, still facing the iPad.</p>
Maximum repetition allowance	Up to 3 times each side.
Assessment Responses	Grading as per Oxford Manual Muscle Test (Rupp et al., 2021; Medical Research Council, 1943):

	<ul style="list-style-type: none"> - 0 = No visible or palpable contraction - 1 = Visible or palpable contraction with no motion - 2 = Full range of motion with gravity eliminated
Link to video performance	Royal Brisbane & Women's Hospital Physiotherapy Department – Clinician Resources

Test: Extensor Hallucis Longus (ASIA L5)	
Patient starting position/stance	<p>Side-lying on non-test side, pillow placed between legs to ensure uppermost hip in neutral abduction/adduction and ankles separated/supported by pillow.</p> <p>Hip and knee both at 45* flexion; ankle can be placed into various ranges of dorsiflexion as required.</p>
iPad position relevant to patient start position	Stationed perpendicular (90* to the side) to plinth, to visualise whole plinth (and patient in side-lye) +/- ability to zoom in to patient's lower limbs throughout movement.
Clinician Instructions & Testing Procedure based on Grade	<p>Gravity-minimised tests only to be performed if patient unable to achieve Grade 3 strength for equivalent muscle group.</p> <ul style="list-style-type: none"> - <i>Lying on your side in a comfortable position, have your top foot relaxed and in a slightly pointed position. Now while keeping your ankle and foot still, bend your big toe up towards you.</i> - Observe for any big toe extension movement. - <i>Is it pain or weakness that is restricting you?</i> <p>Muscle palpation point for Grade 0-1 (as appropriate & relevant): Extensor Hallucis Longus – along shaft of first metatarsal (if able to self-palpate from test position)</p> <p>Repeat test on opposite side by asking patient to place head at opposite head of the bed, still facing the iPad.</p>
Maximum repetition allowance	Up to 3 times each side.
Assessment Responses	<p>Grading as per Oxford Manual Muscle Test (Rupp et al., 2021; Medical Research Council, 1943):</p> <ul style="list-style-type: none"> - 0 = No visible or palpable contraction - 1 = Visible or palpable contraction with no motion - 2 = Full range of motion with gravity eliminated
Link to video performance	Royal Brisbane & Women's Hospital Physiotherapy Department – Clinician Resources

Test: Ankle plantar flexion (ASIA S1)	
Patient starting position/stance	<p>Side-lying on non-test side, pillow placed between legs to ensure neutral abduction/adduction of uppermost hip, and ankles separated/supported by pillow.</p> <p>Hip and knee both at 45* flexion; ankle can be placed into various ranges of dorsiflexion as required.</p>
iPad position relevant to patient start position	Stationed perpendicular (90* to the side) to plinth, to visualise whole plinth (and patient in side-lye) +/- ability to zoom in to patient's lower limbs throughout movement.
Clinician Instructions & Testing Procedure based on Grade	<p>Gravity-minimised tests only to be performed if patient unable to achieve Grade 3 strength for equivalent muscle group.</p> <ul style="list-style-type: none"> - <i>Lying on your side in a comfortable position, bend your ankle so that your toes come up towards you. From this position, now point your toes and foot downwards as far as you can by bending your ankle.</i> - Observe for any ankle plantar flexion movement. - <i>Is it pain or weakness that is restricting you?</i> <p>Muscle palpation point for Grade 0-1 (as appropriate & relevant): Gastrocnemius – medial/lateral heads immediately distal to the posterior knee (if able to self-palpate from test position).</p> <p>Repeat test on opposite side by asking patient to place head at opposite head of the bed, still facing the iPad.</p>
Maximum repetition allowance	Up to 3 times each side.
Assessment Responses	<p>Grading as per Oxford Manual Muscle Test (Rupp et al., 2021; Medical Research Council, 1943):</p> <ul style="list-style-type: none"> - 0 = No visible or palpable contraction - 1 = Visible or palpable contraction with no motion - 2 = Full range of motion with gravity eliminated
Link to video performance	Royal Brisbane & Women's Hospital Physiotherapy Department – Clinician Resources

Deep Tendon Reflexes

Test: Patella reflex	
Patient starting position/stance	Seated on edge of plinth, feet and lower legs unsupported with knee approximately 90° flexion.
iPad position relevant to patient start position	45° angle from anterior of patient; able to clearly visualise correct position of hammer strike, and resultant knee extension.
Assistive Device	Reflex hammer
Clinician Instructions AND Test Procedure	<ul style="list-style-type: none"> - <i>Pick up the tendon hammer and sit on the middle of the bed with your legs relaxed over the edge. Make sure that your feet are not touching the ground.</i> - <i>First let's practice by briskly tapping the reflex hammer into your hand by holding the hammer as if you were about to hammer in a nail.</i> - Ensure patient can adequately hold and use the hammer; assessor to provide demonstration as required. - <i>Use your non-dominant hand to feel for the bottom edge of your kneecap. From there go a bit lower and you will be able to feel your patella tendon. Move your fingers back up to the bottom of your knee cap.</i> - <i>Hold the reflex hammer like we practiced, and now hit/tap the tendon below your fingers. Make sure your leg is completely relaxed.</i> - Monitor resultant ROM of the lower leg. - <i>Now are you able to try that on the other side. You don't need to swap hands with the reflex hammer.</i> <p>Additional information / cues:</p> <ul style="list-style-type: none"> - No facilitation (e.g. jaw clenching) introduced as part of examination. - Any repeats of test – can refine position and increase force as appropriate.
Maximum repetition allowance	Up to 3 times each side.
Assessment Responses	Grading as per Hallett et al. (1993): <ul style="list-style-type: none"> - 0 = reflex absent - 1 = reflex small, less than normal - 2 = reflex in lower half of normal range - 3 = reflex in upper half of normal range - 4 = reflex enhanced, more than normal ± clonus
Link to video performance	Royal Brisbane & Women's Hospital Physiotherapy Department – Clinician Resources

Test: Achilles Reflex	
Patient starting position/stance	<p>Standing facing armchair, leaning forwards with one arm on armrest for balance/support and knee of tested limb resting on chair and ankle/foot unsupported.</p> <p>Only to be attempted if Romberg's sign negative.</p>
iPad position relevant to patient start position	Directly to the side of chair/patient, able to visualise whole body and specifically ankle movement through range.
Assistive Device	Reflex hammer
Clinician Instructions AND Test Procedure	<ul style="list-style-type: none"> - Check available ankle ROM prior to commencing test (performed as part of the Grade 3 ASIA S1 myotome test) - <i>Now we are going to test your ankle reflexes. First let's practice by briskly tapping the reflex hammer into your hand by holding the hammer as if you were about to hammer in a nail.</i> - Ensure patient can adequately hold and use the hammer; assessor to provide demonstration as required. - <i>Keeping hold of the tendon hammer, stand facing the chair, hold one side of the chair and place your (left/right) knee on the chair, and let your (left/right) foot hand relaxed. Have at least the top half of your shin supported by the chair. As you need to, rest one hand on the top of the backrest of the chair and look backwards so that you can see the back of your ankle.</i> - <i>Hold the reflex hammer like we practiced, and now hit/tap the tendon on the back of your ankle. Make sure your foot/ankle is completely relaxed.</i> - Monitor resultant ROM of tested ankle. - Repeat on the other side. - Note that the patient can hold the reflex hammer in either hand and rotate trunk in either direction to best visualise ankle and perform test. <p>Additional information / cues:</p> <ul style="list-style-type: none"> - No facilitation (e.g. jaw clenching) introduced as part of examination. - Any repeats of test – can refine position and increase force as appropriate.
Maximum repetition allowance	Up to 3 times each side.
Assessment Responses	<p>Grading as per Hallett et al. (1993):</p> <ul style="list-style-type: none"> - 0 = reflex absent - 1 = reflex small, less than normal - 2 = reflex in lower half of normal range - 3 = reflex in upper half of normal range - 4 = reflex enhanced, more than normal ± clonus
Link to video performance	Royal Brisbane & Women's Hospital Physiotherapy Department – Clinician Resources

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