

Online Appendix

Table 1: Core Virtual Knee Exam		
For Physicians:		
<p>The left column contains the physical exam component. The middle column contains recommended medical record documentation fields. The right column contains standardized verbal instructions in layman’s terms that the clinician may provide to the patient for each physical exam component.</p> <p>*The virtual examination has been modified to allow patients to perform each component <u>independently</u>. Some additional components marked with asterisk may be included if a remote examiner is present with the patient.</p>		
Physical Exam Component	Documentation	Verbal Instructions for Patient
Knee		
Inspection	<input type="checkbox"/> Normal <input type="checkbox"/> Effusion <input type="checkbox"/> Abrasion <input type="checkbox"/> Swelling <input type="checkbox"/> Rash <input type="checkbox"/> Ecchymosis <input type="checkbox"/> Erythema <input type="checkbox"/> Scar(s) <input type="checkbox"/> Healed incision(s) <input type="checkbox"/> Healing incision(s) <input type="checkbox"/> Other:	<p>“We are going to now start examining your knee.”</p> <p>“Please stand facing the camera so that I can see the front of your knees.”</p> <p>“Now, turn sideways so that I can see your (right/left) knee from the side.”</p> <p>“Now, turn so I can see the back of the (right/left) knee.”</p>
Atrophy	<input type="checkbox"/> None <input type="checkbox"/> Quad <input type="checkbox"/> VMO <input type="checkbox"/> Other:	
Alignment	<input type="checkbox"/> Neutral <input type="checkbox"/> Mild valgus <input type="checkbox"/> Severe valgus <input type="checkbox"/> Mild varus <input type="checkbox"/> Severe varus	
Pain Location	<input type="checkbox"/> None <input type="checkbox"/> Quad tendon <input type="checkbox"/> Medial patella <input type="checkbox"/> Lateral patella <input type="checkbox"/> Inferior pole <input type="checkbox"/> Tibial tubercle <input type="checkbox"/> Medial epicondyle <input type="checkbox"/> Medial joint line <input type="checkbox"/> Pes <input type="checkbox"/> Lateral joint line <input type="checkbox"/> Fibular head <input type="checkbox"/> Popliteal fossa	<p>“Does your knee hurt anywhere specifically? If so, please point to the location using one finger.”</p>

	<input type="checkbox"/> Other:									
Gait	<input type="checkbox"/> Antalgic <input type="checkbox"/> Coxalgic <input type="checkbox"/> Trendelenburg <input type="checkbox"/> Flexed knee <input type="checkbox"/> Stiff knee <input type="checkbox"/> Varus thrust <input type="checkbox"/> Valgus thrust <input type="checkbox"/> Other:	<p>“Please walk directly away from the camera for at least four steps. Turn around and face the camera.</p> <p>Stand with your feet shoulder-width apart.</p> <p>Now walk directly back toward the camera to your starting position. Turn around and walk away from the camera and then again back towards the camera.”</p>								
Ambulatory Assist	<input type="checkbox"/> None <input type="checkbox"/> Cane <input type="checkbox"/> Crutch x1 <input type="checkbox"/> Crutch x2 <input type="checkbox"/> Walker <input type="checkbox"/> Wheelchair									
Knee Progression	<input type="checkbox"/> Neutral <input type="checkbox"/> Internal <input type="checkbox"/> External									
Foot Progression	<input type="checkbox"/> Neutral <input type="checkbox"/> Internal <input type="checkbox"/> External									
Foot Type	<input type="checkbox"/> Neutral <input type="checkbox"/> Planovalgus <input type="checkbox"/> Cavovarus	<p>“Tilt the camera down to show your feet while standing.”</p>								
Range of Motion										
Terminal Extension / Recurvatum <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">Sensitivity</td> <td>33%-94%</td> </tr> <tr> <td>Specificity</td> <td>N/A</td> </tr> <tr> <td>LR+</td> <td>N/A</td> </tr> <tr> <td>LR -</td> <td>N/A</td> </tr> </table>	Sensitivity	33%-94%	Specificity	N/A	LR+	N/A	LR -	N/A	<input type="checkbox"/> Painful <input type="checkbox"/> >-15 <input type="checkbox"/> -15 <input type="checkbox"/> -10 <input type="checkbox"/> -5 <input type="checkbox"/> 0 <input type="checkbox"/> 5 <input type="checkbox"/> 10 <input type="checkbox"/> 15 <input type="checkbox"/> 20 <input type="checkbox"/> <20	<p>“Lie down on the floor, bed, or couch positioned so that I can see your painful knee from the side. Place a soup can or small rolled up towel under your heel. Straighten out your knee as far as you are able. Try to straighten the knee as much as possible and let your muscles relax. Try to push down and try to touch the back of your knee to the floor. Does this cause pain?”</p>
Sensitivity	33%-94%									
Specificity	N/A									
LR+	N/A									
LR -	N/A									
Terminal Flexion	<input type="checkbox"/> Painful <input type="checkbox"/> 140 <input type="checkbox"/> 130 <input type="checkbox"/> 120 <input type="checkbox"/> 110 <input type="checkbox"/> 100 <input type="checkbox"/> 90 <input type="checkbox"/> <90	<p>“Now, bend your knee as far as you are able. You can use a towel to assist if you wish. Does this cause pain?”</p>								
Double Leg Squat / Single Leg Squat	<input type="checkbox"/> Good control <input type="checkbox"/> Poor control <input type="checkbox"/> Painful	<p>“Face the camera so that I can see from your waist to your feet. Standing on both feet, squat down far as you can, hold for one second, and then stand up. Repeat this a second time.</p> <p>Use a stable chair as a support, now squat down as far as you can with one leg, hold for one second, and then stand up. Repeat this a second time. ”</p>								

Neurovascular		
Sensation (General)	<input type="checkbox"/> LFCN <input type="checkbox"/> AFCN <input type="checkbox"/> PFCN <input type="checkbox"/> Obturator <input type="checkbox"/> SPN <input type="checkbox"/> DPN <input type="checkbox"/> Tibial <input type="checkbox"/> Sural <input type="checkbox"/> Saphenous	“Do you have any areas of numbness, burning, or tingling? If so, please point to these areas.”
Motor (General)	<input type="checkbox"/> TA <input type="checkbox"/> GS <input type="checkbox"/> Intact distally	“Do you feel weak with any particular movements? If so, what feels weak?” “Do the following – walk on your toes for several step. Now turn and walk in the other direction several steps on your heels.”
Circulation		“We are going to test the circulation of your extremities.”
Well perfused	<input type="checkbox"/> Symmetric <input type="checkbox"/> Cooler <input type="checkbox"/> Warmer	“Does your foot feel the same temperature on both sides.”
Capillary refill	<input type="checkbox"/> <2 seconds <input type="checkbox"/> >2 seconds	“Using your thumb, press your toenail until it turns white. Then, release your thumb and allow it to pink back up. How long did it take to pink back up?”
Pitting edema	<input type="checkbox"/> None <input type="checkbox"/> Mild <input type="checkbox"/> Moderate <input type="checkbox"/> Severe	“Make sure the camera is able to see your lower leg. Using two fingers, press down on the front of your shin just above your ankle.”

VMO vastus medialis oblique, TA tibialis anterior, GS gastrocsoleus, AFCN anterior femoral cutaneous nerve, PFCN posterior femoral cutaneous nerve, LFCN lateral femoral cutaneous nerve, SPN superficial peroneal nerve, DPN deep peroneal nerve, LR likelihood ratio.

Source: Lamplot JP, Pinnamaneni S, Swensen-Buza S, et al. The virtual shoulder and knee physical examination. *Orthop J Sports Med.* 2020;8. <https://doi.org/10.1177/2325967120962869>

Table 2: Knee Ligament Tests										
Lever Test	<input type="checkbox"/> Negative <input type="checkbox"/> Equivocal <input type="checkbox"/> Positive	“Now, place the soup can under the top part of your calf muscle so that your knee is partially bent and your heel touches the floor. Place the base of your palm just above your kneecap. Using both hands, push down toward the floor.”								
<table border="1"> <tr> <td>Sensitivity</td> <td>79%</td> </tr> <tr> <td>Specificity</td> <td>100%</td> </tr> <tr> <td>LR+</td> <td>N/A</td> </tr> <tr> <td>LR -</td> <td>N/A</td> </tr> </table>	Sensitivity	79%	Specificity	100%	LR+	N/A	LR -	N/A	<input type="checkbox"/> Negative <input type="checkbox"/> Equivocal <input type="checkbox"/> Positive	“Bend both of your knees to 90° while keeping your feet on the floor. Let your thigh muscles completely relax.”
Sensitivity	79%									
Specificity	100%									
LR+	N/A									
LR -	N/A									
<table border="1"> <tr> <td>Sensitivity</td> <td>54%-98%</td> </tr> <tr> <td>Specificity</td> <td>97%-100%</td> </tr> <tr> <td>LR+</td> <td>N/A</td> </tr> </table>	Sensitivity	54%-98%	Specificity	97%-100%	LR+	N/A	<input type="checkbox"/> Negative <input type="checkbox"/> Equivocal <input type="checkbox"/> Positive	“Now, in the same position, tighten your quadriceps muscle as if trying to straighten your knee without moving the position of your foot.”		
Sensitivity	54%-98%									
Specificity	97%-100%									
LR+	N/A									

LR -	N/A		
Dial Test*		<input type="checkbox"/> Negative <10 deg diff <input type="checkbox"/> >10 deg diff (30 deg) <input type="checkbox"/> >10 deg diff (90 deg)	“Direct the camera so that I am able to see both of your feet. Lay face-down on your belly with your knees together. The examiner will bend both of your knees to 90°. The examiner will rotate your feet away from one another while keeping your knees close together and observe for any side-to-side difference. The examiner will then straighten both of your legs such that they are 30° off of the floor. The examiner will again rotate your feet away from one another while keeping the knees close together, observing for any side-to-side difference.”

Source: Lamplot JP, Pinnamaneni S, Swensen-Buza S, et al. The virtual shoulder and knee physical examination. *Orthop J Sports Med.* 2020;8. <https://doi.org/10.1177/2325967120962869>

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Table 3: Meniscal Tests			
Bounce test		<input type="checkbox"/> Negative <input type="checkbox"/> Positive	“Lie down on the floor positioned so that I can see your painful knee from the side. Place a soup can behind your heel. Slightly bend your knee and then allow it to bounce down so that it is completely straight. Repeat this several times quickly. Does this cause pain?”
Hyperflexion		<input type="checkbox"/> Negative <input type="checkbox"/> Positive	“Wrap both of your hands or a towel around the front of your ankle. Pull your heel toward your buttock as far as it will go. Relax the towel and then pull it back again several times quickly. Does this cause pain?”
Thessaly		<input type="checkbox"/> Negative <input type="checkbox"/> Positive	“Now stand up and face the camera. You may use a table, chair or wall for balance. Stand on your injured leg only. Bend your knee slightly, to about 20°. Twist your body around your knee back and forth several times. Does this cause pain?”
Sensitivity	64%-90%		
Specificity	53%- 98%		
LR+	N/A		
LR -	N/A		
Apley Grind*		<input type="checkbox"/> Negative <input type="checkbox"/> Positive	“Lay face down on your belly. The examiner will bend your knee to 90° so that your foot is pointing straight up. The examiner will use the base of his/her hand to push firmly down on your heel while rotating your foot clockwise and counterclockwise. Does this cause pain?”
Sensitivity	22%		
Specificity	88%		
LR+	N/A		
LR -	N/A		

Table 4: Patellofemoral Joint Tests

Crepitation	<input type="checkbox"/> None <input type="checkbox"/> Mild <input type="checkbox"/> Moderate <input type="checkbox"/> Severe	“Sit on a chair. With the knee bent to 90°, place your hand over your kneecap. Straighten and bend your knee several times. Do you feel any popping or crunching under your kneecap? Would you describe this?”								
J-sign	<input type="checkbox"/> None <input type="checkbox"/> Mild <input type="checkbox"/> Severe	“Now, remove your hand covering your kneecap so that I can see it. Slowly straighten your knee all the way and then bend it. Do this 2-3 times.”								
Apprehension [3, 21] <table border="1" style="width: 100%; margin-top: 5px;"> <tr> <td style="width: 15%;">Sensitivity</td> <td>37%</td> </tr> <tr> <td>Specificity</td> <td>70%-92%</td> </tr> <tr> <td>LR+</td> <td>N/A</td> </tr> <tr> <td>LR -</td> <td>N/A</td> </tr> </table>	Sensitivity	37%	Specificity	70%-92%	LR+	N/A	LR -	N/A	<input type="checkbox"/> Negative <input type="checkbox"/> Positive	“Cross your ankles so that your painful leg is on top. Your knee should be bent 20-30 degrees. Use both of your thumbs to push the inside part of the kneecap towards the outside of the knee. Does this make you nervous? Is this painful?”
Sensitivity	37%									
Specificity	70%-92%									
LR+	N/A									
LR -	N/A									
Single Leg Squat	<input type="checkbox"/> Good control <input type="checkbox"/> Poor control <input type="checkbox"/> Valgus collapse	“Stand up facing the camera so that I can at least see you from your waist to your feet. Stand on the uninjured leg. Squat down on one leg as far as you can , and then stand up. Repeat this. Not do the same on the painful leg. Squad down as far as you can, and then stand up. Repeat this.”								
Popliteal Angles*	<input type="checkbox"/> WNL <input type="checkbox"/> Tight	“Turn the camera so that the doctor can see your legs from the side. Bend your hip so that your thigh is pointing straight up toward the ceiling. With your thigh pointing straight up, straighten out your knee as much as you can. Repeat on the other side.”								
	<input type="checkbox"/>									

WNL within normal limits.

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Table 5: Beighton Criteria

Beighton Criteria		"Each of the following tests should be done on the right and left side.
Thumb-to-Forearm	RIGHT <input type="checkbox"/> Positive <input type="checkbox"/> Negative LEFT <input type="checkbox"/> Positive <input type="checkbox"/> Negative	"Bend your wrist. Now, bend your thumb down and try to make it touch it to your forearm."
5 th MCP >90	RIGHT <input type="checkbox"/> Positive <input type="checkbox"/> Negative LEFT <input type="checkbox"/> Positive <input type="checkbox"/> Negative	"Bend your pinky back as far as it will go"
Elbow >10	RIGHT <input type="checkbox"/> Positive <input type="checkbox"/> Negative LEFT <input type="checkbox"/> Positive <input type="checkbox"/> Negative	"Stand with your side facing the camera. Straighten your elbows as far as they go."
Knee >10	RIGHT <input type="checkbox"/> Positive <input type="checkbox"/> Negative LEFT <input type="checkbox"/> Positive <input type="checkbox"/> Negative	"Step back and stand with your side facing the camera. Straighten your knees as far as they go."
Palms to Floor	<input type="checkbox"/> Positive <input type="checkbox"/> Negative	"Bend at the waist while keeping your knees straight and attempt to place both palms on the floor."

MCP medial coronoid process. **LR likelihood ratio.**

Source: Lamplot JP, Pinnamaneni S, Swensen-Buza S, et al. The virtual shoulder and knee physical examination. *Orthop J Sports Med.* 2020;8. <https://doi.org/10.1177/2325967120962869>