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Special Article

An Algorithmic Approach to the Physical Exam for the Pain Medicine Practitioner: A Review of the Literature with Multidisciplinary Consensus

Sayed E. Wahezi, MD,* Robert Duarte, MD,† Chong Kim, MD,‡ Nalini Sehgal, MD,§ Charles Argoff, MD,¶ Kristina Michaud, DO,| Michael Luu, DO,| Joseph Gonnella,|| and Lynn Kohan, MD|

*Department of Physical Medicine and Rehabilitation, Montefiore Medical Center, Bronx, New York, USA; †Department of Neurology, Northwell Health, Great Neck, New York, USA; ‡Department of Physical Medicine and Rehabilitation, Metro Health, Cleveland, Ohio, USA; §Department of Physical Medicine and Rehabilitation, University of Wisconsin Health, Madison, Wisconsin, USA; ¶Department of Neurology, Albany Medical Center, Albany, New York, USA; |Department of Anesthesiology, University of Virginia Health System, Charlottesville, Virginia, USA; and ||Department of Anesthesiology, Sidney Kimmel Medical College, Philadelphia, Pennsylvania, USA

Correspondence to: Sayed E. Wahezi, MD, Pain Medicine, Department of Physical Medicine and Rehabilitation, Montefiore Medical Center, 111 East 210th Street Bronx, NY 10467-2401, USA. Tel: (718) 920-7246; Fax: (718) 920-2287; E-mail: swahezi@montefiore.org.

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Abstract

Background. Increased utilization of telemedicine has created a need for supplemental pain medicine education, especially for the virtual physical assessment of the pain patient. Traditional clinical training utilizes manual and tactile approaches to the physical examination. Telemedicine limits this approach and thus alternative adaptations are necessary to acquire information needed for sound clinical judgement and development of a treatment plan. Clinical assessment of pain is often challenging given the myriad of underlying etiologies contributing to the sensory experience. The COVID-19 pandemic has led to a dramatic increase in the use of virtual and telemedicine visits, further complicating the ease of assessing patients in pain. The increased reliance on telemedicine visits requires clinicians to develop skills to obtain objective information from afar. While eliciting a comprehensive history and medication assessment are performed in a standard fashion via telemedicine, a virtual targeted physical examination is a new endeavor in our current times. In order to appropriately diagnose and treat patients not directly in front of you, a pivot in education adaptations are necessary. **Objective.** To summarize best care practices in the telemedicine physical exam while presenting an algorithmic approach towards virtual assessment for the pain practitioner. **Design.** Review of the literature and expert multidisciplinary panel opinion. **Setting.** Nationally recognized academic tertiary care centers. **Subjects.** Multidisciplinary academic experts in pain medicine. **Methods.** Expert consensus opinion from the literature review. **Results.** An algorithm for the virtual physical exam for pain physicians was created using literature review and multidisciplinary expert opinion. **Conclusions.** The authors here present simple, comprehensive algorithms for physical exam evaluations for the pain physician stemming from a review of the literature.

Key Words: Telemedicine Exam; Algorithmic Approach for Pain Physical Exam; Algorithmic Approach for Physical Exam; Virtual Medicine; Virtual Physical Exam

Introduction

Clinical assessment of pain is often challenging given the myriad of underlying etiologies contributing to the sensory experience. The COVID-19 pandemic led to an increase in the use of virtual and telemedicine visits [1], complicating the comprehensive pain assessment by limiting physical examination feasibility and reliability. The increased reliance on telemedicine visits requires clinicians to sharpen passive evaluation techniques [2]. While the interview portion of a patient visit conducts in a standard way, (obtaining comprehensive history of present illness, past medical history, past surgical history, review of systems, allergies, current medication list, etc.) a targeted physical examination is an essential component to elucidating the diagnosis, which can be challenging via virtual medicine.

While obtaining a thorough history is unlikely to be limited by the use of a telemedicine platform, the performance of a traditional physical examination may be limited. Traditional clinical training utilizes manual/tactile approaches to the physical examination. Telemedicine limits this approach, and thus alternative adaptations are necessary to acquire information needed for sound clinical judgement and development of a treatment plan.

Our article will provide a review of essential components to conduct a proper telemedicine physical examination for patients suffering from various types of bodily pain.

Methods

Pain Medicine, Rehabilitation, Orthopedic, Rheumatology, and Neurology physicians from across the country performed a comprehensive review of current telemedicine examination literature. They designed an algorithmic approach for the telemedicine examination. (Figures 1–3). A PubMed search was performed using the keywords Telemedicine and Pain which yielded 200 results. Ten manuscripts were selected based on their applicability to the Chronic Pain Medicine Telemedicine examination. The multidisciplinary team of physicians collaboratively crafted an algorithm in real-time based on personal experience and the information reviewed.

General Principles to the Virtual Physical Exam

Patient access to appropriate technology should be assessed prior to initiating a telemedicine video visit. Having a proper electronic device with adequate internet connection and appropriate understanding of software and hardware is paramount before the patient or patient-delegate is able to join the meeting. Specific preparation for the telemedicine visit must be performed in advance in order to minimize superfluously utilized time during the televisit. Instructional information should be prepared and presented to the patient or patient-delegate prior to the visit, by the physician administrators. This is to include, but not limited to, appropriate patient attire, video device placement, ideal lighting and environmental atmosphere. The environment should be one in which is well lit, minimizes outside noise, and spacious enough to move around in all directions. In an effort to visualize as much of the patient from a 2D view as possible, we recommend that patients wear a collarless shirt, shorts, and tie up any hair that may be sitting on the neck. The video device should be placed on a flat and stable surface top. The device should also be positioned in a hands-free way. The patient should be sitting approximately two to six feet from the video device and have six feet of space to move around in all directions. Special patient considerations should be noted and addressed prior to the telemedicine encounter—this includes, but is not limited to, the preparation of any potential props that may be helpful during the examination of a particular body region during the televisit. Personalized instructions should be made in instances where patients are not able to meet the above recommendations. The medical provider may have props, as well, to show to the patient including pictorial diagrams or anatomical models, similar to those used in the office setting. Additionally, the provider should be able to verbally describe the exam, in common language understandable to the general population. To increase the clinical value of the telemedicine visit, the clinician must listen actively and observe intently. As with all new endeavors, flexibility and openness to modify are key [3].

Physical Exam by Chief Complaint

When evaluating patients with a chief complaint of pain in a body region, both history and physical exam are integral parts of diagnosis and further appropriate treatment. Performing a history of present illness and past medical history should conduct as it normally would in an office setting, with special focus on potential for depression, anxiety, and psychosocial hardships. It may be prudent to begin the visit with a determination of the patient's cognitive competence, which includes asking the patient their name, date of birth, reason for visit, and perhaps memory recall. The next step after eliciting cognitive competence and performing a thorough history of present illness and past medical history is a focused physical exam [3].

Headache

Performing a virtual physical examination for headache patients should be conducted via the following basic principles. Advise the patient to sit approximately two feet away from the camera, instruct patients to tie up hair such that it is out of the face and off of the neck, recommend a non-collared shirt, and limit jewelry on the head and neck. The pain physician should begin their telemedicine physical exam with a basic observation of the patients head and neck. Special focus should be on eliciting if any of the following are present—head or neck

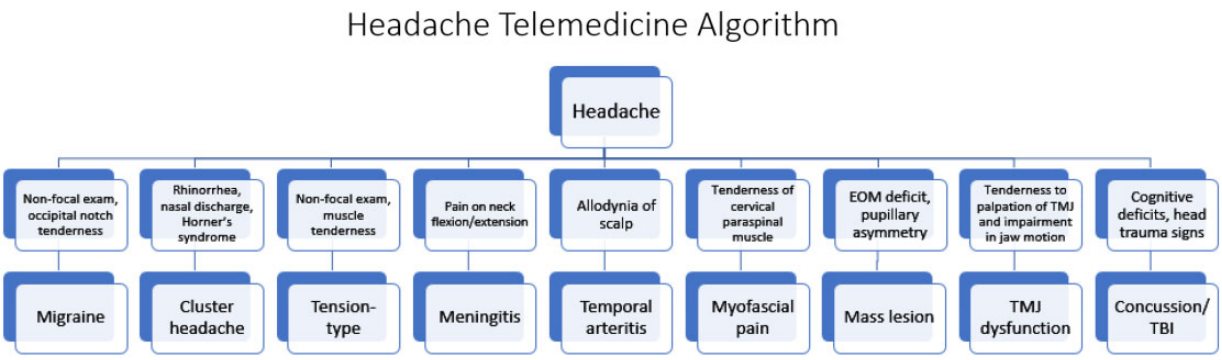


Figure 1. Headache Telemedicine Algorithm.

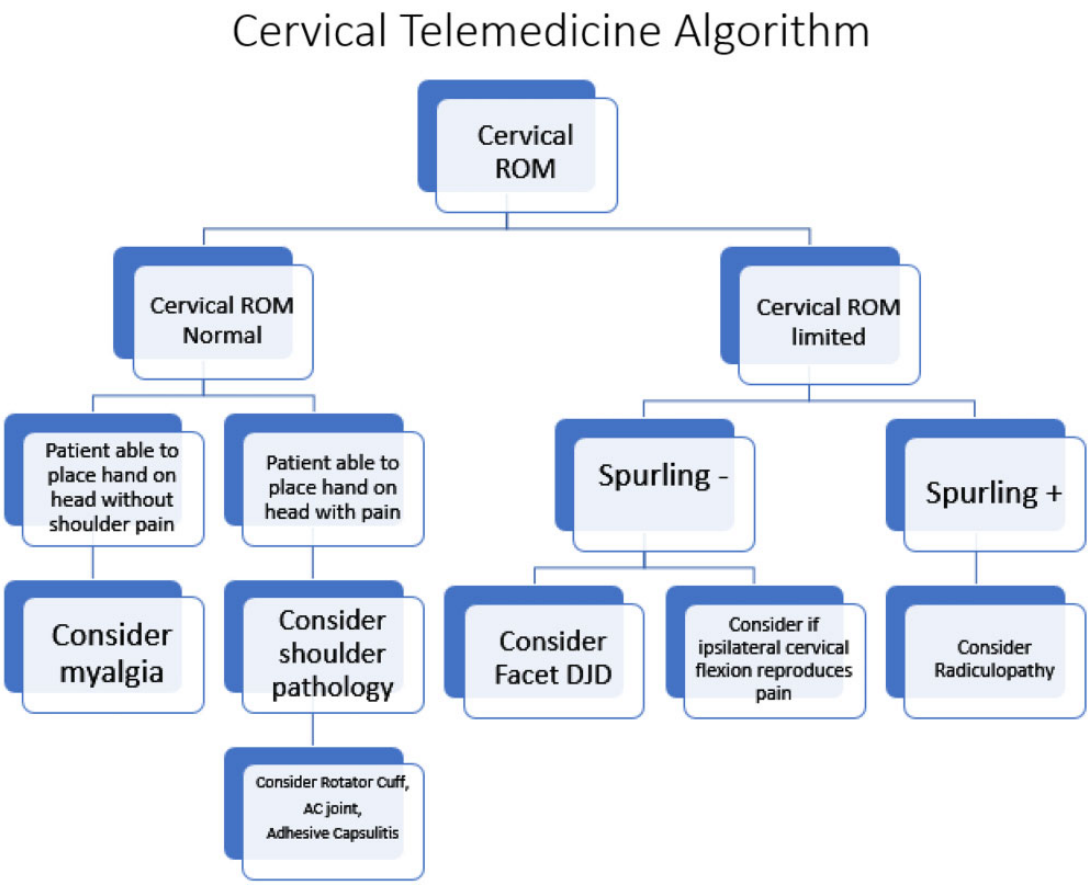


Figure 2. Cervical Telemedicine Algorithm.

trauma, signs of toxicity, photophobia, rhinorrhea, rash, erythema, purpura, and so forth. [4]. Pupillary function may also be assessed for opiate or sympathomimetic stimulant usage, but requires the patient to have a light source such as a flashlight or cell phone light, as ambient light variability can complicate the pupillary examination. Constriction suggests opiate usage, whereas dilation may indicate opiate withdrawal or sympathetic stimulant administration [5]. In order to perform a focused optical exam, instruct the patient to look directly at the camera and place the light source in the ipsilateral hand with the arm fully extended away from their head. A full examination of the eye may be performed with the patient holding the light source and covering one eye at a time, including assessment of pupil size, reactivity to light, extraocular muscle function, accommodation, ptosis and more. Additional assessments may include instructing the patient to fixate on your finger in primary gaze and then on horizontal and vertical gaze. Facial sensation can be assessed by having the patient stroke each trigeminal nerve division bilaterally using their index finger. In addition, the patient may be asked to palpate their posterior

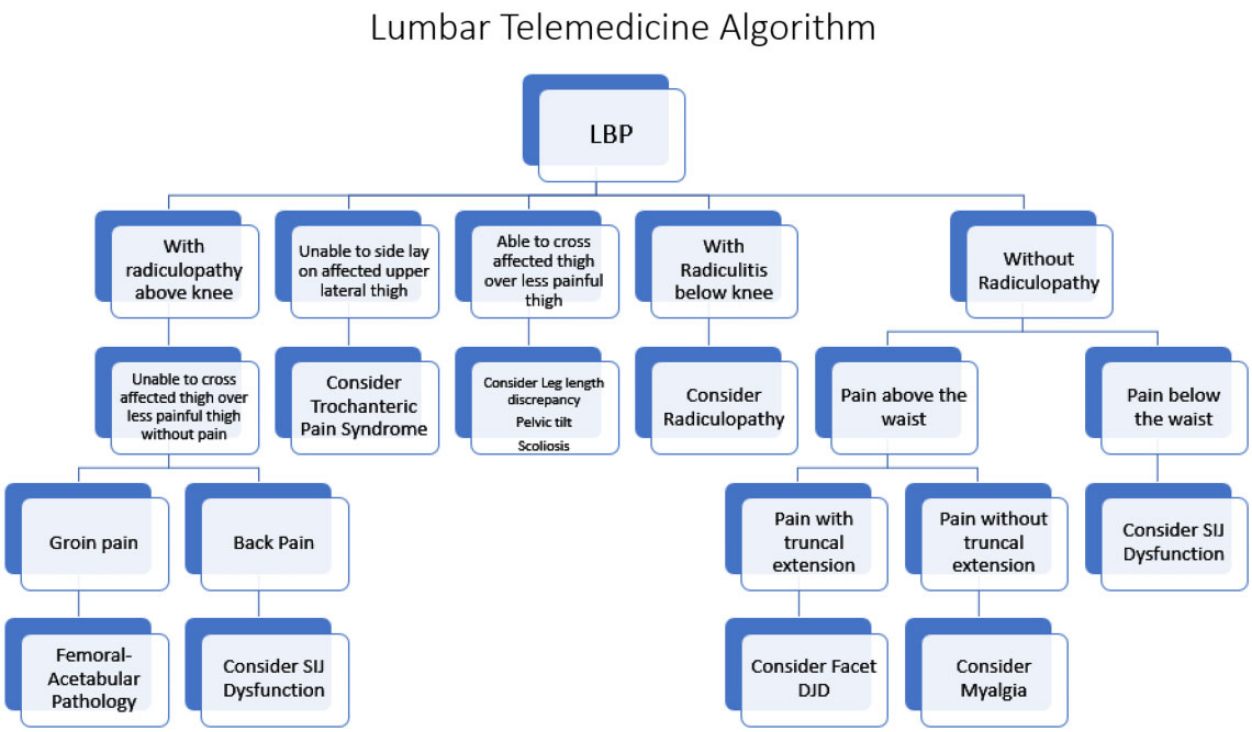


Figure 3. Lumbar Telemedicine Algorithm.

scalp to assess for occipital neuropathy and migraine. TMJ dysfunction may be elicited by a patient-performed deep palpation of the temporomandibular joint, temporalis, pterygoid, and masseter muscles. The context of the cranio-facial and pupillary exam in a supporting clinical setting may direct the pain physician to a potential list of differential diagnoses [4] (Figure 1, Tables 1 and 7).

Neck and Upper Extremities

Wahezi et al. suggest that the patient with neck and upper extremity pain sit approximately 4 feet from the camera, preferably in a space where there is an abundance of props that the physician may direct the patient to use for examination assistance [3]. Potential props that may assist in examination include a pointing device, such as a 12-inch ruler or a long wooden spoon, a 16 to 28-inch hand towel, an easily graspable cylindrical object such as a 16-ounce soda bottle, 2-liter soda bottle, gallon jug of milk or jar of pasta sauce. The exam may begin by asking the patient to simply point to the area of most tenderness—this may require a finger or an elongated object such as a ruler. The pain physician may direct the patient to palpate the cervical paraspinal muscles including the occipital notch to assess for tenderness to palpation or spasm. Cervical range of motion (ROM) may be performed by instructing the patient to rotate their head laterally to each shoulder, side-bending which includes touching ear to ipsilateral shoulder, then flexion and extension maneuvers. Gross upper extremity ROM maneuvers may then be performed followed by upper extremity strength testing—this may be evaluated by patient-performed shoulder flexion with the arms extended in prone position; subtlety of weakness may be evaluated if the patient performs the task with eyes closed. Also, using a 2-liter soda bottle or a gallon jug of milk, basic strength testing of the shoulder muscles may be performed [3].

Specialty testing, such as the Spurling test for cervical radiculopathy, traditionally requires compression by the examiner [10]. During a telemedicine examination, the patient may be instructed to put a folded towel, lengthwise over their head, holding both ends. Then the patient is instructed to turn their head toward the painful side so that the chin touches the shoulder. The patient is then instructed to tilt their head so that the ear moves closer to the shoulder. If able and without significant discomfort, the towel may be used to further pull the head down toward the ground, simulating further compression. If this self-compression maneuver cannot be performed then non axial loaded rotation and extension may also provoke radicular symptoms in patients with moderate to severe foraminal stenosis. The Jobe Empty Can test can be similarly replicated as in the office by using a full 16-ounce soda bottle or pasta jar where the patient is instructed to hold their arm in 90 degrees of abduction with 30 degrees of forward flexion while the arm is held in internal rotation, so the thumb is pointing to the floor [11]. Hawkins and Neers tests may be performed with the same 16-ounce soda bottle or pasta jar prop. The patient is instructed to have their shoulder held in 90 degrees of forward flexion with the

Table 1. Guide to the modified neck examination through telemedicine

Body Part	Instruction Neck Examination	Clinical Value	Images
Pre-visit instructions	Ensure the patient has about 6 feet (2 meters) free space in all directions. Video device to be placed 6 feet (2 meters) directly in front of patient and propped on a stable surface.	Mobility and position. Patient may be asked to sit and stand to observe balance and sit-stand position transition.	
Physician props	Diagram of neck musculature and spine model	Educate patient on neck anatomy to describe painful condition once examination is complete.	
Patient props	12-inch ruler (30 cm) or wooden spoon Hand towel (~16'–28" [40–70 cm] in length)- for use with exam	Long object used to point to painful area(s) Force application across painful sites	
Patient Clothing and prep	Collarless shirt Hair tied up If patient has long hair	Allow visualization of examination areas	
General appearance	Sit or stand naturally facing the camera	Chin deviation from midline. Identify behaviors indicative of pain or non-organic pathology	
Symmetry	Sit or stand naturally facing the camera and away from the camera	Muscle atrophy, or winging or drooping of the shoulder (may be observed with radiculopathy, brachial plexopathy, or nerve entrapment).	
Point to area of maximum pain	Using a wooden spoon, point to area that is usually the most painful	Helps to confirm patients description of pain area	 

(continued)

Table 1 continued

Body Part	Instruction Neck Examination	Clinical Value	Images
Range of motion	Move chin to touch the chest. Tilt head back. Turn neck to move the chin to the shoulder. Repeat to other side. Tilt head so that ear goes to the shoulder on one side. Repeat on other side.	Abnormal lateral or forward flexion, or rotation, may indicate torticollis Failure of chin to return to vertical/horizontal midline may suggest dystonia	   
Shoulder Abduction (Bakody's sign) 40–60% sensitivity 88–90% specificity [6]	Instruct the patient to place the hand on the painful side on top of the head	Improvement of radicular symptoms suggests diagnosis of cervical radiculopathy	
Valsalva 22% sensitivity 94% specificity [7]	Instruct patient to "bear down" or try to breath out forcefully with their mouth and nose closed	Referred electric sensation suggests cervical radiculopathy	

(continued)

Table 1 continued

	Instruction		
Body Part	Neck Examination	Clinical Value	Images
L'Hermitte's sign 65% sensitivity 97% specificity [8]	Instruct patient to rest their chin on their chest	Shock-like sensation in arms/legs suggests cervical myelopathy or meningeal irritation Note: neck pain without electrical sensation suggests trapezius and/or splenius as source of pain	
Spurling Test 40–60% sensitivity 85–95% specificity [9]	Instruct patient to put the folded length wise towel over their head, holding onto both ends. Then have patient turn head toward the painful side so that chin goes to the shoulder. Then have patient tilt the head so that the ear moves closer to the shoulder. If able, use the towel on the head to pull down toward the ground	Cervical radiculopathy	 

(continued)

Table 1 continued

	Instruction		
Body Part	Neck Examination	Clinical Value	Images
Jackson compression Not validated for facet joint pain. 93% specificity [9] Sensitivity N/A	Instruct patient to put the folded length wise towel over their head, holding onto both ends. Then have patient move the ear toward the shoulder. If able, use the towel on the head to pull down toward the ground	Cervical radiculopathy/ myelopathy. Believed to create facet load of mid cervical facets (that project laterally- C34 C45 C56 C67)	

Table 2. Guide to the modified shoulder examination through telemedicine

	Instruction		
Body Part	Shoulder Examination	Clinical Value	Images
Previsit instructions	Ensure the patient has about 3 feet free space in all directions. Video device to be placed 3 feet directly in front of patient and propped on a stable surface.	Mobility and position. Patient may be asked to sit and stand to observe balance and sit-stand position transition.	
Physician props	Diagram of shoulder anatomy	Educate patient on shoulder anatomy to describe painful condition once examination is complete.	
Patient props	Heavy cylindrical object such as a can of pasta sauce or soda can.	Easy grasp object for muscle testing	
Patient Clothing	Tank top	Allows inspection of shoulder	
Inspection	Examine the shoulders, arms, front and back looking for asymmetry, swelling, erythema, and wasting.	Any abnormal findings may help to establish a differential diagnosis.	
Palpation	Have the patient point to the area of maximum tenderness or pain. Use anatomic photos or models to assist.	Tenderness in the anterior acromial region or greater tuberosity may indicate rotator cuff syndrome. Tenderness in the acromioclavicular joint may be indicative of arthritis or acromioclavicular (AC) separation.	
Shoulder specific tests			
Jobe empty can test Sensitivity 52.6% Specificity of 82.4% for full-thickness supraspinatus tears [13].	Patient holds glass jar of pasta sauce (or equivalent). The patients arm is held in 90 degrees of abduction with 30 degrees of forward flexion and the arm is held in internal rotation so the thumb is pointing to the floor.	Weakness or pain may demonstrate a supraspinatus tear or rotator cuff impingement. Ability to hold weighted object upside down also tests grip strength	

(continued)

Table 2 continued

Body Part	Instruction Shoulder Examination	Clinical Value	Images
Hawkins test 79% sensitivity for subacromial impingement [14]. Specificity 59%	The shoulder is held in 90 degrees of forward flexion with the elbow in 90 degrees of flexion. The shoulder is internally rotated.	Pain may indicate subacromial impingement, rotator cuff syndrome	
Modified Hawkins-Kennedy for telemedicine	Patient touches top of non-affected shoulder with hand of affected side while lifting elbow	Pain may indicate subacromial impingement, rotator cuff syndrome	
Painful arc test Sensitivity 53% Specificity 76% [14]	The patient abducts arms from his sides, with the thumbs pointing up.	Pain from 60 degrees to 120 degrees of abduction may indicate subacromial impingement. Pain from 150 to 170 degrees of abduction may indicate AC pathology.	

(continued)

Table 2 continued

Body Part	Instruction Shoulder Examination	Clinical Value	Images
Neer impingement test Sensitivity 72% Specificity 60% [14]	Patient holds glass jar of pasta sauce (or equivalent). The patient performs maximal forward flexion of the shoulder with the thumb pointing down.	Anterior shoulder pain with this maneuver may indicate subacromial impingement. Posterior shoulder pain is more indicative on internal impingement.	
Anterior apprehension test Sensitivity 72–98% Specificity 72–96% [15]	Typically used for younger patients (under 30 years of age). Have the patient position their shoulder in 90 degrees of abduction and external rotation.	Apprehension or pain in this position may indicate moderate anterior shoulder instability or a possible labral tear.	

(continued)

Table 2 continued

Body Part	Instruction Shoulder Examination	Clinical Value	Images
Modified Anterior apprehension test Sensitivity 78% Specificity 75%	Can increase the forces on the anterior capsule if patient places elbow on a sold vertical surface and leans forward 10–20 degrees.	Apprehension or pain in this position may indicate small anterior shoulder instability or a possible labral tear.	
Cross-body adduction Sensitivity 77% Specificity 79% for acromioclavicular joint pathology.	With the shoulder in 90 degrees of elevation and the elbow straight, the patient should reach across their body as far as possible using the contralateral arm to adduct the shoulder	Pain in the AC joint region with this provocative test may indicate AC pathology.	

(continued)

Table 2 continued

Body Part	Instruction Shoulder Examination	Clinical Value	Images
Speeds test Sensitivity 32% Specificity 61% [16]	With the hand supinated and arm outstretched raise the arm from the waist while holding a glass can or 1/2 filled 2 L bottle of soda.	Pain with this motion may indicated biceps tendon pathology or superior labrum pathology	
Strength testing	Using a gallon of milk or similar heavy object have the patient raise their arm (in the thumbs up and thumbs down position)	Weakness or pain may indicate rotator cuff pathology.	 
Range of motion tests Forward flexion	Elevate arms straight in front of body up above head	Evaluate for total forward flexion and symmetry. Limitations in flexion may indicate various pathologies such as impingement, adhesive capsulitis, rotator cuff tears and others. If active forward flexion is limited have the patient attempt to perform the motion with assistance from the other hand. This test can rule out adhesive capsulitis.	

(continued)

Table 2 continued

Body Part	Instruction Shoulder Examination	Clinical Value	Images
Abduction	Elevate arms at sides up above head.	This exam is best observed from behind, if possible, to evaluate scapulothoracic motion as the arm externally rotates at 90 degrees of abduction in order for the greater tuberosity to pass under the acromion and continue to full 180-degree abduction. If active abduction is limited have the patient attempt to perform the motion with assistance from the other hand. This test can rule out adhesive capsulitis.	
External rotation at side	With the elbow close to the body and in 90 degrees of flexion the patient externally rotates both arms keeping the elbows tucked close to the body.	Normal external rotation ranges from 45–90 degrees in this position. Significant loss of external rotation can indicate adhesive capsulitis or glenohumeral arthritis	
External rotation at 90 degrees of shoulder abduction	With the shoulder in 90 degrees of abduction and the elbow in 90 degrees of flexion the forearm is maximally internally and externally rotated.	This test can help to assess for shoulder anterior instability if the patient feels apprehension with external rotation, or posterior capsular tightness if there is limitations in internal rotation.	 

Table 3. Guide to the modified hand/wrist/elbow examination through telemedicine

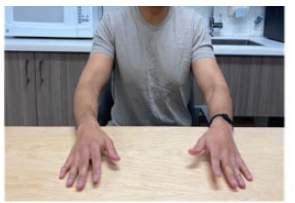
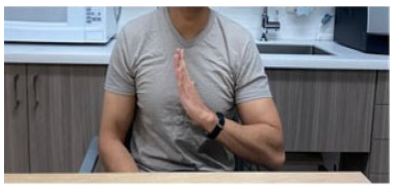
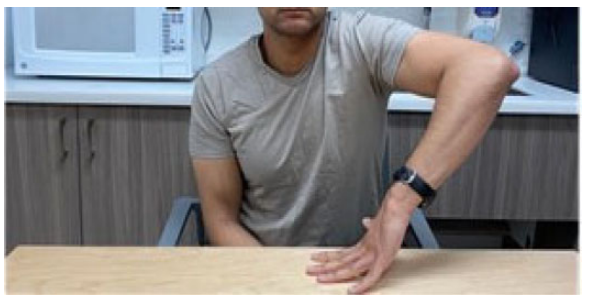
Body Part	Visualization/Patient Instructions Hand/Wrist/Elbow	Clinical Value	Images
Previsit instructions	Ensure the patient has about 3 feet free space in all directions. Video device to be placed 2–3 feet directly in front of patient and propped on a stable surface.	Mobility and position. Patient may be asked to sit and stand to observe balance and sit-stand position transition.	
Physician props	Diagram of hand/wrist/elbow	Educate patient on hand/wrist/elbow anatomy to describe painful condition once examination is complete.	
Patient props	Mug with large handle, pen/pencil, sheet of paper, jar with lid	Used for fine and gross muscle motor evaluation	
Patient clothing	Short sleeves shirt	Allows inspection to visualize hand, wrist, forearm and elbow	
Inspection	Dorsal aspect: Inspect wrist, elbow, metacarpophalangeal (MCP), proximal interphalangeal (PIP) and distal interphalangeal (DIP) joints for swelling or erythema. Look for bony deformities including Heberden's and Bouchard's nodes. Volar aspect: Inspect the thenar muscle at the radial aspect of the palm at the base of the thumb. Inspect the hypothenar muscle at the medial aspect above the wrist	Swelling and/or erythema at MCPs/PIPs/DIPs may represent synovitis. Swelling of an entire digit may represent dactylitis. Squared appearance at the base of the thumb along with pain may represent carpometacarpal (CMC) arthritis. Swelling at the olecranon may represent olecranon bursitis. Thenar atrophy may represent carpal tunnel syndrome/median neuropathy. Hypothenar muscle atrophy may represent ulnar neuropathy	 
Range of motion	Assess finger extension by asking patient to hold hand in front of body, chest height and spread fingers. Note if DIP, PIP and MCP joints extend fully. MCP joint extension beyond neutral is normal Assess finger flexion by observing patient make a fist. Lay palm flat on a table or surface and then flex MCPs, PIPs, and DIPs 90 degrees. In order to assess grip strength, have patient make a tight fist around a pen. With the opposite hand, have patient try to forcibly remove pen out of gripped hand.	If patient unable to fully extend MCP joints, it may represent extensor tendon dysfunction. Inability to perform or maintain full grip may be caused by joint, ligament/tendon or nerve derangement.	 

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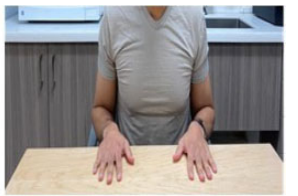
Table 3 continued

Body Part	Visualization/Patient Instructions Hand/Wrist/Elbow	Clinical Value	Images
Wrist	Have patient turn palms directly upward (90° supination) and downward (90° pronation) while keeping the elbows at sides. With patient's elbows at the side, ask the patient to press the palms together and point fingers upward; then, ask the patient to press the back of the hands together and point the fingers downward.	Difficulty in wrist pronation/supination may reflect instability of the distal radioulnar joint, carpal ligaments, forearm fracture and/or elbow impairment. Wrists should extend and flex approximately to 90.	    
Elbow	Full flexion and extension should be without pain. Pain with flexion and extension may reflect underlying synovitis.	Pain with flexion and extension may reflect underlying synovitis.	 
Trigger finger (Hand) Specificity 95% Sensitivity 66%	Grabbing and releasing large handle of a mug with digits 2–5	Reproduces pressure at the volar aspect of the MCPs and produces finger flexion. Subsequent extension with pain and "triggering" of a digit after removing the digits from the handle may represent a trigger finger. The superficialis tendons extend to the base of the middle phalanx and the flexor profundus tendons extend to the base	

(continued)

Table 3 continued

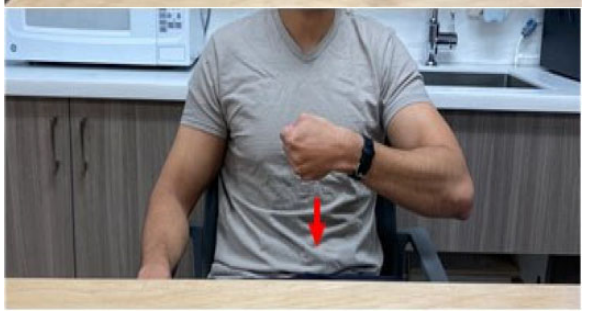
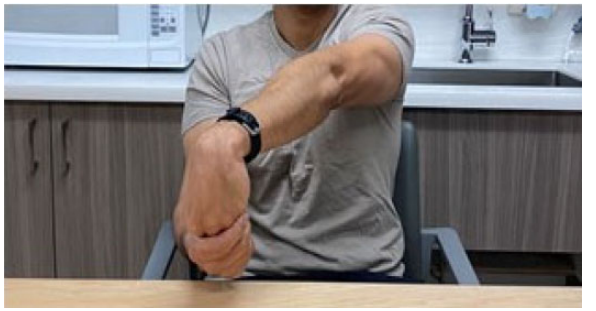
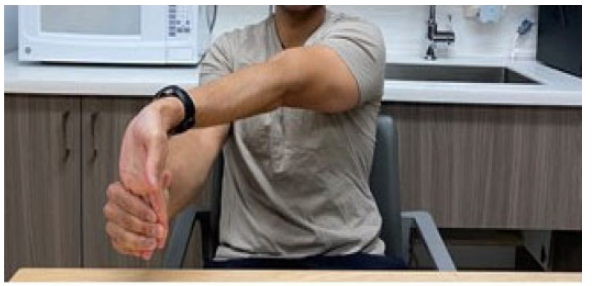
Body Part	Visualization/Patient Instructions Hand/Wrist/Elbow	Clinical Value	Images
		of the distal phalanx of each finger. If the patient experiences tenderness with pressure and a popping sensation or locking of a digit upon flexion (digits around mug handle) with pain and clicking on subsequent extension (releasing digits from the handle), it may suggest a trigger finger.	
De Quervain's tenosynovitis: Finkelstein's test (Wrist) Sensitivity 99%; Specificity 29% [17]	Have patient flex and abduct thumb across palm, and then flex fingers around the thumb. Have patient bend wrist towards the 5th digit (ulnar deviation).	Pain with this maneuver may suggest tendonitis of abductor pollicis longus and extensor brevis. Patients may also have tenderness to palpation and swelling on inspection of region at radial styloid.	
Lateral epicondylitis: Mill's test (Elbow) Sensitivity 53% Specificity 100%	Have patient extend pronated arm straight in front with wrist in flexion. With opposite hand, grip the fingers of the flexed wrist and pull downwards	A stretch should be felt in the dorsal aspect of forearm and pain may be elicited at the area of the lateral epicondyle. Patient may have pain on palpation at the lateral epicondyle.	
Medial epicondylitis: Reverse Mill's test (Elbow)	Have patient extend arm straight in front (palm up) with wrist in extension. With opposite hand, grip the fingers of the extended wrist and pull back	A stretch should be felt in the volar aspect of forearm and pain may be elicited at the area of the medial epicondyle. Patient may have pain on palpation at medial epicondyle.	

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Table 3 continued

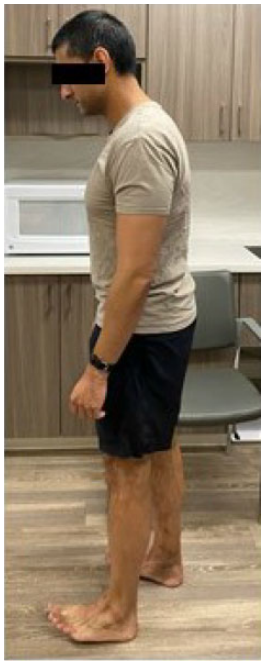
Body Part	Visualization/Patient Instructions Hand/Wrist/Elbow	Clinical Value	Images
Degenerative Joint Disease (DJD)			
1st carpometacarpal (CMC) joint	Have patient pinch a piece of paper in between thumb and 2nd digit. With opposite hand try to remove paper with a significant "tug". Repeat using thumb and 3rd digit.	Pain at base of thumb with CMC arthritis.	
1st carpometacarpal (CMC) joint	Have patient try to twist open lid of an unopened jar	Patient will have pain at base of thumb with CMC arthritis.	

Table 4. Guide to the modified lumbar spine examination through telemedicine

	Instruction		
Body Part	Back Examination	Clinical Value	Images
Previsit instructions	Ensure the patient has about 6 feet free space in all directions. Video device to be placed 6 feet directly in front of patient and propped on a stable surface. Position the device to be able to visualize from head to toe.	Mobility and position. Patient may be asked to sit and stand to observe balance and sit-stand position transition.	
Physician props	Spine model	Educate patient on lumbar anatomy to describe painful condition once examination is complete.	
Patient props	Chair, bed or couch Q-tip for light touch testing. Wooden spoon	Assess position changes Point to painful area(s)	
Patient Clothing	Shorts and T shirt	Allow easy visualization of examination areas	
Activity	**Instructions**	**Clinical value**	
General appearance	Patient to stand naturally in front of camera	Asymmetry during standing suggests limb or lumbar pathology. Patients with sacroiliac joint pain may offload painful side	
Gait	Instruct patient to walk towards or away from the camera and turn around and walk back	Gait assessment Antalgia suggests painful hip, knee, ankle, foot Increased hip rise may mean that patient is unable to clear the floor normally with foot. Consider weak dorsiflexors as explanation. Cross-reference with heel walk suggests (L4) nerve root pathology	

(continued)

Table 4 continued

Body Part	Instruction Back Examination	Clinical Value	Images
Muscle strength	Instruct patient to walk on their heels	Poor/no heel walk Weak ankle dorsi-flexors: TA, EDL, EHL (L4) Heel walk is also a recognized test for proprioception	
	Instruct patient to walk on their toes	Poor/no toe walk suggests weak ankle plantar- flexors: Gastro-soleus (S1, S2)	

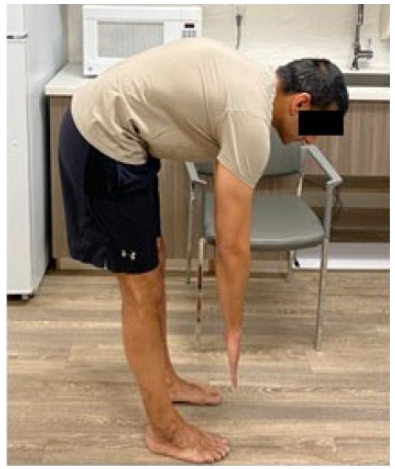
(continued)

Table 4 continued

Body Part	Instruction Back Examination	Clinical Value	Images
	Instruct patient to stand on one leg	Pelvis on unsupported leg does not elevate consider Gluteus medius weakness (L5) Positive Trendelenburg's test	 
Inspection Validated tool	Ask patient to stand comfortably 6 feet from camera.	Asymmetrically high pelvis on one side and ipsilateral shoulder drop suggests advanced degenerative spondylosis due to scoliosis. Consider lumbar facet test for confirmation of pain generator. Muscle bulk and symmetry: paraspinals, thigh, leg wasting/asymmetry Muscle atrophy; Neuropathy Using a wooden spoon, point to area that is usually the most painful point at PSIS Suggests SIJ pathology (Fortin Finger test)	
Posture	Advise that patient stand sideways in relation to the video camera	Pronounced kyphosis suggests old compression fractures. Spondylolisthesis. Pronounced lumbar lordosis suggests muscle imbalances: weak abdominal muscles, tight or weak iliopsoas, hamstrings Hip flexion with forward inclined trunk, flat back Sway back posture	

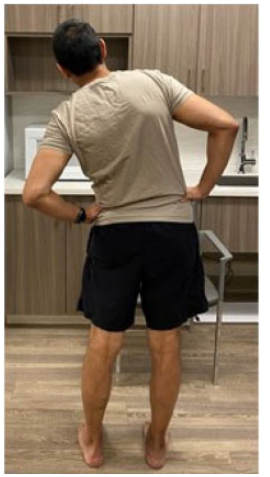
(continued)

Table 4 continued

Body Part	Instruction Back Examination	Clinical Value	Images
ROM	Instruct the patient to turn and touch their toes	Pain radiates into lower limb/s with flexion suggests HNP, discogenic pain, paraspinous spasm. Pain without radiation may suggest inflammatory arthritis, Spondylosis.	
ROM	Instruct the patient to extend their spine	Extension and referred pain into lower limb/s with extension suggests central canal stenosis, HNP/nerve root irritation. Pain without radiation suggests facet pathology	

(continued)

Table 4 continued

	Instruction		
Body Part	Back Examination	Clinical Value	Images
ROM	Instruct patient to side bend to left and right side	Radiating leg pain suggests neuroforaminal stenosis	 

(continued)

Table 4 continued

Body Part	Instruction Back Examination	Clinical Value	Images
Hip ROM	Instruct the patient to cross one thigh over the other (Always test hip ROM with back exam)	Limited hip flexion and internal rotation with groin pain. Suspect hip pathology causing lumbar pain.	
Palpation	Instruct patient to press hand over lumbar area corresponding to spine, quadratus lumborum, and periiliac crest areas	Tenderness at lumbar spinous process, sacrum, facet/SIJ/para-spinal or gluteal, piriformis muscles, greater trochanters. Reproducible lumbar pain with palpation may suggest episacral fat pad as cause of symptoms	

(continued)

Table 4 continued

	Instruction		
Body Part	Back Examination	Clinical Value	Images
Sitting Maneuvers			
Slump test 84% sensitivity 83% specificity	Advise patient to place hands behind back, then perform chin to chest tuck and lean forwards, straighten out right leg. Repeat with left side	Positive slump test: reproducible and radiating low back and lower limb pain suggests HNP/Nerve root irritation	
Muscle strength	Instruct patient to raise right knee off the chair or bed	Hip flexor strength L2/L3 radiculopathy or iliopsoas weakness Inability to keep thigh up for 60 seconds suggests hip flexor weakness Ability to rise from chair without using arms for assistance suggests normal hip flexor, knee extensor, and hip extensor strength.	

(continued)

Table 4 continued

Body Part	Instruction Back Examination	Clinical Value	Images
SLR test Sensitivity 95% Specificity 95% Crossed SLR Test Sensitivity 95% Specificity 95%	Instruct patient to extend leg while sitting in chair	Knee extensor strength L3/4 radiculopathy or weak quadriceps Radiating posterior thigh pain may be due to tight hamstring or HNP If non painful leg raise causes ipsilateral symptoms more strongly suggestive of radiculitis (Crossed SLR)	
Seated FABER 41% sensitivity 100% specificity	Instruct patient to cross leg and place ankle on opposite knee then push the bent knee down with your hand.	Ipsilateral buttock pain suspicious for SIJ pathology	
Seated Valsalva	Instruct patient to perform Valsalva while seated and in truncal flexed position	Suggests HNP, but also may rule out abdominal visceral pathology as source of referred pain to lumbar region	

Table 5. Guide to the modified hip examination through telemedicine

	Instruction		
Body Part	Hip Examination	Clinical Value	Images
Physician props	Diagram of hip anatomy	Educate patient on hip anatomy to describe painful condition once examination is complete.	
Patient props	Chair and table	Chair will allow patient to perform range of motion and provocative maneuvers. Table for balance during examination.	
Patient clothing and prep	Shorts- allows visualization of painful area Leggings/Yoga Pants- nonrestrictive and allow ROM assessment Ensure patient has have about 6 feet of space in all directions and able to position on the chair, and away from the camera	Allow visualization of examination of torso and trunk	
Single leg sit stand	Instruct patient to stand up using the strength of one leg. The contralateral hand is used for balance.	Weakness could suggest glut med weakness or L5 radiculopathy	 

(continued)

Table 5 continued

Body Part	Instruction Hip Examination	Clinical Value	Images
Raise your knee	Advise lift thigh and push the knee down with hands,	Suggests hip flexor strength, L2 radicular pathology or iliopsoas tendinopathy	
Hip ROM	Instruct the patient to cross one thigh over the other (Always test hip ROM with back exam).	Limited hip flexion and internal rotation with groin pain. Suspect hip pathology	
Seated FABER 41% sensitivity 100% specificity	Cross leg putting your right ankle on your left knee. Now push your right knee toward the ground. Any pain?	Pain: piriformis pain or SI joint pathology	
Trochanter Palpation	Palpate lateral hip for tenderness.	Suggests greater trochanteric bursitis	
FADIR- Flexion, Adduction and Internal Rotation Sensitivity 41% Specificity 47%	Patient places the foot of the leg to be evaluated onto a chair while stabilizing balance using their ipsilateral hand on the chair back Both knee and hip are placed in a flexed posture. Contralateral hand draws the knee across the midline, resulting in relative adduction and internal rotation of the hip joint with the joint in flexion	Patients with symptomatic hip articular pathology will often experience reproduction of their typical mid-inguinal groin pain at this stage (positive test).	

Table 6. Guide to the modified knee examination through telemedicine

Body Part	Knee Examination	Clinical Value	Images
Previsit instructions	Ensure patient has a minimum 6 feet of space around them in order to position yourself to stand and sit at a chair, move from side to side and forward and backwards. Position camera 6 feet away so physician can see both knees and thigh up to mid torso	Mobility and position. Patient may be asked to sit and stand to observe balance and sit-stand position transition.	
Physician props	Knee model or diagram	Educate patient on neck anatomy to describe painful condition once examination is complete.	
Patient props	2 chairs for use with exam	Maneuverability and balance during exam	
Patient clothing	Dressed in shorts that end above the knee. May need to be rolled up for visualization of quadriceps muscle	Allow visualization of examination areas	
Inspection	Instruct patient to stand in front of chair with legs close together for comparison	Compare for effusion, abrasions, bruising, ecchymosis, muscle atrophy, patella alta and baja, patella subluxation/dislocation. Assess for unilateral lower extremity edema and erythema to rule out potential deep venous thrombosis (DVT). COVID infection and/or lack of activity due to pain may induce coagulopathy [2].	
Gait	Have patient walk back and forth in front of camera	Assess gait pattern: antalgic, hip rise, stance phase, heel rise, swing phase, heel rise and toe touch	
Palpation	Have patient point to area of tenderness or maximal pain.	Helps confirm patient's description of pain area	

(continued)

Table 6. continued

Body Part	Knee Examination	Clinical Value	Images
Active straight leg raise	Instruct patient sit on one chair with legs on another chair close together. Have patient do straight leg raise.	Checks for extensor mechanism to evaluate for quadriceps or patella tendon rupture.	
Quadriceps contraction	Instruct patient sit on chair and contract quadriceps	Checks for flexion contracture/inability to fully extend for possible intraarticular pathology (meniscus, osteochondral defect, cruciate injury, hamstring tightness)	
Range of motion	While still sitting with both legs on other chair have patient flex affected knee then contralateral knee for comparison	Range of motion with assessment of pain	
Patella palpation	While sitting have patient palpate medial and lateral patella facets, inferior pole and superior pole of patella.	Assessment for chondromalacia patella, patella tendinopathy and quadriceps tendinopathy	

(continued)

Table 6. continued

Body Part	Knee Examination	Clinical Value	Images
			
			

(continued)

Table 6. continued

Body Part	Knee Examination	Clinical Value	Images
Single leg stance	Instruct the patient stand. Then have patient single leg stance on affected side then non affected side. Have patient move from side to side.	If no pain, with good motion and balance this test can effectively rules out ACL, meniscus injury, fracture, patella dislocation, osteochondral injury.	
Varus/valgus Test Valgus sensitivity 86–96%; Specificity not reported Varus sensitivity 25%; Specificity not reported	Instruct patient to sit on chair. Foot of affected knee firmly planted on floor with knee flexed 20–30 degrees. Have patient apply a varus load with hand to knee and then a valgus load	Collateral Ligament Injury Patients with suspected MCL or LCL injury may have pain with joint opening with manual stress	 

(continued)

Table 6. continued

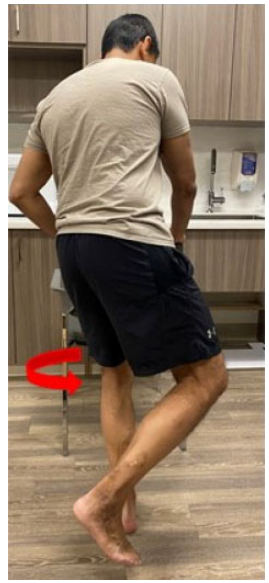
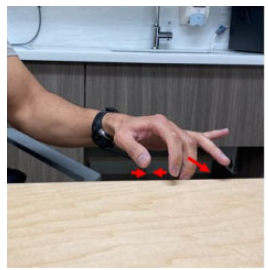
Body Part	Knee Examination	Clinical Value	Images
Thessaly test Sensitivity 62% Specificity 55%	Have the patient hold on the back of the chair with both hands while stands flat-footed on the floor. The patient then rotates his or her knee and body, internally and externally, three times, keeping the knee in slight flexion of 20 degrees	Meniscus Injury Patients with a suspected meniscal tear will experience medial or lateral joint line pain if the test is positive.	
Patella apprehension test Sensitivity 100% Specificity 88%	With patient sitting down have patient put laterally directed stress on patella from medial side	Assessment for patella instability. Test will show apprehension and pain.	

Table 7. Guide to the modified neurologic examination through telemedicine

Body Part	Instruction Neurological Examination	Clinical Value
Mental status Modified Standardized Assessment of Concussion Scale for telemedicine (SAC). May serve as a competency guide for procedure consent.	Competency Ask the patient their name, DOB, and address at the beginning of the visit. After physical exam explain their condition. Have patient repeat your assessment in their own words 2 separate times (spaced 5 minutes apart).	If patient able to perform these tasks this is suggestive of appropriate orientation immediate/delayed memory, and concentration.
	Mood and behavior	Look for grimacing, sighing, moaning, splinting, guarding, and cautious movement when changing position. This passive evaluation of the pain exam suggests an organic pain response.
Pupillary exam	Observe size of each pupil Patient should be position 2 feet (<1 meter) in front of their camera. Observe size of each pupil	Pupillary constriction can be secondary to use of prescription or recreational opioids Pupillary dilation can be secondary to barbiturates, benzodiazepines, alcohol, cannabinoids, stimulants
Motor examination Adopted from National Institutes of Health Stroke Scale (NIHSS)	Tone Ask patient to flex at both elbows slowly Upper Extremity Strength testing Ask patient to extend their arms in the front for 10 seconds. Keep elbows as straight as possible and close eyes. Retest with eyes open if patient fails.	Look for symmetry and/or difficulty performing one or both upper extremities. Asymmetry indicative of pathologic muscle loss. Anti-gravity testing suggested to replace manual muscle testing for the telemedicine exam.
NIHSS leg drift	Lower extremity Ask patient to sit in chair and elevate leg individually for 5 seconds	Should be graded as below No drift for 10 seconds 0 Drift, but doesn't hit bed or chair +1 Drift, hits bed/chair +2 Some effort against Gravity +2 No effort against gravity. +3 No movement 4 No drift for 5 seconds. 0 Drift, but doesn't hit chair +1 Drift, hits chair +2 Some effort against gravity +2 No effort against gravity +3 No movement +4

(continued)

Table 7 continued

Body Part	Instruction Neurological Examination	Clinical Value	
			
Reflexes Detailed deep tendon reflex exam is limited over tele neurology, however pathological hyperreflexia may be detected by the listed exams.	Instruct patient to extend their middle finger at the corner of the table and flick their middle finger –	1. Modified Hoffman sign: Pincer movement of thumb and first finger suggests upper motor neuron pathology	
	Patient should be instructed to squeeze the calf muscles	2. Modified Plantar sign (Gordon's sign) Up going toe suggests upper motor neuron pathology	

(continued)

Table 7 continued

Body Part	Instruction Neurological Examination	Clinical Value
Sensory examination Light touch, temperature Allodynia Loss of sensation	Ask the patient to check sensation in upper and lower extremities for loss of sensation by using an ice cube or back of spoon and compare with non-affected limb	Altered light touch: absent: anesthesia ↓: hypoesthesia ↑: hyperesthesia ↑+ painful: allodynia ↑+tingling: paresthesias Painful paresthesias: dysesthesias
Sensory testing	Instruct patient to use Q tip to touch medial, lateral, dorsum of affected limb and compare with non-affected limb.	Sensory abnormality with corresponding spinal nerves: Dorsum of digits #1/2: C5,6 Dorsum of digits #3/4: C7 Dorsum of digit #5: C8/T1 Upper thigh/groin: L1/L2 Lower thigh/knee: L3/L4 Medial Malleolus: L4 Dorsum foot: L5 Heel: S1

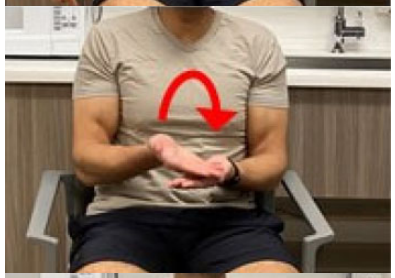
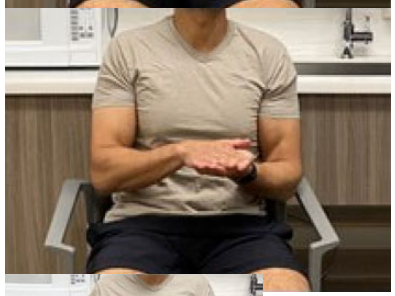
(continued)

Table 7 continued

Body Part	Instruction Neurological Examination	Clinical Value
		
		
Gait	Normal gait	Observe stance and gait
	Tandem walking	Look for ability to tandem walk
	Instruct patient to walk up to 10 feet (3 meters) away from, and then towards, the computer	
Balance	Instruct patient to walk up to 5 feet (1.5 meters) away and then towards the computer	Assess how many steps it takes for patient to execute 180 degree turn. Three steps to make 180 turn suggests normal balance.

(continued)

Table 7 continued

Body Part	Neurological Examination	Instruction	Clinical Value	
Coordination	Finger to nose testing	Ask patient to extend their arms bilaterally and touch their nose with their right then the left index finger	Normal finger to nose testing should be smooth.	
	Rapid alternating movement	Alternately swipe palmar and dorsal aspects of right palm and vice versa.	Look for irregularity or slowness on one or both sides	 
	Heel to shin test	Ask patient to sit in chair, touch right heel to left knee and then slide down the front of shin. Then reverse the limbs.	Normal heel to shin testing should be smooth Abnormalities of any of these exams suggests upper motor neuron pathology	

elbow in 90 degrees of flexion while the shoulder is internally rotated [12] (Figure 2, Tables 2, 3, and 7).

Lower Extremities, Low Back, Hip and Sacroiliac Joint (SIJ)

Patients with lumbar and lower extremity pain should be dressed in shorts and seated 6–8 feet away from their camera as this generally improves gross visualization of the lower extremity. Begin the exam with a pointed observation for obvious bony or musculature abnormalities in the lower extremities including the joints of the hip, knee, ankle, and foot. The clinician should observe for abnormal seated or standing posture, irregular pain behaviors, guarding, involuntarily rubbing, avoidance in touching the painful area, use of a cane or walker, and imbalance. Ask the patient to point to the site of the most tender pain. As an example, patients with SIJ pain report pain below the belt line and point at the PSIS (positive Fortin finger test). Patients with painful hip joint or SIJ pain also tend to sit or stand leaning off the painful limb [3]. The joints of the pelvis and lower extremity are interlinked in a series in the kinetic chain, such that any dysfunction or pathology at one joint potentially alters the biomechanics at other joints within the kinetic chain [6]. Similarly with the upper extremities, ROM and strength testing may be performed on the lower extremities via instruction through the basic movements that would be performed in office. Instruct the patient to bend forward as far down as possible without bending their knees. Similarly, ask the patient to stand and turn to their side, bend backwards and then sideways to the right and left to evaluate for lumbar range of motion in sagittal and coronal planes and concomitantly facet load test. Common language may help with patient instruction [3]. Observe the quality of movement and whether pain is associated. As an example, limited lumbar extension with pain may be facetogenic [13, 15], however the diagnostic accuracy is low [14]. Important questions to ask the patient are: where is the location of the pain, is the pain above or below the belt line, is there associated numbness, tingling, weakness with pain in the lower limb on the painful side. Neurological symptoms with pain suggest radiculopathy or other peripheral neuropathy [3] (Figure 3).

Gait is an important part of the physical exam, as well. Gait abnormalities may be due to pain, muscular weakness, joint instability, or a fused joint. Instruct the patient to walk at normal pace, and then walk on their heels and toes. An antalgic gait occurs with heel spurs, ankle or knee joint injury or osteoarthritis (OA). Quadricep (L3) weakness and knee instability result in back knee gait where the knee hyperextends during stance phase. A drop foot or ankle dorsiflexor (L4) weakness causes foot slap on heel strike and steppage gait, i.e., excessive knee flexion during swing phase. Patients with weak gluteus medius (L5) and hip joint OA, ambulate with lateral trunk lean, referred to as "abductor lurch" or "Trendelenburg gait." A compensatory posterior trunk lean called an "extensor lurch" occurs with gluteus maximus (S1) weakness. Patients with plantar flexor or gastroc-soleus weakness (S1, S2) have difficulty with toe walking and single-leg heel raises and demonstrate easy fatigability on their weak side [7–9].

Specialty tests may be performed after ROM and strength testing. The seated straight leg raise test may be performed by asking the patient to sit and lift one leg up with the knee straight in extension in front of them. For the seated slump test, the patient sits with arms behind in forward slump position and lifts the leg up straight. Pain radiation from the lumbar spine to the back of knee or distally indicates sciatic nerve irritability with lumbar herniated nucleus pulposus [16]. Functional tests consisting of sit to stand and single leg heel raise serve as excellent substitutes for manual muscle tests (MMT). Patients with weak knee extensors (L3, L4) cannot stand up from a seated position without support from their arms. Those with ankle dorsiflexion weakness (L4) are unable to perform heel walking, while plantar flexor or gastroc-soleus weakness (S1, S2) causes difficulty with toe walking and single-leg heel raises [13].

The author's test for hip and SIJ pain is conducted by asking the patient to cross his/her symptomatic ankle over the opposite knee while pulling the ipsilateral knee towards chest in the seated position. Groin pain suggests hip joint pain, while back pain suggests SIJ dysfunction. Next, the pain physician may ask the patient to adopt a position like that seen in a figure of 4. The FABER maneuver is conducted by having the patient place one ankle or foot on the opposite knee and then asking the patient to press down on their flexed knee. Back pain with this maneuver suggests SIJ dysfunction [17] (Figure 3, Tables 4, 5, 6 and 7).

Discussion

The clinical challenges associated with a virtual physical exam are ubiquitous. During clinical training, the focus of the physical exam has classically been centered around manual, tactile and resistance evaluations which assist in making the correct diagnosis, in the context of the historical information provided by the patient. While obtaining an accurate patient history is not often negatively impacted by telemedicine, the act of performing a physical exam needs to be revisited and re-learned by most physicians who plan to employ telemedicine during virtual visits. The authors here have created a practical guide for performing the telemedicine virtual physical examination based on multispecialty recommendations (Wahezi et al., "A Practical Guide and Best Practices Approach for the Orthopedic and Neurological Pain Physical Examination").

Although the authors submit that the Telemedicine examination may be improved by following the

recommendations in this manuscript we caution the reader to apply these principles carefully with patient physical and cognitive barriers in mind. The telemedicine exam can be used to assert a diagnosis if a history and radiographic evaluation is commensurate with the results of the telemedicine examination; however, if the telemedicine examination cannot be completed, or is deemed unreliable, towards that end then the patient should be invited for a person visit for a more traditional examination. We also recognize that what has been developed is a guide for future exploration and improvement of the field of Telemedicine. The approaches discussed here require validation by future controlled studies to demonstrate equivalence to their practitioner-administered counterparts we recognize that they may play an important role in the current state of medical care.

Telemedicine is a clinical tool that will be utilized for patient care into the foreseeable future. However, there is a lack of instruction on how to improve the efficiency and efficacy of the virtual examination. There is also a knowledge gap in how to create a differential diagnosis based on the findings of inspection and instruction-based physical examination. Furthermore, most clinicians struggle with performing a virtual examination, likely because it was not widely utilized prior to the COVID-19 pandemic and graduate medical education does not require it as part of their curriculum for most programs. This presents a challenge for developing education in this space, as there is a knowledge gap amongst educators which ultimately affects learners. Until telemedicine education is mandated by graduate medical education, the current de facto educational tools include peer-reviewed proactive approaches to instruct our learners. In turn, these manuscripts will be used as the basis for refining and developing educational tools for the next generation of telemedicine.

Conclusion

While pain physicians have embraced telemedicine, the efficiency and value of the examination component seems elusive. Here, authors present a review of clinical pearls for the virtual physical examination for the pain physician and an algorithmic approach that may be helpful for clinicians in all levels of training.

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