

# Prevalence Of Popliteus Tendinopathy in Marathon Runners

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**Abstract—Background:** The popliteus muscle and its tendon complex play crucial role in knee joint stability and biomechanics, serving as dynamic and static stabilizers. Popliteus tendinopathy, characterized by degeneration or injury of the popliteus tendon, poses challenge for athletes, particularly marathon runners. Understanding the prevalence of this condition and reliable diagnostic methods is essential for the effective management and prevention of long-term complications. **Aim:** The study is aimed to determine the prevalence of popliteus tendinopathy among marathon runners using the Garrick test. **Methodology:** Ninety-seven marathon runners from the age group of 35 to 45 years underwent assessment for popliteus tendinopathy. Participants with positive pain at the posterolateral aspect of the knee joint were subjected to the Lachman test, Posterior sag sign, Varus test, and Garrick test. **Outcome measures include demographic variables, pain, intensity on the Numeric Pain Rating Scale (NPRS), work out duration, and years of experience. Results:** Statistical analysis was done using MS Excel 2016 software. Out of the 97 participants, 77% exhibited popliteus tendinopathy. The Garrick test showed the highest sensitivity for detecting the condition. Positive correlation was observed between pain intensity and work out duration ( $r = -0.22, p < 0.05$ ), indicative of reduction in pain with increased work out duration. However, no significant correlation was found between pain intensity and years of experience. **Conclusion:** Popliteus tendinopathy is prevalent among marathon runners from age of group 35 to 45 years. The Garrick test emerges as valuable tool for diagnosis. Additionally, pain intensity decreases in participants with longer work out duration, suggesting a potential protective effect of exercise. However, years of experience do not appear to influence pain intensity. Early detection and intervention are crucial for managing popliteus tendinopathy and optimizing athletic performance.

**Index Terms—**Popliteus tendinopathy, marathon runners, Garrick test, posterolateral knee pain.

## I. INTRODUCTION

The popliteus muscle plays a key role in knee biomechanics. It primarily acts as an internal rotator of the tibia, aiding in knee flexion and unlocking the hyperextended knee by initiating rotational movement. Additionally, it serves as a secondary stabilizer, preventing posterior translation of the tibia relative to the femur, especially during movements involving posterolateral rotation <sup>[1]</sup>. In the hyperextended position, the popliteus is the only muscle capable of rotation, allowing the knee to transition smoothly from extension to flexion by guiding the femur's lateral condyle and facilitating posterior movement <sup>[2]</sup>. As the knee flexes, the popliteus also helps position the lateral meniscus, contributing to joint stability during flexion, while the hamstrings take over the primary role in rotation <sup>[3]</sup>.

### A. Popliteus Tendon

The popliteus tendon originates at the proximal fifth of the popliteus sulcus on the femur and extends distally, stabilizing the knee. It branches into three fascicles (anteroinferior, posterosuperior, and posteroinferior) that aid in lateral meniscus stability during movement <sup>[2]</sup>. Positioned at the posterolateral angle of the tibia, the tendon attaches firmly to the joint capsule, forming part of the arcuate ligament and enhancing knee stability <sup>[3]</sup>.

### B. Biomechanics of the Popliteus Complex

The popliteus complex stabilizes the knee dynamically and statically, facilitating external rotation of the femur when the foot is planted and internal tibial rotation when the foot is not fixed, essential during walking and running <sup>[4]</sup>. It helps unlock the knee from full extension by externally rotating the femur, enabling knee flexion during weight-bearing <sup>[4]</sup>.

### C. Popliteus Tendinopathy

Tendinopathy involves structural changes in tendons due to overuse, resulting in pain, swelling, and reduced functionality. [5][6]

#### D. Etiology of Popliteus Tendinopathy

Popliteus tendinopathy is common in athletes, especially those running on inclined surfaces or engaging in activities with excessive tibial rotation, such as hill running or knee hyperextension with internal rotation. [5]

#### E. Isolated Popliteus Tendinopathy

Though rare, isolated popliteus tendinopathy manifests as chronic pain around the tendon attachment on the lateral femoral condyle. Symptoms worsen with activities like downhill running or during weight-bearing, and rest typically alleviates the pain. [4]

#### F. Mechanism of Trauma

Popliteus injuries can result from:

Varus force with tibial external rotation: A lateral blow or twisting motion applies stress to the tendon.

Knee hyperextension/flexion with forced tibial external rotation: Seen in sports with rapid pivoting or cutting. [4]

#### G. Symptoms of Popliteus Tendinopathy

Symptoms include sharp pain, swelling, and tenderness in the posterolateral knee. Activities like downhill running worsen the pain, and muscle spasms or crepitation may occur during knee flexion. Athletes, particularly runners and triathletes, are commonly affected by this condition.

## II. PROCEDURE

Ethical approval was obtained from the Protocol Committee of D. Y. Patil Education Society, Kolhapur, and D.Y Patil College of Physiotherapy, Kolhapur. The participants were included in the study based on inclusion and exclusion criteria by simple random sampling method, and the procedure was explained to them in their vernacular language. Written informed consent was taken from the participants willing to participate. The prevalence of popliteus tendinopathy in elite marathon runners is a prevalent study that was performed in the marathon events conducted in Kolhapur with prior permission

Methods of data collection-Primary Data Collection  
Type of study- Observational Study  
Study design - Cross sectional Study  
Sampling technique - Simple Random Sampling  
Duration of Study: 6 months

Sample size- 97  
Inclusion criteria- Female and Male marathon runners, marathon runners of demographic age 35 to 45 years, average running per week -5 to 6 times  
Years of experience. Exclusion criteria- Any individuals who have undergone any knee surgery or injury in past 6 months, any participant with lateral collateral ligament injury, anterior cruciate ligament injury, posterior cruciate ligament injury. A brief demographic dataset including details like name, age, gender, average time of work out per week, past history of any injury/surgery in the past 6 months, as per the data collection sheet, was recorded. Participants with pain over the postero-lateral aspect of the knee joint were assessed by NPRS. Further, with a set of elimination tests such as the Lachman test, Posterior sag sign, Varus test, and the confirmatory test Garrick test, to confirm Popliteus tendinopathy were performed over the participants. The study was concluded by statistical analysis of the outcome measures.

The following procedure was conducted for assessing popliteus tendinopathy in marathon runners.

97 participants of age  $38.13 \pm 4.31$  (age ranging from 35 to 45 years) were assessed with positive pain over posterolateral corner of knee joint. The following steps represent the steps of assessment during Popliteus tendinopathy – Lachman Test -The Lachman Test evaluates anterior cruciate ligament (ACL) integrity by assessing tibial movement relative to the femur. The procedure involves flexing the knee while stabilizing the femur and applying anterior force to the tibia. A positive test indicates excessive anterior translation and lack of a firm endpoint. Posterior Sag Sign The Posterior Sag Sign is indicative of posterior cruciate ligament (PCL) rupture. It is observed when the tibia appears to sag posteriorly at 90° knee flexion. This visual cue aids in diagnosing a PCL injury, facilitated by gravitational pull causing posterior displacement of the tibia relative to the femur. Varus Test the Varus Test assesses lateral knee stability, particularly identifying potential posterolateral knee injuries. It involves applying a lateral force at full extension, eliciting varus angulation or lateral opening. A positive result suggests compromise to lateral stabilizing structures of the knee. Garrick Test the Garrick Test evaluates popliteus involvement by assessing knee rotation. The patient lies supine with hips and knees flexed at 90 degrees, followed by resisted internal and passive external knee rotation.

Pain elicited during either movement indicates potential popliteus involvement.

### III. RESULT

Total number of participants are 97 out of which no. of males are 84 (87%) and no. of females are 13 (13%). The demographic variables age, height, weight, BMI, are represented as mean  $\pm$  SD; Age =  $38.13 \pm 4.31$  Height =  $169.93 \pm 10.47$  Weight =  $71.23 \pm 7.98$  BMI =  $24.72 \pm 2.22$  The variable average time of work out is represented as mean  $\pm$  SD;  $10.34 \pm 2.95$  The variable Pain on NPRS is represented as mean  $\pm$  SD;  $5.55 \pm 1.16$  The variable years of experience is represented as mean  $\pm$  SD;  $4.03 \pm 2.75$

The outcome measures utilized in this study encompass a range of diagnostic tests aimed at assessing various knee conditions. These tests include the Lachman test, Posterior sag sign, Varus test, and Garrick test, each providing valuable insights into the participants' knee health. Starting with the Lachman test, it was observed that none of the participants exhibited a positive result in their left knee, while 39 participants tested negative. Similarly, in the right knee, none showed a positive Lachman test result, with 58 participants testing negative. Moving on to the Posterior sag sign, again, no participants displayed a positive result in their left knee, with 39 participants testing negative. Likewise, in the right knee, none showed a positive Posterior sag sign, with 58 participants testing negative.

Next, the Varus test results revealed that 2 participants had a positive result in their left knee, while 37 tested negatives. On the other hand, in the right knee, 7 participants showed a positive Varus test result, with 51 testing negatives.

The Garrick test served as the confirmatory test for positive popliteal tendinopathy. It was found that 31 participants tested positive in their left knee, while 8 tested negatives. Similarly, in the right knee, 44 participants tested positive, while 14 tested negatives. Furthermore, out of the total 75 participants with a prevalence of popliteal tendinopathy, it was observed that 9 participants, representing 12% of the sample, tested positive in both the Varus test and Garrick test, indicating a concurrent presence of tendinopathy along with varus instability in their knees.

Correlation between NPRS and average time of work out per week shows negative association with  $r = -0.22$  and  $p$  value = 0.03. Since the  $p$  value is  $< 0.05$ , the present correlation between NPRS and average time of work out per week is said to be significant.

As a result, it shows that as the average time of work out increases the intensity of pain over NPRS decreases. Correlation between NPRS and years of experience shows a flat trendline with no association between the data and  $r = 0.02$  and  $p$  value = 0.85. Since the  $p$  value is  $> 0.05$ , the present correlation between NPRS and years of experience is said to be not significant. Therefore, years of experience has no direct relation with the intensity of pain on NPRS.

### IV. DISCUSSION

The purpose of this study was to assess Popliteus Tendinopathy in marathon runners using Garrick test. We have found 77% prevalence of popliteus tendinopathy in marathon runners. Furthermore, the study also found a negative correlation between pain intensity and average time of work out per week. The present study included participants from age group of 35 to 45 years with mean age 38.13 years. The lower limit of age as 35 years and upper limit as 45 years. As per previous studies younger age was notably associated with reduced risk for unspecified overuse injuries overall. As individuals age, knee joint cartilage naturally thins without any cartilage disease present. Elderly individuals exhibit distinct levels of cartilage deformation compared to younger individuals. M. Hudelmaier et al revealed a notable decrease in cartilage thickness in the femur among elderly women and men. It has been theorized that variances in anatomical structure might make females more prone to differences in their running mechanics. Over numerous repetitions, these differences could lead females to experience distinct injury patterns compared to males of the same age. Research indicates that females are nearly twice as likely to suffer from injuries related to running. While studying the lower extremity structure, the kinetics and kinematics of lower extremity of both genders' male and female, it shows as a contributing factor for differences in running mechanics between the genders. As presented in previous studies female are more prone to overuse injuries due to distinct running mechanics from males, it is suggested for athletic footwear for females to

reduce the incidence of running injuries. On the contrary, Leena Ristolainen et al suggests overuse injuries were more common in male runners compared to their female counterparts. A greater proportion of male long-distance runners experienced at least one overuse injury compared to female long-distance runners. While the present study shows a higher incidence of males (n= 84) having popliteus tendinopathy as compared to females(n=13). This could be suggestive of a reduced muscle strength of lower extremity, muscle tightness of calf muscles, premature degenerate of knee joint structure in men more than in women of the same age category. In the present study the mean works out time per week is 10.34 hours. Despite, these participants were experiencing pain in the PLC post marathon run. Along with this we have also found a negative association of pain intensity with average work out time, which states that with increase in work out duration per week there will be reduction in pain in marathon runners post run. Since work out is the primary means of strengthening the PLC musculature along with the musculotendinous complex of PLC which includes the popliteus tendon, this could reduce the incidence of injuries to knee joint along with popliteus tendinopathy.

Injuries among marathon runners can result from various factors, but often stem from errors in training. As stated by Michael Frederics on et al the three primary independent factors commonly cited for injuries are: (i) a rapid increase in weekly mileage, (ii) a history of previous injuries, and (iii) a competitive training mindset. Clearly, the distance covered while running stands out as one of the most significant risk factors for injury, alongside sudden spikes in mileage or alterations in training volume or intensity. Running is among the most common sports associated with overuse injuries in the lower back and legs. The knee is the primary site of leg injuries. Tissues with poor blood supply, such as ligaments, tendons, and cartilage, are particularly susceptible to injury because they adapt more slowly than muscles to increased mechanical loads. Participants in the current study are having  $4.03 \pm 2.75$  years of experience, out of which many have participated for the very first time. Van Gent and colleagues discovered compelling proof indicating that men who trained more frequently per week were at greater risk of running injuries. Conversely, women who ran only once a week were

also susceptible to overuse injuries. This is likely due to the strain running places on the musculoskeletal system, which lacks adequate time to adjust with infrequent sessions. In summary, preventing overuse running injuries necessitates optimizing and tailoring training regimens, taking into consideration the evidence suggesting that both running and training factors impact injury risk. Scant evidence suggested that increased running experience posed a risk for overall running injuries, with limited evidence indicating that less running experience (less than one year) was somewhat protective against such injuries. Furthermore, limited evidence indicated that more running experience was linked to higher risks of knee and foot injuries.

Overuse injuries of the musculoskeletal system typically arise from repetitive exposure to loading forces. When these forces fall below the threshold for acute injury, they eventually induce fatigue in the specific structure.

Consistently, prior injuries were identified as a significant factor in running injuries, particularly among men. A history of past running injuries significantly increased the likelihood of experiencing running injuries shortly before or during a marathon. The present, therefore excludes all the participants having any previous injury for past 6 months along with any surgery for knee joint. The primary trigger for the onset of tendinopathies is widely believed to be the excessive strain experienced during physical activity. Repetitive stressors push the tendon past its natural limits, resulting in degeneration. Athletic traumas are frequently associated with injuries to the posterolateral corner (PLC) of the knee. Common mechanisms leading to such injuries involve a blow to the front-inner side of the knee when it's nearly fully extended, hyperextension injuries both with and without contact, and a valgus force applied to a bent knee. Another injury mechanism involves a significant external rotation force applied to the tibia with the knee either flexed or hyperextended. The PLC comprises various muscles and ligaments, with specific structures varying depending on the description's source. In a biomechanical model using cadavers, Csintalan et al. demonstrated that external rotation injuries with the knee partially flexed could result in tears to the popliteus tendon. After sustaining a PLC injury, individuals may experience pain along the inner or outer joint line, or the back outer side of

the knee. In our study we have performed eliminating test to exclude any other overlapping injuries PLC, which include Lachman Test, Posterior sag Sign, Varus test to eliminate Injuries to ACL, PCL, LCL. To confirm the presence of popliteus tendinopathy we have performed Garrick test. Low Sensitivity of Lachman and Posterior Sag Sign: The Lachman Test and Posterior Sag Sign showed no positive results for either the right or left side, which indicates of participant not having any ACL or PCL injury.

Varus Test Results: The Varus Test showed some positive results, with 7 positives on the right and 2 on the left. However, it also had a significant number of negative results. This is suggestive of 9 participants having involvement of LCL for posterolateral pain of knee joint. High Sensitivity of Garrick Test: The Garrick Test demonstrated a higher number of positive results compared to the other tests, especially on the right side with 44 positives. This suggests that the Garrick Test is more sensitive in detecting popliteal tendinopathy among marathon runners. Along with this we also have found 12% participants with positive varus test as well as Garrick test, which is suggestive of overlapping injuries in the PLC including popliteus tendinopathy and injury to LCL.

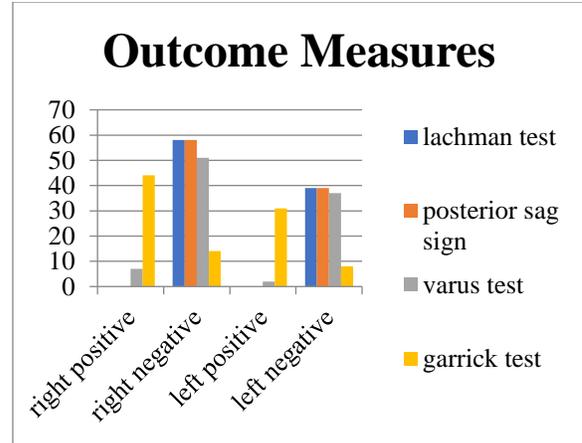
A. Figures and Tables

Variable	Mean	SD
Age	38.13	4.31
Height (cm)	169.93	10.47
Weight (kg)	71.23	7.98
BMI	24.72	2.22
Average time of work out per week	10.34	2.95
Pain on NPRS	5.55	1.16
years of experience	4.03	2.75

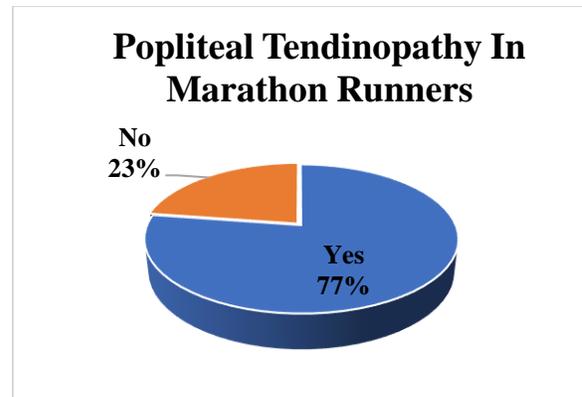
Table 01- Descriptive statistics of age, height, weight, BMI, average time of work out, Pain on NPRS, years of experience

Outcome Measure	Positive No. of Participants
Garrick + Varus Test	11%

Table 02– Outcome Measure for positive varus test and Garrick test



Graph 01- Outcome measures.



Graph 02– Popliteal tendinopathy in Marathon Runners

Correlation Between	Correlation Coefficient ( r )	t - statistic	P Value	Decision
N P R S Average time of work out per week	-0.22	2.20	0.03	Significant
N P R S Years of Experience	0.02	0.19	0.85	Not Significant

Table 03– Correlation of NPRS and average time of work out per week and years of experience.

## V. CONCLUSION

The study concluded that having 77% marathon runners are prevalent for popliteus tendinopathy.

This study also concludes that there is a negative correlation between Pain on NPRS and Average time of work out per week in hours. The current study also proves that there is no correlation between Pain on NPRS and Number of years for experience.

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## VII. CONFLICT OF INTEREST

The authors declare no conflict of interest.

## REFERENCES

- [1] Kannus P, Bergfeld J, Järvinen M, Johnson RJ, Pope M, Renström P, Yasuda K. Injuries to the posterior cruciate ligament of the knee. *Sports Medicine*. 1991 Aug; 12:110-31.
- [2] LaPrade RF, Wentorf F. Diagnosis and treatment of posterolateral knee injuries. *Clinical Orthopaedics and Related Research (1976-2007)*. 2002 Sep 1; 402:110-21.
- [3] Last RJ. The popliteus muscle and the lateral meniscus. *The Journal of Bone and Joint Surgery. British volume*. 1950 Feb;32(1):93-9.
- [4] J. Zabrzynski et al. Current concepts on the morphology of popliteus tendon and its clinical implications. *Via media journals*, publication date: 2 September 2020.
- [5] Popliteus tendinopathy, physio-pedia, com,18/04/2024 [https://www.physio-pedia.com/Popliteus\\_Tendinopathy](https://www.physio-pedia.com/Popliteus_Tendinopathy)
- [6] Garrick Test, wikism.org,13/03/2024 [https://wikism.org/Garrick\\_Test](https://wikism.org/Garrick_Test)
- [7] Coffey R, Bordoni B. Lachman test. *InStatPearls [Internet]* 2023 Jul 24. StatPearls Publishing.
- [8] Kannus P, Bergfeld J, Järvinen M, Johnson RJ, Pope M, Renström P, Yasuda K. Injuries to the posterior cruciate ligament of the knee. *Sports Medicine*. 1991 Aug; 12:110-31.
- [9] Coffey R, Bordoni B. Lachman test. *InStatPearls [Internet]* 2023 Jul 24. StatPearls Publishing.
- [10] Ristolainen L, Heinonen A, Waller B, Kujala UM, Kettunen JA. Gender differences in sport injury risk and types of injuries: a retrospective twelve-month study on cross-country skiers, swimmers, long-distance runners and soccer players. *Journal of sports science & medicine*. 2009 Sep;8(3):443.