

ASSESSMENT OF SHOULDER JOINT STRENGTH DISPROPORTION OF MASTERS SWIMMERS

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Abstract The aim of this study was to find out whether Masters class swimming affects strength disproportion and if there is a correlation between the length of sport swimming training in Masters swimmer's past (SST) and strength parameter's deficits? Eighteen Masters category swimmers affiliated in Szczecin Masters Team (178.3 ± 2.28 m; 77.9 ± 2.86 kg) participated in the study. Isokinetic strength measurement was made on Biodex S4 dynamometer. Subjects performed shoulder flexion/extension moves: 3 repetitions – 60 deg/sec and 20 repetitions – 180 deg/sec. Following values were used: peak torque (PT), maximal repetition work (MRW), coefficient of variation (COV), total work (TW), average power (AP), agonist to antagonist ratio (AG:AN). None of the investigated variables were statistically significant in side to side comparison. All of the parameters were higher in extension. Also, no statistically significant difference between sides in AG:AN. Moderate positive correlation was found between SST and PT deficit in extension movement (0.420). Also low positive correlation between SST and PT deficit in flexion (0.396), and MRW deficit in extension (0.352). Masters class swimming did not affect side strength disproportion or agonist to antagonist differences. However, it is possible that swimming training in other categories does.

Key words shoulder joint, strength, Masters swimmers, Biodex

Introduction

The number of masters athletes is increasing. They spend more time working out, playing sport and have better health than other people (Rittwager, di Prampero, Maffulli, Narici, 2009). Masters athletes are active, full of power and vital forces. They want to live a healthy, fulfilled life (Dionigi, 2006). The effects of regular Masters trainings provide that the older athletes perform much better than younger people that lead sedentary lives (Ransdell, Vener, Huberty, 2009). Researchers Young and Medic (2011) were also examining social influences on the sport commitment of Masters swimmers. Hodge, Allen, Smellie (2008) studied the relationships amongst achievement goals, social goals and motivational correlates in Masters sport. Others Petrescu, Pițigoi, Păunescu (2014) are highlighting the role and influence of Masters swimming on mental condition.

However, the question arises whether Masters sport swimming is certainly good for older athletes strength and health? Abrahin's et al. (2016) results showed that swimming has no positive influence on bone mineral density. Baniyas and Rasadean (2011) highlighted the reduction of swimming speed in relation to age, in freestyle men events. Muscle area decreases by 40% in the ages section between 20 and 80 years. Decreased power, lower force production and less efficient agonist-antagonist muscle group coordination is observed (Lemmer et al., 2003). Nevertheless the strength abilities are very important element that has an impact on the final swimming result (Crowe, Babington, Tanner, Stager, 1999; Dopsaj, Matković, Thanopoulos, Okičić, 2004; Kjendlie, Thorsvald, 2006; Morouco et al., 2011). Numerous repeats can cause an imbalance in muscle strength of the shoulder girdle (Bak, 1996). Batalha, Marmeleira, Garrido, Silva (2014), Batalha, Raimundo, Tomas-Carus, Barbosa, Silva (2013), Ramsi, Swanik, Swanik, Straub, Mattacola (2004) and Walker, Gabbe, Wajswelner, Blanch, Bennell (2012) indicate that swimming technique can cause a lack of balance in shoulder muscle strength. Olivier, Quintin, Rogez (2008) formulated a conclusion that sport swimming at the highest level weakens the shoulder joint and interferes muscle balance. Havriluk (2009) identified three factors limiting the effectiveness of swimming: the differences between the right and left shoulder, loss of strength and unnecessary movements. These factors may affect all swimmers.

The main aim of this study was to find out whether Masters class swimming affects side strength disproportion or agonist to antagonist differences?

The purpose was to find statistically significant differences in: peak torque, work done in maximal repetition, repeatability of movements, total work done and average power between the right and the left arm in flexion and extension in Masters swimmers. Furthermore it was to find out significant differences in agonist to antagonist strength ratios of their right and left shoulder and a correlation between the length of sport swimming training in Masters swimmer's past and strength parameter's deficits.

Methods

Eighteen subjects (178.3 ± 2.28 m; 77.9 ± 2.86 kg) participated in the study. They were all Masters category swimmers affiliated in Szczecin Masters Team. Participants gave written consent to the test. Bioethics Committee at the Regional Medical Chamber in Szczecin has expressed a positive opinion about the research project in the following range (resolution No. 15/KB/VI/2013 dated 10.12.2013). At first, subjects performed 5-minute warm up on the cross trainer device, then 5-minute warm up focused on the shoulder joint. The isokinetic strength measurement was made on the Biodex S4 dynamometer (Biodex Corp., Shirley, NY, USA). During the test, subjects done 3 shoulder flexion/extension repetitions with the 60 deg/sec angular speed (protocol 1). After 2-minute break they performed 20 shoulder flexion/extension repetitions with the 180 deg/sec angular speed (protocol 2). There was a 4-minute rest between right and left limb measurement. Preparation part and the measurement were made in accordance with instructions (Biodex Medical Systems, Inc. *Biodex Multi-Joint System – Pro. Setup/Operation Manual*).

The following values were used: peak torque (PT), maximal repetition work (MRW) from protocol 1 and coefficient of variation (COV), total work (TW), average power (AP), agonist to antagonist ratio (AG:AN) from protocol 2 (for both – flexion and extension).

For statistical data analyzing a Statistica 12.5 and descriptive statistics tools were used. To check whether samples came from a normally distributed population, researchers used a Shapiro-Wilk test. If the result of Shapiro-Wilk's test was significant (significance level 0.05) in at least one of the two compared variables, a nonparametric

Mann-Whitney U test was used. Otherwise a t-Test: two-sample assuming equal variances data analysis tool (significance level 0.05) was used. Pearson correlation coefficients were computed between the length of sport swimming training (SST) in the subjects' past and PT, MRW, TW and AP side deficits.

Results

Only one parameter difference – COV, was close to statistically significant. PT and COV were higher in right shoulder in both moves. MRW, TW and AP were higher in the left arm in both directions. But none of the investigated variables were statistically significant in side to side comparison. All of the parameters were higher in extension moves (Table 1). Left shoulder had higher agonist to antagonist strength ratio, but also there was no statistically significant difference between sides (Table 2).

Table 1. Differences in right and left shoulder joint strength in Masters swimmers

Variable	Flexion		Extension		
	Average ± SD	P	Average ± SD	P	
PT (Nm)	right shoulder	56.39 ±4.18	0.9152	65.25 ±5.80	0.8615
	left shoulder	55.77 ±4.02		63.85 ±5.45	
MRW (J)	right shoulder	154.88 ±11.85	0.9502	174.68 ±16.04	0.9248
	left shoulder	155.88 ±10.59		176.72 ±14.23	
COV (%)	right shoulder*	15.76 ±2.02	0.0556	20.92 ±3.31	0.5166
	left shoulder*	10.97 ±0.91		16.39 ±2.23	
TW (J)	right shoulder	1,663.82 ±150.63	0.8955	1,803.26 ±261.71	0.7036
	left shoulder	1,691.79 ±148.22		1,934.58 ±220.59	
AP (W)	right shoulder	53.04 ±5.55	0.7205	59.17 ±9.33	0.6962
	left shoulder	55.86 ±5.49		64.06 ±8.19	

* A nonparametric Mann-Whitney U test was used.

Table 2. Differences of agonist to antagonist strength ratio in Masters swimmers shoulder joint

Variable	Average ± SD	P	
AG:AN (%)	right shoulder*	87.92 ±16.52	0.937
	left shoulder*	89.21 ±18.48	

* A nonparametric Mann-Whitney U test was used.

The length of sport swimming training (SST) in the subjects' past was compared with PT, MRW, TW and AP side deficits. Moderate positive correlation was found between SST and PT deficit in extension movement (0.420). Low positive correlation was found between SST and PT deficit in flexion (0.396), also MRW deficit in extension (0.352) (Table 3).

Table 3. Correlations between length of sport swimming training (SST) in the subjects' past and measured variables deficits

Variables	Flexion				Extension			
	PT def.	MRW def.	TW def.	AP def.	PT def.	MRW def.	TW def.	AP def.
SST	0.396	0.008	-0.164	-0.146	0.420	0.352	0.057	0.097

Discussion

There are no statistically significant differences in: peak torque, work done in maximal repetition, total work done and average power between the right and the left arm in flexion and extension in Masters swimmers. Also, no difference in dominant and non-dominant shoulder motor function was seen in either the younger or older untrained men in Gallagher, Zuckerman, Cuomo, Ortiz (1996) research. Subjects in this studies had higher PT scores than untrained persons results: extension 53.9 Nm and flexion 43.5 Nm (Ivey, 1985). Study was carried out on Cybex. As well as PT was higher than average presented by Mayer (2001) 48 Nm in flexion, 62 Nm in extension, both measured in 60 deg/sec.

All isokinetic variables were higher in the extension movements, for both sides. This is consistent with the Alonso-Cortés Fradejas et al. (2006) results. Also Ivey (1985) results indicates that in untrained persons shoulder strength extension results were higher than in flexion in 60 deg/s test. In individual analysis of subjects results, there were notable differences and large variables deficits. Masters athletes should accept that they will not achieve the same level as they did when they were younger. Aging will cause changes in the body as well as in their ability to compete. Weight training prevention program should be applied to avoid the lean body mass loss and strength decline (Ransdell et al., 2009). According to Alonso-Cortés Fradejas et al. (2006) sport swimming participants should seek for a harmonious development of both sides of the body.

The repeatability of movements – coefficient of variances was high, but also no statistically significant difference was noticed between the right and left shoulder. Acceptable COV is less than or equal to 15% (Isokinetic testing and data interpretation) as in the extension in subjects results. COV of shoulder flexion was just above this limit. Ransdell et al. (2009) indicates that the quantity of training can't be more important than its quality.

The agonist to antagonist strength ratios of Masters swimmers are higher than suggested by Biodex – 83% (Isokinetic testing and data interpretation), but there is no significant difference between right and left shoulder. The AG:AN ratio is important information in pathological states, and its normalization must be the main goal of rehabilitation (Codine, Bernard, Pocholle, Herisson, 2005). Misalignment of AG:AN ratio can lead to injuries (Isokinetic testing and data interpretation). Many authors (Batalha et al., 2014; Batalha et al., 2013; Ramsi et al., 2004; Walker et al., 2012; Wiażewicz, 2015) postulates enforcement of compensatory programs, because of the agonist to antagonist ratio disorder.

There were moderate and low positive correlations between length of sport swimming training in the subjects' past and measured variables deficits. Although swimming is symmetrical sports, long-term and intensive water training, causes asymmetry targeted to the stronger arm (Olivier et al., 2008). The results of Batalha et al. (2014) also suggests that swimming training macrocycles lead to an increase of the shoulder rotator muscles imbalance in younger swimmers.

Conclusion

Masters class swimming did not affect side strength disproportion or agonist to antagonist differences. However, it is possible that swimming training in other categories does. It should be considered to perform a similar study with sport swimmers from other categories with high training experience.

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Cite this article as: Wiażewicz, A., Eider, J. (2016). Assessment of Shoulder Joint Strength Disproportion of Masters Swimmers. *Central European Journal of Sport Sciences and Medicine*, 16 (4), 85–90. DOI: 10.18276/cej.2016.4-09.