RELEVANCE OF EARLY STRETCHING IN OVERHEAD ATHLETES

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Overhead athletes often develop, over time, a tightness of the posterior structures of the shoulder, which may be associated with injuries. Ten symptomatic (with pain) and ten asymptomatic players with a tight shoulder were compared and the effect of a self-applied stretching program was evaluated. Before and after the stretching program, pain and stiffness of the shoulder were evaluated. Our results demonstrate that risk factors for shoulder pain such as glenohumeral internal rotation deficit and total range of motion deficit may only be limited in symptomatic athletes. The mobility of the shoulder was significantly improved after the stretching program for both groups. Pain was reduced when present. Because of the limited differences between the symptomatic and asymptomatic athletes, clinicians may find it advantageous to initiate early prevention or rehabilitation programs.

KEY WORDS: pain, prevention, shoulder.

INTRODUCTION: Athletes involved in regular and intensive overhead activities training usually develop specific adaptations at their throwing arm. The glenohumeral external rotation range increases whereas the glenohumeral internal rotation range decreases. The glenohumeral internal rotation deficit (GIRD) has been related to a tightness of the posterior structures of the shoulder (capsule, rotator cuff) as well as osseous modeling of the immature skeleton. Athletes with GIRD or a total arc of motion deficit (TAMD) are more likely to be injured (Wilk et al., 2011). GIRD, among others causes including faulty posture, muscle imbalances or altered kinematics, favors the appearance of sub-acromial impingement syndrome (SAIS) (Michener, McClure, & Karduna, 2003). SAIS can then lead to the degeneration of tendons of the posterior rotator cuff muscles, Superior Labrum from Anterior to Posterior lesions and pain.
Pro-active medical care can, in general, reduce the gravity of an injury or, if identified soon enough, even prevent it. Prevention programs focusing on players with a tight shoulder who are still able to play should consequently be developed. Physical therapy based on stretching has been shown to be an effective approach to reduce the pain of the symptomatic shoulder as well as to restore its mobility (Cools, Johansson, Cagnie, Cambier, & Witvrouw, 2012; Tyler, Nicholas, Lee, Mullaney, & McHugh, 2010). Asymptomatic subjects also seem to benefit from a stretching programs (Maenhout, Van Eessel, Van Dyck, Vanraes, & Cools, 2012).
This study focused on athletes who are still able to practice their sport even if they report some pain. The two main aims were 1/ to compare mobility risk factors of asymptomatic and symptomatic players with a tight shoulder and 2/ to evaluate the effects of self-applied stretching to this population of active players.

METHODS: Twenty male overhead athletes playing either handball or volleyball were recruited. To be eligible, participants had to be aged between 18 and 30 years old and had practiced, per week, more than 6 hours during the 5 years preceding the study. None of the participants had a past of surgery on their dominant (throwing) side. Furthermore, the participants should present, on their dominant side, a glenohumeral internal rotation deficit (GIRD) and a horizontal adduction deficit. These variables were estimated using both the sleeper stretch (Forthomme, Wieczorek, Frisch, Crielaard, & Croisier, 2013) and the cross body arm (Myers et al., 2007) tests. A participant was considered as stiff when its results were in the extreme 10% values of a healthy, non-athlete population tested in our laboratory using the same protocol. The thresholds of both tests are: superior to 19 cm for the sleeper stretch and inferior to 28° for the cross body arm. The sleeper stretch and cross body arm

evaluations were performed using a measuring tape and a goniometer respectively. The volunteers were divided into 2 groups. The volunteers of the first group (asymptomatic group – 22.0 ± 4.2 years, 1.85 ± 0.09 m, 76.2 ± 10.9 kg) did not suffer any pain at their dominant shoulder whereas the others (symptomatic group – 24.8 ± 4.0 years, 1.84 ± 0.05 m, 78.9 ± 7.1 kg) reported, at the beginning of the study, a painful dominant shoulder during training and competition (a score of at least 3 on a Visual Analog Scale of 10 was required). The pain should however not prevent them from practicing their sport. The participants performed daily two different stretching exercises on their dominant side for 4 weeks (5 repetitions of 30 seconds with 30 seconds pause between each): the sleeper stretch and the cross body arm.
All the evaluations were performed twice by the same experimenter: once before the stretching program and once after. Pain during physical activity (training and competition) was reported using a Visual Analog Scale (VAS) ranging from 0 (no pain) to 10 (severe pain). The stiffness of the shoulder was measured using the sleeper stretch and the cross body arm tests. The stiffness of the pectoralis minor muscle was evaluated thanks to the measurement of the distance between the posterior angle of the acromion and the surface of the table while the subject lies in the supine position (Nijs, Roussel, Struyf, Mottram, & Meeusen, 2007). Passive internal and external range of motion of the shoulder was assessed with the athletes in supine position and their shoulder at 90° of abduction in the frontal plane. The examiner mobilized the glenohumeral joint up to a maximal rotation. The rotation was measured using a goniometer. The stiffness tests were complemented by a physical examination of the shoulder, which was divided into two parts: detecting an impingement syndrome (Neer's, Hawkins', and Yocum's tests) and detecting a rotator cuff lesion (Jobe's test, Patte's test, lift-off test, and palm-up test).
Descriptive statistics (mean and standard deviation) of the measures are presented. As the samples were not found to follow a Gaussian distribution (Kolmogorov-Smirnov test), non-parametric paired tests were used to compare the parameters before and after the stretching program. Non-parametric non-paired tests were used to compare the parameters of the two groups. A significance level of .05 was used.

RESULTS: Before stretching, the symptomatic group reported statistically more pain than the asymptomatic group (Table 1). There was a significant decrease of pain in the symptomatic group after stretching, even if it did not completely disappear. Prior to stretching, the symptomatic group had statistically more positive tests for impingement syndrome and rotator cuff lesion. Even if the number of positive tests remained higher in the symptomatic group after stretching, the positive tests in the two groups were no longer significantly different.
Both groups presented a stiffer posterior shoulder on their dominant side (Table 2). The TAMD was equal to 3.9° in the symptomatic group. The GIRD was equal to 12° and 9° in the asymptomatic and symptomatic groups respectively.
The stretching program led to a significant decrease of the stiffness in both groups and an increase of the internal passive mobility of the shoulder, which was only significant in the asymptomatic group (Table 3). There are no longer differences between the two groups at the end of the stretching program.

DISCUSSION: The posterior stiffness of the shoulder in both groups reveals a modification of the normal mobility of the shoulder. The GIRD observed in the symptomatic group (9°) was however smaller than the ones reported in the literature. (Burkhart, Morgan, & Kibler, 2003) reported a limit of 25° for symptomatic GIRD. Other studies (Myers, 2005; Wilk et al., 2011) proposed smaller values (20°) but they were still nearly twice as large as our observations. For some authors (Seroyer & Nho, 2009), the risk is increased if the loss of internal rotation is not compensated by an equivalent gain of external rotation. (Wilk et al., 2011) reported that players with a TAMD superior to 5° are twice as more at risk to get injured than the other players. We observed in the present study that the symptomatic group presented a TAMD inferior to limit used by Wilk (Wilk et al., 2011). These results advocate for the development of prevention programs for even small GIRD or TAMD.

Table 1
Clinical tests of the dominant arm

	Before Mean ± std		After Mean ± std		Statistics
	Asymptomatic group				
Impingement syndrome tests (% of all tests)	13.3	23.3	6.7	13.3	*
Rotator cuff lesion tests (positive on 4)	0.1	0.3	0.0	0.0	*
Visual Analog Scale (from 0 to 10)	0.0	0.0	0.0	0.0	* †
	Symptomatic group				
Impingement syndrome tests (% of all tests)	46.7	36.7	23.3	26.7	*
Rotator cuff lesion tests (positive on 4)	1.1	1.3	0.4	0.7	*
Visual Analog Scale (from 0 to 10)	4.9	1.1	2.9	1.9	* † ‡

*Significant differences: * (before "asymptomatic"-"symptomatic"), † (after "asymptomatic "-" symptomatic "), ‡ (before-after)*

Table 2
Stiffness tests of the dominant and non-dominant arms before the stretching program

	Dominant Mean ± std		Non-dominant Mean ± std		Statistics
	Asymptomatic group				
Slepper Stretch (cm)	22.3	2.8	14.0	3.0	*
Cross Body Arm (°)	11.2	3.3	23.1	3.9	*
Internal rotation (°)	29.4	5.0	41.4	3.7	*
External rotation (°)	103.9	8.5	91.2	4.6	*
Range of motion (°)	133.3	11.5	132.6	6.9	-
	Symptomatic group				
Slepper Stretch (cm)	22.8	2.4	17.3	3.4	*
Cross Body Arm (°)	14.3	3.8	24.0	3.6	*
Internal rotation (°)	35.6	9.1	44.6	11.6	*
External rotation (°)	96.7	6.9	91.6	2.5	-
Range of motion (°)	132.3	11.6	136.2	12.3	-

*Significant differences on the dominant side: - (no difference), *(difference)*

Table 3
Stiffness tests of the dominant arm before and after the stretching program

	Before Mean ± std		After Mean ± std		Statistics
	Asymptomatic group				
Slepper Stretch (cm)	22.3	2.8	13.9	3.4	‡
Cross Body Arm (°)	11.2	3.3	24.2	4.2	* ‡
Pectoralis minor stiffness (cm)	7.3	0.9	6.2	0.9	‡
Internal rotation (°)	29.4	5.0	41.6	5.6	* ‡
External rotation (°)	103.9	8.5	101.1	8.0	-
	Symptomatic group				
Slepper Stretch (cm)	22.8	2.4	14.5	2.5	‡
Cross Body Arm (°)	14.3	3.8	21.7	3.8	* ‡
Pectoralis minor stiffness (cm)	7.2	0.6	6.6	1.2	-
Internal rotation (°)	35.6	9.1	42.0	7.0	*

External rotation (°)	96.7	6.9	97.8	4.3	-

*Significant differences on the dominant side: - (no difference), * (before "asymptomatic "-" symptomatic "), ‡ (before-after)*

This study has evaluated the effects of a self-applied stretching program. The symptomatic population reported a significant reduction of pain and, as in the asymptomatic population, a decrease of the posterior stiffness of the shoulder. The reduction of pain may be explained by the reduction of impingement symptoms as shown by the significant decrease of positive impingement tests. This hypothesis is also supported by (Maenhout et al., 2012), who found using ultrasound imaging that stretching increases the sub-acromial space after a 6-weeks program. At the end of the stretching program, pain had however not completely disappeared in the symptomatic group. This result may be explained by the persistence of positive impingement tests. Our results regarding the effectiveness of the stretching protocol shows that stretching can be effective without the presence of a physiotherapist at every stage of the program and open interesting opportunities to implement such programs in sport clubs.

CONCLUSION: Based on the results of this study, symptomatic players may report pain with GIRD and TAMD lower than the values usually reported in the literature. Rehabilitation or prevention program might therefore be valuable as soon as limited deficits appear. The self-applied stretching program used in this study reduced the pain reported in the symptomatic group similarly as in previous studies where stretching was performed by a trained physiotherapist.

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Acknowledgement

This work was co-supported by the Fédération Wallonie-Bruxelles (Belgium).