

## SHOULDERING ON: SWIMMING OVERUSE INJURIES

By Jessica Heath and Neal Goulet

Michael Phelps may have been born for swimming greatness: size 14 feet, a wingspan that exceeds his height, and a heart that pumps blood to his muscles at a rate twice as fast as that of the average adult male.

But Phelps didn't become the most-decorated Olympian in history – 22 medals, 18 of them gold – without a lot of hard work. During his teens, for instance, he went six years without missing a day of training, according to CBS' "60 Minutes."

Phelps also has been relatively healthy in a sport in which overuse injuries – particularly to the shoulders – are legion.

The incidence of "swimmer's shoulder" has been reported to be as low as 3 percent and as high as 67 percent. When defined as "significant shoulder pain that interferes with training or progress in training," an incidence of 35 percent has been reported among elite and senior-level swimmers.

Swimmer's shoulder describes any type of pathology or injury related to the acromioclavicular joint, glenohumeral joint, rotator cuff, long head of the biceps, labrum or shoulder instability caused by the high stresses of the sport.

### OVERUSE INJURIES

Swimming is an unusual sport as it demands use of the shoulders and upper extremities



Significant shoulder pain interferes with training among a reported 35 percent of top swimmers.

for locomotion, while requiring increased shoulder flexibility and range of motion for maximal efficiency. What's more, water offers more resistance to movement compared with air.

Overuse injuries are the result of repeated stress to muscles, tendons and joints often caused by poor technique and overtraining. When a swimmer's muscles are fatigued, they work less efficiently; they work harder to cover the same distance.

To better understand how the shoulder works in swimming, think of the upper extremity as a lever akin to a canoe paddle. The swimmer's hand functions as the flat end of the paddle.

Swimmers often develop an increase in joint flexibility (also called joint laxity) that can be advantageous initially. However, eventually it can cause slight injuries and micro-trauma, creating an unstable shoulder that

may lead to pain and tendinitis.

Swimmers require flexibility for efficient strokes and to assist with recovery. Increased laxity of the glenohumeral joint capsule and ligaments – the static stabilizers of the shoulder – enables increased shoulder flexibility and range of motion.

This laxity must be compensated for by a stronger rotator cuff in order to keep the humeral head centered in the glenoid socket. This is required for efficient stroke work as well as to avoid injury to the labrum and cuff.

Because of the increased demand placed on the rotator cuff caused by joint laxity or instability, the most common overuse injury is rotator cuff tendinitis.

Muscle imbalances such as underdeveloped strength in the shoulder girdle, including the rotator cuff or scapular stabilizers, can lead to problems.

Sudden increases in training can cause injury, too. An increase in duration or in the intense use of training devices (such as paddles or pulling gear) can lead to high demand on the shoulder.

Improper stroke mechanics are another factor: for instance, breathing only to one side versus alternately breathing to each side. This may lead to muscle imbalances in strength and flexibility and can result in overuse.

### MUSCLE IMPINGEMENTS

Shoulder muscles can become impinged between bony structures in competitive swimming. The four basic strokes are freestyle, backstroke, breaststroke and butterfly. In the overhead freestyle stroke, impingement of the shoulder muscles can occur during the pull-through and recovery phases.

**Pull-through:** This phase begins when the hand enters the water and ends when the arm has pulled through and is about to exit. If the hand upon entering is across midline, the biceps tendon will become pinched.

**Recovery:** This begins when the arm leaves the water and continues until the hand hits the water again. A swimmer has greater difficulty lifting his arm out of the water when he fatigues. When the shoulder muscles do not work properly, the supraspinatus tendon gets pinched between the humerus

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and the acromion.

Both of these impingements can lead to injury. In a 10,000-yard training session, each arm may complete 4,000 or more strokes.

Treatment of shoulder pain in swimmers often involves several levels of care. The first step is rest. Initially, the pain may be noted only with swimming. However, if the patient does not rest adequately, the pain often becomes more constant and affects activities out of the water.

If shoulder pain continues, or if a click is felt upon the resumption of activity, a physician may refer the swimmer for further testing or rehabilitation.

X-rays may rule out injury such as a stress fracture. MRIs may be used if the physician suspects a rotator cuff tear or labral tear, but in most cases of swimmer's shoulder these tests show more signs of tendinitis or bursitis.

A subacromial injection into the joint that may include an anti-inflammatory and numbing agent can be given for diagnostic purposes, but it also may give the patient several weeks of pain relief.

### PHYSICAL THERAPY

A physician may refer an athlete to physical therapy when rest and activity modification have failed.

The therapist will work to normalize the mechanics of the shoulder girdle. This may include scapular strengthening, thoracic spine mobilization, and restoration of normal strength in the rotator cuff.

Strength and power are required for maximal propulsion; however, it is important to extend this beyond the shoulder. Swimmers require adequate core

and hip strength to assist with body propulsion. A therapist can assist swimmers with this type of strengthening and conditioning.

Working with a physical therapist can be helpful, particularly to transition the athlete from dry-land exercises to swimming. A physical therapist can assist in identifying problems with stroke mechanics and training errors.

Surgical intervention may be considered for athletes who have a labral tear, rotator cuff tear, or complete joint laxity and/or who continue to have shoulder pain after a minimum of six months of guided rest and rehabilitation.

Athletes do risk some loss of flexibility in order to gain shoulder stability with surgery. This makes it difficult for a swimmer to return to the same performance level as before an injury.

### SUMMARY

Shoulder injuries are common in swimmers. Proper strength, range of motion, stroke mechanics, and training can help minimize the risk for shoulder injuries in these athletes. Most injuries can be treated conservatively with proper rest, physical therapy and progressive training. When needed, surgical intervention can reduce swimming performance due to reductions in shoulder range of motion. ■

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## Q&A

# SWIMMER'S SHOULDER

By Jessica Heath

### WHAT IS THE ANATOMY OF THE SHOULDER?

The shoulder or shoulder girdle is made up of the scapula, clavicle and humerus. These bones form the glenohumeral joint (humerus and scapula) and the acromioclavicular joint (clavicle and scapula), each of which is surrounded by a number of ligaments, muscles and tendons.

The key muscle group, the rotator cuff, comprises the subscapularis, supraspinatus, infraspinatus, and teres minor muscles. The rotator cuff is the dynamic stabilizer of the glenohumeral joint.

All of these components work together to provide stability during activities such as reaching and lifting.

### WHAT MAKES SWIMMERS SO PRONE TO SHOULDER INJURIES?

Strength and power are required for maximal stroke propulsion, while flexibility (laxity) is required for an efficient and fast stroke recovery. Increased shoulder flexibility and range of motion are beneficial to all strokes but can result in increased laxity of the glenohumeral joint capsule and ligaments, a key static stabilizer of the shoulder. The rotator cuff often must compensate for this laxity and can become overused and injured.

### WHY ARE THE THORACIC SPINE AND SCAPULA SUCH KEY COMPONENTS WHEN TREATING THE SHOULDER?

The scapula is positioned on the thoracic spine to create a base of support allowing the shoulder girdle to work. When the thoracic spine has a decreased or increased kyphosis (curve), the muscles that attach to the scapula are not at their most efficient length. The trapezius, levator scapulae, rhomboids, and serratus anterior muscles stabilize and position the scapula. If the scapula is not working properly (for example, not achieving full upward rotation), impingement can occur at the acromion and block elevation of the humerus, causing irritation of the tissues, most often the rotator cuff tendons.

### HOW CAN PHYSICAL THERAPY HELP WITH 'SWIMMER'S SHOULDER'?

A physical therapist can help improve shoulder mechanics in order to increase efficiency. The first goal of the physical therapist is to assist in pain relief. The second goal is to restore normal range of motion of the shoulder. The third goal is to improve the mechanics of the shoulder girdle by facilitating scapular stabilization, rotator cuff strength, thoracic mobility, and core and gluteal strength, each of which is important for power and endurance. ■

## CASE STUDY

# ROTATOR CUFF IMPINGEMENT

By Jason Williamson

## PATIENT HISTORY

A 47-year-old right-handed female injured her left shoulder while working as a lifeguard. When her injury worsened in a six-week period, she was referred to physical therapy.

She re-aggravated the injury while training for the swimming portion of a triathlon. She reported feeling a dull pain at rest and painful “catches” while trying to swim. She rested her shoulder and took an over-the-counter anti-inflammatory medicine for her pain. After two weeks with no relief, she was seen by her primary care physician and instructed to initiate outpatient physical therapy.

At the time of her physical therapy evaluation, she had stopped swimming but continued to bike and to run. Her left shoulder pain persisted with any overhead movements, including reaching, and when washing her hair. She reported pain with activities of daily living and when sleeping on her left side.

## ASSESSMENT

At initial evaluation, the patient reported vague and dull left shoulder pain of 2/10 on a visual analog scale during rest. Her pain increased with activity and became sharp, rating 7/10.

### Postural observation/alignment:

- Anterior view revealed that her left humerus was medially rotated.
- Lateral view of the shoulder and trunk revealed an increase in thoracic kyphosis (curve), forward head posture.
- Posterior view revealed downwardly rotated scapula bilaterally.

### Movement analysis:

#### RANGE OF MOTION (\*\*DENOTES PAIN)

CERVICAL FLEXION	55°
CERVICAL EXTENSION	55°

	LEFT	RIGHT
CERVICAL SIDEBENDING	45°	30°
PASSIVE SHOULDER FLEXION	170**	170
PASSIVE SHOULDER ABDUCTION	140**	170
PASSIVE SHOULDER EXTERNAL ROTATION	80°	90°
INTERNAL ROTATION	50°	70°

During shoulder flexion, the scapula 'wings' (comes off thorax) slightly. The patient had painful arc of motion, and pain at end range flexion.

### Muscle length assessment:

- Decreased flexibility noted bilaterally (left greater than right) in pectoralis minor, pectoralis major, latissimus dorsi and rhomboids.

### Strength assessment: left shoulder

- Upper trapezius, 4/5; serratus anterior, 3/5; lower trapezius, 3/5; supraspinatus, 4/5 (pain).

### Special tests:

- Provocation of pain with scapular resist test (blocked all scapular upward rotation during glenohumeral elevation).
- Positive pain relief with scapular assist test (assisted scapular upward rotation during glenohumeral flexion).
- Positive Hawkins-Kennedy test.
- Negative empty can test.

Based on the assessment, we hypothesized that this individual was experiencing rotator cuff (supraspinatus) impingement caused by a downwardly rotated scapula. This limits full upward rotation, reducing the space inside of the glenohumeral joint as the arm attempts to elevate overhead.

## TREATMENT

The multifaceted treatment included flexibility, progressive functional strengthening, scapular stabilization and behavior modification.

### Flexibility exercises:

- Supine stretches to improve length of latissimus dorsi and pectoralis major.
- Therapist-assisted stretches for pectoralis minor and upper thoracic mobilization.

### Strengthening exercises (progression based on patient's control and scapular awareness):

- Prone: scapula upward rotation and abduction with therapist cues and facilitation of scapular motion.
- Quadruped: rocking with emphasis on scapular upward rotation and shoulder elevation during backward rocking.
- Standing exercise: shrug progression
  - Forward-facing wall slides with shoulder shrugs from 90 degrees to end range.
  - Overhead shoulder shrug with resistance: levator scapula is less active in the overhead position, which allows the upper trapezius to be



strengthened as an upward rotator. The scapular elevation in return can offset the motion of the latissimus dorsi.

### Behavior modification:

- Sleep: avoidance of sleeping on her left shoulder, using pillow placement to decrease stress on glenohumeral joint.
- Breathing: diaphragmatic breathing techniques to avoid apical (chest) breathing patterns commonly seen in swimmers.
- Recreation: patient was instructed to stretch prior to swimming and to vary her swim strokes in order to alternate the loading of the shoulder complex to prevent injury risk.

## OUTCOME

After six weeks of physical therapy, education and task modification, the patient returned to training for her triathlon without shoulder pain. 🏊‍♀️

## RESEARCH ABSTRACT

# INJURY PATTERNS IN COLLEGIATE SWIMMERS

By Dr. Irene Davis

## INTRODUCTION

More than 42,000 male and female swimmers have competed at the National Collegiate Athletic Association (NCAA) Division I-A level. Collegiate swimming has evolved into a yearlong sport, and overuse injuries are common. These athletes undergo intense in-pool and out-of-pool training, along with their competitive events. However, there have been no comprehensive assessments of injuries in these athletes. The purpose of this study was to examine injury patterns in collegiate swimmers.

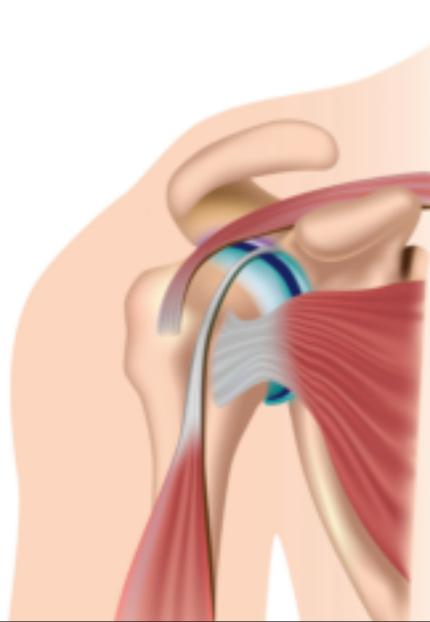
## METHODS

This was a retrospective review of athletic training room injury reports and physician records for male and female swimmers on the University of Iowa swim team from August 2002 to July 2007. An athletic trainer entered all injuries in these reports into an electronic database for further analysis.

An injury was defined as any musculoskeletal problem associated with swimming that was examined by an athletic trainer or physician. An exposure was defined as participation in one game, practice, strength-training, conditioning or cross-training activity.

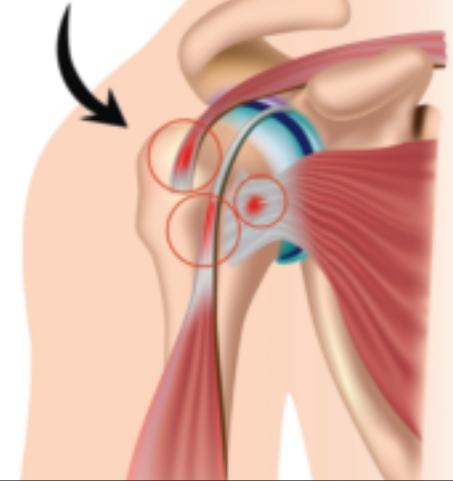
Injuries by body part and

## Normal



## Rotator cuff problems

Inflamed/torn tendons



Among males and females, this study found, the shoulder and upper arm were injured most often.

overall injury rates were compared between genders. Comparisons were made among athlete eligibility (freshman, sophomore, junior, senior); stroke pattern (freestyle, breaststroke, backstroke, butterfly, individual medley); and position (distance or sprint, with sprint being fewer than 200 meters).

## RESULTS

- Ninety-four swimmers competed during the course of this study.
- Of the 44 males, 32 sustained 90 injuries; of the 50 females, 35 sustained 76 injuries.
- Males and females were injured at a similar rate (4.0 vs. 3.78 injuries per 1,000 exposures).

- The shoulder and upper arm were the most often injured body part, making up 31 percent of male and 36 percent of female injuries.
- Back and neck injuries were the next most common in males and females.
- Four male swimmers underwent nine surgeries (four shoulder, four elbow, one foot); four females underwent five surgeries (all shoulder).
- Male and female freshmen experienced the most injuries.
- While the freestyle stroke was associated with the most number of injuries, it also is the most common stroke specialty among swimmers. Those swimmers specializing in strokes other than freestyle exhibited a 33 percent greater injury risk.

## DISCUSSION

Injury patterns were similar between male and female collegiate swimmers. A large number of injuries occurred in early eligibility years. Therefore, training regimens for freshman swimmers should be adjusted and closely monitored for signs of overuse. As the shoulder is the most commonly involved body part, injury prevention should be focused in this area. ■

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