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Analysis of Superior Extremity Strength on the Groundstroke Attack Skills of Tennis Athletes

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Abstract

A tennis player must be able to produce groundstroke attacks effectively because these strokes have an important strategic role in controlling and dominating the course of the match. To produce a groundstroke attack, a tennis player must have muscle strength in the superior extremities, because the superior extremities are the primary source of kinetic energy required to transfer momentum to the racket. Apart from that, good coordination between the muscles of the arms, shoulders, and back is also important to achieve optimality in groundstroke attacks. In a coordinated movement, energy from the tennis player's body is transferred through the arms to the tip of the racket when the racket makes contact with the ball. The aim of this study was to determine how much influence superior extremity strength has on forehand groundstroke skills. The type of research used is a correlational description, involving the independent variable being superior extremity muscle strength while the dependent variable is forehand groundstroke attack skill. The research sample was 20 POMNAS South Sulawesi tennis athletes taken by purposive sampling. The instruments used were the Bouncing Medicine Ball Test and the Hewitt Tennis Performance Test. Analysis through a correlation regression test. The results concluded that the ability to groundstroke attack was influenced by upper limb muscle strength by 59.3%.

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INTRODUCTION

The game of tennis is influenced by external factors from the environment, which are quite difficult to control (Vaverka et al., 2018). According to Singh et al., tennis players must have different strategies and techniques. The ball cannot be expected to move quickly and, therefore, requires fast and precise reflexes to make a shot (Tantri & Simangunsong, 2021). In the game of tennis, there are two basic groundstroke techniques, namely the backhand and forehand techniques. This shot is usually played from the back of the court during the baseline rally (Saleh, 2022). Groundstrokes can also be used to attack opponents with speed and strength. Because of this, he is a reliable tennis player and has strong and stable groundstrokes on both sides of the court. For the intermediate level, players must master basic techniques and consistently perform various variations of punches, including groundstroke attacks. Groundstroke attack is the term for a strong and fast-attacking shot. Tennis players always use the power of punches on the top or on the rise to actively attack their opponents

Groundstroke techniques are widely used during games (Saleh, 2019). Sukadiyanto (2016) found that approximately 47% of groundstrokes were the most dominant strokes used during the game. Research results (Rohadi et al., 2021) state that in one game, 80% of the techniques used in the game are groundstrokes. Based on the various results of this research, the high percentage shows how effective the use of groundstrokes is in playing tennis. Therefore, it is important for a tennis player to develop this skill. To produce a groundstroke attack, a tennis player must have muscle strength in the superior extremities. According to Angga (2014), superior extremity muscles are the main source of punching power for tennis athletes. Superior extremity muscle strength is the key for tennis players who want to develop punching power. It is predicted that having strong superior extremity muscles allows tennis players to produce strong and fast blows that are difficult for opponents to return. Physiologically, muscle strength is the ability of a group of muscles to perform one maximum contraction against resistance or load (Adhi et al., 2017). Superior limb muscle strength in tennis can be interpreted as the ability of the muscles to produce the power needed to hit the ball with optimal speed and power in groundstrokes, as well as helping to maintain consistency and quality of shots throughout the match. The main punches and how the action, muscles, and muscle contractions are related to produce an effective and powerful punch (E. Paul Roetert and Mark S. Kovacs, 2018)

Superior extremity muscle strength can work optimally if the energy released can be controlled properly (Supriyanto & Martiani, 2019). The greater the importance of superior extremity muscle strength when executing a groundstroke attack, the greater the ability to produce higher ball speed and shooting power. Based on direct observations in the field and interviews with the South Sulawesi POMNAS Tennis Team trainer, the reality is that many athletes during training and competition are weak in groundstroke attack techniques. This is predicted to occur due to athletes not having sufficient muscle strength in the superior extremities to create ball speed and the desired distance for the ball to fall, making it difficult to produce aggressive shots and ultimately making the rhythm of the game less interesting to watch. The problem of this research is in line with the problem of research

conducted (Amni et al., 2019) that it was found from clubs in West Java that the level of achievement was decreasing, which resulted in the national ranking of men and women decreasing in athletes aged 14–16. This was due to technical mastery. The basics of forehand and backhand groundstrokes are still lacking, one of which is proven by data obtained by PB PELTI.

METHODS

The method used in this research is descriptive-correlational, involving the independent variable superior extremity muscle strength and the dependent variable groundstroke attack skill in tennis. The research instruments used were the medicine ball bounce test (Torres-Luque et al., 2018) and the Hewitt tennis performance test (Yapıcı et al., 2018). The medicine ball bounce test is used to measure superior extremity muscle strength, while the Hewitt tennis performance test evaluates the three basic strokes of tennis skills, namely forehand, backhand, and serve, as well as to interpret, measure, and improve athletes' tennis performance (Cengiz Ölmez, 2023). The research was analyzed through correlation regression with a significance level of 0.05.

PARTICIPANTS

The research subjects were 20 POMNAS South Sulawesi tennis athletes taken using purposive sampling.

RESULTS

Table 1. Description of Research

Statistics	Superior Extremity Strength	Groundstrokes Attack
Samples (N)	20	20
Mean	23.50	33.70
Std. Deviation	3,517	4,996
Range	13	21
Minimum	15	20
Maximum	16	41
Sum	470	674

Based on Table 1, it can be stated that superior extremity muscle strength was obtained by a sample of 20 people, with an average of 23.50, a standard deviation of 3.517, a range of 13, a minimum value of 15, a maximum of 16, and a sum of 470. Meanwhile, a groundstroke attack was obtained by a sample size of 20 people, an average of 33.70, a standard deviation of 4,996, a range of 21, a minimum value of 20, a maximum of 41, and a sum of 674.

Table 2. Normality Test Results

Variable	p-value	Sig.	Information
Superior Extremity Strength	0.120	0.05	Normal
Groundstroke Attack	0.580		Normal

In Table 2 the results of the normality test for each variable show that the normality test is greater than 0.05. So that all variables are normally distributed.

Table 3. Relationship Linearity Test

Correlation	Fcount	Ftable
X – Y	0.686	2.90

P Value	Sig.	Information
0.643	0.05	Linear

Based on Table 3 of the linearity test of the relationship, the calculated F value = 0.686 (p> 0.05). It can be concluded that limb muscle strength is superior to groundstroke skills attacks have a relationship or are linear.

Table 4. Regression Analysis Results for Hypothesis

Variable	N	Regression Coef. (B)	R^2
Superior Extremity Muscle Strength and Groundstroke Attack	20	8,000	0.593
F	**t**	**p**	**α**
26,194	5.118	0,000	0.05

Based on the results of testing the regression equation in Table 4, it was found that Y = 8,000 + 1,094X. This means that without superior limb muscle strength, the groundstroke attack ability is 8,000. Meanwhile, the regression coefficient for the superior extremity muscle strength variable is 1.094, stating that every 1% increase in superior extremity muscle strength causes an increase in groundstroke attacks of 1.094. Table 4 shows that the regression coefficient value is 8,000 (0.000< α 0.05), and the coefficient of determination is 0.593. This means a groundstroke attack is influenced by superior extremity muscle strength (59.3%). While the remainder (100% - 59.3% = 40.7%) is caused by other factors. Furthermore, Table 4 also shows that the calculated t-value was 5.118 (0.000 < α0.05). This means that Ho is rejected and H1 is accepted, or superior extremity muscle strength has a significant impact on groundstroke attacks. Thus, there is a contribution of superior limb muscle strength to groundstroke attack skills of 59.3%. From the F test, the calculated F is 26.194 with a significance level of 0.000. Because the probability (0.000) is smaller than α 0.05, this regression model can be used to predict groundstroke attack skills. So Ho is rejected and H1 is accepted, thus there is a contribution of superior limb muscle strength to groundstroke attack skills. With these results, the better the superior extremity muscle strength results, which means the stronger and faster the superior extremity muscles, the better the groundstroke attack skill will be, or, in other words, superior extremity muscle strength can predict groundstroke attack skill.

DISCUSSION

Based on the results of this research analysis, it appears that superior extremity muscle strength contributes to groundstroke attacks in tennis. In tennis, axial hip rotation and a strong upper body allow the transfer of energy from the inferior extremity to the superior extremity in the forehand. The upper trunk tends to rotate approximately 90–100° from parallel to the baseline and approximately 30° beyond the hips in the transverse plane (Elliott et al., 1996). Forward rotation of the upper trunk coincides with a lag in the superior extremities that is counteracted by the action of the eccentric and horizontal adductor muscles of the greater shoulder dorsum and internal rotation torque (Bahamonde & Knudson, 2003).

Superior extremity muscle strength is a very important factor to consider when carrying out groundstroke attacks in tennis. Superior extremity muscle strength will provide pressure against hard and strong blows, making it difficult for the opponent to return the blow. Physical elements such as power, speed, and strength will make it easier for tennis players to carry out difficult movements, especially in positioning the body and being able to return every opponent's blow, not easily fall or get injured when returning the ball from the opponent, and make it easier for tennis players to perform various techniques. As stated (Kovacs et al., 2008) eccentric strength in both the superior and inferior extremities can help maximize tennis performance and help prevent injury.

The results of this study show that there is a 59.3% contribution between superior extremity muscle strength and the ability to perform groundstroke attacks. This means that the greater the muscle strength of a player's superior extremities, the better and stronger the groundstroke attack he has. This shows that it is important to train superior extremity muscle strength to improve groundstroke attack performance. This research is in line with what was conducted (Elliott et al., 1997), which found that the muscles found in the superior extremities, namely the forearm flexors and digitorum muscles, are important in the tennis forehand. These muscles create a lot of joint rotation to accelerate the racket. Likewise, research (P, 2014) found that arm muscle strength in field tennis forehand groundstrokes in Unesa field tennis UKM athletes obtained a contribution of 67.73%. From the results of this study, the influence of superior extremity muscle strength on groundstroke attacks was 59.3% and 40.7% determined by other factors such as speed, flexibility, balance, and coordination (Agusni, 2015; P, 2014), training methods (Amni et al., 2019), drill training (Afida Ahmad Dahlan et al., 2022) (Nababan & Sinulingga, 2021), and mental aspects (Zoki & Saputra, 2018). Based on an anatomical review, the groundstroke attack is influenced by the deltoid (anterior part), which helps move the superior extremity forward when swinging the racket. Pectoralis major helps maintain stability and provides power when hitting the ball with the racket. The upper superior extremity muscles consist of the biceps brachii (front upper superior extremity muscle) and triceps brachii (rear upper superior extremity muscle), which work together to produce hitting power and stability when the player's racket impacts the ball with a certain force and direction. This impact results in a transfer of energy from the racket to the ball, which in turn affects the speed, direction, rotation, and quality of the shot. To perform a strong, fast, and stable groundstroke attack in tennis, apart from superior limb muscle strength, players must also have good footwork, especially when facing the ball. Attack shots will be good if they are supported by good footwork (Abdul, 2019) (Fahada & John, 2019). Footwork is a "key" element in the game of tennis. Footwork is also a determining factor for a tennis player's success (Saleh, 2022). (Javier, 2020), which states that the feet are the 'launching platform' for the hitting movement. The energy generated from leg movements in tennis is then released through a sequence of movements and body rotations from the back leg to the front leg. This bodyweight transition allows the player to create linear and angular momentum, which ultimately transfers power into consistently stronger and harder shots.

Thus, A Tennis Player Who Performs A Groundstroke Attack Correctly Requires Superior Extremity Muscle Strength As Well As The Correct Body Position And Footwork According

To The Desired Stroke. Exercises That Can Be Done To Increase Superior Extremity Muscle Strength And Ultimately Influence Groundstroke Attacks Include Throwing A Medicine Ball. (Roetert Et Al., 2009) Stated That Medicine Ball (Mb) Throwing Helps Increase Upper And Lower Body Eccentric Strength. Furthermore, The Forms Of Exercise That Can Be Done Include Medicine Ball Deep Groundstroke, Medicine Ball Short Groundstroke, Medicine Ball Wide, Medicine Ball Wall Open Stance, Cable Rotation In The Transverse Plane, Wrist Roller, Weighted Forearm Pronation, And Supination (Roetert Et Al., 2009)

CONCLUSION

The Effectiveness Of Groundstroke Attacks In Tennis Is Very Dependent On Muscle Strength In The Superior Extremities. This Muscle Strength Is The Main Source Of Kinetic Energy Needed To Transfer Momentum To The Racket So That It Can Produce A Strong And Coordinated Stroke. Apart From That, Good Coordination Between The Muscles Of The Arms, Shoulders, And Back Also Makes A Significant Contribution To Optimal Groundstroke Attacks. Based On The Results Of The Research And Discussion Above, It Can Be Concluded That There Is An Influence Of Superior Extremity Muscle Strength On Groundstroke Attacks Of 59.3%. Thus, The Results Of This Study Provide A Deeper Understanding Of The Relationship Between Muscle Strength And Technical Skills In The Game Of Tennis, Especially In The Context Of Groundstroke Attacks. The Practical Implications Of This Research Can Be Used To Develop Training Programs That Are More Targeted And Effective In Improving Forehand Groundstroke Skills In Tennis Players.

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