



# Musculoskeletal Neurological Examination

## In-person 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.

Published by the State of Queensland (Metro North Hospital and Health Service), May 2024



This document is licensed under a Creative Commons Attribution 3.0 Australia licence. To view a copy of this licence, visit [creativecommons.org/licenses/by/3.0/au](https://creativecommons.org/licenses/by/3.0/au)

© State of Queensland (Metro North Hospital and Health Service) 2024

You are free to copy, communicate and adapt the work, as long as you attribute the State of Queensland (Metro North Hospital and Health Service).

For more information, contact:

Physiotherapy Department, Metro North Hospital and Health Service, Level 2 Ned Hanlon Building, Royal Brisbane and Women's Hospital, Herston QLD 4029, phone (07) 3646 4319 for RBWH Physiotherapy Department.

An electronic version of this document is available at <https://metronorth.health.qld.gov.au/rbwh/healthcare-services/physiotherapy/mpsc>

Disclaimer:

The content presented in this publication is distributed by the Queensland Government as an information source only. The State of Queensland makes no statements, representations or warranties about the accuracy, completeness or reliability of any information contained in this publication. The State of Queensland disclaims all responsibility and all liability (including without limitation for liability in negligence) for all expenses, losses, damages and costs you might incur as a result of the information being inaccurate or incomplete in any way, and for any reason reliance was placed on such information.

## Summary:

The following (in-person) 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*”. The proforma was developed through collaboration between the RBWH Physiotherapy and Neurosurgery Departments, and was 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, and therefore this proforma was developed to ensure consensus between individuals and professions, as well as drawing on existing literature wherever relevant. Some in-person tests were slightly altered (e.g. patient test position) for the purposes of consistency with the equivalent telehealth proforma.

## Contents:

<b>Special Tests:</b>	
- Gait	3
- Toe Walk	3
- Heel Walk	4
- Romberg’s Sign	4
- Triceps Surae (Ankle) Clonus	5
- Babinski’s Sign	6
- Hoffman’s Sign	6
<b>Dermatomal (light touch sensation) tests</b>	<b>7</b>
<b>Strength tests (Myotomes) – Against Gravity (Grade 3 – 5)</b>	
- Hip Flexion (ASIA L2)	8
- Knee Extension (ASIA L3)	9
- Ankle dorsiflexion/inversion (ASIA L4)	10
- Extensor Hallucis Longus (EHL) (ASIA L5)	11
- Ankle plantar flexion (ASIA S1)	12
<b>Strength tests (Myotomes) – Gravity minimised (Grade 0 - 2)</b>	
- Hip Flexion (ASIA L2)	12
- Knee Extension (ASIA L3)	13
- Ankle dorsiflexion/inversion (ASIA L4)	14
- Extensor Hallucis Longus (EHL) (ASIA L5)	14
- Ankle plantar flexion (ASIA S1)	15
<b>Deep Tendon Reflexes:</b>	
- Patella Reflex	16
- Achilles Reflex	16

## Special Tests:

Test: Gait	
Patient starting position/stance	Standing in open space (+/- usual mobility aid) with adequate space to mobilise away from examiner
Clinician Instructions AND Test Procedure	<ul style="list-style-type: none"> <li>- <i>I would now like to watch you walk normally. Can you please walk away from me toward X [e.g. the far wall].</i></li> <li>- <i>And turn around and walk back toward me.</i></li> </ul> <p>Additional cues:</p> <ul style="list-style-type: none"> <li>- <i>Can you do that again?</i></li> <li>- <i>Can you now walk a little faster / slower?</i></li> <li>- <i>Does that feel normal?</i></li> </ul> <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, altered base of support, ataxic, shuffling, festinating, antalgic (Pirker &amp; Katzenschlager, 2017).</p>
Link to video performance	<a href="#">Royal Brisbane &amp; Women's Hospital Physiotherapy Department</a> – Clinician Resources

Test: Toe Walk	
Patient starting position/stance	Standing in open space (+/- usual mobility aid) with adequate space to mobilise away from examiner
Clinician Instructions AND Test Procedure	<p>Ensure examiner is able to observe heels - posterior view</p> <ul style="list-style-type: none"> <li>- <i>Standing up on your toes, please walk away from me.</i></li> <li>- May offer support for balance.</li> </ul> <p>Additional cues:</p> <ul style="list-style-type: none"> <li>- May need to demonstrate to patient prior to commencement of test.</li> <li>- <i>Right up on your toes</i></li> <li>- <i>As high as you can go</i></li> <li>- <i>(Does that feel the same?)</i></li> </ul> <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"> <li>- Observe for minimal heel drop from bilateral to single leg stance.</li> <li>- Difference reported by the patient (e.g., reported effort or pain)</li> <li>- Coordination of gait (see gait abnormalities listed under 'Gait').</li> </ul>
Link to video performance	<a href="#">Royal Brisbane &amp; Women's Hospital Physiotherapy Department</a> – 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.
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"> <li>- <i>Lifting the front of your feet off the ground, please walk towards me on your heels.</i></li> <li>- May offer support for balance</li> </ul> <p>Additional cues:</p> <ul style="list-style-type: none"> <li>- May need to demonstrate to patient prior to commencement of test.</li> <li>- <i>(Does that feel the same?)</i></li> </ul> <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"> <li>- Observe for equal and adequate dorsiflexion of toes and ankles through gait.</li> <li>- Observe for prominence of tendons, specifically EHL and tibialis anterior</li> <li>- Coordination of gait (see gait abnormalities listed under 'Gait')</li> </ul>
Link to video performance	<a href="#">Royal Brisbane &amp; Women's Hospital Physiotherapy Department</a> – Clinician Resources

Test: Romberg's Sign	
Patient starting position/stance	Standing without aid or lower limb support.
Clinician Instructions AND Test Procedure	<p>Standing within arm's reach of patient but not providing any assistance/support.</p> <ul style="list-style-type: none"> <li>- <i>Now standing facing me</i></li> <li>- <i>Start by standing with your feet close together, eyes open and hands by your side; try and hold still in this position for 10 seconds.</i></li> <li>- <i>And keeping your feet together, now close your eyes; try and hold still in this position for 10 seconds.</i></li> <li>- <i>Now keeping your eyes closed, please cross your arms across your chest; try and hold still in this position for 30 seconds.</i></li> </ul> <p>Progressive test* of balance applied (Centres for Disease Control and Prevention, 2020):</p> <ol style="list-style-type: none"> <li>1. <b>Feet close, eyes open (FCEO)</b> – aim for maximum 10 seconds</li> <li>2. <b>Feet close, eyes close (FCEC)</b> – aim for maximum 10 seconds</li> <li>3. <b>Feet close, eyes close (FCEC) + hands crossed</b> – aim for maximum 30 seconds</li> </ol> <ul style="list-style-type: none"> <li>- Assessor to stand to side of patient; count seconds out aloud.</li> <li>- Assessor prepared to offer support/assistance if fall is considered imminent.</li> </ul>

	* Progressive testing was applied to ensure consistency with telehealth examination proforma, where it was deemed appropriate for safety netting.
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 includes 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	<a href="#">Royal Brisbane &amp; Women's Hospital Physiotherapy Department</a> – Clinician Resources

<b>Test: Triceps Surae (Ankle) Clonus</b>	
Patient starting position/stance	Supine on plinth with single pillow under head.
Clinician Instructions AND Test Procedure	<ul style="list-style-type: none"> <li>- <i>This time I am going to stretch your ankle.</i></li> <li>- (check passive ankle dorsiflexion ROM for available range and any pain response prior to commencing formal test): <i>“Is that OK?”</i></li> <li>- <i>Now I'll do that again but faster. You do not need to do anything.</i></li> </ul> <p>Testing procedure:</p> <ul style="list-style-type: none"> <li>- Check passive ankle dorsiflexion ROM is comfortable (as described above).</li> <li>- If pain response apply test to less painful side first.</li> <li>- One hand supports lower leg with other hand on plantar surface of forefoot (ball of foot).</li> <li>- Ensure that brisk passive ankle dorsiflexion to end of available range is applied.</li> <li>- 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.</li> </ul>
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 = &gt;3 beats on any one attempt (Suri, 2021)</p>
Link to video performance	<a href="#">Royal Brisbane &amp; Women's Hospital Physiotherapy Department</a> – Clinician Resources

<b>Test: Babinski's Sign (Plantar response)</b>	
Patient starting position/stance	Supine on plinth with single pillow under head. Consideration of skin integrity; if concerned, do not proceed with test.
Clinician Instructions AND Test Procedure	<ul style="list-style-type: none"> <li>- <i>This time I am going to scratch the bottom of your foot with this [instrument]. Again you do not have to do anything.</i></li> </ul> <p>Testing procedure:</p> <ul style="list-style-type: none"> <li>- Tendon hammer in testing hand and support dorsum of tested foot with 'other' hand.</li> <li>- With pointed end of tendon hammer, scratch lateral border of sole of foot in the direction of the heel to the first toe.</li> <li>- Repeat with more firm pressure as required.</li> <li>- If uncertain (or response is mild), palpate dorsum of first toe distal phalanx for any dorsiflexor pressure (i.e. EHL contraction)</li> </ul> <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"> <li>- 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)</li> <li>- Negative = plantar flexion/down-going or no response elicited</li> </ul>
Link to video performance	<a href="#">Royal Brisbane &amp; Women's Hospital Physiotherapy Department</a> – Clinician Resources

<b>Test: Hoffman's Sign</b>	
Patient starting position/stance	Seated on edge of plinth, with feet supported* <i>* Patient position selected to ensure consistency with telehealth examination proforma.</i>
Clinician Instructions AND Test Procedure	<p><i>Keep your arm and hand relaxed as I hold your hand.</i></p> <p>Testing procedure:</p> <ul style="list-style-type: none"> <li>- Support patient hand and arm in pronation (or neutral) with slight wrist extension and finger flexion;</li> <li>- Check patient has relaxed hand and fingers;</li> <li>- Do not obstruct thumb or fingers;</li> </ul> <p>With your other hand 'snap' the nail of the middle finger into flexion.</p>
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"> <li>- Positive = flexion of the distal phalanx of the thumb / Adduction and flexion of the thumb <b>AND/OR</b> exaggerated finger flexion</li> </ul> <p>Care that the strength of the stimulus does not cause overflow movement of fingers.</p>
Link to video performance	<a href="#">Royal Brisbane &amp; Women's Hospital Physiotherapy Department</a> – Clinician Resources



## Dermatomal (light touch sensation) tests

Test: Sensation testing (L2 – S2)	
Patient starting position/stance	Supine
Clinician Instructions AND Test Procedure	<p>- <i>Now we are going to check your sensation with a tissue.</i></p> <p>Start with Forehead test (assuming no altered sensation) as baseline.</p> <p>- <i>Can you feel the tissue clearly?</i></p> <p>- <i>Does that feel normal to you?</i></p> <p>- <i>Now I am going to test different parts of each leg and, each time, I will ask you if they feel the same side to side and also if they feel 'normal' like your forehead. Please make sure that your eyes remain closed for the duration of the test.</i></p> <p>Test Procedure:</p> <ul style="list-style-type: none"> <li>- Each dermatomal level (L2-S2) is tested bilaterally.</li> <li>- Key sensory points (according to ASIA Impairment Scale (Rupp et al., 2021), include: <ul style="list-style-type: none"> <li>• L2: anterior-medial thigh at the midpoint drawn connecting midpoint of inguinal ligament &amp; medial femoral condyle</li> <li>• L3: Medial femoral condyle above the knee</li> <li>• L4: Medial malleolus</li> <li>• L5: Dorsal foot at third metatarsal phalangeal (MTP) joint</li> <li>• S1: Lateral heel (calcaneus)</li> <li>• S2: Midpoint of popliteal fossa.</li> </ul> </li> </ul> <p>Additional Clinician instructions/questions for testing at each level bilaterally:</p> <ul style="list-style-type: none"> <li>- <i>Does that feel the same?</i></li> <li>- <i>Does that feel equal between sides?</i></li> <li>- <i>And does that feel normal (compared to your forehead)?</i></li> </ul>
Maximum repetition allowance	Up to 3 times per dermatomal test side, per side.
Assessment Responses	<p>Grading as per ASIA Impairment Scale (Rupp et al., 2021):</p> <ul style="list-style-type: none"> <li>- 0 = absent</li> <li>- 1 = altered</li> <li>- 2 = normal / intact</li> </ul>
Link to video performance	<a href="#">Royal Brisbane &amp; Women's Hospital Physiotherapy Department</a> – Clinician Resources



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

Test: Hip Flexion (ASIA L2)	
Patient starting position/stance	Supine, with non-test hip in crook lying position if required for comfort.
Clinician Instructions & Testing Procedure based on Grade	<p><b>Prior to commencement of muscle tests:</b></p> <ul style="list-style-type: none"> <li>- <i>Lying on your back I am going to test your muscle strength. As these are tests for strength, I need you to tell me if any of these tests make your pain worse. As we move through the test, I will progressively add more resistance. I would like you to try and not let me move you.</i></li> </ul> <p><b>Grade 3:</b></p> <ul style="list-style-type: none"> <li>- Clinician standing ipsilateral side of bed, caudal to knee.</li> <li>- <i>Now bend your hip and knee up to 90* (or so your knee points towards the ceiling).</i></li> <li>- Observe if active ROM to 90* can be achieved; if unable, determine if limited by pain or weakness.</li> </ul> <p><b>Grade 4 &amp; 5:</b></p> <ul style="list-style-type: none"> <li>- Clinician standing ipsilateral side of bed, caudal to knee.</li> <li>- Bilateral hands grasp distal thigh with hip at 90* flexion.</li> <li>- <i>Keep your knee there and do not let me move you ... Keep it there.</i></li> <li>- Apply progressive resistance; cease at either break-point or unnecessary pain provocation.</li> </ul> <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"> <li>- 3 = Full range of motion against gravity</li> <li>- 4 = Full range of motion against gravity, moderate resistance in a muscle specific position</li> <li>- 5 = Full range of motion against gravity, maximal resistance in a muscle-specific position expected from an otherwise unimpaired person</li> </ul>
Link to video performance	<a href="#">Royal Brisbane &amp; Women's Hospital Physiotherapy Department</a> – Clinician Resources

Test: Knee Extension (ASIA L3)	
Patient starting position/stance	Supine
Clinician Instructions & Testing Procedure based on Grade	<p><b>Prior to commencement of muscle tests:</b></p> <ul style="list-style-type: none"> <li>- <i>Lying on your back I am going to test your muscle strength. As these are tests for strength, I need you to tell me if any of these tests make your pain worse. As we move through the test, I will progressively add more resistance. I would like you to try and not let me move you.</i></li> </ul> <p><b>Grade 3:</b></p> <ul style="list-style-type: none"> <li>- Clinician standing at ipsilateral side of bed, caudal to knee.</li> <li>- Assessor's forearm supports ipsilateral knee in flexion.</li> <li>- Palpate quadriceps throughout test.</li> <li>- <i>Please straighten your knee. Hold it there ...</i></li> <li>- Observe if active ROM to 0° can be achieved; if unable, determine if limited by pain or weakness.</li> </ul> <p><b>Grade 4 &amp; 5:</b></p> <ul style="list-style-type: none"> <li>- Assessor place other hand onto distal lower leg and provide downward force on the leg – assess for any movement.</li> <li>- <i>Now keep your knee straight and do not let me move you.</i></li> <li>- Apply progressive resistance; cease at break point or unnecessary pain provocation.</li> </ul> <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"> <li>- 3 = Full range of motion against gravity</li> <li>- 4 = Full range of motion against gravity, moderate resistance</li> <li>- 5 = Full range of motion against gravity, maximal resistance</li> </ul>
Link to video performance	<a href="#">Royal Brisbane &amp; Women's Hospital Physiotherapy Department</a> – Clinician Resources

<b>Test: Ankle dorsiflexion/inversion (ASIA L4)</b>	
Patient starting position/stance	Supine
Clinician Instructions & Testing Procedure based on Grade	<p><b>Prior to commencement of muscle tests:</b></p> <ul style="list-style-type: none"> <li>- <i>Lying on your back I am going to test your muscle strength. As these are tests for strength, I need you to tell me if any of these tests make your pain worse. As we move through the test, I will progressively add more resistance. I would like you to try and not let me move you.</i></li> </ul> <p>Test is performed bilaterally.</p> <p><b>Grade 3:</b></p> <ul style="list-style-type: none"> <li>- Clinician standing at the foot of the bed.</li> <li>- <i>Bend both ankles [feet] up towards your head.</i></li> <li>- Observe full range against gravity and note any differences between sides; if there is a difference, determine if this is due to pain, weakness, or a passive restriction.</li> <li>- Consider palpating tibialis anterior tendon as required.</li> </ul> <p><b>Grade 4 &amp; 5:</b></p> <ul style="list-style-type: none"> <li>- Crossing hands over to resist tibialis anterior (DF and inversion) holding the medial border of the foot including the first metatarsal.</li> <li>- <i>“Keep your feet there and do not let me move you.”</i></li> <li>- Apply progressive resistance; cease at break point or unnecessary pain provocation.</li> </ul>
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"> <li>- 3 = Full range of motion against gravity</li> <li>- 4 = Full range of motion against gravity, moderate resistance</li> <li>- 5 = Full range of motion against gravity, maximal resistance</li> </ul>
Link to video performance	<a href="#">Royal Brisbane &amp; Women’s Hospital Physiotherapy Department</a> – Clinician Resources

<b>Test: Extensor Hallucis Longus (EHL) (ASIA L5)</b>	
Patient starting position/stance	Supine
Clinician Instructions & Testing Procedure based on Grade	<p><b>Prior to commencement of muscle tests:</b></p> <ul style="list-style-type: none"> <li>- <i>I am going to test your muscle strength. As these are tests for strength, I need you to tell me if any of these tests make your pain worse. As we move through the test, I will progressively add more resistance. I would like you to try and not let me move you.</i></li> </ul> <p><b>Grade 3:</b></p> <ul style="list-style-type: none"> <li>- Clinician standing at the foot of the bed.</li> <li>- <i>Keep your feet there and pull your big toe up toward you.</i></li> <li>- Observe for full 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.</li> </ul> <p><b>Grade 4 &amp; 5:</b></p> <ul style="list-style-type: none"> <li>- Using index and or middle finger, assessor provides plantar flexor (PF) load over distal phalanx of first toe.</li> <li>- <i>Keep your big toe there and do not let me move you.</i></li> <li>- Apply progressive resistance; cease at break point or unnecessary pain provocation.</li> </ul>
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"> <li>- 3 = Full range of motion against gravity</li> <li>- 4 = Full range of motion against gravity, moderate resistance</li> <li>- 5 = Full range of motion against gravity, maximal resistance</li> </ul>
Link to video performance	<a href="#">Royal Brisbane &amp; Women's Hospital Physiotherapy Department</a> – Clinician Resources

<b>Test: Ankle plantar flexion (ASIA S1)</b>	
Patient starting position/stance	Standing, with light upper limb support (for balance only)
Clinician Instructions & Testing Procedure based on Grade	<ul style="list-style-type: none"> <li>- <i>Now stand with your fingers on the wall/bed for balance.</i></li> <li>- Observe bilateral heel raises (x 3 reps) for safety, capability and ROM.</li> <li>- <i>Now rise up on both feet onto your toes 3 times.</i></li> <li>- If unable to achieve 3 reps of bilateral heel raises (with full available ROM), determine whether due to pain or weakness.</li> </ul> <p><b>Grade 3:</b></p> <ul style="list-style-type: none"> <li>- <i>Using the wall for balance, bring one knee up so that it rests on the chair, and your foot is unsupported. Now point your toes up towards the ceiling, as far as you can go.</i></li> <li>- Observe full range against gravity and note any differences between sides; if unable to achieve full ROM, determine if this is due to pain, weakness or a passive restriction.</li> <li>- Be aware of safety with respect to single-leg balance with chair.</li> </ul> <p><b>Grade 4 &amp; 5:</b></p> <ul style="list-style-type: none"> <li>- <i>Now standing on your (right/left) foot next to the wall/plinth, come all the way up onto your toes, and do that 10 times in a row, without a break.</i></li> <li>- <i>Now do the same on the other side. Does one side feel stronger than the other, or are they the same?</i></li> <li>- Make sure any upper limb support is for balance only.</li> </ul> <p>Repeat test on opposite side.</p>
Maximum repetition allowance	Up to 3 times each side, per grade of strength (as applicable).
Assessment Responses	Grading as per Oxford Manual Muscle Test (Rupp et al., 2021; Medical Research Council, 1943): <ul style="list-style-type: none"> <li>- 3 = Full range of motion against gravity</li> <li>- 4 = Full range of motion against gravity, between 1-9 repetitions achieved.</li> <li>- 5 = Full range of motion against gravity, 10 repetitions achieved.</li> </ul>
Link to video performance	<a href="#">Royal Brisbane &amp; Women's Hospital Physiotherapy Department</a> – Clinician Resources

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

<b>Test: Hip Flexion (L1,2); ASIA L2</b>	
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).
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"> <li>- <i>Now try to bring you knee up towards your chest by bending your hip.</i></li> <li>- Observe for any hip flexion movement.</li> <li>- <i>Is it pain or weakness that is restricting you?</i></li> </ul> <p>Clinician muscle palpation point for Grade 0-1: Psoas Major – place fingers hallway between the umbilicus and the anterior superior iliac spine (ASIS), gently pushing toward the posterior abdominal wall.</p> <p>Repeat test on opposite (unaffected) side.</p>
Maximum repetition allowance	Up to 3 times each side.
Assessment Responses	<p>Grading as per Oxford Manual Muscle Test (Rupp et al., 2021):</p> <ul style="list-style-type: none"> <li>- 0 = No visible or palpable contraction</li> <li>- 1 = Visible or palpable contraction with no motion</li> <li>- 2 = Full range of motion with gravity eliminated</li> </ul>
Link to video performance	<a href="#">Royal Brisbane &amp; Women's Hospital Physiotherapy Department</a> – Clinician Resources

<b>Test: Knee Extension (ASIA L3)</b>	
Patient starting position/stance	<p>Side-lying on non-test side, pillow placed between legs to ensure neutral abduction/adduction of uppermost hip.</p> <p>Hip at 45* flexion and knee in 90* flexion (other ranges of knee extension allowed as required).</p>
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"> <li>- <i>Try to straighten your top knee.</i></li> <li>- Observe for any knee extension movement.</li> <li>- <i>Is it pain or weakness that is restricting you?</i></li> </ul> <p>Clinician muscle palpation point for Grade 0-1: Rectus Femoris – palpate RF on distal third of anterior thigh.</p> <p>Repeat test on opposite (unaffected) side.</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"> <li>- 0 = No visible or palpable contraction</li> <li>- 1 = Visible or palpable contraction with no motion</li> <li>- 2 = Full range of motion with gravity eliminated</li> </ul>
Link to video performance	<a href="#">Royal Brisbane &amp; Women's Hospital Physiotherapy Department</a> – Clinician Resources

<b>Test: Ankle dorsiflexion/inversion (L4,5); ASIA L4</b>	
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; ankle can be placed into various ranges of dorsiflexion as required.
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"> <li>- <i>Try to bend your foot (ankle) up towards you.</i></li> <li>- Observe for any ankle dorsiflexor movement.</li> <li>- <i>Is it pain or weakness that is restricting you?</i></li> </ul> Clinician muscle palpation point for Grade 0-1: Tibialis Anterior – anterolateral upper third of shin  Repeat test on opposite (unaffected) side.
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"> <li>- 0 = No visible or palpable contraction</li> <li>- 1 = Visible or palpable contraction with no motion</li> <li>- 2 = Full range of motion with gravity eliminated</li> </ul>
Link to video performance	<a href="#">Royal Brisbane &amp; Women's Hospital Physiotherapy Department</a> – Clinician Resources

<b>Test: Extensor Hallucis Longus (EHL) (ASIA L5)</b>	
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; ankle can be placed into various ranges of dorsiflexion as required.
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"> <li>- <i>Try to bend your big toe up towards you.</i></li> <li>- Observe for any knee extension movement.</li> <li>- <i>Is it pain or weakness that is restricting you?</i></li> </ul> Clinician muscle palpation point for Grade 0-1: Extensor Hallucis Longus – along shaft of first metatarsal.  Repeat test on opposite (unaffected) side.
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"> <li>- 0 = No visible or palpable contraction</li> <li>- 1 = Visible or palpable contraction with no motion</li> <li>- 2 = Full range of motion with gravity eliminated</li> </ul>
Link to video performance	<a href="#">Royal Brisbane &amp; Women's Hospital Physiotherapy Department</a> – Clinician Resources

<b>Test: Ankle plantar flexion (ASIA S1)</b>	
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; ankle can be placed into various ranges of dorsiflexion as required.
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"> <li>- <i>Try to point your foot (ankle) down as far as you can.</i></li> <li>- Observe for any knee extension movement.</li> <li>- <i>Is it pain or weakness that is restricting you?</i></li> </ul> Clinician muscle palpation point for Grade 0-1: Gastrocnemius – medial/lateral heads immediately distal to the posterior knee.  Repeat test on opposite (unaffected) side.
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"> <li>- 0 = No visible or palpable contraction</li> <li>- 1 = Visible or palpable contraction with no motion</li> <li>- 2 = Full range of motion with gravity eliminated</li> </ul>
Link to video performance	<a href="#">Royal Brisbane &amp; Women's Hospital Physiotherapy Department</a> – Clinician Resources

## Deep Tendon Reflexes

<b>Test: Patella reflex</b>	
Patient starting position/stance	Seated on edge of plinth, feet and lower legs unsupported with knee approximately 90° flexion.
Clinician Instructions AND Test Procedure	<ul style="list-style-type: none"> <li>- Assessor palpates location of proximal patella tendon during test for any response.</li> <li>- <i>Now I want to test your knee reflexes. Just let your legs hang there.</i></li> <li>- Tendon hammer commences at horizontal and with slight swing hits inferior to fingers in mid-tendon.</li> <li>- Monitor ROM of the lower leg.</li> </ul> <p>Additional information / cues:</p> <ul style="list-style-type: none"> <li>- No facilitation (e.g., jaw clenching) introduced as part of examination.</li> <li>- Any repeats of test – can refine position and increase force as appropriate.</li> </ul>
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"> <li>- 0 = reflex absent</li> <li>- 1 = reflex small, less than normal</li> <li>- 2 = reflex in lower half of normal range</li> <li>- 3 = reflex in upper half of normal range</li> <li>- 4 = reflex enhanced, more than normal ± clonus</li> </ul>
Link to video performance	<a href="#">Royal Brisbane &amp; Women's Hospital Physiotherapy Department</a> – Clinician Resources

<b>Test: Achilles Reflex</b>	
Patient starting position/stance	Seated on edge of plinth, feet unsupported
Clinician Instructions AND Test Procedure	<ul style="list-style-type: none"> <li>- Check available ankle ROM prior to commencing test.</li> <li>- <i>Now I want to test your ankle reflexes. I just want you to relax your leg as much as possible.</i></li> <li>- Slowly extend knee passively (be mindful of neuromechanosensitivity)</li> <li>- Assessor places hand on ball of foot and with minimal effort passive DF ankle / palpating tibialis anterior to ensure relaxed.</li> <li>- Tendon hammer commencing 45° above vertical, swings through vertical and strike distal 1/3 of Achilles tendon.</li> </ul> <p>Additional information / cues:</p> <ul style="list-style-type: none"> <li>- No facilitation (e.g., jaw clenching) introduced as part of examination.</li> </ul> <p>Any repeats of test – can refine position and increase force as appropriate.</p>
Maximum repetition allowance	Up to 3 times each side.

Assessment Responses	Grading as per Hallett et al. (1993): <ul style="list-style-type: none"> <li>- 0 = reflex absent</li> <li>- 1 = reflex small, less than normal</li> <li>- 2 = reflex in lower half of normal range</li> <li>- 3 = reflex in upper half of normal range</li> <li>- 4 = reflex enhanced, more than normal ± clonus</li> </ul>
Link to video performance	<a href="#">Royal Brisbane &amp; Women's Hospital Physiotherapy Department</a> – Clinician Resources

## References:

- Centres for Disease Control and Prevention. (2020). *National Health and Nutrition Examination Survey (NHANES): Balance Manual*. Retrieved from <https://wwwn.cdc.gov/nchs/nhanes/continuousnhanes/manuals.aspx?BeginYear=2019>
- Cook, C., Roman, M., Stewart, K. M., Leithe, L. G., & Isaacs, R. (2009). Reliability and diagnostic accuracy of clinical special tests for myelopathy in patients seen for cervical dysfunction. *J Orthop Sports Phys Ther*, 39(3), 172-178. <https://doi.org/10.2519/jospt.2009.2938>
- Farmer, J., Anning, J., Baxter, B., Matthews, L., McLean, R., Nolan, D., Simmons, N., Williams, E., & Swete Kelly, P. (2021). *Neurological exam in musculoskeletal physiotherapy*. State of Queensland: Queensland Health
- Hallett, M. (1993). NINDS myotatic reflex scale. *Neurology*, 43(12), 2723. <https://doi.org/10.1212/wnl.43.12.2723>
- Medical Research Council, & University of Edinburgh. (1943). *Aids to Investigation of Peripheral Nerve Injuries. Medical Research Council Memorandum no. 7*. Her Majesty's Stationary Office.
- Pirker, W., & Katzenschlager, R. (2017). Gait disorders in adults and the elderly: A clinical guide. *Wiener klinische Wochenschrift (The Central European Journal of Medicine)*, 129, 81-95. <https://doi.org/10.1007/s00508-016-1096-4>
- Rupp, R., Biering-Sørensen, F., Burns, S. P., Graves, D. E., Guest, J., Jones, L., Read, M. S., Rodriguez, G. M., Schuld, C., Tansey-Md, K. E., Walden, K., & Kirshblum, S. (2021). International Standards for Neurological Classification of Spinal Cord Injury: Revised 2019. *Top Spinal Cord Inj Rehabil*, 27(2), 1-22. <https://doi.org/10.46292/sci2702-1>
- Suri, V. (2021). Reflexes. In V. Suri (Ed.), *Clinical Neurological Examination and Localization* (pp. 91-99). Springer Singapore. [https://doi.org/10.1007/978-981-16-1228-2\\_7](https://doi.org/10.1007/978-981-16-1228-2_7)