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Original Article

Correlation between Palmaris Longus Muscle and Carpal Tunnel Syndrome in Badminton Players

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ABSTRACT

Background: Carpal Tunnel Syndrome (CTS) is commonly observed in athletes, especially those engaged in sports involving repetitive wrist activities. The role of the Palmaris Longus Muscle (PLM) in the development of CTS has been a subject of interest due to its anatomical location.

Objective: To examine the correlation between the presence or absence of the PLM and the incidence of CTS among badminton players.

Methods: In this cross-sectional study, 258 badminton players aged 18-23 years were assessed. Players with a history of carpal tunnel release surgery were excluded. The presence of the PLM was evaluated using Schaeffer's test, while Phalen's test was used to diagnose CTS. Statistical analysis involved chi-square tests to determine the association between PLM and CTS.

Results: Of the participants, 193 (74.8%) had a positive Schaeffer's test (indicating the presence of PLM), and of these, 72 (37.3%) also had a positive Phalen's test (indicative of CTS). Conversely, among the 65 (25.2%) with a negative Schaeffer's test, only 10 (15.4%) had a positive Phalen's test. The chi-square analysis yielded a P-value of 0.001, indicating a statistically significant association between the presence of PLM and the occurrence of CTS.

Conclusion: There is a significant correlation between the presence of the Palmaris Longus Muscle and the development of Carpal Tunnel Syndrome in badminton players. These findings underscore the importance of considering anatomical variations in PLM during the assessment and management of CTS in athletes.

Keywords: Athletes, Badminton Players, Carpal Tunnel Syndrome, Palmaris Longus Muscle, Phalen's Test, Schaeffer's Test, Chi-Square Test.

INTRODUCTION

The palmaris longus muscle (PLM), a fusiform muscle characterized by significant anatomical variability, plays a crucial but not fully understood role in the biomechanics of the forearm and hand. It is noteworthy for its high incidence of absence, estimated at about 22.4% across populations, with a variability range from 3.0% to 63.9% depending on ethnic background (1-3) (Boltuch et al., 2020). This absence rate is indicative of its evolutionary redundancy, yet its precise functional significance remains a topic of debate. Located in the anterior compartment of the forearm, the PLM, when present, exhibits a range of anatomical variations including in its origin, insertion, and morphology (4) (Joo et al., 2022). These variations, ranging from being reversed to bifid, have led to questions about its potential impact on related musculoskeletal structures and conditions (5-7).

The carpal tunnel, a narrow passageway on the palmar side of the wrist, houses critical neurovascular structures including the median nerve. This nerve, originating from the brachial plexus (C6-T1), is crucial for motor and sensory functions of the forearm and hand (8-10). The transverse carpal ligament forms the roof of this tunnel, under which reside the tendons of the flexor pollicis longus, the flexor digitorum superficialis muscles, and the flexor digitorum profundus, along with the median nerve (11) (Zitek et al., 2023). Carpal Tunnel Syndrome (CTS), a common entrapment neuropathy, occurs when the median nerve is compressed within this confined space. The tunnel's dimensions, which are influenced by wrist and finger positions, play a role in this pathology. It has been suggested that a ratio exceeding 0.70 in the tunnel's cross-sectional area is a potential risk factor for CTS (12) (Lopes, 2007).

In the context of sports, particularly in badminton, players frequently engage in repetitive wrist and finger movements that could potentially affect the carpal tunnel's dynamics. This study aims to explore the relationship between the presence or absence of the PLM and the incidence of CTS in badminton players (13, 14). Given the PLM's role in wrist and finger movements and its anatomical proximity to the carpal tunnel, it is hypothesized that variations in PLM may influence the biomechanics of the forearm, potentially affecting the risk of developing CTS (15-17). This investigation seeks to provide insights into whether the structural variability of the PLM is a factor in the development of CTS among badminton players, thereby contributing to a better understanding of preventive and therapeutic approaches in sports-related musculoskeletal disorders (18, 19).

MATERIAL AND METHODS

In this cross-sectional study, data were gathered from 258 health profession students across Pakistan, aged between 18 and 23 years, utilizing a non-probability convenient sampling technique. The study specifically targeted individuals with carpal tunnel syndrome (CTS), excluding those who had undergone carpal tunnel release surgery, any wrist-related pathology, or surgeries involving the wrist, including tendon replacement or palmaris longus tendon procedures (3, 20, 21).

Data collection was facilitated through the distribution of Google Forms across various universities in Pakistan. Local representatives were appointed to assist in this process. Prior to participation, informed consent was obtained from all participants, ensuring ethical compliance and understanding of the study's purpose and procedures.

To determine the presence or absence of the palmaris longus muscle, Schaeffer's Test was employed. This test, established in 1990, involves the participant maintaining their forearm at a 90-degree angle, then opposing the thumb to the little finger with the wrist in partial flexion (17, 18). The emergence of a prominent tendon was recorded as an indication of the presence of the palmaris longus muscle.

For the diagnosis of CTS, the Phalen test, also known as the wrist-flexion test, was utilized. Participants were instructed to press the backs of their hands and fingers together, maintaining their wrists in a flexed position and fingers pointed downward for a duration of one to two minutes (9). The onset of tingling or numbness in the fingers during this period was considered indicative of carpal tunnel syndrome and was duly recorded.

The collected data were analyzed using SPSS version 23.0. For the purpose of summarization, frequencies were used for categorical variables and means with standard deviations (SD) for quantitative variables. Additionally, bar charts were created to visually represent the findings.

This methodology aimed to establish a robust correlation between the anatomical presence of the palmaris longus muscle and the incidence of carpal tunnel syndrome among the sampled population, thereby contributing valuable insights into the implications of anatomical variability on musculoskeletal disorders in a specific demographic group. The choice of tests, population, and analytical methods were all aligned to ensure that the study was comprehensive, reliable, and scientifically rigorous.

RESULTS

The data represents a study conducted on 258 individuals, primarily focusing on the prevalence of certain clinical test results among students from different medical departments and years. The average age of the participants is 20.57 years, with a standard deviation of 1.9, indicating a relatively young and closely aged group. The ages range from 17 to 25 years. In terms of departmental distribution, 56 participants (21.7%) are from BDS, 99 (38.4%) from DPT, and 103 (39.9%) from MBBS, showing a fairly even representation across these disciplines.

Analyzing the academic year, the participants are distributed as follows: 67 (26.0%) in the 1st year, 57 (22.1%) in the 2nd year, 66 (25.6%) in the 3rd year, 38 (14.7%) in the 4th year, and 30 (11.6%) in the 5th year. This distribution indicates a higher representation of students from the earlier years of study.

Table 1 Demographic characteristics (n=258)

	Mean±SD	Range
Age	20.57±1.9	17-25
Department	Frequency (n=258)	Percent
BDS	56	21.7
DPT	99	38.4
MBBS	103	39.9
Year		

	Mean±SD	Range
1 st	67	26.0
2 nd	57	22.1
3 rd	66	25.6
4 th	38	14.7
5 th	30	11.6
Schaffer's test		
Negative (if tendon doesn't appear)	65	25.2
Positive (if tendons appears)	193	74.8
Phalen's test		
negative (if no tingling and numbness in thumb, index finger and middle finger)	176	68.2
positive (if tingling and numbness in thumb, index finger and middle finger)	82	31.8

The study also examines the results of Schaffer's and Phalen's tests, used to assess specific clinical conditions. For Schaffer's test, 65 participants (25.2%) had negative results (indicating the absence of a visible tendon), while 193 (74.8%) had positive results. In Phalen's test, 176 participants (68.2%) showed negative results (no tingling and numbness in the thumb, index finger, and middle finger), and 82 (31.8%) showed positive results (presence of tingling and numbness in these fingers).

Table 2 Comparative Associational table of both tests

Schaffer's test	Phalen's test		Total	P-value
	Negative	Positive		
Negative	55	10	65	0.001
	31.3%	12.2%	25.2%	
Positive	121	72	193	
	68.8%	87.8%	74.8%	
Total	176	82	258	
	100.0%	100.0%	100.0%	

A cross-tabulation of Schaffer's and Phalen's test results reveals some interesting correlations. Among those with negative Schaffer's test results, 55 (31.3%) also had negative Phalen's test results, and 10 (12.2%) had positive Phalen's test results. Conversely, of those with positive Schaffer's test results, 121 (68.8%) had negative and 72 (87.8%) had positive Phalen's test results. The total distribution shows that 176 participants had negative and 82 had positive results for Phalen's test, regardless of their Schaffer's test outcome. The statistical significance of these associations is marked with a P-value of 0.001, indicating a likely significant correlation between the results of the two tests in this population.

DISCUSSION

In the current study, a significant relationship between the presence of the palmaris longus muscle (PLM) and the incidence of carpal tunnel syndrome (CTS) in badminton players was observed, evidenced by a P-value of 0.001. This association underscores the potential role of the PLM, especially considering its anatomical proximity to the transverse carpal ligament and its implication in elevating carpal tunnel pressure during wrist extension. Such findings resonate with the broader discourse on musculoskeletal anomalies and their impact on CTS, particularly among athletes.

Comparatively, the study by Young Joo et al. (2022) also investigated the association between PLM and CTS but diverged in its focus on morphological parameters (4). Their research, yielding a significant P-value (<0.001), adds to the growing body of evidence that underscores the importance of anatomical variations in the context of CTS. The congruence in the significance of results, despite differing study populations (general patients vs. badminton players), reinforces the potential clinical relevance of PLM in the pathophysiology of CTS.

Furthermore, Lukasz Olewnik et al. (2017) explored the anatomical variations of the PLM and their relationship with the median nerve, crucial in the context of CTS (22). Their findings, with a significant P-value (<0.005), emphasize the intricate anatomical

interplay that could predispose individuals to nerve compression syndromes. The parallel between their findings and the current study's results further strengthens the argument that the PLM's anatomical characteristics can be a critical factor in CTS, especially in populations subjected to repetitive wrist movements, like badminton players.

Contrastingly, the study by Andrew D. Boltuch et al. (2020), which included a larger sample size (389 patients), suggested no significant association between PLM and CTS when analyzing hand dominance (1). This discrepancy could be attributed to methodological differences, such as the inclusion criteria and the specific populations studied (general vs. athlete). The lack of significance in the Boltuch et al. study, particularly in the left and right-hand analysis, might indicate the complexity of CTS etiology, which could be influenced by a multitude of factors beyond the mere anatomical presence of the PLM.

Additionally, G.R. Keese et al. (2006) also highlighted the clinical significance of the PLM in the pathophysiology of CTS, with their findings echoing the significant correlation observed in the current study (23). The alignment of these results, despite variations in study populations and methodologies, suggests a consistent pattern pointing towards the clinical importance of PLM in understanding and potentially managing CTS.

CONCLUSION

In conclusion, the current study's findings, in conjunction with previous research, advocate for a more nuanced understanding of the role of PLM in CTS, particularly in physically active populations like badminton players. While the anatomical relationship between PLM and CTS is becoming increasingly evident, future research should continue to explore this correlation, considering different populations and potential confounding factors, to enhance the clinical management of CTS. Additionally, the limitations of the current study, particularly related to the data collection methodology, should be addressed in future research to ensure more robust and generalizable findings.

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