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Prevalence of the Palmaris Longus and its Impact on Grip Strength in Elite Gymnasts and Non-Athletes

Prevalencia del Músculo Palmar Largo y el Impacto en la Fuerza de Agarre en Gimnastas de Elite y No Atletas

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SUMMARY: In elite athletes, the palmaris longus (PL) presence has a potential contribution to hand strength, smaller reaction time, better shooting speed and power. The aim of this study was to investigate the prevalence of PL in elite competitive artistic gymnasts and its impact on grip strength compared to a control group of moderately active non-athletes. This prospective study included 370 subjects divided in two groups (170 elite artistic gymnasts and 200 moderately active non-athletes, students of medicine). The study consisted of two clinical sets of examination: a search for the clinical presence of PL was initially conducted followed by the assessment of maximal grip strength. Standard and six additional tests were performed to confirm PL tendon absence. Maximal grip strength was measured bilaterally with an electronic hand dynamometer. Bilateral absence was more common than unilateral, predominately noted on left side in both study groups. Unilateral PL absence was correlated to decreased grip strength in students, while the opposite was found in gymnasts. The mean value of grip strength in some age groups was higher on the side where the PL was absent. The results of our study show that the presence of the PL doesn`t affect the hand grip strength in gymnasts. Due to the low incidence of unilateral PL absence, further large-sampled research is warranted to assess PL contribution to hand grip strength and to other hand functions that could be of significant importance for athletes and non-athletes.

KEY WORDS: Palmaris longus muscle; Prevalence; Hand grip strength; Elite athletes; Gymnasts.

INTRODUCTION

Palmaris longus (PL) is one of the most variable muscles in the human body (Tubbs *et al*., 2016) and the most studied in clinical anatomy (Gangata, 2009; Kose *et al*., 2009; Eric *et al*., 2010; Kyung *et al*., 2012; Snell, 2012; Abdolahzadeh Lahiji *et al*., 2013; Raouf *et al*., 2013; Standring, 2016). The overall clinical absence of PL has been reported to be 20.25 % (Yammine, 2013), higher than the 15 % usually stated in standard textbooks (Saldana, 1996; Smith, 2002; Snell). The frequency of PL absence has been shown to present wide variations, mostly in relation to ethnicity (Yammine). The variation has been reported to range between 0.6 % in Korean population to 63.9 % in Turkish population (Ceyhan & Mavt, 1997; Ahn *et al*., 2000). The meta-analysis of Yammine showed no statistically differences of prevalence values between unilateral and bilateral presence, and between females and males. However and in discordance with the literature, PLA was statistically more predominant on the right side.

Besides being of high clinical practice where it is often used as a tendon graft for reconstructive hand surgery (Kleinert *et al*., 1991), its function as a flexor of the wrist has been usually defined as minor (Verdan & Poulenas, 1975; Sebastin *et al*., 2005; Karahan *et al*., 2017). Nevertheless, this statement has been challenged by many when PL contribution was assessed in professional sport players

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(Menevse, 2011; Fowlie *et al*., 2012; Koc, 2015). Though the potential contribution to hand strength was found to be not negligible, Fowlie *et al*. reported that bilateral and unilateral presence of PL in dominant hand was higher in elite athletes dealing with dominant-handed and two-handed cylindrical grip sports. Handball players with the presence of the PL muscle were found to have a better shooting speed and shooting power (Koc). Menevse noted a smaller reaction time in participants having PL compared to those lacking this muscle. Almost in all investigated age subgroups, Cetin *et al*. (2013) found higher grip strength in the case of PL presence but difference was not statistically significant. Maybe PL doesn`t impact the grip strength but according to previous study it is very likely that presence of this muscle has some other advantages in athletes (Menevse; Koc). In addition, few studies reported a significant contribution of the PL muscle in thumb abduction (Fahrer, 1973; Gangata *et al*., 2010; Moore *et al*., 2018) and opposition movement of the fingers (Cetin *et al*.).

Considering that PL muscle could have potential advantages in gymnasts, this study aims to investigate the prevalence of PL in elite competitive artistic gymnasts and its impact on grip strength compared to a control group of moderately active non-athletes.

MATERIAL AND METHOD

This is a prospective controlled study where 370 subjects were recruited and divided in two groups. The investigated group included 170 elite junior and senior artistic gymnasts who compete at the international level and their trainers who also were elite artistic gymnasts, while the control group included 200 moderately active non-athletes, students of medicine. The study consisted of two clinical sets of examination: a search for the clinical presence of PL was initially conducted followed by the assessment of maximal grip strength. This study involved subjects willing to participate who had a normal range of motion of hand joints and wrist. We excluded individuals with a disease or congenital abnormality, prior upper limb surgery or injury that could precludes examination for the presence of the PL tendon. The study was approved by the independent Ethics Committee.

Clinical tests for PL presence: A single examiner tested bilaterally all subjects. All participants were initially asked to perform the Standard (Schaeffer`s) test. If the PL tendon was not visualized or palpable, six additional tests were performed to confirm PL tendon absence.

The following tests were used: Standard (Schaeffer`s) test: the subject is asked to oppose the thumb to the little finger and flex the wrist (Schaeffer, 1909).

Thompson's test: the subject is asked to make a fist, then flex the wrist and finally the thumb is opposed and flexed over the fingers (Thompson *et al*., 1921).

Mishra's test I: the metacarpophalangeal joints of all fingers are passively hyperextended by the examiner and the subject is asked to actively flex the wrist (Mishra, 2001).

Mishra's test II: the subject is asked to abduct the thumb against resistance with the wrist in slight palmar flexion (Mishra).

Pushpakumar's "two-finger sign" method: the subject is asked to fully extend the index and middle finger, the wrist and other fingers are flexed, and finally the thumb is fully opposed and flexed (Pushpakumar *et al*., 2004).

Gangata`s test: application of manual isometric resistance against wrist flexion onto the palmar surface at the level of the heads of the second to fifth metacarpals and, simultaneously, manual isometric resistance is applied against thumb abduction onto the lateral surface (where the palmar skin of the hand meets the dorsal skin) of the first metacarpo-phalangeal joint (Gangata).

Hiz-Ediz test: This was performed by applying resistance to flexion of fingers and wrist while all fingers were at the opposite position with the wrist at slight flexion (Hiz *et al*., 2011).

Grip strength assessment: Maximal grip strength was measured bilaterally with an electronic hand dynamometer (CAMRY, model EH101, Zhongshan, China). The device allowed continuous monitoring and recording of the grip strength. Measured values were expressed in kilograms (kg) and divided in three categories (weak, normal, strong) according to the reference age-related intervals (http://latodis-med.com/upload/pdf/dinamometru-digital-camry-eh-101.pdf) recommended by the manufacturer of the applied dynamometer (CAMRY, model EH101) and grip strength norms according to Mathiowetz *et al*. (1986) for children aged 7 to 9 years. Measurements were performed in standardized positioning (Fess, 1992): sitting with the shoulder in adduction and neutral rotation, elbow flexed at 90 degrees, forearm in neutral position and wrist between 0 and 30 degrees of extension. After giving the needed instructions, the subject was asked to squeeze the handles of the dynamometer towards each other as hard as possible.

Statistical analyses. StatsDirect was used to perform the statistical analysis. Independent t-test and z-test were used to look for mean and proportion differences between the two studied groups. A paired t-test was used to look for

differences between the sides of same subjects. Multiple linear regression analyses were conducted to search for potential predicators of the grip strength outcome. The X2 test was used to determine if there is a significant relationship between hand grip categories.

RESULTS

Characteristics of the sample: The total sample of 370 subjects included 155 females and 215 males.

The gymnastic group included 170 athletes (55 females and 115 males) with a mean age of 19.9 ±12.42 years (range: 7 to 65). The mean training period was 9.6±6 years, ranging from 2 to 30 years. The demographic characteristics of the investigated group are shown in Table I. Fourteen (8.2 %) subjects had left hand dominance. All gymnasts but six performed mixed disciplines; 4 trained on the pommel horse, 1 on parallel bars and 1 on the balance beam.

The control group included 200 nonathletes (100 females and 100 males) with a mean age of 19.46±1.34 years (range: 18 to 25). Sixteen (8 %) subjects had left hand dominance.

PL in gymnasts

PL prevalence: The crude prevalence of PL was found to be 81.2 % (138 out of 170 subjects) and the true prevalence at 74.1 % (252 out of 340 forearms). The detailed results are shown in Tables II and III.

When analyzing the interaction between side and sex, PL prevalence values demonstrated that in males and females, a clinical absence on one side yielded frequencies of clinical absence on the other side in 56.4 % and 58.8 %, respectively.

Maximum grip strength: The mean maximum grip strengths on the right and left sides were found to be 35.3 ±16.11 and 34.4 ±16.0, respectively. The paired t-test yielded significant difference between both sides (p = 0.002) in favor of the right side.

The grip strength on right side was 3 % higher in right-handers and 0.2 % in left-handers. The in grip strength in gymnasts who had unilateral PL agenesis on right side was 9.6 % higher on right side while in gymnasts who had PL agenesis on left side the grip strength of the left hand was 4.6 % higher.

Table I. Demographic characteristics of the investigated group.

Country	Sample size	Mean age (years)	Males	Females	Training period (years)
Croatia	41	22.3 ± 13.4	31	10	10.8 ± 5.4
Serbia	48	20 ± 13.5	33	15	8.4 ± 5.8
Bulgaria	9	22.1 ± 10.6	9	0	10.1 ± 4.9
Slovenia	42	17.4 ± 10.3	13	29	8.8 ± 6.2
Denmark	6	21 ± 14.9	6	0	12 ± 10
France	4	19.2 ± 10.7	4	0	15 ± 8.3
Romania	15	18.1 ± 12.8	14	1	9.6 ± 6.9
South Africa	5	20.2 ± 12.5	5	0	10.4 ± 7.2
Total	170	19.9 ± 12.42	115	55	9.6 ± 6

Table II. PL prevalence of the investigated group.

Country	Crude prevalence of PL	Bilateral prevalence of PL	Bilateral absence of PL	True prevalence of PL	Right absence	Left absence
Croatia	34 (82.9 %)	31 (75.6 %)	7 (17 %)	65 (79.3 %)	0 (0 %)	3 (7.3 %)
Serbia	37 (77.1 %)	29 (60.4 %)	11 (22.9 %)	66 (68.8 %)	2 (4.2 %)	6 (12.5 %)
Bulgaria	6 (66.7) %	3 (33.3 %)	3 (33.3 %)	9 (50 %)	2 (22.2 %)	1 (11.1 %)
Slovenia	36 (85.7 %)	30 (71.4 %)	6 (14.3 %)	66 (78.6 %)	3 (7.1 %)	3 (7.1 %)
Denmark	6 (100 %)	5 (83.3 %)	0 (0 %)	11 (91.7 %)	1 (16.7 %)	0 (0 %)
France	2 (50 %)	2 (50 %)	2 (50 %)	4 (50 %)	0 (0 %)	0 (0 %)
Romania	13 (86.7 %)	10 (66.7 %)	2 (13.3 %)	23 (76.7 %)	2 (13.3 %)	1 (6.7 %)
South Africa	4 (80 %)	4 (80 %)	1 (20 %)	8 (80 %)	0 (0 %)	0 (0 %)
Total	138 (81.2 %)	114 (67.1 %)	32 (18.8 %)	252 (74.1 %)	10 (5.9 %)	14 (8.2 %)

Table III. PL presence in the investigated and control group.

PL	Investigated group (gymnasts)			Control group (students)		
	males	females	total	males	females	total
Bilateral presence	76 (66.1 %)	38 (69.1 %)	114 (67.1 %)	63 (63 %)	69 (69 %)	132 (66 %)
Bilateral absence	22 (19.1 %)	10 (18.2 %)	32 (18.8 %)	24 (24 %)	12 (12 %)	36 (18 %)
Right absence	8 (7 %)	2 (3.6 %)	10 (5.9 %)	3 (3 %)	8 (8 %)	11 (5.5 %)
Left absence	9 (7.8 %)	5 (9.1 %)	14 (8.2 %)	10 (10 %)	11 (11 %)	21 (10.5 %)
Total	115	55	170	100	100	200

Table IV. The age related measured mean values of grip strength and PL presence in gymnasts.

Sex	Age (years)	No of subjects	hand	PL	No of hands	Mean grip strength	p
Males (115)	7-9	10	Right	Present	9	17.4±2.7	0.8820
				Absent	1	17.7±0	
			Left	Present	8	15.5±2.7	0.2120
				Absent	2	18.4±3.4	
	10-11	18	Right	Present	17	21.8±4.2	0.8636
				Absent	1	22.3±0	
			Left	Present	16	21.3±4.1	0.7398
				Absent	2	20.3±1.5	
	12-13	12	Right	Present	10	26.1±5.2	0.9609
				Absent	2	25.9±6.9	
			Left	Present	11	23.7±4.6	0.1266
				Absent	1	29.4±0	
	14-15	14	Right	Present	11	34.2±12.7	0.4556
				Absent	3	40.6±12.2	
			Left	Present	9	31.7±10.0	0.1373
				Absent	5	42.5±15.6	
	16-17	12	Right	Present	6	46.6±7.0	0.3195
				Absent	6	52.5±12.0	
			Left	Present	7	48.3±8.5	0.4794
				Absent	5	53.9±17.6	
	20-24	6	Right	Present	4	46.2±6.9	0.9430
				Absent	2	45.8±6.6	
			Left	Present	4	48.3±11.1	0.8607
				Absent	2	46.7±6.9	
	25-29	9	Right	Present	5	53.2±2.0	0.0182
				Absent	4	59.4±4.0	
			Left	Present	4	45.1±6.2	0.0294
				Absent	5	56.5±6.2	
	30-34	10	Right	Present	7	56.0±14.8	0.5570
				Absent	3	62.2±14.9	
			Left	Present	8	56.6±12.8	0.9323
				Absent	2	55.7±11.0	
	35-39	11	Right	Present	6	53.4±8.4	0.3856
				Absent	5	57.4±5.8	
			Left	Present	8	50.0±8.4	0.4896
				Absent	3	54.3±10.5	
	40-44	7	Right	Present	5	52.9±5.1	0.9850
				Absent	2	53.0±12.7	
			Left	Present	5	50.5±6.0	0.3195
				Absent	2	56.2±6.6	
	45-65	6	Right	Present	5	52.0±7.4	0.3924
				Absent	1	57.2±0	
			Left	Present	4	53.7±4.2	0.5142
				Absent	2	50.9±5.4	

Sex	Age (years)	No of subjects	hand	PL	No of hands	Mean grip	p
Females (55)	10-11	25	Right	Present	20	19.5± 4.2	0.1303
				Absent	5	16.2± 4.1	
			Left	Present	21	18.6± 3.8	0.1750
				Absent	4	15.7± 3.4	
	12-13	16	Right	Present	13	27.5± 6.5	0.8161
				Absent	3	26.6± 0.8	
			Left	Present	11	26.4± 6.0	0.8786
				Absent	5	26.9± 1.8	
	18-19	5	Right	Present	3	34.2± 7.5	0.5680
				Absent	2	30.7± 0.6	
			Left	Present	2	37.2± 9.3	0.3853
				Absent	3	32.2± 0.5	
	20-24	4	Right	Present	4	33.6± 4.7	/
				Absent	0	0	
			Left	Present	4	33.9± 5.1	/
				Absent	0	0	
	35-65	5	Right	Present	3	35.3± 5.8	0.6493
				Absent	2	32.8± 5.3	
			Left	Present	2	33.1± 4.3	0.8504
				Absent	3	34.0± 5.2	

The age related measured mean values of grip strength and PL presence in gymnasts are shown in Table IV.

Multivariate analysis: Setting the grip strength as the outcome, multiple linear regression analyses with sex and PL presence on the right side as predicators, yielded significant positive correlation for male sex ($P < 0.0001$) and significant negative correlation with PL presence ($P = 0.0006$). The model had a $R^2 = 24.83$ % ($P < 0.0001$). Similar results were found on the left side with a $R^2 = 23.04$ % ($P < 0.0001$).

PL in students

PL prevalence: The crude prevalence of PL was found to be 82.0 % (164 out of 200 subjects) and the true prevalence at 74.0 % (296 out of 400 forearms). The detailed results are shown in Table III.

When analyzing the interaction between side and sex, PL prevalence values demonstrated that in males and females, a clinical absence on one side yielded the same on the other side in 64.9 % and 38.7 %, respectively.

Maximum grip strength: The mean maximum grip strengths on the right and left side were found to be 40.77 ±11.6 and 38.4 ±10.9, respectively. One way analysis of variance yielded significance in favor of the right side ($P = 0.038$).

Table V. The age related measured mean values of grip strength and PL presence in students.

Sex	Age (years)	No of subjects	hand	PL	No of hands	Mean grip strength	p
Males	18-19	69	Right	Present	50	49.9±7.6	0.6267
				Absent	19	48.8±8.1	
			Left	Present	47	45.4±7.6	0.1132
				Absent	22	48.7±8.2	
	20-24	31	Right	Present	23	51.2±7.3	0.1263
				Absent	8	56.1±8.5	
			Left	Present	19	50.1±6.5	0.5259
				Absent	12	48.4±7.9	
Females	18-19	72	Right	Present	65	31.3±4.5	0.4622
				Absent	17	30.4±4.5	
			Left	Present	64	29.8±4.6	0.1879
				Absent	18	28.3±3.6	
	20-24	18	Right	Present	15	30.9±4.6	0.8750
				Absent	3	31.3±3.3	
			Left	Present	13	29.5±4.0	0.8537
				Absent	5	29.1±4.1	

The grip strength on right side was 6.5 % higher in right-handers and 1.8 % in left-handers. The grip strength in students who had right-sided unilateral PL agenesis was 1.9 % higher on right side while in students who had PL agenesis on left side the grip strength of the right hand was 4.8 % higher.

The age related measured mean values of grip strength and PL presence in students are shown in Table V.

Multivariate analysis: Setting the grip strength as the outcome, multiple linear regression analyses with sex and PL presence on the right side as predicators, yielded significant positive correlation for male sex ($P < 0.0001$) and non-significant negative correlation with PL presence ($P = 0.9$). The model had a $R^2 = 70.14$ % ($P < 0.0001$). Similar results were found on the left side with a $R^2 = 67.6$ % ($P < 0.0001$).

Comparison of grip strength categories of both groups: The grip strength on the right side in males was stronger in investigated group (34.8 % vs. 21.0 %) and this difference was statistically significant ($X^2=5.00$, $p=0.03$) while no significance was found in females (40.0 % vs. 40.0 %) where the p value was 1. The grip strength on the left side was stronger in investigated group, in males (29.6 % vs. 12.0 %) yielded significant difference ($X^2=9.81$, $p=0.001$) but in females (43.6 % vs. 32.0 %) difference was not statistically significant p=0.2 (Table VI).

Table VI. Grip strength category and PL prevalence in the investigated (gymnasts) and control (students) group

	Right hand			Left hand		
Males (investigated group)						
Grip strength	N	PL present	PL absent	N	PL present	PL absent
Strong	40 (34.8 %)	26 (30.6 %)	14 (46.7 %)	34 (29.6 %)	22 (26.2 %)	12 (38.7 %)
Normal	72 (62.6 %)	56 (65.9 %)	16 (53.3 %)	76 (66.1 %)	57 (67.9 %)	19 (61.3 %)
Weak	3 (2.6 %)	3 (3.5 %)	-	5 (4.3 %)	5 (5.9 %)	-
Total	115 (100 %)	85 (100 %)	30 (100 %)	115 (100 %)	84 (100 %)	31 (100 %)
Females (investigated group)						
Grip strength	N	PL present	PL absent	N	PL present	PL absent
Strong	22 (40.0 %)	16 (37.2 %)	6 (50.0 %)	24 (43.6 %)	14 (35.0 %)	10 (66.7 %)
Normal	33 (60.0 %)	27 (62.8 %)	6 (50.0 %)	31 (56.4 %)	26 (65.0 %)	5 (33.3 %)
Weak	-	-	-	-	-	-
Total	55 (100 %)	43 (100 %)	12 (100 %)	55 (100 %)	40 (100 %)	15 (100 %)
Males (control group)						
Grip strength	N	PL present	PL absent	N	PL present	PL absent
Strong	21 (21.0 %)	16 (21.9 %)	5 (18.5 %)	12 (12.0 %)	6 (9.1 %)	6 (17.6 %)
Normal	77 (77.0 %)	56 (76.7 %)	21 (77.8 %)	84 (84.0 %)	57 (86.4 %)	27 (79.4 %)
Weak	2 (2.0 %)	1 (1.4 %)	1 (3.7 %)	4 (4.0 %)	3 (4.5 %)	1 (2.9 %)
Total	100 (100 %)	73 (100 %)	27 (100 %)	100 (100 %)	66 (100 %)	34 (100 %)
Females (control group)						
Grip strength	N	PL present	PL absent	N	PL present	PL absent
Strong	40 (40.0 %)	34 (42.5 %)	6 (30.0 %)	32 (32.0 %)	28 (36.4 %)	4 (17.4 %)
Normal	59 (59.0 %)	45 (56.3 %)	14 (70.0 %)	67 (67.0 %)	48 (62.3 %)	19 (82.6 %)
Weak	1 (1.0 %)	1 (1.2 %)	-	1 (1.0 %)	1 (1.3 %)	-
Total	100 (100 %)	80 (100 %)	20 (100 %)	100 (100 %)	77 (100 %)	23 (100 %)

DISCUSSION

According to the results of our study overall PL absence in gymnasts and students was 33.9 % and 37 %, respectively. Bilateral absence was more common than unilateral, predominately noted on left side in both study groups. There

are a numerous scientific papers that described similar findings (Ceyhan & Mavt; Kose *et al*., 2009; Eric´ *et al*., 2011), however, the meta-analysis of Yammine showed no statistically differences between unilateral and bilateral absence with predominance of PL absence on the right side.

In the last decades, the functional value of this muscle increasingly intrigues investigators. There are divided opinions about PL functional importance and reparation after its injury. Verdan & Poulenas advocated the opinion that PL has small importance and because of that its reparation is not necessary, but authors of the later studies usually advocated its reparation (Brand & Hollister, 1993; Sarangapani & Brown, 1977; Sebastin *et al*.). Their attitude was defended by the facts that PL protects the median nerve, its function will be restored and its preservation gives possibility to use it as a tendon graft or tendon transfer (Sarangapani & Brown; Brand & Hollister; Sebastin *et al*.). However, some authors noted significant positive correlation between PL presence and Dupuytren's contracture (Powell *et al*., 1986) as well as carpal tunnel syndrome (Keese *et al*., 2006).

Searching the literature, the authors of this paper noticed that there is no studies to date that have investigated whether the PL presence contributes to grip strength in gymnasts. Our results show that the mean maximum grip strength was higher in students but it was expected considering the age range of gymnasts involved in the study (7 to 65 years). Even 109 (64.1 %) gymnasts were younger than the age of 18 while the age range of students was between 18 and 25. However, according to the age-related norm values of the hand grip strength, 35.3 % of investigated gymnasts had strong grip strength in comparison with 26.3 % of students. Around 1/3 of male and more than 2/5 of female gymnasts had strong grip strength. Students had normal grip strength more frequently (71.8 %) in comparison with gymnasts (62.4 %). That was expected with regard to the level of gymnasts training.

Until now, only a few studies investigated contribution of the PL muscle to the grip strength (Sebastin *et al*.; Gangata *et al*.; Koc & Aycan, 2011; Kose *et al*., 2012; Fowlie *et al*.; Cetin *et al*.; Barkáts, 2014; Vercruyssen *et al*., 2016). The results of our study, in line with many others (Sebastin *et al*.; Kose *et al*., 2009; Gangata *et al*.; Cetin *et al*.; Vercruyssen *et al*.), show that the grip strength was not correlated with PL presence. Reason for that could be a contribution of the PL muscle in thumb abduction (Fahrer; Gangata *et al*.; Moore *et al*.) while position of the grip involves thumb adduction. Three studies demonstrated that the presence of the PL muscle may positively affect the grip strength (Koc & Aycan; Fowlie *et al*.; Barkáts).

Generally, it is accepted that the grip strength of the dominant hand in right-handed subjects is 10 % stronger than the nondominant left hand while in left-handed subjects the difference ranges from 0 to 5 % (Petersen *et al*., 1989) in favor of the nondominant right hand. Some previous studies confirmed that this rule is not always true (Barkáts). According to the results of our study, the difference between right and left hand grip strength in right-handed subjects ranged from 3 % (gymnasts) to 6.5 % (students) while in left-handed ranged from 0.2 % (gymnasts) to 1.8 % (students). A smaller difference between dominant and non-dominant hand grip strength in gymnasts can be explained by the level of gymnasts training and the equal usage of both hands.

Taking in account that it is very difficult to quantify the functional contribution of the PL muscle separately from the other muscles of the anterior forearm compartment we additionally analyzed hand grip strength in those subjects who had unilateral absence of the PL muscle. In gymnasts, the difference of right and left hand grip strength was in favor to the side where the PL was absent (9.6 % right and 4.5 % left). In all students with unilateral PL absence, the difference of grip strength was in favor to the right side (right absence 1.9 %; left absence 4.8 %). Accordingly, we noticed that in students the grip strength slightly decreases in case of PL absence while the values in gymnasts are contrary; nevertheless, our findings suggest that the PL presence doesn`t impact the grip strength where the mean value of grip strength in some age groups was higher on the side where the PL was absent. In relation to grip strength's correlation with PL, the study has some limitations; the small sample size of subjects with unilateral PL absence (24 gymnasts and 32 students), the wide variation of the age range of gymnasts and the presence of different ethnic groups (from European countries and South Africa).

Ideally, the best scenario to study the PL impact on grip strength would be on subjects with a present PL which is to be removed for a reconstructive non-hand surgery, taking pre and post-operative grip strength measurements. The congenital absence of PL may not necessarily be the same as loss of this muscle during the life because of its injury or surgery.

As a conclusion, the results of our study show that the presence of the PL doesn`t affect the hand grip strength in gymnasts. Concerning the small number of gymnasts especially those with unilateral PL presence we couldn`t be sure are the present results a product of accidental coincidence. Therefore, further research is warranted to assess PL contribution to hand grip strength and to other hand functions that could be of significant importance for athletes and non-athletes.

ERIC, M.; YAMMINE, K.; VASIC, G.; DEJANOVIC, M. & KARABA JAKOVLJEVIC, D. Prevalencia del músculo palmar largo y su impacto en la fuerza de agarre en gimnastas de elite y no atletas. *Int. J. Morphol., 37(4)*:1361-1369, 2019.

RESUMEN: La presencia del músculo palmar largo (MPL) en atletas de élite tiene el potencial de aportar mayor fuerza a la mano, un tiempo de reacción menor, mejor velocidad de tiro y potencia. El objetivo de este estudio fue investigar la prevalencia de MPL en las gimnastas artísticas competitivas de élite y su impacto en la fuerza de agarre en comparación con un grupo control de no atletas moderadamente activos. El estudio incluyó 370 sujetos divididos en dos grupos (170 gimnastas artísticas de élite y 200 no atletas moderadamente activos, estudiantes de medicina). El estudio consistió en dos series clínicas de examen: inicialmente se realizó una búsqueda de la presencia clínica de MPL, seguido de la evaluación de la fuerza máxima de agarre. Se realizaron pruebas estándar y seis pruebas adicionales para confirmar la ausencia del tendón del MPL. La máxima fuerza de agarre se midió bilateralmente con un dinamómetro de mano electrónico. La ausencia bilateral fue más común que unilateral, predominantemente observada en el lado izquierdo en ambos grupos de estudio. La ausencia unilateral de MPL se correlacionó con una menor fuerza de agarre en los estudiantes, mientras que en gimnastas se encontró lo contrario. El valor medio de la fuerza de agarre en algunos grupos de edad fue mayor en el lado donde el MPL estaba ausente. Los resultados de nuestro estudio muestran que la presencia de MPL no afecta la fuerza de agarre de la mano en gimnastas. Debido a la baja incidencia de ausencia unilateral de MPL, se justifica una investigación adicional de gran tamaño para evaluar la contribución de MPL a la fuerza de agarre de la mano y otras funciones de la mano que podrían ser de gran importancia para los atletas y no atletas.

PALABRAS CLAVE: Músculo palmar largo; Prevalencia; Fuerza de agarre de la mano; Atletas de elite; Gimnastas.

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