

An Active Shoulder Warm-Up for the Competitive Swimmer

George T. Edelman, MPT, OCS, MTC

April 8, 2009

Athletes often stretch with the misconception that they will increase muscle flexibility, reduce the risk of skeletal muscle injury, and improve performance. Stretching has been well accepted among the swimming community. It is advocated in literature by its governing body^{1 2} and in books considered to be the authority on swimming.³ Accordingly, swimmers and their coaches tend to devote a considerable time to stretching. However, there is little evidence to support the relationship between muscle stretching and a reduction in injury.^{4 5 6 7 8} In addition, pre-exercise stretching has been found to decrease muscle strength, power output and balance performance.^{9 10 11 12 13 14}

The shoulder is made up of four joints: the glenohumeral joint, the acromioclavicular joint, the sternoclavicular joint and the scapulothoracic joint. As compared to other joints in the body, the shoulder is unique in the fact that it allows for multiple planes of motion and as a result it is inherently unstable. Stability is predominantly provided by dynamic and static stabilizers. The dynamic stabilizers include the rotator cuff musculature and the surrounding periscapular muscles. The static stabilizers of the shoulder are composed of the articular, capsular and ligamentous structures. Instability describes a pathological environment in the joint representing excessive motion as a result of insult to the stabilizing components, which could lead to shoulder pain in the competitive swimmer.^{15 16 17}

The shoulder is the most frequently stretched joint among the swimming community. To date, swimmers have adopted stretches that target the static stabilizers of the glenohumeral joint. From the grass roots level to the elite National Team, the stretches shown in figure A are routinely identified on the pool deck before practice and before a race. In addition to these stretches, some swimmers will incorporate a pre-race ritual that is similar to a ballistic windmill motion with their arms in which one arm is going in the direction of the clock and the other arm is going counter-clockwise. Other pre-race rituals include clapping the hands in front of the trunk similar to horizontal adduction and then clapping the hands behind the back in a horizontal abduction motion. Many of these traditional stretches and pre-race rituals tend to emphasize increasing tissue extensibility of the static stabilizing components of the shoulder and may contribute to instability if routinely completed on a daily basis.

Recent research on swimmer's flexibility^{18 19} suggests there is no indication that extraordinary shoulder joint motion or flexibility is necessary to achieve a fast, efficient stroke. Elite level competitive swimmers are naturally selected to their sport.^{20 21} They are generally flexible and possess loose connective tissue (general joint laxity).^{22 23} Because of their inherent laxity, swimmers should emphasize preserving the overall stability of the shoulder, and the stretches targeting the static stabilizers as pictured in figure A are strongly discouraged.

Despite the overwhelming evidence that stretching does not reduce injury and that pre-exercise stretching negatively impacts muscle performance, there remains a role for stretching in the sport of swimming. When compared to age-matched controls, competitive swimmers present with limited shoulder rotation range of motion.²³ Stretching is athlete specific. When selecting stretches as part of a routine, it is important that the stretches target the muscle tissue and do not jeopardize the integrity of the static stabilizing components of the joint. Observationally, there are four muscle groups that tend to shorten during the course of a swim season for many swimmers. In an effort to maintain normal rotation range of motion, offset the development of a muscle imbalance, and prevent dysfunctional shoulder mechanics, it is recommended to stretch the following muscles: 1) Upper Trapezius, 2) Levator Scapulae, 3) Pectoralis Major and Minor and 4) the Latissimus Dorsi. The recommended stretches are described below in figures B-D.

It is recommended that swimmers stretch at a time unrelated to working out and competition, stretching at least several hours prior to getting in the water. For coaches interested in crafting recovery programs for their teams, post-exercise stretching is not encouraged. Stretching fatigued muscles tends to facilitate muscle spindle and inhibit GTO firing^{24 25} which does not allow for the muscle to relax and effectively elongate. Stretching that is incorporated into a recovery program should take place several hours after practice or on lighter training days

when the muscles are not fatigued. General guidelines for stretching include completing a specific static stretch that targets muscle tissue 1-3 times for 15-30 seconds each, approximately 5 days a week.^{26 27 28 29}

A sport-specific warm-up is essential to prepare the body for exercise and competition. Contrary to the deleterious effects of static stretching prior to workout, a dynamic warm-up has been found to produce short term and long term performance enhancements in power, agility, strength, muscle endurance, and anaerobic capacity.^{30 31 32} Because of these documented benefits, an active on-deck shoulder warm-up (Figure E) has been developed for swimmers to implement before workout and competition. Five activities are offered with pictures indicating the beginning and ending positions. The swimmer is instructed to complete 15 repetitions of each activity and then complete the entire group twice. The swimmer should employ a steady pace with each activity and avoid ballistic type motions. The order of the activities is purposely designed to sequentially warm-up the tissues in increasingly elevated positions.

Figure A: The five stretches pictured below are no longer advocated for the swimming community.

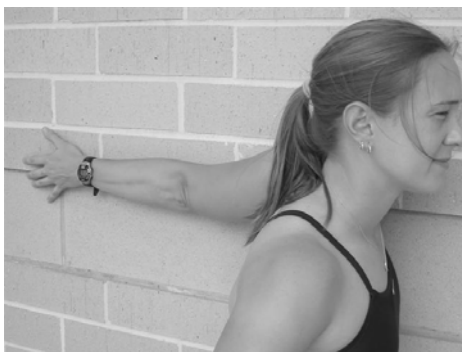


Figure B: Recommended Stretch #1 - Door Frame Stretch for the Pectoral Group

Stand at doorway with forearm on doorframe. Elbow bent to 60-90 degrees. Step through the door. A good stretch should be felt along the anterior chest, not the shoulder joint. If you are stretching the right shoulder, step through with the right leg. Complete 3 x 30 seconds each side. The angle of the arm can vary depending on which fibers of the pectoral group you wish to stretch. A combination of angles can be added to the stretching routine to incorporate the different fibers.



Figure C: Recommended Stretch #2 - Two Part Latissimus Dorsi Stretch

Arch your back up like an angry cat to round out your back. Keep your back rounded and drop your rear to your heels. Reach out with your hands and then reach to a side to specify the stretch and address each of the Latissimus Dorsi. Hold each stretch 30 seconds and repeat three times, alternating sides.



Figure D: Recommended Stretch #3 - Upper Trapezius / Levator Scapulae Stretch

Sit on a chair and grasp the seat with the hand on the side of the tightness. Place your other hand on your head as outlined below and gently pull down and diagonally to the other side. Two versions of this stretch are shown below. The first version is to turn your nose towards your armpit and gently pull down. The second version is to look straight ahead and gently pull down. Hold for 30 seconds and repeat three times, alternating sides.

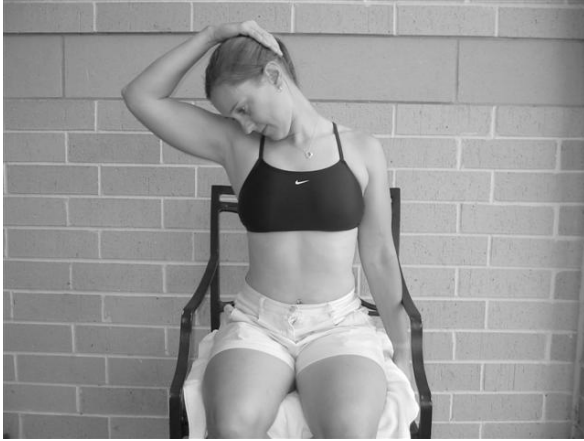
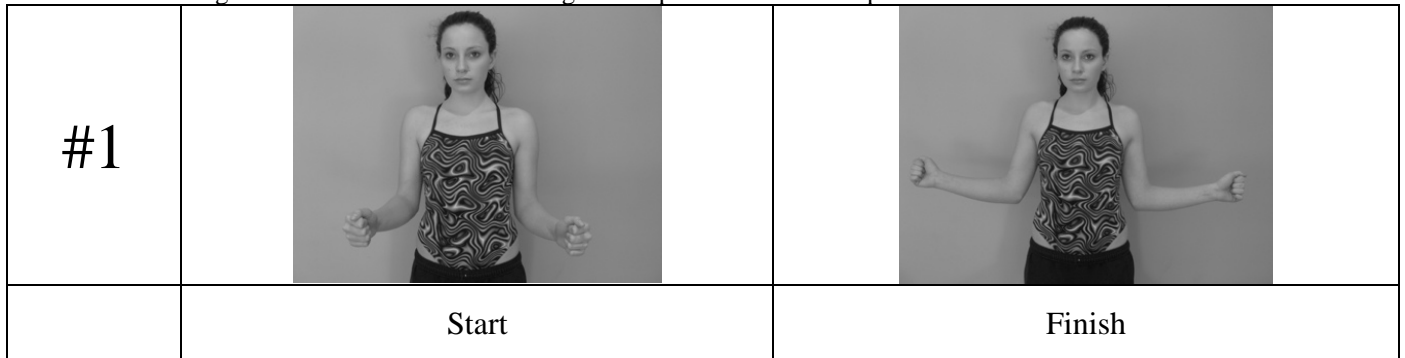


Figure E: On-Deck Active Warm-Up

Complete 2 sets of 15 for each activity

Active Warm-Up #1 – Place your arms by your side, bend your elbows to 90° to assume the start position. Externally rotate your arms to the end range at a comfortable pace and then return to the starting position. As you externally rotate, pinch your shoulder blades together. Do not force the end range. Complete 2 sets of 15 repetitions.



Active Warm-Up #2 – Place the back of your hands on your back at the belt line and bring your elbows forward to assume the start position. Squeeze your elbows and shoulder blades together and then return to the start position. Complete 2 sets of 15 repetitions.





Active Warm-up #3 – Forward elevate your arms to 90° and then bend your elbows to 90° to assume the starting position. Horizontally abduct your arms to a “goal post” position, squeezing your shoulder blades together at the same time. Then return to the starting position. Complete 2 sets of 15 repetitions.





On-Deck Active Warm-Up – Con't

Active Warm-up #4 – Abduct your arms to 90° and bend your elbows to 90° to assume the starting position. Then externally rotate your shoulders to achieve the “goal post” position. Return to the starting position. Complete 2 sets of 15 repetitions.











#4		
	Start	Finish

Active Warm-up #5 – Assume a tight streamline for the start position. Drop your elbows into your “back pockets”, while squeezing your shoulder blades together and keeping your hands up. Return to the streamline position and complete 2 sets of 15 repetitions.

#5		
	Start	Finish

On-Deck Active Warm-Up

Complete 2 sets of 15 for each activity

#1		
	Start	Finish
#2		
	Start	Finish
#3		
	Start	Finish
#4		
	Start	Finish
#5		
	Start	Finish

-
- ¹ Troup JP, United States Swimming Sports Medicine Program – Information Series – Swimmers’s Shoulder and Rehabilitation. Hand-Out (date unavailable).
- ² Dr. Ron Karnaugh SWIM May/June 1998
- ³ Maglischo EW. *Swimming Faster, A Comprehensive Guide to the Science of Swimming*. Palo Alto, CA: Mayfield Publishing Company; 1982
- ⁴ Herbert RD, Gabriel M. Effects of stretching before and after exercising on muscle soreness and risk of injury: systematic review. *Br Med J*. 2002;325:468-473.
- ⁵ Hartig DE, Henderson JM. Increasing hamstring flexibility decreases lower extremity overuse injuries in military basic trainees. *Am J Sports Med*. 1999;27:173-176.
- ⁶ Pope RP, Herbert RD, Kirwan JD, Graham BJ. A randomized trial of preexercise stretching for prevention of lower-limb injury. *Med Sci Sports Exerc*. 2000;32:271-277.
- ⁷ Shrier, I. Stretching before exercise does not reduce the risk of local muscle injury: a critical review of the clinical and basic science literature. *Clin J Sports Med*. 1999; 9:221-227.
- ⁸ Weldon, SM, Hill RH. The efficacy of stretching for prevention of exercise-related injury: a systematic review of the literature. *Man Ther*. 2003; 8:141-150.
- ⁹ Knudson DV, Magnusson P, and McHugh M. Current issues in flexibility fitness. *Pres Council Phys Fitness Sports* 2000;3: 1-6.
- ¹⁰ Kokkonen JA, Nelson AG, Cornwell A. Acute muscle stretching inhibits maximal strength performance. *Res Q Exerc Sport* 1998;69:411-15.
- ¹¹ Fowles JR, Sale DG, MacDougall JD. Reduced strength after passive stretch of the human plantar flexors. *J Appl Physiol* 2000;89:1179-88.
- ¹² Cornwell AG et al. Acute effects of passive muscle stretching on vertical jump performance. *J Hum Mov Stud* 2001;40:307-24.
- ¹³ Knudson D et al. Acute effects of stretching are not evident in the kinematics of the vertical jump. *J Strength Cond Res* 2001;15(1):98-101.
- ¹⁴ Cramer JT et al. Acute effects of static stretching on peak torque in women. *J Strength Cond Res* 2004;18(2):236-41.
- ¹⁵ Bak K. Nontraumatic glenohumeral instability and coracoacromial impingement in swimmers. *Scand J Med Sci Sports*. 6: 132-144, 1996
- ¹⁶ Bak K, Fauno P. Clinical Findings in Competitive Swimmers with Shoulder Pain. *Am J Sports Med* 1997; 25:254-260
- ¹⁷ Rupp S, Berninger K, Hopf T. Shoulder Problems in High Level Swimmers – Impingement, Anterior Instability, Muscular Imbalance? *Int J. Sports Med*. 1995; 16: 557-562
- ¹⁸ Borsa PA, Scibek JS, Jacobson JA, Meister K. Sonographic Stress Measurement of Glenohumeral Joint Laxity in Collegiate Swimmers and Age-Matched Controls. *Am J Sports Med* 2005;33:1077-1084.
- ¹⁹ Sein ML, Walton J, Linklater J, Appleyard R, Kirkbride B, Kuah D, Murrell G. Shoulder Pain in Elite Swimmers: Primarily Due to Swim-volume-induced Suprspinatus Tendinopathy. *Br J. Sports Med* 2008; doi:10 1136
- ²⁰ Zemek MJ, Magee DJ: Comparison of glenohumeral joint laxity in elite and recreational swimmers. *Clin J Sport Med* 6: 40-47, 1996
- ²¹ McMaster et al.: A Correlation Between Shoulder Laxity and Interfering Pain in Competitive Swimmers. *Am J Sports Med* 26: 83-86, 1998
- ²² McMaster WC: Painful shoulder in swimmers: A diagnostic challenge. *Physician Sportsmed* 14(12): 108-122, 1986
- ²³ Jansson A. The Impact of age and gender with respect to general joint laxity, shoulder joint laxity and rotation – A study of 9, 12 and 15 year old students. Department of Surgical Sciences, Section of Sports Medicine, Stockholm, Sweden, 2005.
- ²⁴ Nelson HL, Hutton RS: Dynamic and static stretch responses in muscle spindle receptors in fatigued muscle, *Med Sci Sports Exerc* 17:445-450, 1985.
- ²⁵ Hutton RS, Nelson DL: Stretch sensitivity of golgi tendon organ in fatigued gastrocsoleus muscle, *Med Sci Sports Exerc* 18:69-74, 1986.
- ²⁶ Decoster LC., Scanlon RL., Horn KD., and Cleland J., Standing and Supine Hamstring Stretching Are Equally Effective. *J Athl Train*. 2004 Oct-Dec; 39(4): 330-334
- ²⁷ Bandy WD, Irion JM, Briggler, M. The effect of time and frequency of static stretching on flexibility of the hamstring muscles. *Phys Ther*. 1997; 77: 1090-1096
- ²⁸ Bandy WD, Irion JM. The effect of time on static stretch on the flexibility of the hamstring muscles. *Phys Ther*. 1994; 74: 845-852.
- ²⁹ Bandy WD, Irion JM, Briggler M. The effect of static stretch and dynamic range of motion training on the flexibility of the hamstring muscles. *J Orthop Sports Phys Ther*. 1998; 27: 295-300.
- ³⁰ Bishop, D. Warm-up II: performance changes following active warm-up and how to structure the warm-up. *Sports-Med* 33: 483-498, 2003.
- ³¹ McMillan, DJ, Moore, JH, Hatler, BS and Taylor, DC, Dynamic vs. static stretching warm-up: the effect on power and agility performance. *J Sports Sci* 20: 492-499, 2006.
- ³² Herman, SL and Smith, DT. Four-Week Dynamic Stretching Warm-Up Intervention Elicits Longer Term Performance Benefits. *J Strength Cond Res* 22: 1286-1297, 2008.