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Comparison of Hand Grip Strength in Different Wrist Positions in Right and Left Handed Tennis Players

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Abstract: ***Wrist position is one of the major factors that affect grip strength. In tennis, the quality and strength of stroke depends largely onracket grip. Compared to normal population, higher prevalence of left-handedness has been reported at elite level sports like cricket, baseball and tennis suggesting that left-handed athletes might have an advantage in these domains.Thus, this study was conducted to compare hand grip strength in different wrist positions in right and left handed tennis players. Hand grip strength of 40 Tennis players (20 right and 20 left handed) was measured using Jamarhandheld dynamometer in different wrist positions.Prior to the test, age, height and weight were recorded. Hand grip force was 33.75±9.77 – 33.18± 5.79 kg (mean ± SD <right hand-left hand>), 23.80 ± 8.14 – 24.63 ±6.98 kg, 25.92± 7.78 – 28.41±5.53 kg, 23.77 ± 6.79 – 25.02 ±5.42 kg and 25.75 ± 11.48 – 25.21 ±4.93 kgat neutral, wrist flexion, wrist extension, ulnar deviation and radial deviation respectively. (p≤0.05)There was no significant difference in hand grip strength in different wrist positions between right and left handed tennis players.***

Keywords: Grip-strength, hand dominance, tennis players,wrist position

1. Introduction

Hand grip strength is a physical trait that plays an important role in providing effectiveness and efficiency during daily work and sports activities [1]. Hand grip Muscle strength has been defined as forceful flexion of all fingers with maximum voluntary force that the subject is able to exert under normal bio-kinetic conditions [2]. Grip strength determines the handedness of an individual, an important field of population's variation study. It is often used as an indicator of overall physical strength[3], hand and forearm muscle performance and as a functional index of nutritional status and physical performance[4].

Manyfactors can influence the strength of the grip including wrist position, hand dominance, time of the day, age, nutrition, pain, fatigue, cooperation of the patient, presence of amputations, restricted motion, pain and sensory loss. The synergistic action of flexor and extensor muscles and the interplay of muscle groups is an important factor in the strength of resulting grip [5].

In Tennis, strokes are performed by holding the racket while the wrist is in different degrees of orientation and depending on the stroke and type of shot being hit, players have to manage grip forces and control racquet at ballimpact[6]. Left-handed players are said to have an advantage in tennis, especially when serving against a right-handed player to the advantage court [7]. Right- and left-handed serves differ significantly. As a consequence, players have to take into account different probabilities regarding the direction of serve when awaiting right- vs. left handed serves[8].At the same time, they also need to adjust their return stroke due to the different spin imposed on balls served right- vs. left-handed [9].

In sports, left-handedness is rarer than right-handedness. However, compared to the normal population, a higher prevalence of left- handedness has been reported at elite level interactive sports likecricket[10], baseball, table tennis and tennis suggesting that left-handed athletes might have an advantage in these domains[11]. So the aim of study was to compare maximum isometric grip strength at five different wrist positions: neutral, extension, flexion, ulnar deviation and radial deviation in right and left handed tennis players.

2. Methods

A comparative observational study was carried out among 40 tennis players (20 right and 20 left handed) from different tennis clubs in Surat, India with convenient sampling method.After getting ethical approval, participants were selected according to inclusion and exclusion criteria. All the participants agreed and signed informed consent form to extend full co-operation for data collection.

Inclusion criteria included tennis players, both males and females of age 16 to 50 years having normal body mass index, who were having at least 1 year ofexperience and practiced minimum1 hour per day for minimum 4 days per week. Individual with any musculoskeletal, cardio-respiratory and neurological impairment, diabetes mellitus,

hypertension, any structural deformity / trauma or surgical procedure inupper limb in past 6 months were excluded from the study. Purpose of the study was explained to the participants. Preliminary measurements and demographic data including age, gender, height and weight were collected. Edinburgh Handedness Inventory scale was used to assess hand dominancy[12].

A Jamarhand-held dynamometer with a dual scale readout displaying grip force in kilogram and pound was used to measure isometric grip force in five different wrist positions including neutral, maximal flexion, maximal extension, maximal ulnar and maximal radial deviation in dominant hand of each subject. Before testing, the examiner gave a verbal explanation followed by the demonstration to all subjects on how to hold the handle of the dynamometer. Standardized testing protocol for the handgrip strength was used in which subjects were seated in a chair with the shoulder adducted and neutrally rotated, the elbow flexed at 90° and forearm in neutral. For each wrist position subjects were instructed to move their wrist into the "end active range of motion" position, while holding the hand-dynamometer and the trial was recorded only when the subjects were unable to further move the joint. The examiner instructed the subject to "squeeze as hard as possible…harder…harder and relax". To control for the effects of fatigue, the subjects were asked to rest for 2 minutes. They were then required to produce three sets of two second maximal isometric grip efforts[13].Hand grip strength in kilograms was used as an outcome measure. The average value of three trials was used for data analysis.

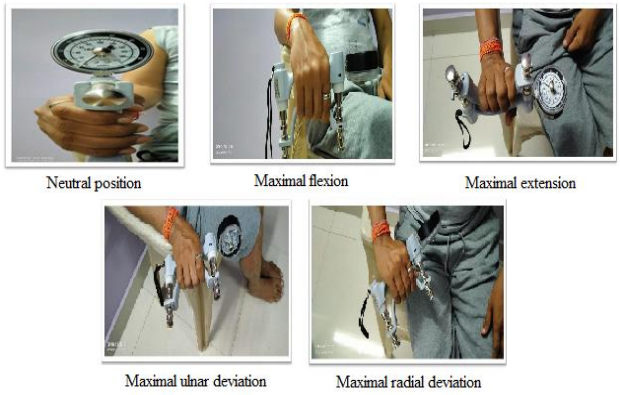

Figure 1: Measurement of hand grip force using Jamar hand-held dynamometer

3. Statistical analysis and results

The data was analyzed using SPSS 20.0 version. Mean and Standard Deviation (SD) were calculated as a measure of central tendency and measure of dispersion respectively. Descriptive statistics of the participants and assessed variables were calculated and Shapiro-Wilk test was used to determine normal distribution with the 95%c onfidence interval of mean. Non-parametric tests were used as the variables did not follow normal distribution. Mann-Whitney U test was used to find if there is any significant difference in hand grip strength in 5 wrist positions between two hand dominant groups. Results were considered to be significant at p≤0.05 and confidence interval was set at 95%.

Table 1: Comparison in neutral position of wrist in right and left handed players

Wrist position	Dominance	Mean	SD	Z	P
Neutral	Right	33.75	9.77	- 0.29	0.76
	Left	33.18	5.79		

Table 1 shows mean and SD of the variables and non-parametric Mann-Whitney U test which shows there is no significant difference (p=0.76) among right and left handed players in neutral wrist position. (95% of confidence interval p≤0.05)

Table 2: Comparison in maximal flexion of wrist in right and left handed players

Wrist position	Dominance	Mean	SD	Z	P
Maximal flexion	Right	23.80	8.14	- 0.42	0.66
	Left	24.65	6.98		

Table 2 shows mean and SD of the variables and non-parametric Mann-Whitney U test which shows there is no significant difference (p=0.66) among right and left handed players in maximal flexion of wrist. (95% of confidence interval p≤0.05)

Table 3: Comparison in maximal extension of wrist in right and left handed players

Wrist position	Dominance	Mean	SD	Z	P
Maximal extension	Right	25.92	7.78	- 1.03	0.30
	Left	28.41	5.53		

Table 3 shows mean and SD of the variables and non-parametric Mann-Whitney U test which shows there is no significant difference (p=0.30) among right and left handed players in maximal extension of wrist. (95% of confidence interval p≤0.05)

Table 4: Comparison in maximal ulnar deviation of wrist in right and left handed players

Wrist position	Dominance	Mean	SD	Z	P
Maximal ulnar deviation	Right	23.77	6.79	- 0.66	0.50
	Left	25.02	5.42		

Table 4 shows mean and SD of the variables and non-parametric Mann-Whitney U test which shows there is no significant difference (p=0.50) among right and left handed players in maximal ulnar deviation of wrist. (95% of confidence interval p≤0.05)

Table 5: Comparison in maximal radial deviation of wrist in right and left handed players

Wrist position	Dominance	Mean	SD	Z	P
Maximal radial deviation	Right	25.75	11.48	- 0.65	0.51
	Left	25.21	4.93		

Table 5 shows mean and SD of the variables and non-parametric Mann-Whitney U test which shows there is no significant difference (p=0.51) among right and left handed players in maximal radial deviation of wrist. (95% of confidence interval p≤0.05)

4. Discussion

The objective of this study was to compare hand grip strength in different wrist positions in right and left handed

tennis players usingtheJamar hand-helddynamometer. Non-parametric Mann-Whitney U test was used and the results show that there was no significant difference in hand grip strength in different wrist positions in right and left handed tennis player with 95% of confidence interval $p \leq 0.05$.

The human hand can be used to grip objects in several different positions. These different positions require different types of grip strength which are typically quantified based on the way the hand is being used[14]. Grip strength has been demonstrated to correlate strongly with many fitness and performance measures such as body composition, energy expenditure, aerobic power, lower limb strength, speed, flexibility, functional body movements and agility. All of these measures play an obvious role in sports performance, and indeed research had found correlations between grip strength and performance in a variety of sports including swimming and wrestling[15].The importance of grip strength in sports played with a racquet is amplified because of the involvement of the hand in controlling of the racquet[16].

The exertions performed in this study were isometric. Muscle lengths remained constant throughout the study and muscle lengthening velocities were zero. For tasks that involve wrist movements, changing muscle lengths and muscle shortening and lengthening significantly influences both grip and wrist strengths.

Current study did not attempt to assess grip endurance. It was possible that measuring grip endurance may have led to a different study outcome. With that said, Kramer and Knudson suggested that maximal grip force was fatigue resistant in their study sample of female and male college tennis players [17].

5. Conclusion

Grip strength of tennis players of various standards was significantly lower at all the wrist positions compared to neutral. Therefore, it is reasonable to suggest that at ball impact, being in ‘extreme’ wrist positions associates with higher vulnerability,wrist position should be close to neutral, the position allowing to produce the highest hand grip force, in order to minimize soft tissues overloading.This study suggested that there is no significant difference in hand grip strength in different wrist positions between right handed tennis players vs. left handed tennis players.

6. Future Scope

Comparision of hand gip strength in different types of strokes in tennis will futher help in understanding biomechanics of various strokes. Because only a limited number of healthy participants were tested, these results may not be directly extrapolated to a large population or persons who may have pain or discomfort with gripping. Nevertheless, this study provides useful guidelines for occupational therapists in assessing grip strength in clinical settings as well as implications of the wristpositions.

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