Doing Just Swimmingly

Avoiding injury while swimming

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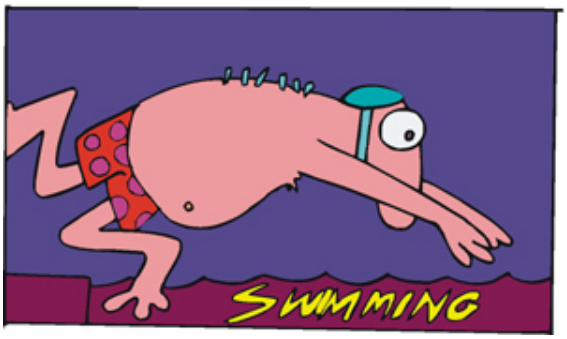

Swimming is a wonderful, refreshing summer pastime, but it is also a great form of exercise and an Olympic sport. Injury rates in swimming are low when compared to other sports; approximately 2.2 injuries per 1000 occasions of participation.[1,2] The elite swimmer experiences higher injury rates than the recreational swimmer primarily because training tends to stretch the body to its limits of endurance. These injuries are more likely to be overuse injuries rather than sudden acute or traumatic injuries. Injuries of the amateur swimmer tend to be acute injuries resulting from careless behavior such as slips while running on wet pool decks or drowning while trying to swim under the influence of alcohol.[1] Interestingly, slips and falls on the pool deck account for most of the swimming-related injuries over the whole population.[3]

In this article, we will discuss primarily the sources of overuse or repetitive trauma injuries related to swimming as a sport, with a very brief look at traumatic injuries in sport swimming.

Swimming Injury

Acute injuries are fairly rare in competitive swimming since it is not a contact sport and it takes place in a forgiving body of water at relatively slow speeds. A clash of hands or fingers while swimming in lanes can cause temporary impairment of hands.[1] And diving in shallow water has its risks. However, acute, painful muscle strains can occur if there is not adequate warm-up or if there is overstretching.[1]

Most of the injuries swimmers experience are chronic in nature and are due to repetitive microtrauma or overuse.[1, 3] Elite swimmers often swim a minimum of two hour workouts more than 11 times per week. The typical daily training distance averages 10,000 to 15,000 yards with as many as 16,000 shoulder revolutions per week.[4,5] Young athletes often begin competitive swimming as early as age 5, and there is an increasing popularity of masters swim teams whose members range in age from 20 to 95. Competitive swimmers train intensely, often with no breaks from October to July.[5] If a person starts swimming at age 5 and continues until age 95, it seems obvious that body parts will begin to wear out at some time. Many injuries sustained by elite college swimmers are the cumulative result of minor injuries occurring several years earlier.[3]

Intrinsic risk factors that contribute to overuse injuries include joint alignment problems, muscle imbalance, inflexibility, muscle weakness, and ligament instability.[3] Nutritional concerns are also critical. During high-intensity workouts, glycogen levels fall to low levels, and if depleted, the body must break down stored fats; an inefficient method of obtaining energy during high energy demand.[3] This contributes to fatigue. Fatigue is an enemy. Stroke mechanics change with fatigue, increasing the risk of injury to joints.[3,5]

Extrinsic factors that contribute to overuse injuries include poorly planned or executed training programs, poor swim techniques, swimming too many events, or a mismatch between a swimmer and the events.[3] There is increased stress to the joints if technical stroke flaws exist. Training too hard and too fast is likely to put the swimmer at risk of injury.[3]

Injury Prevention

1. *Warm-up* is critical to injury prevention during swimming.[3] The best method for warming up is light swimming. To prepare all the muscles to be used later when swimming for speed and conditioning, all strokes except the butterfly should be incorporated into the warm-up. The butterfly is too powerful a stroke to be considered warm-up intensity.[3] Warm-up should be 20-33% of the total swim workout. If a training session is broken up into a phase of kick-only laps, it is important to do some additional warm-ups to the upper extremities because the arms will tend to cool down during kick-only sets.[3]

2. *Specific stretches* are important to swimmers to increase muscle length and flexibility.[3] These should focus on the neck, shoulders, trunk, low back and legs, while other parts are generally only exercised within their midrange and do not require stretching.[3] Avoid over-stretching, ballistic stretches, and partner stretching.

3. *Strengthening* through both dry-land and pool-based exercises should focus on both joint-specific strengthening and functional multi-joint free-weight exercises.[3] Moderate resistance and high repetitions address both the muscle strength and endurance demands of swimming. A six to eight week long weight training program of 3 – 5 sets of 10 repetitions done 3 times per week with relatively light weights (60-70% of a 10-repstition maximum) will help develop muscular endurance in the extremities and trunk needed for swimming.[3] Building bulk is to be avoided with swimmers.[3] Because of the unique resistance of water, significant time can be spent building strength, power and endurance in the pool. Use of hand paddles and webbed gloves can increase drag in the water, using the water's resistance for strength training.[3] Care must be taken when using this equipment to avoid injury.

4. Proper *stroke technique* greatly improves the ability to train without injury.[3] It is the duty of the coach to identify problems with stroke mechanics for each individual swimmer. Training and competition should not be allowed until proper technique is mastered.[3]

5. *Pool temperature* should be kept between 77 and 81° F for training and competitions. Cold pools can cause muscles to be more prone to strain due to decreased blood flow. Additional warm-up may be necessary in colder pools. [3] Warmer pools may increase the core temperature of the swimmer and lead to fatigue and poor muscle performance.[3]

6. As with all sports, it is important that every aspect of the athlete's physique, fitness, training program, equipment, diet and lifestyle are reviewed to maximize health and minimize the risk of injury.[1] Reducing muscle fatigue is achieved by increasing endurance through high-intensity aerobic and anaerobic conditioning, both in and out of the water. A well-balanced diet without rapid weight loss is important to maintain muscle strength and power.[3] Intake of high-carbohydrate gels or drinks within 30 minutes of swimming during intense training is often recommended.[3]

Recovery from Injury

The concept of *relative rest* involves a program where the injured structure is rested, but the swimmer keeps active with alternative swimming activities and dry-land exercises that do not

stress the injured structure.[3] The repetitive nature of the swim stroke and kick makes it relatively easy to re-injure joints if the person returns to using the injured body part prematurely.[3]

For good reason, swimmers are reluctant to take time off for rehabilitation. Rest is critical to healing and rehabilitation, however studies have shown that a 4-week interruption in training dramatically changes the metabolic characteristics of a swimmer's muscle.[3,5] Although aerobic capacity and muscle strength are maintained despite reduced training for this period of time, the ability to generate power during swimming is significantly reduced and complete inactivity leads to decreased aerobic capacity.[3,5]

Training

Competitive training consists of three different phases or periods.[3]

1. *Over-distance period* is the precompetition phase. It is at the beginning of each season when the swimmer gets a feel for the water and develops the basic techniques of the strokes. Speed is not emphasized.

2. *Specialty period* is the dual-meet competition phase where swimmers focus on their specialty strokes. Intensity of workouts and stroke drills are specifically targeted to promote maximum performance within the specialty stroke of each individual swimmer. This phase is the most demanding phase of training. Stroke-specific injuries and chronic fatigue are most common toward the end of this phase.[3]

3. *Taper period* is the time when the swimmer is preparing for championship meets. It spans 2-6 weeks.[3,5] At this point, the swimmer will cut back yardage and dry-land exercises by 50% to 90% in order to avoid cumulative trauma and chronic fatigue.[3,5] The exact timing of the taper period is determined for each individual swimmer by injuries, illnesses, total yardage swum, and total events participated in during dual meets.

This system of "periodization" allows for scheduling of the season, structures rest periods both within and between sessions and from week to week, and focuses on quality of the training rather than emphasizing quantity.[1] Because the beneficial aspect of exercise actually takes place during the recovery phase, adequate rest is essential to allow tissue to adapt and undergo further activity without injury.[6] Time between morning and afternoon practices may be up to 8 hours to avoid fatigue.[3]

Cross training

Cardiovasular conditioning should be accomplished with both swimming and dry-land conditioning such as running, cycling or rowing.[3] Swimming for cardiovascular fitness is great for the general population, but it is not a good idea for competitive swimmers due to the repetitive nature of swimming and the risk of overuse from both swimming for practice and for cardiovascular conditioning. Impact activities such as running may be especially important to swimmers because the stress-free environment of the water does not assist the development of bones.[3] Compressive forces are required for bone development.

A 7-year study of 68 female swimmers who participated in cross-training found an overall injury rate of 2.12/1000 occasions of participation (either a practice session or competition). 44% of the injuries were due to swimming and of these, there was an upper to lower extremity injury ratio of 3:1. 44% of the injuries were due to cross-training and of these, there was an upper to lower extremity injury ratio of 1:4. 11% of the injuries were unrelated to athletics. What this shows is that swimming injuries are predominantly upper body injuries, while cross-training tends to injure

the lower body. Clearly this indicates that care should be used in designing cross-training programs to avoid injuries to the lower body.[2]

Overtraining

Overtraining is a significant problem; 10-21% of swimmers experience some symptoms during the course of a season.[3,5] Overtraining occurs when swim training outpaces rest and recovery.[3] As few as 10 days of increased training without adequate rest may decrease performance.[5] A sudden, unexpected drop in performance that can't be explained by illness or injury is the primary indication of overtraining. There is a multitude of physical and psychological complaints including sleep and appetite disturbances, tiredness or fatigue, aching heavy muscles, depression, irritability, and loss of motivation.[1,3,5] A rising resting pulse rate may indicate overtraining.[5] In general, it is a breakdown in the balance between the demands placed on the body and its ability to recover; essentially an overuse injury affecting the whole body.[1] It is important to recognize the importance of sufficient rest, good diet, appropriate level of fitness, mental status, lifestyle stresses, and the effect of recent illness.[1,3,5]

Treatment for overtraining involves rest with very light aerobic exercise for a few days to several weeks.[1,3,5] Overtraining can be prevented if both the coach and the athlete recognize that adequate rest is part of training, especially during the heaviest training periods and following injury.[3,5]

Technique

Interestingly, humans are the only mammals that must learn how to swim.[7] All other mammals instinctively know how to swim. Regardless of which stroke is used, it is important to master technique to avoid injury and achieve efficiency in the water.[7]

Swim speed is the product of stroke length and stroke frequency, with stroke length being the more important of the two.[7] World class swimmers are not fast because they take a lot of strokes; they are fast because they travel further in the water with each stroke. In order to do this, you must reduce the resistance to forward progress.[7]

One of the most important concepts in swimming, drag force, is the mechanical factors unique to the water environment. *Form drag* is the resistance exerted on the body dependent on the position of the body in the water. Any position of the body angled from horizontal will increase form drag. *Wave drag* is the increased resistance of water caused by the wavelike movement of the water due to wind or turbulence from other swimmers in the pool. In open water, wave drag can be caused by wind, boats, and water currents.[3] Wave drag is decreased in deeper pools and pools using wave-dispersing lane lines. *Frictional drag* is created between the body and the water. Body hair, swim suit materials, and swim caps all have an effect on frictional drag. Some swimmers shave their bodies to reduce this force, though it should be reserved for the championship phase because it can induce infections of the hair follicles.[3]

These are some tips to help you improve technique and travel farther with each stroke.

1. Taking advantage of whatever *buoyancy* you have will improve your speed. Balance yourself by consciously pushing or pressing your upper chest into the water. This brings your hips closer to the surface and reduces your frontal resistance so you can move more easily through the water.[7]

2. Maintain a long, *streamlined* body. While swimming freestyle, pause slightly between strokes with one hand extended in front of you. This introduces a longer glide

and streamlines your body.[7] Movements of the arms and legs during the swim stroke causes deviation from the streamlined position.[3]

3. Place your hand in a *sculling* position, an oblique angle to the direction of travel. This creates forward propulsion of the body in the water.[3]

4. When swimming backstroke and freestyle, *roll your body side to side* from the hips up the torso to the shoulder.[7] Just before you begin the arm pull, you should begin to rotate in the opposite direction. This rotational force or torque, helps to pull you through the water...and helps to prevent shoulder injuries, too.[7]

5. Do not force your hands through the water. As technique improves, you should feel like you are climbing a "water ladder" with your hands and forearms resting against solid rungs of water.[7]

6. The use of kickboards, hand paddles, and leg floats should be reserved for swimmers with firmly established technique.[7] This equipment alters your center of buoyancy and may harm your technique. Swim fins are acceptable, but should fit well to avoid damaging the skin.

What's next?
The next article will continue on the topic of swimming, addressing specific injuries, their prevention and treatment.

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