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The Sensitivity and Specificity of Thessaly Test for the Diagnosis of Meniscus Injuries in Patients with Symptoms of Chronic Internal Derangements of the Knee

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Abstract: ***The original study of Thessaly test showed high diagnostic accuracy for early detection of meniscus tears. However, in a patient with chronic knee symptoms and multiple knee pathologies, the accuracy of this test remains unclear. We reviewed 97 patients with chronic knee symptoms treated by arthroscopic surgery, comparing the Thessaly test results with arthroscopic findings and assessed its sensitivity and specificity for meniscus tears. The Thessaly test had 53.3% sensitivity, 81.1% specificity for lateral meniscus tears, 51.3% sensitivity, 86.2% specificity for medial meniscus tears. We conclude that the Thessaly test did not accurately diagnose meniscal tears in patients with multiple knee pathologies.***

Keywords: Thessaly test, meniscus, diagnostic accuracy

1. Introduction

The menisci play essential roles in normal knee functions. They provide distribution of load-bearing, facilitate lubrication and increase the joint stability. Meniscus injury commonly occurs from athletic events and activities of daily living [1]. The injury may occur in isolation or in association with other structures, particularly the cruciate ligaments. Knee injuries are known as one of the most common causes of visits to orthopaedic clinics. In our local settings, late visits after the initial injuries are not uncommon. Patients may present after many months of injury during which at the time of presentation, secondary injuries may have occurred, making the clinical diagnosis as the first part of assessment less accurate. Magnetic Resonance Imaging (MRI) is often used as an alternative to the invasive gold standard diagnostic arthroscopy in detectingthe meniscal injury. However, it is not widely available and has an inter-observer error. The Thessaly test was introduced in addition to various other clinical tests for early detection of meniscal tear [2]. The test demonstrated higher diagnostic accuracy for diagnosing both medial and lateral meniscus tear compared to other traditional clinical tests for meniscus injury [2]. However, the presence of multiple knee pathologies inevitably affects the diagnostic accuracy of these provocative tests as other conditions such as cartilage or ligaments injuries may produce similar symptoms when the test manoeuvre is performed.

Therefore, the objective of this study is to assess the correlation between the Thessaly clinical test and meniscus injury in patients presented with chronic symptoms of derangement of the knee by comparing the clinical examination finding to arthroscopic examination findings. Secondly, to determine the specificity and sensitivity of the test in predicting meniscus injury in this group of patients.

2. Materials and Methods

We retrospectively reviewed the information in our database, which was collected prospectively. The study protocol was approved by our hospital Institutional Review Board. We included the data from 97 patients who presented with chronic knee symptoms who were treated with arthroscopic surgery in our institution from January 2017 to June 2019. The inclusion criteria were, all patients who presented with symptoms of internal derangements of the knee including pain, instability, locking and abnormal mobility (limitation in knee motion) after an episode of knee injury for three months or more who underwent treatment with arthroscopic surgery. The exclusion criteria were patients who presented with severe knee pain in which the specific clinical test for meniscus injury could not be performedand patients who had knee surgery in the previous three months. The patient comprised of 78 men and 19 women with a mean age of 28.5 ± 9.0 (range; 17 – 60) at the time of surgery. The recorded clinical finding of Thessaly test, McMurray test and joint line tenderness were reviewed and compared with the recorded arthroscopic findings.

Index Test

The index tests –the Thessaly test was performed as part of preoperative assessment one day before the scheduled surgery date and recorded in the clinical sheets. The Thessaly test was performed by an experienced sports physician according to the methods initially described by Karachialos T et al [2]. The Thessaly test was performed at 20º of knee flexion. The examiner held the patient's outstretched hands while the patient stands flat-footed on the floor. The patient then internally and externally rotates his knee and body, three times, keeping the knee in 20º flexion. Patients with suspected meniscal tears experience medial or lateral joint line discomfort or sense of locking or catching. The test was performed first on the normal knee to train the patient, especially on maintaining the degree of knee flexion

and how to recognize the possible positive result of the symptomatic knee by comparison with the normal knee.

Reference test

The arthroscopic examinations were used as the reference test. Arthroscopy of the affected knee was performed by two senior arthroscopists in our institution.

3. Data Analysis and Statistics

We used descriptive statistics to report basic measures. Values were given as means and standard deviation or ranges, where appropriate. We used Pearson's Chi-square test (Chi-square test of association) for the analysis of the correlation between the clinical test and arthroscopic finding. All statistical analyses were performed by using SPSS version 20 software (IBM, Chicago, Illinois, USA); $P < 0.05$ was considered significant. The sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) with their 95% confidence interval were calculated using the statistical analysis website vassarstat.net. Two by two tables were created to assist in the calculation, whereby the results of each clinical test were plotted against the results of arthroscopy. We determined the sample sizeusing correlation sample size calculator (masc.org.au) website. The correlation coefficient, r was set as 0.5 (moderate correlation), power = 0.8 and $P = 0.05$.

4. Results

Patient demographics and characteristics of injury are as shown in Table I. Based on the arthroscopic examinations, 79 of 97 patients (81.4%) had meniscus injury. 57 of 97 patients (58.8%) had a meniscus tear involving either one of the lateral or medial menisci,of whom 19 (19.6%) had a tear in the medial meniscus, and 40 (41.2%) had a tear in the lateral meniscus. 20 (20.6%) patients had both medial and lateral meniscus tears. Multiple pathologies were found in 84 (86.6%) patients. Two patients were diagnosed with isolated meniscus injuries, three patients with an isolated cruciate injury, seven patients had cartilage injury, and one patient had symptomatic medial synovial plicae (Table 2).

Table 1: Patients characteristics

Characteristics	*Participants*
Sex	
Male	78 (80.4)
Female	19 (19.6)
Age (Mean ± SD, year)	28.5 ± 9.0 range; 17 - 60
Affected Knee	
Left	58 (59.8)
Right	39 (40.2)
Symptoms	
Pain	20 (20.6)
Instability	8 (8.2)
Pain, locking	7 (7.2)
Pain, instability	33 (34.0)
Locking, instability	5 (5.2)
Pain, locking, instability	24 (24.7)
Sports injury	73 (75.3)
Non-sports-related injury	24 (24.7)
Duration of symptoms (Mean ±SD, months)	14 ± 9.7 range; 3 - 48
Values are n (%)	

Table 2: Arthroscopic examination findings

Pathologies	
Isolated meniscus injury	2 (2.1)
Isolated cruciate injury	3 (3.1)
Cartilage injury	7 (7.2)
Medial plicae	1 (1.0)
Meniscus with cruciate injury	24 (24.7)
Meniscus with cartilage injury	11 (11.3)
Cruciate with cartilage injury	6 (6.2)
Meniscus, cruciate and cartilage injury	40 (41.2)
Symptomatic medial plicae with cartilage injury	1 (1.0)
Meniscus, cruciate, symptomatic medial plicae.	1 (1.0)
Meniscus, cruciate, symptomatic medial plicae, cartilage injury.	1 (1.0)
values are n (%)	

In the correlation analysis, the Thessaly test was found to be significantly associated with a meniscus injury (X^2 =11.3, P = 0.001 for lateral meniscus, X^2 = 16.0, P = 0.000 for medial meniscus). Similarly, the McMurray test showed a significant association with meniscus injuries (lateral meniscus, X^2 = 11.7, P = 0.001, medial meniscus, X^2 = 36.9, P = 0.000). There was a significant association between lateral joint line tenderness and presence of lateral meniscus injuries (X^2 = 8.9, P = 0.003) and, between medial joint line tenderness and the presence of medial meniscus injuries (X^2 = 11.3, P = 0.001) (Table 3).

Table 3: Correlation between clinical test and meniscus tear

	X^2	*P*	*Phi*	*P*
Thessaly test				
Lateral Meniscus	11.3	0.001	0.34	0.001
Medial Meniscus	16.0	0.000	0.41	0.000
McMurray Test				
Lateral Meniscus	11.7	0.001	0.35	0.001
Medial Meniscus	36.9	0.000	0.62	0.000
Joint line tenderness				
Lateral Meniscus	8.9	0.003	0.30	0.003
Medial Meniscus	11.7	0.001	0.35	0.001

We ran a point biserial correlation to determine the relationship between the clinical tests and the size of meniscus tears and the duration of symptoms. There was a positive correlation between the Thessaly test and the size of tear (r = 0.22, P = 0.03; r = 0.33, P = 0.001 for lateral and medial meniscus respectively), joint line tenderness with the size of meniscus tear (r = 0.33, P = 0.01, r = 0.31, P = 0.002 for lateral and medial meniscus respectively) and between McMurray test and the size of tear (r = 0.21, P = 0.04; r = 0.53, P = 0.000 for lateral and medial meniscus respectively). The duration of symptoms did not correlate with all the three tests (Thessaly test; r = -0.22, P = 0.03, r = 0.02, P = 0.87 for lateral and medial meniscus respectively, joint line tenderness; r = -0.17, P = 0.10, r = 0.08, P = 0.43 for lateral and medial meniscus respectively, McMurray test; r = -0.16, P = 0.10, r = 0.017, P = 0.87 for lateral and medial meniscus respectively).

The Thessaly test at 20˚of flexion demonstrated a 53.3% sensitivity and 81.1% specificity, with 82.1% positive predictive value (PPV) and 51.7% negative predictive value (NPV) for lateral meniscus injury. The values were comparable with that of joint line tenderness and McMurray test for lateral meniscus injury (Table 4). For medial

meniscus injury, the Thessaly test had 51.3% sensitivity, 86.2% specificity with 71.4% positive predictive value and 72.5% negative predictive value. The McMurray test showed the highest specificity and sensitivity (61.5% and 94.8% respectively) with 88.9% positive predictive value and 78.5% negative predictive value for medial meniscus injury (Table 4). The Thessaly test recorded 48.3% (28 knees) false-negative results and 17.9% (7 knees) false-positive results for lateral meniscus injury. For medial meniscus injury, 19 knees had false-negative results (27.5%) whereby eight knees had false-positive results (28.6%). Both patients with isolated meniscus injuries (both unstable lateral meniscus tear) had positive Thessaly test. Five of seven patients with isolated cartilage injuries had positive Thessaly test. In patients with cruciate ligaments injury, the Thessaly test at 20˚ of flexion had 50.9% sensitivity, 77.2% sensitivity with 84.4% PPV and 39.5% NPV for lateral meniscus injury. Five knees (15.6%) recorded false-positive results and 26 knees (60.5%) recorded false-negative results. For medial meniscus injury, the Thessaly test demonstrated 50% sensitivity, 93.3% specificity with 83.3% PPV and 73.7% NPV. Three knees (16.7%) recorded false-positive results, and 15 (26.3%) knees recorded false-negative results.

Table 4: Values for diagnostic parameters of the clinical examination tests

	Lateral Meniscus (n = 60)	Medial Meniscus (n = 39)
Prevalence	61.9 (51.4-71.4)	40.2 (30.5-50.7)
Thessaly		
Sensitivity	53.3 (40.1-66.1)	51.3 (35.0- 67.3)
Specificity	81.1 (64.3-91.4)	86.2 (74.1-93.4)
PPV	82.1 (65.9-91.9)	71.4 (51.1-86.0)
NPV	51.7 (38.3-64.9)	72.5 (60.2-82.2)
Joint line tenderness		
Sensitivity	60.0 (46.5-72.2)	56.4 (40.0-71.8)
Specificity	75.7 (58.4-87.6)	77.6 (64.4-87.1)
PPV	80.0 (65.0-90.0)	62.9 (44.9-78.0)
NPV	53.8 (43.2-63.7)	72.6 (59.6-82.8)
McMurray		
Sensitivity	53.3 (40.1-66.1)	61.5 (44.7-76.2)
Specificity	81.1 (64.3-91.4)	94.8 (84.7-98.7)
PPV	82.1 (65.9-91.9)	88.9 (69.7-97.1)
NPV	51.7 (38.3-64.9)	78.5 (66.8-87.1)

Abbreviations: PPV; positive predictive value, NPV; negative predictive value. Values are in % (upper and lower limit of 95% confidence interval)

5. Discussion

Meniscus injuries are among frequently reported injuries in orthopaedics. Meniscus tears may occur during acute knee injury or develop as a secondary injury, commonly in patients with cruciate ligament tear. Secondary meniscal tears after an anterior cruciate ligament (ACL) injury are reported to be most common among patients undergoing delayed treatment for the primary cruciate ligament injury [3].The McMurray test and joint line tenderness are among the commonly used physical tests in the diagnosis of meniscus injury with variable diagnostic accuracy described in the literatures[5], [6], [7], [8]. The Thessaly test was later introduced for early diagnosis of a meniscus tear. The test was designed to reproduce the symptoms of meniscus tear and reported to have superior diagnostic accuracy compared to other clinical tests [2]. However, the accuracy of this test when performed in patients with multiple pathologies remained unclear as concomitant pathologies such as cartilage or ligament injury are likely to affect the results of the tests.

In this study, we found that all three clinical tests showed significant association with meniscus tear suggesting their values in the diagnosis of meniscus injuries. Furthermore, all tests, including the Thessaly test at 20˚of knee flexion correlated significantly with the size of the meniscus tear. This finding indicates that for all the three tests, larger meniscus tears are likely to result in a positive clinical test compared to smaller ones.

In our current study, we found that the Thessaly test at 20˚of knee flexion demonstrated lower sensitivity and specificity values for both lateral and medial meniscus tears compared with reported in the original study [2]. Although the test showed the specificity of more than 80%, the sensitivity values were both less than 60%. We also found a high false-negative result for a lateral meniscus tear. In this study, our patient populations consist of those who presented late after the initial injuries with the mean duration of symptoms of 14 ± 9.7 months. Eighty-four of our patients had multiple knee pathologies. Twenty-four patients had a combination of cruciate ligament and cartilage injury and, 40 patients had concomitant cruciate, cartilage and meniscus injury. These injuries may have co-occurred during the initial traumatic event or may have developed as a secondary injury, especially after a cruciate ligament injury. The original authors developed the Thessaly test with the basis of reproduction the dynamic mechanism of meniscus injury. The single-leg weight-bearing of the knee at 20˚flexion produces load that squeezes the torn meniscus fragments apart and induces the pain and discomfort in patients with meniscus tear [2]. However, the load transmission across injured cartilage or the ACL deficient knee itself could alter the result of the test. Furthermore, a previous study on the Thessaly test in a population with combined meniscus and ACL injury reported a lower diagnostic accuracy with a sensitivity of 78% and specificity of 40% compared to the original study [9].Similarly, we believed that the presence of concomitant pathologies contributes to lower sensitivity and specificity results in our current study.

The reported diagnostic accuracy of the McMurray test and joint line tenderness for meniscus tears has been inconsistent [6],[7], [8]. In our study, the McMurray test showed the highest diagnostic accuracy among the three tests with sensitivity and specificity of 61.5% and 94.8% respectively for medial meniscus injury. Otherwise, both the joint line tenderness and the McMurray test showed a generally low diagnostic accuracy for meniscus injuries.

In general, our findings suggest that these clinical tests, including the Thessaly test at 20 degrees of flexion, undoubtedly has value in assisting the diagnosis of meniscus injury. However, multiple knee comorbidities rendered them to be less accurate. Therefore, these clinical tests should be used cautiously, taking into consideration the mechanism of injury, characteristics of pain and other associated symptoms suggestive of meniscus injury. The test

seems less useful to be used as a screening tool for a meniscus tear.

In this study, we focused on patients with symptoms of chronic internal derangement of knees with the possibility of multiple knee pathologies. We did not limit our study population to those suspected to have meniscus injuries. We believed that by limiting the exclusion criteria, we could improve the strength of our study as it represents a broader patient population with knee dysfunction.

However, we acknowledge several limitations in our study. First, due to the retrospective nature of the study, we include only one examiner who performed the clinical test. Having the test repeated by additional examiners would contribute to the strength of the study. Second, the examiner was not blinded to the history as wells as the site and nature of the meniscal tears, which could affect the decision of the clinical result.

6. Conclusion

The Thessaly test used in patients with symptoms of chronic internal derangement of the knee with multiple knee comorbidities showed generally low sensitivity and specificity values and did not seem useful in accurately diagnosing a meniscal tear.

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Author Profile

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