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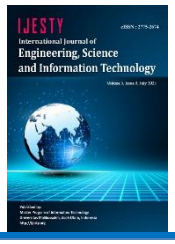

Analysis of Forehand and Backhand Stroke Accuracy and Lateral Epicondylitis Pain among Recreational Tennis Players

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Abstract

The tennis matches require short explosive bursts of energy per match or practice session, and an average tennis match lasts less than one hour or as long as five hours. Tennis players most prominently use the primary ground strokes, such as forehand and backhand strokes. The forehand and backhand strokes are simultaneously activated by a complex sequence of muscle activity that incorporates smooth trunk and lower extremities coordination patterns. Accuracy of the forehand and backhand stroke plays a dominant role in the tennis matches, because accurate movement leads to high-performance skills. The contraption of this study promotes the knowledge on the influence of lateral elbow pain, which affects the players' accuracy in performing the ground strokes during a match, significantly decreasing the players' performance. The participants were recruited according to the inclusion and exclusion criteria. The participants' lateral epicondylitis was assessed using the Cozens test, pain was evaluated using the Numeric pain rating scale, and the ground stroke accuracy was assessed using the Wiebe tennis performance test. During the forehand stroke, the participants reported a visual analogue scale with a mean value of 2.46 and an accuracy rate of 65.71. During the backhand stroke, the participants reported a visual analogue scale with a mean value of 5.66 and an accuracy rate of 37.93. This study concludes that the pain score significantly increased in double and single backhanded strokes, with a decreased accuracy rate. This study also concludes that at least a positive correlation exists between pain intensity and the accuracy rate in the backhand stroke.

Keywords: *Forehand Stroke, Backhand Stroke, Lateral Epicondylitis, Pain, Accuracy Rate.*

1. Introduction

Sports are being transformed from a leisure activity to a significant industry sector. The tennis game was introduced in India in the 1880s by British officers. The length of points, shot choice, strategy, match length, weather, and opponent are all unpredictable in this game. The typical tennis match lasts less than one hour, but few matches may last up to five hours. The matches and practice sessions demand brief, rapid bursts of energy [1].

Each sport has different shooting strategies, which signify the player's performance. The tennis game consists of 8 basic shots, such as 1—the serve- A shot at the beginning of each service game point [2]. The two types of forehand strokes are the open-stance forehand, in which most tennis players hit most of their forehand shots with their legs in an open stance for considerable power, and the forehand return serve, a crucial shot for returning a serve. The forward swing is used when returning a defensive return—the backhand stroke is played on the left side. The volley style is sometimes considered one of the easiest, as it blocks the ball in the air. The Half Volley is a pick-up shot where the ball meets the ground and the racket at the same time. The overhead is called the smash and is often used as a defence, and the drop shots are either forehand or backhand shots used to master slice and backspin [3].

There are primarily two ground strokes, forehand and backhand, which the tennis players use most prominently. A complex series of muscle movements that include the trunk's and the lower extremities' fluid coordination patterns concurrently trigger the forehand and backhand strokes. In the forehand stroke, the player swings the racket with the playing hand (left or right) low to high from the western level, making contact with the ball in front of the body before finishing it over the shoulder and then naturally receiving the racket with the non-playing hand. While using a backhand stroke, a player swings his racket from the side of his body that is not in play with his playing hand (or both hands if it is a one-handed or double-handed backhand) from low to high from the western level. He makes contact with the ball in front of his body and finishes it over his shoulder as he moves from the playing hand side of his body to the backswing. However, in contrast to the two ground strokes, the player often uses the forehand stroke rather than the backhand stroke [4,5].

Among recreational tennis players, the most prevalent site for injuries is the lower limb (31- 67%), followed by (20.5%- 49%) in the upper limb and 3% in the trunk.[6] The lateral epicondylitis is the most prominent injury among tennis player which was first described in the year 1873, it occurs 40 – 50 % among the recreational tennis players than the professional players as stated by Blackwall and

cohalan due to improper technique, use of excessive spin, lack of strength, lack of flexibility, lack of coordination of the body linked system, vibration of the racquet, inappropriate grip size of the racquet etc.

The most often impacted muscle is the extensor carpi radialis brevis (ECRB); however, other wrist extensors, such as the supinator and extensor carpi radialis longus, extensor digitorum, extensor digiti minimi, and extensor carpi ulnaris, may also be affected. Overusing forehand and backhand strokes in a match causes excessive tension on the tendon, increasing cross-linkage and collagen deposition. Then the tendons stretch easily with growing force. Once the tendon reaches the maximum stretched level, it will not return to its normal position, significantly leading to excessive tension and causing micro tears. Multiple micro tears will lead to degenerative changes within the tendon, which are known as tendinosis. The most common symptoms of lateral epicondylitis are lateral elbow pain, swelling, tenderness over the elbow, burning sensation, a weakened grip when holding something, etc. The proportion of comparison between the prevalence rate of injury lateral epicondylitis and medial epicondylitis is less common, about 5:1.

Accuracy of the forehand and backhand stroke plays a dominant role in the tennis matches, because accurate movement leads to high-performance skills. Whiteside et al. 2016[7] Therefore, hitting, kicking, or throwing faster, while preserving accuracy, are critical motor skills in interpersonal sports. The player prepares the stroke once he receives the ball to push it on the opponent's side to gain points with strength and accuracy. If the accuracy in shooting the ball misses, it will significantly change the game's strategy, and on the whole, it will decrease the chances of winning.

Tennis is a sport where skill is the primary prerequisite for successful performance, with a complex interaction of several physical components. Research has shown the prevalence rate of lateral epicondylitis and associated factors. However, to our knowledge, studies on the influence of lateral elbow pain on the accuracy rate of two ground strokes still lag. The contraption of this study promotes the knowledge on the impact of lateral elbow pain, which affects the player's accuracy in performing the ground strokes during a match, significantly decreasing the player's performance.

2. Methods

2.1. Study Design, Period, and Study Area:

The Strobe guidelines report this study. This non-experimental cross-sectional study was conducted between 2023 and 2024 in Bagayam, Vellore district, Northeast region of Tamil Nadu state, India. The Vellore district is located in Tamil Nadu State between latitudes 12° 15' and 13° 15' North and longitudes 78° 20' and 79° 50' East. This district has a total size of 5920.18 square kilometres. According to the 2011 Census, 39,36,331 people are living there. In the urban part of Vellore, there are around 20 Tennis training academies, in which around 800 students are trained under various categories, such as Recreational and professional players for matches.

2.2. Source and Study Population:

The recreational tennis players aged 18- 25 years of both men and women with lateral elbow pain, those who play at least 1 hour per day, 3 days a week, with a minimum of 2 years of experience, were used as the source population. The participants with any injury in the past 6 months or any musculoskeletal disorder and the professional tennis players were excluded from the study.

2.3. Sample Size and Sampling Method:

The Convenient sampling method was used in this study. The sample size was calculated using the following assumptions and formula for single population proportion: 95% confidence interval, infinite population, 5% margin of error, and an expected prevalence of 50% for the widest variability, hence the estimated sample size n = 150. Twenty tennis academies were stratified into tennis clubs and professional training institutions, in which five training centres were proportionally selected, and the samples were proportionally recruited from the coaching centre chosen.

2.4. Data Collection Procedure:

The participants were recruited based on the inclusion and exclusion criteria. The study's procedure and need were explained in detail to the participants. The lateral elbow pain was assessed using the Cozen test, in which patients were made to sit with their elbows extended and forearms in pronation, with the wrist radially abducted with the hand made in a fist. At the same time, the evaluator palpates the lateral epicondyle with his hand over the dorsum of the patient's hand. The patient is asked to move the wrist to dorsiflexion when the therapist provides resistance to this movement. The test is positive if the patient complains of pain. The pain scale was assessed using a visual analogue scale.

Then, the accuracy rate of the tennis player was assessed using the Wiebe tennis performance test, with a credibility of > 0.88 and test validity of r = 0.71. The Wiebe tennis test protocol was described, and each participant stood behind the baseline. The coach then delivered the ball from the baseline on the other side of the court to each player. The players targeted a specific target on the other court to score as many points as possible. Every athlete made 10 tries at the forehand and 10 at the backhand. The region where the ball landed determined each stroke's score, ranging from 0 to 9. Balls that went over the rope, stopped at the net, or fell outside the zones received zero points. A player was given zero points for a stroke deemed played if they could not strike the ball at the beginning of the attempt. Balls that made contact with the net and were considered legitimate were repeated. The total number of points earned after 10 forehand and backhand tries, and the total number of successful strokes at the attempts above, when the ball fell in the graded zones, were used to calculate the test result. Each training unit began with a standard warm-up for the participants.

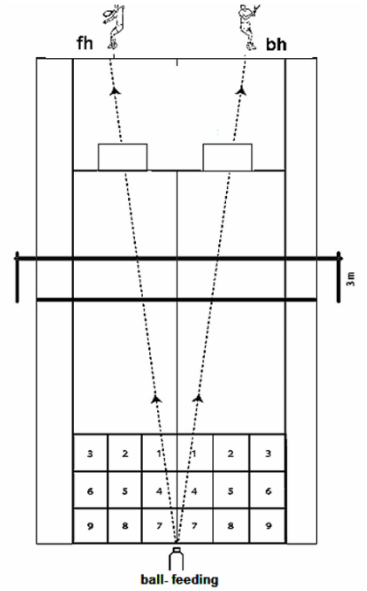

Fig 1. Data Collection

3. Results and Discussion

Table 1. Participants' Demographic Data According to Gender

Gender	Frequency	Percentage
Men	87	58
Women	63	42
Total	150	100

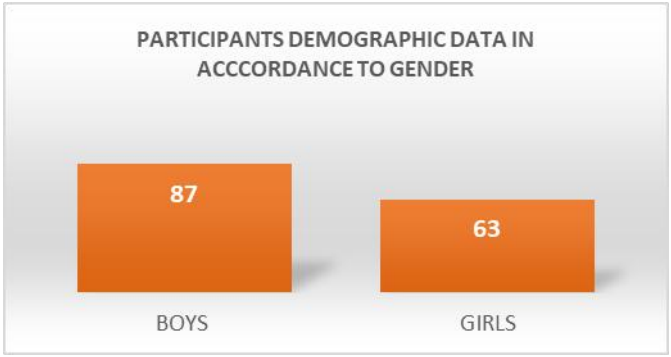

Fig 2. Bar Diagram Illustrates Participants' Demographic Data According to Gender

Table 2. Participants' Demographic Data According to Age

Gender	Frequency	Percentage
18	20	13%
19	10	6.6%
20	21	14%
21	16	10.6%
22	18	12%
23	16	10.6%
24	28	18.6%
25	21	14%

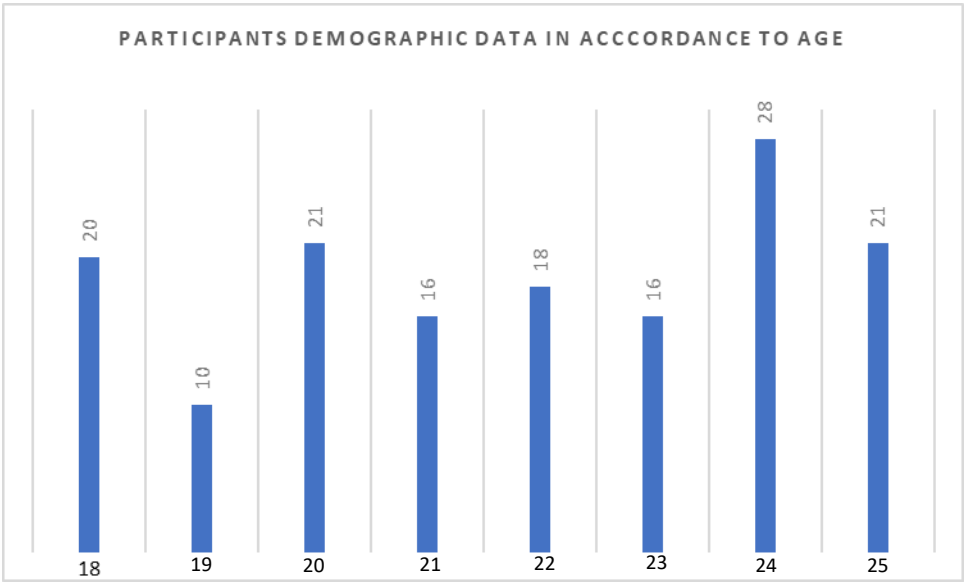

Fig 3. Bar Diagram Illustrates Participants' Demographic Data According to Age

Table 3. The Intensity of Pain and Accuracy In Forehand And Back Stroke Among Men

Men		N	Mean	Std. Deviation	t – Value (P-Value)
FORE HAND	WIEBE TENNIS	87	64.14	18.743	30.570 (0.001)*
	ELBOW PAIN VAS	87	2.52	1.485	
BACK HAND	WIEBE TENNIS	87	36.51	16.697	17.085 (0.001)*
	ELBOW PAIN VAS	87	5.76	1.732	

Table 4. The Intensity Of Pain And Accuracy In Forehand And Backhand Stroke Among Women

Women		N	Mean	Std. Deviation	t – Value (P-Value)
FOREHAND	WIEBE TENNIS	63	67.89	17.825	29.098 (0.001)*
	ELBOW PAIN VAS	63	2.38	1.250	
BACK HAND	WIEBE TENNIS	63	39.89	17.017	15.986 (0.001)*
	ELBOW PAIN VAS	63	5.52	1.242	

Table 5. The Intensity of Pain and Accuracy in Forehand and Backhand Stroke in Both Groups

Men and Women		N	Mean	Std. Deviation	t – Value (P-Value)
FOREHAND	WIEBE TENNIS	150	65.71	18.396	41.992 (0.001)*
	ELBOW PAIN VAS	150	2.46	1.388	
BACK HAND	WIEBE TENNIS	150	37.93	16.859	23.343 (0.001)*
	ELBOW PAIN VAS	150	5.66	1.545	

Table 6. The Association of Pain with Forehand Stroke Accuracy

FORE HAND	Mean	Std. Deviation	N	r- Value (P-Value)
WIEBE TENNIS ACCURACY TEST	65.71	18.396	150	0.084 (0.305)
ELBOW PAIN VAS SCORE	2.46	1.388	150	

Table 7. The Association of Pain and Accuracy with Backhand Stroke

BACK HAND	Mean	Std. Deviation	N	r- Value (P-Value)
WIEBE TENNIS ACCURACY TEST	37.93	16.859	150	0.154 (0.060)
ELBOW PAIN VAS SCORE	5.66	1.545	150	

Tennis is a sport that encompasses both aerobic and anaerobic activities, appealing to individuals of various ages and competitive standards. Research states that the incidence rate of injuries among recreational tennis players varies from 0.05 to 2.9% per year. Among recreational tennis players, the most prominent region for injury is the elbow and wrist [6], in which the prevalence rate of injury in the elbow is 15.6%.7,8,9]

From 2022 to 2023, a study was conducted among recreational tennis players, which portrays the influence of Tennis Court Surface on Outcomes of Circuit Training in speed, agility, and strength 10. During those research we observed recreational tennis players complaints of pain over the lateral elbow while performing double back hand stroke and less commonly in the forehand stroke on parallel which reduces their accuracy rate in hitting the ball over the targeted zone, in accordance to it many recent evidence articles based on lateral epicondylitis and accuracy of the player were reviewed, then narrowing down it we found there are many studies which illustrates the kinetic analysis for lateral elbow pain by stroke performance among professional tennis players, but still the studies on the concept of influence of lateral elbow pain and ground strokes accuracy rate among recreational tennis players still lags, So in preceding this forward the corner stone idea of the research took place.

One hundred fifty samples of both genders of the age group between 18 and 25, those who play a minimum of 1 hour per day, 3 days a week, with a minimum of 2 years of experience, were used as the source population. The participants with any injury for past 6 months or with any musculoskeletal disorder, and the professional tennis players were excluded from the study, the player underwent cozen special test by the therapist to analyse their lateral elbow pain then followed by pain score was analysed visual analogue scale and Wiebe tennis performance test for the accuracy test.

This study states that in comparing the mean value of the visual analogue scale, the players reported a significant pain during the backhand stroke compared to the forehand stroke, followed by the participants scoring a maximum accuracy score in the forehand compared to the backhand stroke. The biomechanics of the stroke performance are illustrated during the stroke performance. The muscles in the forearm flex to support the wrist and grip the racquet when the ball strikes it. Repetitive activities of these muscles produce chronic overload excessive contraction of wrist extensors about it there is also an alternate hypothesis which states that when the ball hits the racquet causes lengthening of the muscle while under tension, the repetitive use of abnormal positioning of back hand stroke will cause excessive load over the tendon and results in tendinitis11. The recreational tennis players most commonly use the single hand technique in their beginning stage of training which causes excessive shoulder and elbow fatigue as the stroke relies only on the upper limb strength, during single back hand stroke once the ball approaches the hip turns slightly transferring the momentum to trunk, the upper arm moves about the shoulder which is then moved into the forearm movement and makes the racquet to be in position for the ball, but on parallel in the double hand technique naturally it increases the linear velocity of sequential end point in which the transfer of linear momentum and step forward at ball contact point, followed by hip rotation, arm of both limb rotation and extension, there is a possible cause when the player adopts to an abnormal position which they feels comfortable for a particular time, but as days goes by it significantly increases the excessive load on the extensor of the forearm and leads to repetitive strain injury13. The adoption of abnormal positioning in backhand takes place due to rapid change of posture in holding the racquet between forehand and backhand, which causes the ECRB tendon to become irritated, overloading of wrist extensors during the backhand tennis stroke. In recreational tennis players, there are many intrinsic and extrinsic factors such as improper flexibility, strength, lack of coordination of the body linked system, different court surface, size of the racquet, and grip size, which appear to be the main parameters for causing the lateral epicondylitis among recreational tennis players. In comparing the professional players who hold the racquet in a neutral position and meet the ball at the centre, recreational tennis players mostly meet the ball in the periphery, which causes excessive vibrations, which is also associated with the lateral epicondylitis[14-20].

A study also states that when the knee flexion of the player is not at 90 degrees of freedom during the backhand stroke, it transfers a significant amount of 40% – 52 % of the load over the shoulder and elbow muscles. The improper forehand stroke significantly causes medial epicondylitis, and the backhand stroke causes lateral epicondylitis. As recreational tennis players play for a hobby, they never look out for these symptoms, but when it comes to their performance, they try to compensate and play. Still, as a result, their accuracy level in hitting the targeted zone will be missed. Most recreational players try to adopt a neutral posture in the forehand stroke. Still, when it comes to the backhand stroke, they adopt a non-neutral backhand posture, which significantly reduces the transitional force of the ball to the opponent side and reduces the accuracy rate of the player. In this study, most players had more successful attempts in the forehand stroke than the backhand stroke.

This study's results align with those of Mansoor Ali Khan et al. (2017), whose findings indicate a difference in accuracy between forehand and backhand drives based on the mean score. Regardless of whether they are forehand or backhand drives, the overall test results show that all individuals had about the same degree of accuracy with just a slight variation on the court [4].

The kinetic chain may be manipulated more effectively by skilled players to decrease the impact pressures applied to the joints of the upper extremities. Conversely, recreational tennis players often use excessive and uncoordinated strength without efficient technique, which does not translate into increased ball velocity but overloads the joint and increases the risk of injury. The outcome of this study suggests that practising improper stroking among recreational tennis players for a prolonged time will significantly increase the consequences of lateral epicondylitis and affect players' accuracy level, which inhibits their performance. This study also states no association between pain intensity and accuracy rate in forehand stroke. Still, on the other hand, there is at least a positive correlation between the pain intensity and the accuracy rate in the backhand stroke.

4. Conclusion

This study concludes that the pain score significantly increased in double and single back-handed strokes, with a decreased accuracy rate. This study also concludes that at least a positive correlation exists between the pain intensity and the accuracy rate in the backhand stroke.

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