

Lateral Dominance Involving Hand Grip Strength among Soft Tennis Players, Swimmers, and General People

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Abstract Tennis players frequently use their dominant arm in training and games; hence, the difference between their left and right hand grip strength may be significant. This study aimed to examine lateral dominance in terms of hand grip strength among soft tennis players, swimmers, and general people. The subjects included 65 soft tennis players, 30 competitive swimmers, and 45 regular people, all of whom were male university students. The three groups did not show significant differences in mean age. The hand grip strength of their dominant and nondominant hands was measured twice. The results of the two-way analysis of variance (ANOVA) (groups × dominant/nondominant hands) showed a significant interaction. Multiple-comparison tests showed that soft tennis players have stronger dominant-hand grip than swimmers and regular people. In addition, the hand grip strength was higher in the dominant hand than in the nondominant hand in all groups. In addition, the one-way ANOVA showed a significantly larger hand grip strength ratio (dominant hand/nondominant hand) in soft tennis players than in swimmers and regular people. In conclusion, soft tennis players have stronger dominant-hand grip than swimmers and regular people as well as a higher marked lateral dominance.

Keywords: *soft tennis players, hand grip strength, dominant arm*

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1. Introduction

Functional laterality or lateral dominance exists in symmetrical body parts in humans [1,2,3,4,5]. Lateral dominance is specifically found in movements involving the upper arm or fingers, such as opening a drawer, using knife, or cutting. Lateral dominance is considered to occur depending on the preferential and more frequent use of a particular hand in daily activities. It was reported that the lateral dominance of the upper limb can be found through the beans-with-tweezers test [6] and in the maximal isometric extension and flexion strengths of hand joints [7]. Meanwhile, lateral dominance involving muscle thickness [8] and muscle strength [9] has also been studied in athletes.

Tennis players use their dominant hand frequently, and it is important for them to exhibit superior muscle strength and power in their dominant arm to perform a fast and strong service or stroke. Miura et al. [9] examined differences between the dominant and nondominant arms of tennis players, boat competitors, baseball players, and

general students, studying the muscle flexion and extension strengths of the elbow and the muscle cross section and bone density of the upper arms, and reported that the muscle flexion strength and muscle cross section of tennis players and general students are significantly greater in their dominant arm. Miura et al.'s report [9] suggested that lateral dominance involving muscular strength occurs depending on acquired factors. It is assumed that soft tennis players in training and games frequently use their dominant arm; hence, muscle strength in the dominant arm develops more than that in the nondominant one, and lateral dominance is more evident in soft tennis players than in the general population and nonunilateral players. The agility and muscle power of the whole body are equally important physical factors for tennis players and soft tennis players. Hence, their physical fitness attributes have been studied by many researchers [10,11,12,13]. Similarly, although the arm and hand's local muscle strength is important for soft tennis players, only a few studies focused on that characteristic.

This study aimed to examine lateral dominance involving the hand grip strength of soft tennis players and compare it to those of swimmers and the general population.

2. Methods

2.1. Subjects

The subjects were 65 soft tennis players (age 19.9 ± 1.0 years, height $174.5 \text{ cm} \pm 3.9 \text{ cm}$, weight $68.5 \pm 4.5 \text{ kg}$), 30 competitive swimmers (age 20.3 ± 1.4 years, height $171.4 \text{ cm} \pm 5.4 \text{ cm}$, weight $64.5 \pm 5.9 \text{ kg}$), and 45 regular people (age 20.2 ± 1.2 years, height $170.5 \text{ cm} \pm 4.8 \text{ cm}$, weight $62.1 \pm 4.5 \text{ kg}$). The subjects all were male university students. Differences in the mean age of the three groups were not significant. The height and weight of soft tennis players were significantly larger than those of swimmers and regular people. There was no significant difference in years of competition experience between soft tennis players (9.6 ± 0.9 years) and swimmers (10.5 ± 3.3 years). Handedness was determined based on Demura's handedness inquiry [14]. The study's protocol obtained approval from the Ethics Committee on Human Experimentation, Faculty of Human Science, Kanazawa University (approval number: 2012-02).

2.2. Measurement of Grip Strength

Maximal grip strength (MGS) was measured using the Smedley Type Hand Dynamometer (YAGAMI INC., ED-D100R), which can measure strength from 0 to 979 N (99.9 kg) with a $\pm 2\%$ accuracy. The subjects exerted MGS

with each hand, holding the arm straight down at the side of the trunk with an upright posture and looking straight ahead. They were instructed to do this after the tester's signal. MGS was measured twice in each hand with a two-minute rest time between trials. The higher values in each hand were used as representative values [15].

2.3. Statistical Analysis

Two-way repeated measures analysis of variance (ANOVA) was used to test mean differences among groups and dominant/nondominant hands for hand grip strength. One-way nonrepeated measures ANOVA was used to test mean differences among groups for grip strength ratio (dominant/nondominant $\times 100$). To show the significant main effect, Tukey's honest significant difference test was used for multiple comparisons. The level of significance was set at 0.05.

3. Results

Table 1 shows the results of the two-way ANOVA and multiple-comparison tests. The interaction effect was significant. Multiple-comparison tests showed that soft tennis players have stronger dominant-hand grip than swimmers and regular people. In addition, the hand grip strength was higher in the dominant hand than in the nondominant hand in all groups.

Table 1. The results of the two-way ANOVA and multiple-comparison tests for hand grip strength

	dominant hand		nondominant hand		F-value			Post-hoc
	Mean	SD	Mean	SD	F1	F2	F3	
soft tennis players	51.1	3.5	43.7	3.1	222.29*	2.60	16.83*	all groups : dominant hand > nondominant hand dominant hand : soft tennis players > competitive swimmers, regular people
competitive swimmers	48.3	9.4	45.5	6.2				
regular people	48.0	5.7	44.7	6.1				

F1: dominant/nondominant hands, F2 : among groups, F3: interaction, * $p < 0.05$, Unit : kg.

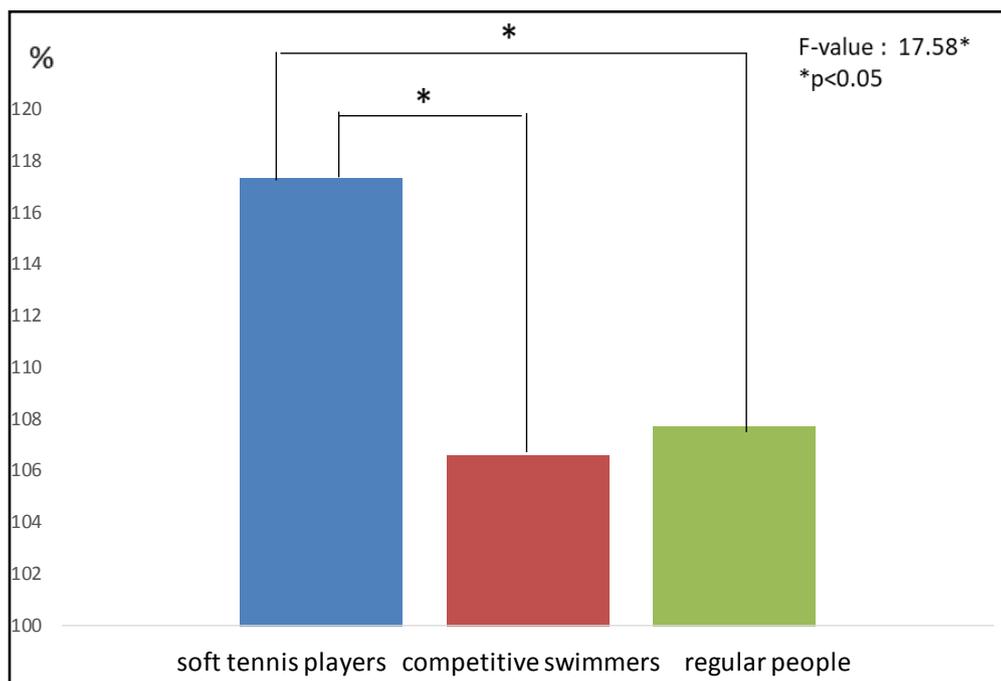


Figure 1. The results of the two-way ANOVA and multiple-comparison tests for grip strength ratio

Figure 1 shows the results of the one-way ANOVA and multiple-comparison tests for grip strength ratio. A significant mean difference was found, and multiple-comparison tests showed that soft tennis players have a higher grip ratio than swimmers and regular people.

4. Discussion

Soft tennis players have greater grip strength in their dominant hand compared to swimmers and regular people. According to Koya's report [15], the dominant-hand grip strength of tennis players is about 53.4 kg at the national representative level, 54.5 kg at the intercollegiate level, 53.7 kg at the Kanto students' league level, and 47.6 kg at other levels. The dominant-hand grip strength in soft tennis players in this study was 51.1 kg. Soft tennis players are considered to have more developed grip strength in their dominant hand than swimmers and regular people because they use it frequently in actions such as serving and smashing. There is a relation between body weight and muscle mass, and generally, persons who weigh more have greater muscle strength. Soft tennis players, in this study, weighed more than swimmers and regular people, but there was an insignificant difference in nondominant-hand grip strength among the three groups. Thus, the effect of weight on grip strength may be ignored. Dominant-hand grip strength was significantly larger than nondominant-hand grip strength in soft tennis players, swimmers, and regular people. Lateral dominance was confirmed in all groups. In daily life, the dominant hand is used more frequently to grasp things. Hence, the cross-sectional muscle area of the dominant arm is greater than that of the nondominant arm [9], and the dominant arm may be able to exert greater muscular force. However, the difference in grip strength between the right and left hands was greater among soft tennis players than among swimmers and regular people, indicating a more marked lateral dominance. Akima et al. [17] reported that strength training improves muscular strength and nerve function. In addition, it was reported that the hypertrophy rate of muscles due to weight training is more than 35% in fast-twitch fibers but less than 20% in slow-twitch fibers [18]. In any case, it is considered that soft tennis players have more developed grip strength in their dominant hand than swimmers and the general population, with the right/left difference of their hand grips being more marked as well. Hence, it will be necessary to examine lateral dominance involving hand grip strength in tennis players and baseball players who use an arm unilaterally and more frequently.

5. Conclusion

In conclusion, soft tennis players have higher dominant-hand grip strength as well as greater marked

lateral dominance than swimmers and the general population.

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