Shoulder Stretching for Competitive Swimmers
Helpful or Harmful?
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Introduction:
It is well documented that up to 80% of competitive swimmer's will suffer from shoulder pain at some point in their career.[1 2 3 4 5] Faulty stroke mechanics, training errors, overuse (repetitive micro-injuries) and muscular imbalances have been postulated as some of the elements that contribute to shoulder pain in swimmers.

The glenohumeral joint (shoulder joint) is inherently unstable, and stability is predominantly provided by the capsular, ligamentous, and muscular structures. Elite level competitive swimmers are naturally selected to their sport.[6 7] They are generally flexible and possess loose connective tissue (general joint laxity).[8] McMaster points out that when this normal laxity increases, joint translation may cross the threshold of stability and into the realm of instability, becoming pathologic.[7] Anterior translation of the humeral head associated with pathologic laxity along with a muscle imbalance of the scapular stabilizers will provoke impingement and contribute to shoulder pain in swimmers.[9 10 11 32] Pain from a secondary impingement is one of the more common presentations of a swimmer who has multidirectional instability of the glenohumeral joint.

Athletes often stretch in an attempt to improve muscle flexibility, reduce the risk of skeletal muscle injury, and improve performance. Shoulder stretching has been well accepted among the swimming community and advocated in literature by its governing body[12 13] and in books considered to be the authority on swimming.[14] Accordingly, swimmers and their coaches tend to devote a considerable amount of time to stretching. Although the most commonly employed shoulder stretches on a pool deck have not changed over the past 30 years, many of these tend to emphasize increasing tissue extensibility of the anterior, posterior and inferior portions of the glenohumeral joint capsule, which are some of the primary static stabilizers of the shoulder.

A compelling question arises as a result of this focused stretching. Could inappropriate stretching during the career of a competitive swimmer be one of the contributing factors leading to multidirectional instability of the glenohumeral joint resulting in secondary impingement and shoulder pain?

The following literature review attempts to highlight the physiological and neurological mechanisms associated with stretching and to apply the best evidence in a comprehensive educational piece recommended for the swimming community in an effort to minimize unnecessary insult to the joint capsule.

Principles of Stretching
Five methods developed to improve flexibility have emerged: ballistic stretching, static stretching, proprioceptive neuromuscular facilitation techniques, dynamic range of motion using active contractions,[15] and eccentric training. Despite efforts to identify more effective and creative means of improving range of motion (ROM), static stretching remains the gold standard.[16 17]

Stretching has proven to increase ROM. The majority of studies investigating the benefits of stretching to date, have been 4-8 weeks in duration and therefore may not be long enough to elicit permanent changes in the physical properties of the muscle.[17 18 19 20] The mechanism for the increased ROM after a short bout of stretching is not clear. LaRoche[17] believes the increase in ROM may result from peripheral or central nervous system accommodation occurring independently from changes in muscle tissue properties.

There is no general consensus regarding the appropriate time frame for a stretching program. However, Roberts[21] revealed that holding an active stretch for 15 seconds results in greater improvements in active ROM compared with holding the stretch for only five seconds. Borms[22] found no significant difference between stretches of 10, 20 and 30 seconds. Several studies demonstrated considerable improvements in ROM when following a program that ranged between 3 and 6 weeks in duration, stretching the muscle for 30 seconds from 1-3 times, 3-5 times a week.[23 24 25 26]

In a study of Division I swimmers, Beach[5] demonstrated that no significant correlation existed between shoulder flexibility, strength ratios and shoulder pain. Bak[27] confirmed these findings and reported no difference in internal and external rotation range of motion can be demonstrated between painful and pain-free shoulders.

Although stretching is widely accepted by coaches, athletes, and recreationalists, there is little evidence to support the relationship between muscle stretching and a reduction in injury.[28 29 30] Unfortunately, the majority of research examining the benefits of stretching has been focused on the hamstring musculature.

Physiology – Delayed Onset Muscle Soreness

Elite level swimmers train nearly 50 weeks of the year. During the peak of training it is common for an athlete to swim 8,000 – 15,000 yards in one day. Researchers believe this equates to approximately 16,000 to 18,000 shoulder revolutions per week[31 32] or as many as 500,000 shoulder revolutions per arm in one year[33].

Delayed onset muscle soreness (DOMS) is a term used to describe skeletal muscle pain and stiffness[34 35 36 37] that evolves over a 24 – 48 hour period following a strenuous workout as described above.[34 37] Researchers believe that DOMS is related to muscle structural damage that is followed by ion imbalance, inflammation, and pain.[34 35 37 38] The mechanical disruptions and the inflammatory responses activate Type III and Type IV pain receptors leading to a stiff, tender feeling.[39] McNair[40] suggests the mechanism of a short duration stretch to ameliorate the sensation of DOMS may be redistribution of liquid and polysaccharides within the collagen matrixes. Instinctively, a swimmer will employ stretches to address the sensation of DOMS.

Neuroscience

The glenohumeral joint of the shoulder is a synovial joint that possesses primary and accessory nerves.[41] These articular nerves terminate in a variety of encapsulated and unencapsulated nerve endings sensitive to mechanical, chemical, and thermal stimuli. Freeman and Wyke[42] described four basic types of afferent nerve endings in periarticular tissues and documented the presence of those endings in a variety of peripheral joints. McLain[41] confirmed the presence of mechanoreceptors in synovial joints and reported that they provide afferent input to the central nervous system. Receptor Types1-3 are encapsulated endings that are thought to respond primarily to extreme, rather than the midrange, joint motion.[43 44]

Researchers have reviewed the role of mechanoreceptors after manipulation of synovial joints in the cervical and lumbar spine. They hypothesize that spinal manipulation may induce a reflex inhibition of pain, or a reflex muscle relaxation by stimulation of the joint capsule mechanoreceptors.[45 46] Many people become addicted to self manipulation of joints because of this temporary inhibition of pain and muscle relaxation. This is most common in the facet joints of the spine and the phalangeal joints in the fingers.

Stretching the joint capsule of the glenohumeral joint to an extreme inhibits pain and triggers reflex muscle relaxation. The stiff and achy sensation of DOMS encourages a swimmer to stretch their shoulder to the extreme in an effort to provide relief and achieve a loose feeling.

Muscle Imbalance

Sherrington first described his law of reciprocal inhibition in the journal of Brain 100 years ago[47]. Vladimir Janda, a Czechoslovakian Physiatrist from Prague, spent his career expanding on Sherrington's law of reciprocal inhibition and applying the knowledge to the study of muscle imbalances.[48] One of his most notable contributions was research describing a crossed shoulder syndrome in which the large anterior muscles of the shoulder inhibit normal muscle activity of the posterior muscles.[49 50] Janda believed that if the pectoralis group, the latissimus dorsi or the sternocleidomastoid were tight, then the middle and lower trapezius muscles would be inhibited from firing properly.

In general, swimmers often present with tightness of the pectoral group, the latissimus dorsi and the neck musculature. According to Sherrington and Janda, then, stretching to keep these muscles at a normal length would prove beneficial for a competitive swimmer in an effort to offset the ill effects of a muscle imbalance.

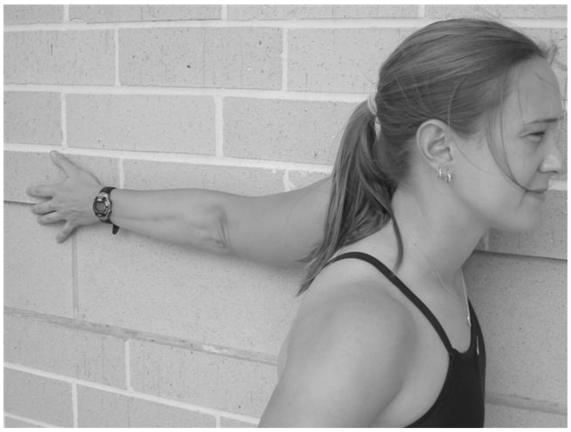
Musculo-tendon Unit

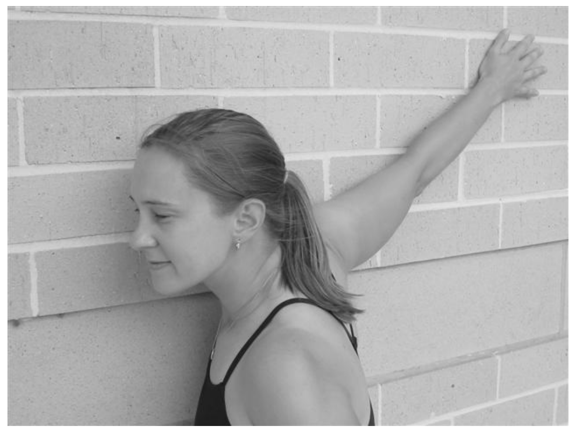
Witvrouw[51] examined the musculo-tendon unit and reported that it may generate forces in two completely different ways, leading to more specific stretching recommendations. The first is via an elastic-like spring in stretch-shortening cycles when involved in plyometric-type activities that utilize energy absorbing properties. He proposed that sports which require jumping and quick changes of direction would benefit from a musculo-tendon unit that is compliant (loose). For these sports, stretching is indicated.

The second function of a musculo-tendon unit is to convert metabolic energy into mechanical work via concentric contractions. Witvrouw reported that cycling, jogging and swimming benefited from a stiff musculo-tendon unit so that the force can be transferred to the muscle-bone junction. "The stiffer the muscle-tendon unit, the faster the force is transferred to the bones, and the resulting movement of the joint is quicker."[51] A stiff musculo-tendon unit is advantageous for the shoulder complex in swimmers and as a result, excessive stretching may not be indicated.

Stretching in the Swimming Community
As previously described, there are a handful of stretches that have been employed by the swimming community for many years. This literature review has identified them as potentially harmful for the inherently lax shoulder joint in swimmers. The inappropriate shoulder stretches identified on the pool deck are as follows:

Inappropriate stretch #1: Placing the upper extremity on a firm surface at 90˚ of forward elevation and greater than 90˚ of horizontal abduction while turning the trunk in the opposite direction – stretching the anterior capsule.





Inappropriate stretch #2: Pulling the elbow overhead with the opposite arm, stretching the inferior capsule.

Inappropriate Stretch #3: Pulling the arm across the trunk in a horizontal adduction direction, stretching the posterior capsule.

Inappropriate Stretch #4: A partner stretch and / or solo stretch in which the swimmer's arms are pulled behind her in a horizontal abduction direction, stretching the anterior capsule.

Some of the fastest and most popular swimmers tend to use these inappropriate stretches. It is possible the younger and more impressionable swimmers will mimic the same stretches in an effort to achieve similar success in the pool.

Discussion

This literature review focuses on the physiological and neurological reasons why stretching in the swimming community is common. However, excessive stretching that incorporates inappropriate technique can contribute to pathologic laxity of the glenohumeral joint, adding to shoulder pain in swimmers. Witvrouw supports that a stiff musculo-tendon unit will encourage enhanced performance. Concurrently, Wilk[52] strongly discourages aggressive stretching of the anterior and inferior glenohumeral structures in athletes with excessive shoulder laxity. Fortunately, with proper education this element can be controlled and minimized.

Evidence suggests that stretching in the swimming community is indicated to offset the effects of DOMS and to prevent muscle imbalances in the shoulder. However, special care should be taken to avoid insult to the joint capsule and respect the advantages of a stiff musculo-tendon unit. The following three stretches should be employed in a dry land exercise routine to target the muscle tissue of the pectoral group, the latissimus dorsi and the neck muscles without jeopardizing the glenohumeral joint capsule. They are as follows:

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, two times a day and especially after workout. 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.

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 twice, alternating sides.

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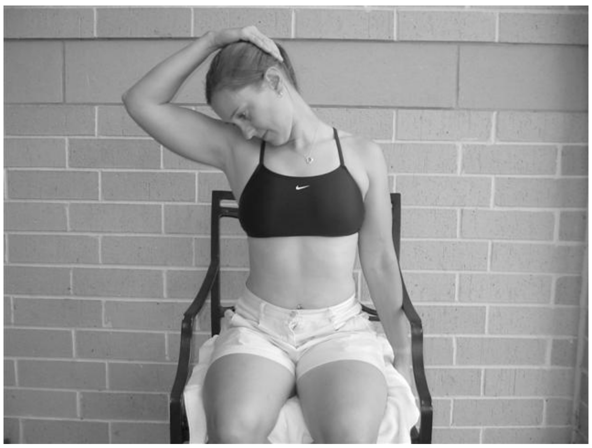
Upper Trapezius / Levator Scapulae Stretch

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 twice, alternating sides.



Conclusion

Shoulder stretches that target the joint capsule of the glenohumeral joint in a swimmer are strongly discouraged unless prescribed by a consulting physician or physical therapist. Although there appears to be a debate with regard to frequency and duration of a stretch, most studies suggest completing a specific stretch 1-3 times for 30 seconds each approximately 5 days a week is appropriate. Generally, stretching a warm muscle is more effective than a cold muscle. Therefore, stretching muscles after a swim practice may be the most optimal time frame. Everyone's physiological makeup is different. If in doubt, please consult a physician or physical therapist to outline a stretching routine that is specific to individual needs.

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