

The Spine Physical Examination Using Telemedicine: Strategies and Best Practices



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Abstract

Study Design: Technical note.

Objectives: To provide spine surgeons new to telemedicine with a structured physical examination technique based on manual motor testing principles.

Methods: Expert experience describing a series of specific maneuvers for upper and lower extremity strength testing that can be performed using a telemedicine platform. In addition, we offer instruction on “setting up” for these visits and highlight special tests that can be used to diagnose specific cervical and lumbar spine conditions.

Results: From our experiences in conducting telemedicine visits, we provide a means of testing and scoring upper and lower extremity strength for interpretation of weakness in the context of traditional manual motor testing. Also, we acknowledge the limitations of a remote examination and discuss maneuvers that cannot be performed remotely.

Conclusions: COVID-19 has drastically altered the delivery of care for patients with spine-related complaints. The need for social distancing has led to the widespread adoption of telemedicine. This technical note provides an urgently needed framework for the standardization of the remote physical exam. Validation of the exam as a diagnostic tool will be a crucial next step in studying the impact of telemedicine.

Keywords

telemedicine, telehealth, physical exam, remote exam, spine

Introduction

The COVID (coronavirus disease) pandemic has strained health care resources worldwide and necessitated drastic changes in several industries. Spine surgery has not been exempt from these changes; social distancing, and the need to divert health care resources have led to the cancellation of elective surgeries and the widespread adoption of telemedicine.^{1,2} Expert opinion estimates that certain restrictions may persist for at least 12 to 18 months.³

Fortunately, the push toward telemedicine has been accompanied by changes in health care policy and reimbursement that have lowered barriers to adoption.⁴ These large-scale practice shifts make it likely that telemedicine will remain an important mode of care delivery even after the COVID-19 pandemic has resolved. Indeed, the remote delivery of clinical care services has been growing for decades, with increasing utilization in

general surgery, medical education, rural medicine, and other surgical subspecialties.⁵⁻⁷ Musculoskeletal medicine providers have used telehealth services for consultations, outpatient care, and postoperative rehabilitation.⁸⁻¹⁰

However, the practical delivery of telemedicine in spine surgery remains a challenge. While it is relatively straight forward to obtain an accurate patient history, the “remote physical exam” is an oxymoron. A thorough physical exam is a critical component of the spine office visit and frequently underpins

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the treatment plan.⁷ Unfortunately, as the pandemic has affected a sea change in practice seemingly overnight, the field of spine surgery has not benefitted from the accumulation and dissemination of expertise that typically accompanies such drastic changes. Furthermore, an expedited study designed to validate a telemedicine exam would be precluded by COVID-19 restrictions designed to decrease nonessential care. Thus, there is clearly an urgent need for a description of remote spine physical examination practices to assist providers that have been forced overnight into conducting telehealth visits. To our knowledge, there are no descriptions of best practices for a remote spine physical examination. The purpose of this article is to summarize our practices when performing a telehealth visit and offer a framework for providers performing remote physical examinations of the spine.

Requirements for Telehealth

Telehealth requires both providers and patients to have access to a video conferencing system. During the COVID-19 pandemic, the Department of Health and Human Services (HHS) has authorized providers to use popular, non-HIPAA compliant platforms (FaceTime, Skype, Zoom, etc) to deliver remote care.¹¹ Of note, these exemptions may not stand once the pandemic resolves.

Patients may use a smartphone, tablet, laptop, or desktop computer to interface with their provider. In our experience, a smartphone is the most effective means through which to conduct a telehealth visit; it is portable, usually has front and rear facing cameras, and because patients can connect to the internet via cellular reception or Wi-Fi, there tend to be fewer connectivity issues.

For new patient visits, we recommend that the patient have someone else in the room with them if possible. This allows their friend or family member to adjust the camera throughout the physical exam. The remote examination should be performed in a comfortable and quiet setting. Patients should be dressed in shorts and either a t-shirt or tank top/sleeveless shirt. A reasonably large room is required so that there is sufficient space to capture a “head to toe” view of the patient. In our experience, at least 10 ft of space is needed. The remaining requirements for the examination are relatively ubiquitous: a standard height chair with arms and a table (for support).

Barriers to the Remote Physical Exam

Notably, this evaluation may not be possible in all populations or settings. From a patient safety and medicolegal perspective, examiners must err on the side of caution when asking patients to perform some exam maneuvers, especially in certain patient subgroups. Elderly patients with debilitating spinal pathology may not be able to complete various portions of the physical exam secondary to deconditioning or instability. We therefore recommend that patients within this demographic complete the more demanding aspects of the exam with an able-bodied assistant (ie, gait examination, transitioning from standing to supine).

Furthermore, some patients may experience issues with the telehealth platform itself, whether it be unfamiliarity, connection difficulties, or simply “computer anxiety.” As with any patient interaction, patience and awareness are crucial elements in performing this exam.

Preserving Patient Rapport

There are several intangible aspects of a face-to-face visit that cannot be replaced by a remote visit. Telemedicine services have the potential to deteriorate trust in the doctor-patient relationship, especially in the context of a new consultation.¹²

Patients may be happy to walk the hallways in your office knowing that you are observing their gait; however, this is less apparent to them when they are walking in their house and you are only present over the camera. For this reason, it is important to be vocal throughout the examination and share your thought process whenever possible, for example, “I am looking to see how you are walking. I’m checking for a limp and your overall posture. They both look good to me.” This type of interaction helps build rapport, reassures the patient that they are being fully evaluated and helps them feel you are “present” for their encounter.

General Physical Examination

Please refer to Video 1 for demonstrations of the following physical examination.

Inspection and Range of Motion

If there is no one available to assist the patient during the visit, the patient can place their phone on a desk facing a hallway or directed into the room. The patient then takes 5 to 10 steps away from the camera. At this point, we have them turn and face the examiner (camera). A general inspection is performed looking for any obvious shoulder asymmetry, pelvic obliquity, or coronal plane deformity. We then examine the patients in profile looking for any obvious sagittal imbalance and other signs of compensation (eg, knee flexion or ankle flexion).

Next, we assess range of motion (ROM), beginning with the cervical spine. Flexion, extension, lateral bending, and rotation are all assessed. Moving caudally, these maneuvers are repeated for the thoracic and lumbar spine: trunk rotation, lateral bending, and lumbar flexion and extension. Note any movements that are painful or reproduce the patient’s symptoms. In the elderly patient, we recommend keeping a chair nearby to assist in balance.

Gait

Following the ROM examination, patients take 5 to 10 steps toward the camera, turn counterclockwise, and return to their starting position. In our experience, this distance is usually enough to notice an abnormal gait pattern (eg, Trendelenburg gait, steppage gait, etc) or asymmetry through the stance and

swing phases. Next, a tandem gait is performed to evaluate balance. Performing this portion of the exam by a wall is preferred in case the patient loses their balance.

Evaluation of the Cervical Spine (Neck and Upper Extremities)

Inspection and Range of Motion

The examination should be conducted with the camera placed at a level that will allow for visualization of the head, shoulders, elbows, and hands. Neck ROM is generally assessed with gait (see above) but can be assessed at this point if a more focused physical is being performed.

Active shoulder ROM can be evaluated in this position and can be helpful in identifying shoulder pathology contributing to pain.¹³ Forward flexion, abduction, internal rotation, and external rotation can all be easily assessed over camera. We then ask patients to hold both hands to the camera; a comparison can be made looking for any atrophy or intrinsic wasting. Subtle atrophy can be nearly impossible appreciate over the camera but obvious thenar or interosseous atrophy will generally be apparent.

Strength and Sensation

Generally, the patient is asked to “show” where they are numb. While this is usually sufficient, if more subtle sensory loss is

suspected or the patient description is unclear, we direct the patient to assess for pinprick. We generally show them on our own hands and arms where they should touch and ask them to report if they have more or less sensation compared to the opposite side. The patient can then repeat the process using an unfolded paperclip or a toothpick.

Upper extremity strength can be tested by having the patients shoulder shrug (trapezius), abduct their shoulder (deltoid), flex their arm (bicep), extend their arms overhead (triceps), flex and extend their wrists and fingers. If available, having the patient perform these movements with a 5- to 10-lb weight (or a book, milk jug, or any other small, heavy object) can confirm at least 4/5 strength. We utilize a modified strength testing scale described in Table 1.

In a remote examination, the presence or absence of asymmetry in strength is critical to assess. While it can be difficult to determine if someone has the equivalent of 5/5 strength on the Manual Motor Testing (MMT) scale, asymmetry in strength is usually apparent even with relatively low demand (eg, 5-10 lb) tasks. This can help localize the level and side of symptomatology in addition to pain complaints. Atrophy of larger muscle groups (deltoid, bicep, triceps) is also easier to appreciate over a remote visit. For the purposes of the remote visit, we propose a modified scoring scale, with a score of 0 equal to an MMT score of <3 (ie, “nonfunctional,” including muscle flicker or absence of activation). We do not propose testing with gravity eliminated (MMT strength = 2) as this may increase demands in positioning.

Table 1. Modified Upper Extremity Motor Testing Scale for Telemedicine.

Muscle group	Nerve root	Strength	Description
Deltoid	C5	0	Absence of any muscle activation
		1	Able to abduct shoulder against gravity
		2	Able to abduct shoulder with 5-10 lb of resistance (dumbbell, etc)
		3	<i>Difficult to assess; can consider full strength if able to abduct shoulder with weight >10 lbs</i>
Bicep	C5, C6	0	Absence of any muscle activation
		1	Able to flex elbow against gravity
		2	Able to flex elbow with 5-10 lb of resistance (dumbbell, etc)
		3	<i>Difficult to assess; can consider full strength if able to flex elbow with weight >10 lbs</i>
Triceps	C6, C7	0	Absence of any muscle activation
		1	Able to extend elbow against gravity
		2	Able to extend elbow with 5-10 lb of resistance (dumbbell, etc)
		3	<i>Difficult to assess; can consider full strength if able to extend elbow with weight >10 lbs</i>
Wrist extensors	C6	0	Absence of any muscle activation
		1	Able to extend wrist against gravity
		2	Able to extend wrist with 2-5 lb of resistance (dumbbell, etc)
		3	<i>Difficult to assess; can consider full strength if able to extend wrist with weight >5 lbs</i>
Finger flexors	C8	0	Absence of any muscle activation
		1	Able to make a full fist in pronation
		2	Able to make a full fist in pronation with some resistance from contralateral hand
		3	<i>Difficult to assess; can consider full strength if make a full fist with near full resistance from contralateral hand</i>
Finger abduction	C8, T1	0	Absence of any muscle activation
		1	Able to abduct fingers with palm perpendicular to flat surface
		2	Able to abduct fingers fully with some resistance from contralateral hand
		3	<i>Difficult to assess; can consider full strength if able to abduct fingers fully with near full resistance from contralateral hand</i>

Special Testing

A modified Spurling's maneuver should be conducted: the patient should be asked to extend at the neck fully, with lateral bending to the right and left shoulder. Reproduction of symptoms, especially with radiation into the upper extremity, denotes a positive test.¹⁴ Similarly, we recommend that patients be evaluated for a Lehermitte's sign: from a seated position the patient should flex slightly forward at the torso, with full neck flexion. The presence of an "electric shock sensation" indicates a positive test for cervical cord compression.¹⁵

Evaluation of Myelopathy

Several clinical tests for myelopathy (the Hoffman sign, hyperreflexia, and clonus) cannot be performed over a telemedicine visit. However, in cases of suspected myelopathy, there are other tests the providers may perform. Table 2 summarizes common tests for myelopathy and whether they can be performed over a remote visit.

Gait and balance can be assessed as described above. Difficulty with tandem gait is usually easy to determine. In older patients or those with more functional limitations, a Romberg test can also be performed to assess for balance. The patient is asked to stand with their feet placed together. The patient should then be instructed to close their eyes; inability to maintain this posture for 30 seconds is indicative of a positive result.¹⁶

Evaluation of the Lumbar Spine (Low Back and Lower Extremities)

Inspection and Range of Motion

This is typically performed as part of the general examination as previously described. For complaints of lower back pain, patients should be asked to turn away from the camera and put

their finger on any area that is point tender. This is especially useful if the history and imaging suggests sacroiliac joint pathology or Bertolotti's syndrome.

Strength and Sensation

Sensation of the lower extremities is assessed in the same manner as the upper extremities, using pinprick if necessary. Lower extremity strength can be assessed through evaluation of hip flexion (iliopsoas), knee extension (quadriceps), ankle dorsiflexion (tibialis anterior), great toe extension (extensor hallucis longus), and ankle plantarflexion (gastrocnemius-soleus complex). In lieu of classic manual muscle testing, we propose a series of functional, bodyweight movements as a surrogate neurologic evaluation of the lower extremities (Table 3).

While performing these tests, the examiner should pay close attention to any perceived or reported difficulty, unilateral weakness, and imbalance. With assessment of tibialis anterior, extensor hallucis longus and calf strength, the examiner should pay close attention to any drop of the tested extremity. Again, these findings must be correlated closely with information gathered from presenting history to help the examiner identify overlapping hip or knee pathology.

Special Testing

There are 3 special tests pertinent to low back or lower extremity complaints that may be performed in the remote setting (Table 4). Of note, the active straight leg raise can be used for two purposes: the first is to note any nerve tension and the second is to isolate hip pathology. Groin pain with active straight leg raise is suspicious for hip osteoarthritis. Should the patient have difficulty transitioning to the supine position, the straight leg raise can be performed in the seated position:

Table 2. Special Tests for Myelopathy That May Be Performed in a Telemedicine Visit.

Test	Description	Positive result	Able to be performed in the telemedicine setting?
Hoffman sign	With long finger proximal interphalangeal joints in full extension flexion/snapping of distal interphalangeal	Flexion of thumb and index interphalangeal joints	No
Reflex exam	Reflex hammer evaluation of myotendinous reflex arcs	Hyperreflexia suggestive of long tract findings	No
Inverted Brachioradial reflex	Tapping distal brachioradialis tendon	Ipsilateral finger flexion (supinator reflex)	No
Finger escape sign	Fingers held in adducted and extended position for 30 seconds	Ulnar drift and flexion of ring and small fingers	Yes
Grasp and release test	Beginning with an open palm, the patient is instructed to grip and release their fingers as many times as possible within a period of 10 seconds.	Inability to complete 20 repetitions within 10 seconds suggestive of underlying myelopathy	Yes
10-second step test	In standing position, patient "marches" in place, taking alternating high steps raising hips to 90° of flexion. Number of alternating steps in 10 seconds recorded	Inability to take 20 total steps within 10 seconds suggestive on underlying myelopathy	Yes

Table 3. Modified Lower Extremity Motor Testing Scale for Telemedicine.

Muscle group	Nerve root	Strength	Description
Iliopsoas ^a	L1, L2, L3	0	Absence of any muscle activation
		1	Able to flex hip against gravity (allow knee to passively flex, chair for balance)
		2	Able to flex hip against gravity, and maintain (allow knee to passively flex, chair for balance)
		3	<i>Difficult to assess; can consider full strength if flex hip against gravity and maintain without difficulty</i>
Quadriceps ^b	L2, L3, L4	0	Absence of any muscle activation
		1	Able to perform a single leg raise from chair with support
		2	Able to perform a single leg raise from chair without support, moderate difficulty
		3	<i>Difficult to assess; can consider full strength if able to perform a single leg raise from a chair without support or perceived difficulty</i>
Tibialis anterior	L4	0	Absence of any muscle activation
		1	Able to raise onto heels, unable to maintain
		2	Able to raise onto heels and maintain this position for 10 seconds
		3	<i>Difficult to assess; can consider full strength if able to raise onto heels and perform lateral walks for 10 paces</i>
Gastrocnemius-soleus complex	S1	0	Absence of any muscle activation
		1	Able to raise onto toes, unable to maintain
		2	Able to raise onto toes (raise heels) and perform 10 heel raises, with some difficulty
		3	<i>Difficult to assess; can consider full strength if able to perform 10 repetitions of heel raises without perceived difficulty</i>

^a May be performed in seated position if patient unable to balance.

^b If unable to perform single leg raise, may perform knee extension and attempt to maintain against gravity

Table 4. Special Tests for Lower Back or Lower Extremity Pathology That May Be Performed Through Telemedicine.

Test	Description	Positive result	Able to be performed in the telemedicine setting?
Babinski	Sharp instrument ran along plantar foot, calcaneus to lateral border of midfoot/forefoot	Dorsiflexion and splaying of toes (upgoing response)	No
Sustained clonus	Rapid dorsiflexion of foot	Sustained (>5 beats) contraction of foot	No
Reflex exam	Reflex hammer evaluation of myotendinous reflex arcs	Hyporeflexia suggestive of short tract findings (lower motor neuron disease)	No
Single leg stance (SLS) test	Beginning in the standing position, the patient is first asked to flex one leg to 90°, allowing knee to passively flex and maintain this position	Inability to maintain stance for 30 seconds indicative of L5 pathology (may overlap with hip pathology)	Yes
5-repetition sit-to-stand (5 R STS) test	From seated position, the patient is asked to stand fully on hearing the starting queue ("Go") and subsequently sit again, touching the seat firmly. This maneuver is repeated for 5 cycles.	Total time >15 seconds associated with worse overall lower extremity function and disability	Yes
Straight leg raise (SLR)	From the supine position, patient acted to actively flex their hip, keeping knee extended	Pain with hip flexion beyond 30° suggestive of herniated nucleus pulposus (HNP). Inability to perform straight leg raise suggestive of iliopsoas weakness	Yes

with the patient hips and knees flexed to 90°, the patient is instructed to fully extend one leg and further flex at the hip.

Discussion

COVID-19 has drastically altered the delivery of care for patients with spine-related complaints. In order to promote the

necessary social distancing to control the pandemic, various agencies have loosened regulations and incentivized providers to employ telemedicine whenever possible.^{2,4} However, near-universal access to video conferencing and inherent conveniences of telemedicine have long supported increased adoption across multiple specialties.¹⁷ Even before COVID-19, the virtual health care market was expected to exceed

\$64 billion by 2025.¹⁸ As early as 2016, the American Medical Association initiated a policy requiring medical schools to incorporate telemedicine training into their curriculum.¹⁹ In addition, systematic reviews and randomized trials have concluded that telehealth visits tend to be nearly equivalent to in-person visits across many metrics.^{20,21} Thus, while our foray into telemedicine has been accelerated by recent circumstances, telemedicine will almost certainly form an increasingly large part of spine care.²²

As we move forward with telehealth practices, spine care providers will be forced to redefine learned methods of establishing diagnoses and treatment plans. In this sense, the telemedicine exam is not meant to replace the physical exam, but rather serve as a surrogate or marker for findings that we have traditionally relied on to make diagnoses. Direct comparisons of telemedicine exams to in-person exams are inherently problematic as no true “gold standard” method has been previously validated; furthermore, traditional physical exams are also notorious for variations between examiners.²³⁻²⁵ Rather, the telemedicine exam must play the same role as the in-person exam—as one part of the overall patient evaluation. As with all “new” things in spine surgery, the ultimate test of telemedicine is not whether it can replicate an in-person physical exam, but whether it is able to lead to the same long-term outcomes as traditional modes of care delivery.

In conclusion, we have provided a simple remote exam method that spine providers can use when conducting a telehealth visit in order to augment their ability to diagnose and treat patients. While current COVID-19 restrictions have precluded our ability to compare the exam to in-person evaluations, we have utilized these strategies for virtual health care in our center and believe they can be of use to surgeons new to telehealth. Furthermore, we hope this manuscript inspires conversations about other methods or tests surgeons have utilized. We firmly believe that defining optimal telemedicine practices is crucial to success in the current healthcare environment. As spine telemedicine continues beyond the COVID-19 pandemic, future study will be needed to determine whether surgeons can provide the same level of care using novel technologies and evaluation techniques.


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Supplemental Material

A supplemental video for this article is available online.

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