Validity of Selective Tissue Tests for Knee Pathologies: An Evidence-to-Practice Review

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ABSTRACT

The knee is the most commonly injured joint in sport, inherently meaning the knee is also the joint most frequently evaluated by healthcare providers. Clinicians evaluate and treat the knee as efficiently as possible to prevent long-term disability of the patient. Clinicians rely on physical examination tests such as McMurray's Test, Apley's Test, Joint Line Tenderness, Lachman Test, Anterior Drawer, Pivot Shift Test, and the Ottawa Knee Rules for initial diagnosis and initiation of care. These physical examination tests have varying levels of diagnostic accuracy and validity. Clinicians should know how definite they can be about a diagnosis from physical examination alone based on the tests' validity and reliability. The purpose of this evidence to practice review was to evaluate the validity of the individual and combinations of two or more selective tissue tests for the knee. The authors included systematic reviews and meta-analyses that reported on the diagnostic properties of one or more physical tests for one or more knee disorders. The 17 articles used were screened independently by two reviewers. Each article was appraised using the Assessment of the Methodological Quality of Systematic Reviews (AMSTAR) ranking system. Articles with the highest AMSTAR ranking for each injury and evaluated the sensitivity, specificity, positive likelihood ratio, negative likelihood ratio, and diagnostic odds ratio were used to make recommendations for validity. Physical examination tests of the knee included in the review were found to be most accurate when performed in combination with each other, as they had only low to moderate diagnostic properties. Physical examination tests for the meniscus, ACL, PCL, patellofemoral pain, and knee osteoarthritis are not valid to be used as individual diagnostic tests. The only exemption to this finding is the Lachman test; with a sensitivity of 85%, the Lachman test is suitable to rule out an ACL tear as a stand-alone test.

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Full Citation
Ulshafer SP, Johnson SD, Schoell KN, Winkelmann ZK. Validity of Selective Tissue Tests for Knee Pathologies: An Evidence-to-Practice Review. *Clin Pract Athl Train*. 2022;5(2): 18-23. https://doi.org/10.31622/2022/0005.02.4.

Submitted: December 7, 2020, **Accepted**: March 3, 2021.

ORIGINAL REFERENCE

Décary S, Ouellet P, Vendittoli PA, Roy JS, Desmeules F. Diagnostic validity of physical examination tests for common knee disorders: An overview of systematic reviews and meta-analysis. Phys Ther Sport. 2017;23:143-155. https://doi.org/10.1016/j.ptsp.2016.08.002

SUMMARY

CLINICAL PROBLEM AND QUESTION

The knee is the most commonly injured joint in sport, and thus the joint most typically evaluated by clinicians.[1] It is important to address and intervene with injuries to the knee as soon as possible to prevent secondary injury and chronic damage to the joint, as knee disorders often cause a decrease in quality of life from loss of optimal function and development of osteoarthritis.[2] Healthcare providers will intervene by performing a myriad of physical examination tests to rule in or out pathologies for the patient. The physical examination is relied upon in many instances due to the significant costs incurred from clinical imaging and the time delay patients may experience while waiting for results and subsequent diagnosis.[3,4] However, while physical

 ISSN Online 2577-8188

examination tests are supposed to give patients and clinicians a firm diagnosis, most of these tests have both low sensitivity and low specificity.[4] The clinician should be familiar with the validity (degree to which a test measures what it is intended to measure) and shortcoming of each selective tissue test they perform, and the shortcomings of certain diagnostic tests.[5] Because of the inconsistent results with many diagnostic physical evaluation tests, the purpose of the guiding systematic review was to evaluate the validity of individual and combinations of selective tissue tests for the knee.[5]

SUMMARY OF LITERATURE

The guiding systematic review's authors conducted a literature search using five databases: PubMed, Medline, CINAHL, Embase, and the Cochrane Database of Systematic Reviews. The authors used relevant, and MESH based keywords for articles published any time before January 2016 on all five databases to determine which systematic reviews and meta-analyses to include. To determine whether a study would be included in the guiding systematic review, the article, title, and abstract were all screened independently by two reviewers. Systematic reviews and meta-analyses that were included in the guiding systematic review had to meet the following inclusion criteria: (1) be a systematic review or meta-analysis, (2) report on the diagnostic properties of one or more physical tests for one or more knee disorders, and (3) be written in English or French.

Following the search using the criteria listed above, 17 systematic reviews and meta-analyses of the original 6,750 systematic reviews and meta-analyses initially identified were included. Of these 17 studies, 11 were meta-analyses while the other 6 were systematic reviews that did not include a meta-analysis. Overall, the systematic reviews and meta-analyses explored selective tissue tests for meniscus injuries (n=8), anterior cruciate ligament (ACL) injury (n=6), the combination of tests from ACL/PCL/meniscus injuries and cartilage defects (n=2), while other systematic reviews and meta-analyses explored a clinical prediction rule for knee fractures (n=2) and knee osteoarthritis (n=2). Each systematic review and meta-analyses were appraised using Assessment of the Methodological Quality of Systematic Reviews (AMSTAR) ranking system. The AMSTAR is a reliable tool that is used to assess the overall quality of the systematic reviews and meta-analyses. Each systematic review and meta-analyses were given an AMSTAR score out of 11 to assess the strength of evidence. A score of an 8 or higher is considered a high-quality systematic review/meta-analysis. A score between 5 and 7 is a moderate quality and a score less than 5 was considered low quality. The AMSTAR ranking for each study was averaged out and inter-rater agreement on each term was accounted for. From the 17 systematic reviews and meta-analyses, seven of them reached an AMSTAR score of 7 or higher.

SUMMARY OF OUTCOMES

The authors of this guiding systematic review extracted sensitivity (ability of a test to rule a diagnosis out), specificity (ability of a test to rule a diagnosis in), positive likelihood ratio (the odds of detecting an injury in a patient who has that injury), negative likelihood ratio (the odds of detecting an injury in a patient who does not have that injury) and provided diagnostic odds ratio (the measure of effectiveness of a diagnostic test) in each of the 17 articles.[4-6] The authors then assessed the data for each of the following selective tissue tests from the studies: McMurray's, Apley's, Joint Line Tenderness, Lachman, Anterior Drawer, Pivot Shift, and the Ottawa Knee Rules. The authors of the guiding systematic review used the highest quality systematic reviews and meta-analyses for each selective tissue test of the knee, based on the respective AMSTAR scores, to assess the sensitivity, specificity, and diagnostic odds ratios of each diagnostic selective tissue test. The

authors also reviewed the likelihood ratios to make recommendations on the validity of the selective tissue test, with ratio of 5 or higher indicating a positive likelihood ratio and 0.2 or lower indicating a negative likelihood ratio. If an injury is present, the test would prove to be positive, and if the injury is not present, the test will prove to be negative.

FINDINGS AND CLINICAL IMPLICATIONS

The authors of the guiding systematic review grouped their findings into six different knee pathologies through nine physical tests and one clinical diagnostic rule with two scenarios that can be found in Table 1. The first pathology was meniscus injuries, with eight systematic reviews and meta-analyses providing data on the selective tissue tests for this pathology. The AMSTAR assessment of the systematic reviews for the clinical tests had ratings between a 2 to an 8. The tests with the highest validity were the McMurray's Test, which had a sensitivity of 70.5% (95% CI: 67.4-73.4) and Joint Line Tenderness test had a specificity of 77.4% (95% CI: 75.6-79.1%).7 When determining likelihood ratios, the Joint Line Tenderness test provided the highest positive likelihood ratio (4.0; 95% CI: 2.1-7.5) and the lowest negative likelihood ratio (0.23; 95% CI: 0.12-0.44). Tests for meniscal injuries of the knee should not be performed individually due to their low diagnostic validity.[7]

Six systematic reviews and meta-analyses provided data on the diagnosis of an ACL injury, with AMSTAR scores ranging from 2 to 8. The selective tissue test with the highest sensitivity was the Lachman test with a sensitivity of 85% (95% CI: 83.0-87.0%).[8] The Lachman test also provided the highest positive likelihood ratio (10.2; 95% CI: 4.6-22.7) and the lowest negative likelihood ratio (0.20; 95% CI: 0.10-0.30) out of all other selective tissue tests performed in the systematic reviews and meta-analyses. The pivot shift test had the highest specificity with a score of 98% (95% CI: 96.0-99.0%).[8] For ACL injuries, the Lachman test has a high diagnostic value to help rule in and rule out the pathology and the pivot shift test is best suited to complement the Lachman test when needing to rule in the condition.

Two systematic reviews, one that included a meta-analysis, were evaluated to look at patellofemoral pain with AMSTAR scores of 6 and 7, respectively.[9,10] The active instability test, pain using stairs, Clarke's Sign, pain during prolonged sitting, and the patella tilt test were all assessed. When looking at likelihood ratios, no test has a significant clinical value to help include or exclude patellofemoral pain. It can be concluded that there are no individual tests recommended to diagnose patellofemoral pain and performing a combination of tests did not improve the positive likelihood ratio.

Only one systematic review was used to look at posterior cruciate ligament (PCL) injuries. The systematic review was given an AMSTAR score of a 7.[11] In the systematic review, 11 studies determined the posterior drawer test to be the most frequent test used to determine a PCL pathology. Based on poor likelihood ratios for the posterior drawer test and despite a high specificity ranging from 96% to 100% for the quadriceps active test, there was no sufficient evidence to help include or exclude a PCL injury with any selective tissue test.[11]

For knee fractures, the Ottawa Knee Rules was examined in two systematic reviews. The Ottawa Knee Rules are used to rule in knee fractures and to avoid unnecessary radiographs.[12] The two systematic reviews received AMSTAR scores of 2 and 7. For the higher scoring systematic review, the sensitivity for the Ottawa Knee Rules was 98.5% (95% CI: 93.2-100%), with a specificity of 48.6% (95% CI: 43.6-51.0%), and a negative likelihood ratio of 0.5 (95% CI: 0.02-0.23).12 The overall findings provide that the Ottawa Knee Rule can be used to help understand if a referral for radiographic imaging should be ordered or not. If one

Table 1. Summary of Diagnostic Validity of Selective Tissue Tests for the Knee

Pathology	Selective Tissue Test	Number of Studies	Sensitivity	Specificity	Diagnostic Odds Ratio
Meniscus	McMurray's	14	71%	71%	4.5
	Apley's	7	61%	70%	3.4
	Joint Line Tenderness	14	63%	77%	4.5
ACL	Lachman's	21	85%	**94%**	70
	Anterior Drawer	20	55%	**92%**	21
	Pivot Shift	15	24%	**98%**	12
Knee Fracture	Ottawa Knee Rules	6	**99%**	49%	.05 (-LR)
Patellofemoral Pain Syndrome	Clarke's Sign	4	39%	76%	N/A
PCL	Posterior Drawer	8	69%	N/A	N/A
Knee Osteoarthritis	American College of Rheumatology Criteria (3 criteria points)	2	**95%**	69%	N/A
	American College of Rheumatology Criteria (4 criteria points)	2	84%	89%	N/A

Items in bold are considered to have good diagnostic perform with a sensitivity or specificity above 90%.

criterion from the Ottawa Knee Rules is deemed positive, then the clinician should not rule out a fracture and referral for radiographic imaging is warranted.

Finally, knee osteoarthritis was examined in two systematic reviews. Each systematic review received a 1 and a 2 for an AMSTAR score.[4,13] The criteria of the American College of Rheumatology to diagnose knee osteoarthritis was examined in the systematic reviews. The criteria included age above 50 years, stiffness for more than 30 minutes, crepitus, bony tenderness, bony enlargement, and no palpable warmth. During an examination, if at least three criteria points are met, the sensitivity and specificity are 95.0% and 69.0%, respectively. When the fourth criteria point is found, the sensitivity and specificity are 84.0% and 89.0%, respectively.[13] Based on the results, it was concluded that the American College of Rheumatology criteria can be used to determine knee osteoarthritis, but magnetic resonance imaging is also necessary to confirm the diagnosis as the AMSTAR scores for the systematic reviews included were low.

CLINICAL BOTTOM LINE

Athletic trainers learn about and implement numerous selective tissue tests of the knee during their evaluation and assessment of patients experiencing orthopedic pain or limitations. The purpose of the selective tissue tests is to provide criteria to the athletic trainer to diagnose the patient. Unfortunately, the guiding systematic review sheds light on the fact that some of the common selective tissue tests used and deployed in patient care do not yield the information we believe they do. It is becoming clearer that the physical aspect of the evaluation process is not as valid when used as a singular test. The findings support the use of Lachman test as a valid selective tissue test for diagnosing or excluding an ACL tear, whether used individually or in conjunction with other tests. In addition, the findings support the use of some clinical prediction rules[14] such as the Ottawa Knee Rules to rule out a knee fracture and the American College of Rheumatology and European League Against Rheumatism (EULAR) Rules to diagnose knee osteoarthritis. However, there are no valid selective tissue tests to diagnose a meniscal injury.

The guiding systematic review suggests that clinicians are often using a combination of many physical tests, as well as a thorough history, to complete a full evaluation of the patient. While not specifically mentioned in the guiding systematic review, there is a clinical prediction rule for meniscal pathology which includes: 1) history of "locking" or "catching", 2) pain with forced hyperextension, 3) pain with maximum flexion, 4) positive result from McMurray's, and 5) joint line tenderness to palpation.15 We suggest that athletic trainers utilize this clinical prediction rule which has between a 90-99% specificity when 3 or more of the 5 criteria are present in the patient.[15] The high specificity takes the findings of the poor diagnostic validity for meniscal injuries and combines it with actionable items to implement when a one selective tissue test alone cannot diagnose the pathology.

The guiding systematic review states that aside from the Lachman test, Ottawa Knee Rules, and EULAR Rules, clinicians should not base their clinical diagnosis from a singular selective tissue test. In terms of ACL injuries, while the pivot shift test and the anterior drawer test had good diagnostic performance, the tests were still not as accurate as the Lachman test (see Table 1). This guiding systematic review assessed many recent systematic reviews and meta-analyses about the validity of physical examination tests for the knee and found that the AMSTAR rating for these was typically moderate. Due to the limited and low-quality research on the validity of knee physical tests on their own, it is best to combine a physical exam with a thorough history or use a combination of data known as clinical prediction rules. For example, a clinician should consider the subjective history such as asking if the patient felt a pop or if their knee feels unstable or like it is going to give way. It is also important to determine what type of pain the patient is feeling; sharp pain refers to skeletal injury, aching pain can indicate muscular trauma or tendinopathy, and throbbing pain can mean a ligamentous injury or inflammation in the joint. Overall, the clinical bottom line from the guiding systematic review is to consider using clinical decision-making tools, such as a clinical prediction rule, to diagnose musculoskeletal pathologies. These clinical prediction rules incorporate history, physical examination, and selective tissue tests to improve the diagnostic accuracy rather than a singular diagnostic test.

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