Development and Evaluation of a Method for Evaluating Pediatric Residents' Knowledge and Skill in Performing Physical Examinations of the Ankle and Knee

Albert C. Hergenroeder, MD*; Larry Laufman, PhD, EdD‡; Joseph N. Chorley, MD*; and Amy C. Fetterhoff, BS§

ABSTRACT. *Background.* **Pediatric residents need the knowledge and physical examination skills to evaluate common musculoskeletal injuries. The ankle and the knee are the 2 most common sites of musculoskeletal injury in young athletes. Methods for evaluating pediatric residents' knowledge and skills in examining the ankle and knee are needed.**

Objectives. **1) To describe the development of a method for evaluating pediatric residents' knowledge and skill in performing physical examinations of the ankle and knee, and 2) to report the reliability of this method.**

Methods. **A written test and a Clinical Skills Assessment Examination (CSAE) with a rating index were developed by the investigators to evaluate pediatric residents' knowledge and skills in examining the ankle and knee. Fifty-eight pediatric residents completed the written test and examined the ankle and knee of one standardized patient at the beginning of a required 1-month adolescent medicine rotation. Forty-eight residents repeated the evaluation at the end of the month. The investigators rated the residents' performance of the CSAE and then assessed interrater reliability using Cronbach's α. Test–retest correlation was calculated to assess the reliability of the written test.**

Results. **Test–retest correlation for the written test was 0.72, establishing its reliability. Interrater reliability for rating the CSAE of the ankle and knee was 0.98 and 0.90, respectively.**

Conclusion. **Pediatric residents' knowledge and skills in examining the ankle and knee can be reliably evaluated using the written test and CSAE described in this article. These could be used to assess the effectiveness of current curricula in improving pediatric residents' knowledge and skill in evaluating ankle and knee complaints and to assist in the design of future curricula.** *Pediatrics* **2001;107(4). URL: http://www.pediatrics.org/cgi/content/full/107/4/e51;** ***musculoskeletal, evaluation methods, resident curriculum.***

ABBREVIATIONS. OSCE, Objective Structured Clinical Examination; CSAE, Clinical Skills Assessment Examination; T_0, baseline evaluation; T_1, immediately after the intervention; T_2, at the end of the 1-month rotation.

From the *Department of Pediatrics, Adolescent Medicine and Sports Medicine Section; the ‡Department of Medicine, Baylor College of Medicine; and the §University of Texas Houston Health Science Center School of Public Health, Houston, Texas.

Amy C. Fetterhoff is currently at Wyle Laboratories, Houston, Texas.

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Reprint request to (A.C.H.) Adolescents Medicine and Sports Medicine Section, Baylor College of Medicine, Texas Children's Hospital, 6621 Fannin St MC3-3340, Houston, TX 77030-2399. E-mail: alberth@bcm.tmc.edu

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Musculoskeletal complaints are common in primary care practice.[1] Annually, there are ~3 million injuries in children and adolescents in the United States requiring time away from sports participation.[1] The estimated direct and indirect costs of recreational/sports injuries in <19-year-olds in the United States in 1994 was $22 billion.[2] There have been recommendations for more training in the diagnosis and treatment of musculoskeletal injuries during medical school and residency.[3–9] Physical examination skills are the cornerstone of making diagnoses of musculoskeletal injuries.

The Objective Structured Clinical Examination (OSCE) is a method that has been used to evaluate residents' competency in assessing clinical problems.[10] The OSCE format has been rated highly by pediatric residents and medical students; however, an OSCE involving pediatric residents examining the musculoskeletal system has not been published.[11] McGaghie et al[12] reported methods in which rheumatologists designed detailed checklists for an ideal performance of the physical examination of the knee (57 items), shoulder (87 items), back (73 items), and general musculoskeletal system (152 items) by medical students. The amount of detail, in terms of the number of items required for each joint examination, limits their use as practical evaluation tools. Lawry et al[13] reported that teaching a 3-minute screening musculoskeletal examination to first-year medical students increased skill in performing the examination at follow up 3 and 16 months later. A checklist was used to evaluate the physical examination skills (43 items). The Society of Teachers of Family Medicine published a curriculum guide for teaching sports medicine to family practice residents suggesting that the evaluation of the residents' ability to perform a focused musculoskeletal examination include direct observation complemented by checklists with component skills.[14] A checklist was not provided and it does not seem that one was developed; rather, a reference was given under the evaluation section of physical examination skills in the bibliography. That reference was used to develop the checklists in this project.[15] Checklists were not published in the studies by McGaghie et al and Lawry et al, although we reviewed the checklist in the former study sent to us by the author. Methods for evaluating pediatric residents' knowledge and skill in performing musculoskeletal examinations, with reliability established

psychometrically, are needed.[3] We are not aware of any such methods that have been tested and found to be reliable in the context of a pediatric residency training program. The ankle and knee are the 2 most common sites of injury in adolescent athletes.[16]

Purpose of the Study

The purposes of this study were: 1) to describe the development of a method to assess pediatric residents' knowledge and skill in performing ankle and knee physical examinations, and 2) to describe the reliability of this method. This study was conducted within a larger study evaluating the effectiveness of a teaching intervention in improving residents' knowledge and skill in performing ankle and knee physical examinations. The results of the teaching intervention are reported in an accompanying article.

METHODS

Study Participants

Between September 1998 and December 1999, there were 60 second-year pediatric and medicine–pediatric residents assigned to a 1-month adolescent medicine rotation, under the supervision of one of the investigators who is board certified in adolescent medicine and sports medicine. The focus of the rotation is adolescent medicine; however, residents see sports medicine patients in the sports medicine clinic of the investigators, which is held in conjunction with the adolescent clinic. Fifty-eight residents participated in the evaluation of a written test and a Clinical Skills Assessment Examination (CSAE), discussed below, at baseline and 48 participated at the end of their rotation. All but 2 of the 10 not available at 1 month were on vacation at the end of their rotation.

Development of the Evaluation Method

The evaluation method tested in this project included a written test and a CSAE.

Knowledge Assessment

A 20-question, multiple-choice written test was developed by the investigators, 2 of whom are pediatricians with board certification in Sports Medicine, a third is a medical educator, and the fourth is an athletic trainer. Ten ankle questions (the ankle component of the written test) and 10 knee questions (the knee component of the written test) were developed. The content validity was based on techniques described in standard textbooks and the investigators' consensus of the key elements of the physical examination of the ankle and knee.[15,17] The test was given to a pilot group of 4 second-year pediatric residents. Poor questions were identified by item analysis and rewritten. The revised test was given to a second pilot group of 5 second-year pediatric residents. After item analysis, the written test was finalized; the final instrument is included as "Appendix 1."

CSAE

The residents' performance of physical examinations of the ankle and knee were assessed using CSAE checklists developed by the investigators (see "Appendix 2"). The checklists were developed based on information in standard textbooks and were modifications of the physical examination forms used in the investigators' sports medicine clinic.[16,17] Development of the checklists was accompanied by the development of written indices, which included criteria for judging whether correct techniques in performing the ankle and knee examinations were demonstrated (see "Appendix 3"). The ankle CSAE checklist had a maximum score of 34 from 29 items and the knee CSAE checklist had a maximum score of 31 from 31 items. Some items had a potential score of 2, because of their importance in the examination, whereas some pairs of items had a 1-point maximum.

The 3 raters for the CSAE were the 2 sports medicine physicians and a certified athletic trainer who also served as the study coordinator and the standardized patient. The certified athletic trainer trained with the 2 physicians before the pilot phase of the study and after each pilot group to standardize her performance as the standardized patient. The CSAE checklists and indices were evaluated in the same 2 groups of residents used to pilot test the written test. After each pilot group, the 3 raters compared CSAE ratings of each resident for each item on the checklists. The raters discussed their reasoning when discrepancies among raters existed during the pilot groups, and based on these discussions, final criteria for correct performance of the physical examination techniques were established. Written notes were added to the checklists to cue the raters to the correct criteria to improve rater consistency.

Administration of the Evaluation Tools

Baseline Evaluations

The baseline evaluation (T_0) occurred just before the teaching intervention, which was within the first 2 days of the 1-month adolescent medicine rotation. The residents were given an identification number and that number, not their name, was recorded on the checklist evaluation sheet and written test. The residents completed the written test and the CSAE. The written test was administered 2 more times: 1) immediately after the intervention (T_1) and 2) at the end of the 1-month rotation (T_2). The questions for the written tests at each time were identical; however, the order of the questions was changed between T_0 and T_1. The T_1 and T_2 written tests were identical and the results of these 2 tests were used to evaluate test–retest reliability.

The CSAEs were conducted in an examination room in the sports medicine clinic of the investigators at T_0 and T_2. There was no CSAE performed at T_1, because this was a time for the teaching intervention, not evaluation. The investigators explained to the residents that the residents' examination of the standardized patient was the first step in the teaching intervention and that the evaluation method and teaching intervention were being tested, not the residents. Each resident was introduced to the standardized patient and short patient scenarios were presented (see "Appendix 2"). The residents were asked to demonstrate physical examination techniques during the CSAE and not to collect additional history or to make a diagnosis. During the CSAE, the resident was encouraged to talk aloud, explaining what they were doing. All CSAEs were audio recorded. In rating each resident's performance for each CSAE item, the standardized patient combined the scores and formulated one composite score. The standardized patient listened to the audiotape after the CSAE to settle discrepancies between raters' ratings, especially for physical examination techniques performed by inspection. For instance, if one rater indicated that a resident inspected for swelling and discoloration of the ankle and the others did not, the rating was done in favor of what was said or not said on the audiotape. The audiotape was reviewed and the CSAE evaluations of the 3 raters were pooled as soon as possible after the CSAE, usually within 24 hours.

The 3 raters recorded their CSAE ratings separately and did not compare rating scores. It was these separate CSAE ratings, recorded before a composite score was formulated, that were used to calculate the interrater reliability for the CSAE ratings. After the raters recorded their CSAE scores for each resident, the study coordinator pooled and recorded the ratings. If $\geq$2 raters concurred in their rating of the resident's performance of an item on the CSAE, then the resident was given credit for that item, unless there was a discrepancy among raters about an inspection technique. These discrepancies were resolved by reviewing the audiotape as discussed in the previous paragraph. The audiotape was reviewed for all CSAEs, regardless of the number of raters. If 2 raters rated the residents' CSAE and they disagreed about whether the resident had performed an item correctly, then an average of the 2 scores for that item was recorded.

After the CSAEs, the teaching intervention began. The teaching intervention included watching a videotape demonstrating the faculty performing the ankle and knee examinations. The video was followed by a skills-based session in which the residents observed one of the physicians demonstrating the techniques on the standardized patient in an examination room, followed by correct demonstration of the techniques on the standardized patient by the resident under the supervision of 1 of the 3 raters. The intervention is discussed in more detail in the accompanying article.

Statistical Analyses

Data from the 2 pilot groups were excluded from analysis. Test–retest reliability for equivalent tests was assessed by calculating the simple correlation between the written test scores at T_1 and T_2.[18] Cronbach's α was used to assess interrater reliability for the CSAE at T_0 and T_2. The raters recorded whether each item was performed correctly by the resident.

RESULTS

Test–Retest Reliability of the Ankle and Knee Components of the Written Test

The test–retest correlation for the ankle component of the written test was 0.62 ($P < .001$). The test–retest correlation for the knee component of the written test was 0.72 ($P < .001$). For the overall written test, combining the ankle and knee components, the test–retest correlation was 0.72 ($P < .001$).

CSAE

Interrater reliability among the 3 raters for the CSAE ratings for the ankle and knee was $\alpha = 0.98$ and 0.90, respectively, at T_0. At T_2, the interrater reliability among the 3 raters for the CSAE ratings for the ankle and knee was 0.99 and 0.84, respectively.

DISCUSSION

The purposes of the study, to describe the development of a method to assess pediatric residents' knowledge and skill in performing ankle and knee physical examinations and to describe the reliability of this method, were accomplished. We are not aware of another method with published reliability data in the context of a pediatric residency training program. The reliability of the written test was high, especially considering that the test and retest were conducted 1 month apart. The correlation coefficient reported here may have been attenuated by many factors that could effect residents' acquisition or retention of information during that month. Thus, the reliability reported here may be an underestimate. The approach used in this study, starting with standard techniques, pilot testing, and then revising the evaluation method twice before implementation, resulted in excellent interrater reliability for the CSAE. McGaghie et al[12] reported a weighted κ-value of 0.72 for interrater reliability in rating a screening musculoskeletal CSAE. Our CSAE was less detailed than that of McGaghie et al and may be more practical for use in pediatric residency training programs. The next step will be to test this method in other residency programs. This will be facilitated through the use of the teaching videotape that demonstrates the techniques assessed in the CSAE and was developed as part of the teaching intervention. This videotape could fill the gap between written descriptions of technique and practical demonstration of techniques. The videotape and skills-based teaching session are described in the accompanying article. A concern may be that because the 3 raters in this project worked together closely in the pilot phase of the study and because the resultant CSAE interrater reliability was so high, it will be difficult to replicate these methods elsewhere. We anticipated this concern and in response developed the detailed CSAE Indices ("Appendix 3"), which describe correct performance of the individual maneuvers. These indices, coupled with the teaching videotape described in the companion manuscript, will facilitate implementation in other settings. The authors will be available for consultation as well.

The written test and CSAE could evaluate residents' performance in these areas and identify areas for curriculum improvement. Residency directors and the residency review committee of the Accreditation Council on Graduate Medical Education could consider requiring the demonstration of these skills as a requirement during residency, similar to the requirement of performing a pelvic examination.[19] The presence of a proven evaluation method may be an incentive for residency programs to make teaching musculoskeletal examination techniques a higher priority. Identifying residents' needs through the method described in this article could be an incentive to increase resources for teaching about the diagnosis of musculoskeletal injuries.

Measurement Issues

Inspection skills should be easy to evaluate if the residents are prompted to talk aloud during their examination of the patient. The audiotape was helpful as an aid in assessing inspection skills but not performance of other skills because some residents verbalized that they were performing a particular examination technique, yet were observed by the raters to be doing so incorrectly. Another potential source of rater disagreement is inherent in the standardized patient being one of the raters, having the added benefit of proprioceptive input into whether the resident performed the examination correctly. This was not an issue in this study.

Although residents were told that they did not have to diagnose the standardized patient's ankle or knee problem and the emphasis was on the physical examination skills, several residents focused their initial examination, after the patient scenarios were read, on making a diagnosis by attempting to obtain additional history rather than performing the physical examination. This may also have been an attempt to organize their thoughts about conducting the examination, which is understandable. A reminder at the beginning of the session focused the resident's attention on the examination.

CONCLUSION

Pediatric residents have the need to improve their skills in performing physical examinations of the ankle and knee. This article describes a reliable method to evaluate pediatric residents' knowledge and skills in performing these examinations. There is no other published method that we are aware of that has been tested in this manner and in the context of a pediatric residency program. The next steps will be to test these evaluation methods in other primary care residency programs, with primary care physicians in practice, and to extend these methods to assess pediatric residents' knowledge and skill in performing physical examinations of the remainder of the musculoskeletal system.

POST-TEST 2

INSTRUCTIONS: THE FOLLOWING QUESTIONS ARE DESIGNED TO TEST YOUR KNOWLEDGE OF THE DIAGNOSIS OF ANKLE AND KNEE INJURIES BASED ON PHYSICAL EXAMINATION. THERE IS ONE BEST ANSWER TO ALL QUESTIONS.

Today's date _ _/_ _/_ _

1. The physical examination test that supports the diagnosis of an isolated anterior cruciate ligament sprain is the:

   A. Valgus test
   B. Anterior drawer test
   C. McMurray test
   D. Apprehension test
   E. Bounce home test

2. A medial collateral ligament sprain would be tested for by doing which of the following tests on the knee?

   A. Lachman test
   B. McMurray test
   C. Apprehension test
   D. Thomas test
   E. Valgus test

3. Following an ankle sprain, which range of motion is the most important to restore?

   A. Plantarflexion
   B. Inversion
   C. Dorsiflexion
   D. Eversion
   E. Internal Rotation

4. Which of the following estimates the flexibility of the hamstring muscle?

A. Popliteal angle
B. Thomas test
C. Apprehension test
D. Bounce home test
E. Ober test

5. What is the best way to assess for the presence of a small knee effusion?

A. Inspect the popliteal fossa
B. Ballotment of the patella
C. Attempt to demonstrate a fluid wave
D. Ask the patient to perform a quadriceps contraction
E. Passive knee flexion

6. The base of the fifth metatarsal is the site of insertion of which structure:

A. Extensor digitorum brevis tendon
B. Anterior talofibular ligament
C. Deltoid ligament
D. Anterior tibialis tendon
E. Peroneus brevis tendon

7. "Quad sets" (i.e. contracting the quadriceps muscle in knee extension) is an important test during the physical examination of a patient with knee pain. The quad set involves contraction of the vastus medialis obliquus (VMO). Which of the following statements is true regarding the "quad set?"

A. Is a functional test to establish eligibility for returning to sports.
B. It requires normal hamstring function.
C. It requires an intact anterior cruciate ligament.
D. Is normal if the tone and bulk of the VMO are normal.

8. The best way to assess gastrocnemius recovery after an ankle sprain is:

A. Patient seated, physician palpation of muscles
B. Patient seated, physician testing resisted plantarflexion
C. Patient supine with toes plantarflexed, physician palpation of muscles
D. Patient seated, physician testing resisted dorsiflexion
E. Patient standing on tip toes, physician observing from behind testing bulk and tone

9. Which of the following would be the most important physical examination technique to assess the functional ability of a patient recovering from an ankle injury?

A. Testing active dorsiflexion (by leaning against the wall with heels on the ground)
B. Hopping on the injured ankle alone compared to the uninjured ankle
C. Testing for balance by having the patient stand on one foot and raising on their toes
D. Testing inversion strength
E. Testing for laxity using the anterior drawer test

10. What is the suggested sequence of the physical examination of an injured joint?

A. Inspection, Palpation, Active range of motion, Resisted range of motion, Passive range of motion, Functional testing, Examine uninjured side.
B. Inspection, Palpation, Passive range of motion, Resisted range of motion, Active range of motion, Functional testing, Examine uninjured side.
C. Examine uninjured side, Inspection, Palpation, Active range of motion, Resisted range of motion, Passive range of motion, Functional testing
D. Examine uninjured side, Functional testing, Inspection, Palpation, Active range of motion, Resisted range of motion, Passive range of motion
E. Examine uninjured side, Active range of motion, Resisted range of motion, Passive range of motion, Functional testing, Inspection, Palpation

11. The clinical test designed to assess for a complete posterior cruciate ligament tear is:

A. Sag
B. Bounce home
C. Anterior drawer
D. Apprehension
E. McMurray

12. A positive apprehension test implies:

A. Medial collateral ligament instability
B. Anterior cruciate ligament instability
C. Laterally collateral ligament instability
D. Medial meniscal injury
E. Patellar subluxation/dislocation

13. Which ligament is most commonly torn during an inversion ankle sprain?

A. Calcaneofibular ligament
B. Anterior talofibular ligament
C. Posterior talofibular ligament
D. Deltoid ligament
E. Syndesmosis

14. Patellofemoral dysfunction is the most common overuse injury of the knee. In the context of the supporting history, the physical examination finding that best supports the diagnosis is:

A. Peripatellar tenderness
B. Positive Ober test
C. Tenderness along the tibial joint line
D. Positive Lachman test
E. Positive McMurray testing

15. On examination of an ankle after an acute injury, the most likely bone to be point tender representing fracture is the:

A. Cuboid
B. Calcaneus
C. Distal fibula
D. Sesamoid

16. If the bounce home test of the knee is abnormal (i.e. positive), it suggests:

A. Patellofemoral dysfunction
B. Iliotibial band tendinitis
C. A meniscal (cartilage) tear
D. Medial collateral ligament sprain
E. Posterior cruciate ligament sprain

17. A 16 year old male presents to his physician's office 30 minutes after injuring his ankle during a basketball game. He is unable to bear weight without pain, and there is moderate ecchymoses over the lateral aspect of the ankle. He will not voluntarily move his ankle. His neurovascular integrity is intact. What key finding would lead you to fracture as the most likely diagnosis?

A. Crepitus of the distal fibula
B. Anterior drawer test, trying to translate the talus forward in the mortise
C. Tilt test or stress inversion test in which the talus is inverted passively
D. Passive dorsiflexion
E. Squeezing the distal tibia and fibula together and then releasing

18. The physical examination maneuver designed to test specifically for cartilage tears is the:

A. Anterior drawer test
B. McMurray test
C. Thomas test
D. Lachman test
E. Ober test

19. The anterior drawer test in the ankle is meant to assess for:

A. The possibility of a fracture
B. Functional instability
C. Ligamentous laxity
D. Range of motion in dorsiflexion
E. Peroneus brevis integrity

20. Which of the following statements is true regarding eversion compared to inversion injuries of the ankle?

A. No difference in the rate of fracture in eversion and inversion injuries
B. A fracture is more likely following an inversion injury
C. The likelihood of fracture cannot be predicted from knowing the injury mechanism
D. A fracture is more likely following an eversion injury

Answer key

1. B	2. E	3. C	4. A	5. C	6. E	7. D	8. E	9. B	10. C
11. A	12. E	13. B	14. A	15. C	16. C	17. A	18. B	19. C	20. D

APPENDIX 2

CSAE CHECKLISTS

Date_____ **Model**_____ **Rater**_____

Rating Form for the Clinical Skills Assessment

The physician can be graded either on what they say they are observing or what they actually do or do not do.

KNEE

Scenario

The patient is a 15 year-old female with left knee pain. She is a runner. She reports having pain for one month. She denies any other history of knee pain. She denies any specific trauma or swelling. She denies any instability or locking and her PMH and ROS are normal. Patient is not taking any medication at this time.

Time_____	Points	
Did they make the patient walk?	2=yes, 0=no	____
Did they compare extremities bilaterally?	1=yes, 0=no	____
Inspect for swelling	1=yes, 0=no	____
	Extra point for trying to demonstrate a fluid wave	____
Did they mention absence of discoloration?	1=yes, 0=no	____
VMO contraction		
KNEE EXTENDED		
Did they ask if painful?	1=yes, 0=no	____
Did they note bulk correctly?	1=yes, 0=no	____
Did they palpate for tone correctly?	1=yes, 0=no	____
Bounce home test	1=did it correctly, 0=did not	____
Apprehension test	1=did it correctly, 0=did not	____
Palpate for peripatellar tenderness	superior pole	____
(1 for each correct answer)	inferior pole	____
MUST INDENT SKIN	medial pole	____
	lateral pole	____
Palpate for patellar tendon tenderness	1=yes, 0=no	____
Palpate for tibial tuberosity tenderness	1=yes, 0=no	____

Flexibility

Did they do popliteal angle correctly? 1=yes, 0=no ____
KNEE @ 90, HIP @least 45
Did they do Ober test correctly? 1=yes, 0=no ____
Did they do Thomas test correctly? 1=yes, 0=no ____

Meniscus

Did they assess for joint line tenderness appropriately? 1=yes, 0=no ____
Did they do the McMurray correctly? (Perform either test) ____
Did they do the modified McMurray correctly? (1 point max.) ____

Ligaments

Did they inspect for posterior cruciate ligament laxity correctly? 1=yes, 0=no ____
Did they do anterior drawer correctly? 1=yes, 0=no ____
" the Lachman correctly ? (Perform either test) ____
" the modified Lachman correctly? (1 point max.) ____
Did they do the pivot shift correctly? 1=yes, 0=no ____
Did they assess the medial collateral ligament
@ 0° correctly? 1=yes, 0=no ____
@ 30° correctly? 1=yes, 0=no ____
Did they assess the lateral collateral ligament
@ 0° correctly? 1=yes, 0=no ____
@ 30° correctly? 1=yes, 0=no ____
TOTAL SCORE (maximum=31) ____

ANKLE

Scenario

A 16 year old male twisted his left ankle yesterday and is able to bear weight. This is the first time he sprained the ankle.

Time _____ Points

Did they make the patient walk? 2=yes, 0=no ____
Did they compare extremities bilaterally? 1=yes, 0=no ____
Did they inspect for swelling? 1=yes, 0=no ____
Did they mention the absence of discoloration? 1=yes, 0=no ____
Did they inspect for or mention absence of gross abnormalities? 1=yes, 0=no ____

Active range of motion	plantar flexion	1=yes,0=no	____
	plantar flexion/inversion	1=yes, 0=no	____
	plantar flexion/eversion	1=yes, 0=no	____
	dorsiflexion	2=yes, 0=no	____
	dorsiflexion/inversion	1=yes, 0=no	____
	dorsiflexion/eversion	1=yes, 0=no	____
Resisted range of motion	plantar flexion	1=yes, 0=no	____
	plantar flexion/inversion	1=yes, 0=no	____
	plantar flexion/eversion	2=yes, 0=no	____
	dorsiflexion	1=yes, 0=no	____
	dorsiflexion/inversion	1=yes, 0=no	____
	dorsiflexion/eversion	2=yes, 0=no	____
Palpation	proximal fibula	1=yes, 0=no	____
	lateral malleolus	1=yes, 0=no	____
	lateral joint line	1=yes, 0=no	____
	base of 5th metatarsal	1=yes, 0=no	____
	anterior joint line	1=yes, 0=no	____
	medial malleolus	1=yes, 0=no	____
	navicular	1=yes, 0=no	____
Did they assess neurovascular function?		1=yes, 0=no	____
Did they do the inversion stress test/talar tilt correctly?		1=yes, 0=no	____
Did they do the anterior drawer test correctly?		1=yes, 0=no	____
Did they ask them to raise up on toes or hop on toes?		1=yes, 0=no	____
Did they perform the 5 hop test?		2=yes, 0=no	____
	TOTAL SCORE (maximum=34)		____

APPENDIX 3

CSAE INDICES

KNEE

Did they make the patient walk?
Learner must ask the patient to walk or they may state that they observed the patient walking into the examination room.

Did they compare extremities bilaterally?
The learner must state that they are going to compare the two knees. Once they do this, the rater tells the learner that they do not need to demonstrate each maneuver for each knee.

Inspect for swelling
Learner must state that they are observing for the presence or absence of swelling. They may be awarded one extra bonus point for correctly demonstrating a fluid wave.

Did they mention absence of discoloration?
Learner must state that they are observing for discoloration or ecchymosis.

VMO Contraction.
Did they ask if painful?
Did they note bulk correctly?
Did they palpate for tone correctly?
Learner must palpate the VMO for tone and observe the VMO during contraction for bulk.
Learner should ask if the VMO contraction was painful.

Bounce Home Test
Place patient in a supine position. Learner should cup the patient's heel in the cup of their hand and bend the knee into 10-20° of flexion, then drop the knee into extension as far as the patient will allow it while still holding onto the heel.

Apprehension Test
Learner should place the patient in the supine position with the knees extended and the quadriceps muscles relaxed. Learner moves the patella laterally using a force sufficient to displace the patella maximally.

Palpate for peripatellar tenderness
Learner must palpate all four poles of the patella, applying enough pressure to indent the skin (1 point for each pole).

Palpate for patellar tendon tenderness
Learner must palpate patient's patellar tendon for tenderness.

Palpate tibial tuberosity tenderness
Learner must palpate patient's tibial tuberosity for tenderness.

Flexibility
Did they do popliteal angle correctly?
Learner must place the patient in the supine position with the ipsilateral hip flexed to 90°. Learner passively extends the knee, while assessing the angle of knee extension as a measure of flexibility, with the starting point being 90°.

Did they do Ober test correctly?
Learner should have the patient lie on his/her side, with the testing leg on top and ask the patient to move toward the edge of the table where the learner is standing. The learner should abduct the patient's hip and support the lower leg on the learner's iliac crest while extending the patient's hip as far as possible (i.e., in line with the spine) and flexing the ipsilateral knee to 90°. The contralateral hip should be flexed to 45-90°. The learner then asks the patient to relax the testing leg and watches how far down the testing hip adducts toward the table.

Did they do Thomas test correctly?
The patient is supine. The patient is asked to passively flexed one knee completely to their chest. The opposite leg rests flat on the table. The patient should start the test sitting slightly off the edge of the table. The learner should then ask the patient to lie supine while still holding the knee to chest. The learner looks for whether the opposite leg raises off the table when the patient is supine.

Did they assess for joint line tenderness appropriately?
The patient is supine with the hips flexed to 45^0, knees flexed to 90^0 and the feet flat on the table. Learner assesses for medial and lateral joint line tenderness. The learner must find the angle between the distal femoral condyle and the tibial plateau and palpate along that joint line.

Did they do the McMurray correctly?
The patient is supine with the hips flexed to 45°, knees flexed to 90° and the feet flat on the table. The learner assesses joint line tenderness as they take the patient's knee into full flexion and extension, while internally and externally rotating the tibia and keeping the hip in a neutral position.

Did they do the modified McMurray correctly?
The patient is supine with the hips flexed to 45°, knees flexed to 90° and the feet flat on the table.. The learner performs the test as described above while also moving the patient's hip into internal and external rotation.

Did they inspect for posterior cruciate ligament laxity correctly?
The patient is supine with hips flexed to 45°, knees flexed to 90° and the feet flat on the table. The learner then observes for a posterior sag of the patient's tibia toward the table from the lateral view.

Did they do anterior drawer correctly?
The patient is supine with the hips flexed to 45° and the knees flexed to 90° and the feet flat on the table. The learner sits on the foot of the knee being assessed. The learner grasps the tibia just below the joint line of the knee. The thumbs are placed along the joint line on either side of the patellar tendon. The index fingers palpate the hamstring tendons medially and laterally to ensure that they are relaxed. The tibia is pulled toward the learner with force adequate to move the patient's body.

Did they do the Lachman maneuver correctly?
The patient is in the supine position with the knee passively flexed approximately 20°. The learner places one hand on the tibia around the level of the tibial tuberosity with the thumb just lateral to the tibial tuberosity and the fingers extending into the popliteal fossa. The other hand grasps the femur just above the femoral condyles. The tibia is then pulled anteriorly with one hand while slight posterior pressure is applied to the femur with the other hand.

Did they do the modified Lachman correctly?
The patient is seated on the edge of the examination table. The learner sits between the patient's legs. The learner stabilizes the femur with one hand and while resting the patient's lower leg on his/her thigh, attempts to translate the tibia anteriorly, using similar techniques to the Lachman maneuver.

Did they do the pivot shift correctly?
The investigators accepted that they could not teach the pivot shift in one session and do not describe it here in text.

Did they assess the medial collateral ligament at 0° correctly? at 30° correctly?
The patient is in the supine position. The learner lifts the patient's ankle with one hand and places the other hand at the lateral joint line of the knee so that the learner's thenar eminence is against the lateral joint line. The learner pushes medially against the knee while stabilizing the patient's lower leg against the learner's flank in an attempt to open the knee joint medially, i.e. valgus stress, at 0° and then at 30° of knee flexion.

Did they assess the lateral collateral ligament at 0° correctly? at 30° correctly?
The patient is in the supine position. The learner lifts the patient's ankle with one hand and places the other hand at the medial joint line of the knee so that the learner's thenar eminence is against the medial joint line. The learner pushes laterally against the knee while stabilizing the patient's lower leg against the learner's flank in an attempt to open the knee joint laterally, i.e. varus stress, at 0° and then at 30° of knee flexion.

ANKLE

Did they make the patient walk?
Learner must ask the patient to walk or state that they observed the patient walking into the examination room.

Did they compare extremities bilaterally?
The learner must state that they are going to compare the two ankles. Once they do this, the rater tells the learner that they do not need to demonstrate each maneuver for each ankle.

Did they inspect for swelling?
Learner must state that they are observing for the presence or absence of swelling.

Did they mention the absence of discoloration?
Learner must state that they are observing for the presence of discoloration or ecchymosis.

Did they inspect for or mention absence of gross abnormalities?
Learner must state that they are observing for the presence of any obvious gross deformities.

Active Range of Motion
Learner must instruct the patient to perform each of the following maneuvers. The learner must stabilize the patient's lower leg while the patient performs the following maneuvers

plantar flexion
plantar flexion/inversion
plantar flexion/eversion
dorsiflexion
dorsiflexion/inversion
dorsiflexion/eversion

Resisted range of motion
Learner must instruct the patient to perform each of the following maneuvers. The learner must stabilize the patient's lower leg and hold the resistance for three seconds.

plantar flexion
plantar flexion/inversion
plantar flexion/eversion
dorsiflexion
dorsiflexion/inversion
dorsiflexion/eversion

Palpation
Learner must actively palpate each of the following structures.
proximal fibula- locate the fibular head superiorly and palpate along the length of the fibula until reaching the lateral malleolus.

lateral malleolus- located at the distal end of the fibula, it extends further distally and is more posterior than the medial malleolus.
lateral joint line- palpate the area inferior to the lateral malleolus.
base of 5th metatarsal- probe proximally along the lateral shaft of the 5th metatarsal to its flared base, the styloid process.
anterior joint line- palpate the area between the medial and lateral malleoli along the anterior aspect of the ankle joint.
medial malleolus-move from the head of the talus, traveling proximally until reaching the medial malleolus.
navicular- palpate the medial aspect of the foot anterior to the talus.

Did they assess for neurovascular function?
Learner must demonstrate or state that they would assess for neurovascular integrity and function.

Did they do the inversion stress test/talar tilt correctly?
Learner is positioned in front of the patient while one hand grasps the calcaneus and maintains the ankle in neutral position, i.e. 90° relative to the long axis of the lower leg. The opposite hand stabilizes the lower leg. The hand holding the calcaneus provides an inversion stress by rolling the calcaneus inward, causing the talus to tilt.

Did they do the anterior drawer test correctly?
Learner is positioned in front of the patient with one hand stabilizing the lower leg. The other hand cups the calcaneus while the forearm supports the foot in a neutral position. The learner draws the calcaneus and talus forward while providing a stabilizing force to the tibia.

Did they ask them to raise up on toes or hop on toes?
Learner must ask the patient to raise up or hop on toes.

Did the learner perform the 5 hop test?
Learner must ask the patient to hop on foot, then the other. If the learner addressed this in the previous question, points will be given for this question.

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