



## Information

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### Swimming Injuries and their Management

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#### Introduction

According to national data of sporting activity, swimming is twice as popular as any other participating sport in the United Kingdom, with about 8% of the population (4.5 million) regularly taking part. Fortunately, a recent survey, sponsored by the Sports Council, has suggested that injury rates in swimming are low when compared to other sports with 2.3 non-trivial injuries occurring per 1000 occasions of participation. Indeed, it was found to be even 'safer' than walking/hiking. Of the common sports in the UK, injuries in rugby were the most common at 57.7 injuries/1000 occasion. Football had an injury rate of 19.3 injuries/1000 occasions, but was the sport with the greatest number of injuries simply because of the large numbers of people playing?

Swimming is often hailed as the ideal activity for the recognised benefits of exercise for both those health and with disease. It exercises the upper and lower body, the cardiovascular system and improves joint mobility in a 'safe' environment. Specifically physical activity has clear benefits in the prevention of stroke and heart disease, high blood pressure and osteoporosis or 'brittle bone disease'. It is also valuable in the management of chronic diseases such as diabetes, arthritis and other musculoskeletal disorders. The spectrum of swimmers, therefore, ranges from those people wishing to improve their health by performing safe exercise, to those who swim regularly for enjoyment, to the committed, disciplined, elite swimmer with high sporting goals.

The elite swimmer, however, can and does encounter injury through swimming much more frequently than the recreational swimmer and these will be discussed later. This does not mean that swimming becomes 'unhealthy' for elite athlete, but modern training practices stretch the human body to the limit such that the balance between well being and injury is often fine. Over the last 25 years, it has become clear that the sporting success does require medical input by doctors trained in the care of athletes in the fields of both treatment and prevention. The Amateur Swimming Association is committed to developing a pro-active network to support our elite swimmers in this manner. As with most National Governing Bodies, this has traditionally been on an informal basis but now with formalised training in sport and exercise medicine and lottery funding coming on-line, there will be a more professional approach in the future.

#### Competitive Swimming

Currently in Great Britain, there are approximately 55 000 registered competitive swimmers and 1600 affiliated clubs to the Amateur Swimming Association, the National Governing Body of swimming in England. The ASA is one of the oldest sporting associations having been established in 1869. Administratively England is divided into 5 districts - North, Northeast, Midlands, South and West. There are also individual swimming associations for Scotland and Wales and an umbrella organisation for International competition, the Amateur Swimming Federation of Great Britain Limited. Unlike other Governing Bodies, the ASA, in addition to the pursuit of excellence at the highest level, has a moral responsibility of safety within general

population in providing everyone the opportunity to learn how to swim. For example, it is not important that everyone is able to play tennis!

Competitive swimming encompasses the disciplines of (speed) swimming, diving, water polo, synchronized swimming and long distance (open water) swimming. In (speed) swimming competitions, there are four recognised strokes, namely Freestyle, Backstroke, Butterfly and Breaststroke and an event, which combines all four - the individual Medley. Currently, the Olympic swimming events are:

50m, 100m, 200m, 400m, 800m, (female), 1500m (male) Freestyle  
100m, 200m Backstroke  
100m, 200m Butterfly  
100m, 200m Breaststroke  
200m, 400m Individual Medley  
4x100m, 4x200m Freestyle Medley  
4x100m Medley Relay

The 50m sprint takes around 22 seconds and the 1500m around 15 minutes, taking approximately four times longer than the equivalent distance would if running on land. Swimming is a unique sport in so much that the athlete is suspended in an unnatural environment i.e. the water that requires specific actions to allow even breathing. Not only is there no firm surface to aid propulsion, the water offers considerable resistance to the forward motion. Again unusually for a sport, swimming relies primarily on the arms to generate forward momentum. The legs only become important during sprints, starts and turns, in balancing strokes and in Breaststroke where they account for around half the propulsion. Streamlining is fundamentally important to swimmers in reducing drag forces to a minimum.

Success in all disciplines is only seen after many years of regular training, often twice or more a day and from a young age. In the past, swimming has been regarded as a 'child's' sport and indeed regular training is not uncommon from the age of 8-10 years. Previously the sport had lost its top swimmers early through 'burnout', both physically and mentally, because of the demands of the elite swimmer lifestyle. However, with the improved training programmes and techniques and the advent of sponsorship, many senior swimmers are remaining in the sport longer at the highest level to their late twenties and beyond. Nationally, there is a continuing trend to de-emphasise competition for the youngest age groups. Top level swimming programmes are typically entered at 13-14 years with the aim of keeping the swimmers in the sport for a further 8 -10 years. Currently at a National level, there are championships for Age Groups (12-16 years), Seniors and more recently masters championships which are events for those aged 19-24 years, 25-29 years, 30-34 years etc., even including a 95 years and over age band! These events provide a whole new challenge for swimming doctor looking after these events!

## **Swimming Injuries**

Swimming injuries may be classified as either acute or due to overuse. Acute injuries are relatively rare as there is a lack of bodily contact and swimming is at a relatively slow speed. Careless behaviour in the pool environment can, nevertheless, carry significant danger. Neck injuries with subsequent paralysis and death have been reported when swimmers misjudge the water depth when diving in. This should not occur in those who have mastered the correct, shallow, competitive dive. Slips while running on wet poolsides can result in heavy falls onto the hard tiled surfaces with consequent injury. Drowning in supervised swimming pools is very unusual. In the UK, drowning more typically occurs following the foolhardy behaviour of young men trying to swim in rivers and lakes while under the influence of alcohol. In the disciplined environment of a competitive swimming club, all these types of catastrophic injury are extremely rare.

The acute injuries that do occur in the elite swimmer are usually fairly minor and need little in the way of treatment. A clash of hands or catching fingers on the modern anti-wave lane ropes can cause temporary impairment. Acute muscle strains can occur following failure to perform an

adequate warm-up or when overstretching. These may be in the large muscle groups of the shoulder or in the 'groin' especially due to the breaststroke leg kick. Avoiding any exacerbating activities, icing the affected area should treat these and gradual stretching to regain full range of motion before returning to unrestricted swimming. It may be possible to continue training and still rest the injured area and so that any associated loss of fitness is minimised.

The majority of injuries that affect swimmers causing disruption to training and performance are chronic in nature. These are related predominantly to repetitive microtrauma or 'overuse'. The combination of too much work with insufficient preparation and too little recovery results ultimately in breakdown and injury. It is perhaps not difficult to appreciate why this might happen. An elite swimmer will not uncommonly spend 25 hours per week training with a water programme of 70km per week (=2800 lengths of a 25 m pool and 56 000 overhead strokes per week!). Distance swimmers may swim up to 110km per week! In addition to this is land work that may include weight training, flexibility and cross training. Overwork is certainly one development of the overuse injuries and partly stems from the belief developed in the early 1970's that the greater the distance swum, the faster the times. This did initially result in significantly improvements in World Records but has also coincided with an 'epidemic' of shoulder injuries in swimmers. Certain training techniques such as the use of drag suits and hand paddles are designed specifically to increase resistance and these may precipitate overuse problems if not used with caution.

Training programmes are now developed to allow physiological adaptation of the body to the demands of training before progressing on to more demanding training. They are also scientifically structured to have in-built rest periods in every aspect, both within and between sessions and from week to week. This system of 'periodisation' allows forward season planning to include the times of peak performance and to a certain extent replaces quantity with quality. If injuries in swimming are to be minimised and prevented then it is important that every aspect of the athlete's physique, fitness, training programme, equipment and lifestyle are reviewed in an attempt to identify any predisposing factors to their injury. Often a doctor or physiotherapist with particular experience in sport is best skilled to do this, as the injury is likely to recur if these factors are not addressed. Elite performance depends on many interplaying factors and it is important not to forget the potentially significant effect of factors outside the swimming environment.

### **Swimmer's Shoulder**

Swimmer's shoulder is a well-recognised pain syndrome following swimming that accounts for approximately 60% of the overuse problems in swimmers. A survey of over 1200 US swimmers found 47% of age groupers and 73% in elite swimmers had at some stage had shoulder pain that interfered with their swimming. The exact process involved remains less clear but most believe that it is a combination of factors resulting in an impingement syndrome - the loss of the normal, smooth, guiding motion and trapping of the soft tissues under the point of the shoulder. In part there is an inflammation of the tendons of the rotator cuff muscles, the small stabilising muscles that lie adjacent to the shoulder joint that are irritated by 'overuse', but it may also be as a result of shoulder joint instability. Laxity of the shoulder joint due to injury, natural flexibility, flexibility training and muscle imbalances of the rotator cuff muscles can lead to excessive movement within the shoulder joint further inflaming the tissues beneath the point of the shoulder.

Treatment for mild problems is by increasing warm-up periods and allowing only pain-free activities. Icing the shoulder following training will help reduce pain and inflammation. The coach should review the swimming technique and training program content for any potential contributory factors. Muscle imbalances can be corrected by simple strengthening exercises using dumbbells or elasticated bands. For more marked problems, in addition to the above, the shoulder may need resting completely by performing only kick work (with the arms by the sides) or alternative exercises such as running or cycling to help maintain cardiovascular fitness. Physiotherapy and anti-inflammatory medications can also be helpful. Once the pain has settled, a gradual increase in swimming load over a period of 4 - 6 weeks should enable return to the former level. In problematic cases with persistent pain, further specialist investigations and even surgery may be required.

## **Breaststroker's Knee**

Knee pain is a further common complaint in swimmers, seen particularly in breaststrokers, accounting for around 25% of chronic injuries. In any young, sporting population knee pain is common and has many potential causes. In inexperienced swimmers, poor technique of the Breaststroke 'whip' kick can lead to problems, though it can still be troublesome in elite swimmers due to the force and frequency of kicking. Typical Breaststroker's knee is felt to be a chronic strain of the ligament that stabilises the inside of the knee - the medical collateral ligament. Large forces are produced in this ligament during the specific movements involved in the kick action.

Minor discomfort is again treated by increasing warm - up periods, stretching and avoidance of intense work that will commonly bring on pain. Thigh strengthening exercises and assessment of the correct technique is necessary. The use of ice packs should be introduced early. For greater levels of pain, further physiotherapy and medications are helpful. Resting the knee by not performing Breaststroke kick and the use of a pull-buoy should be started to allow recovery and yet keep the swimmer in the water.

Repeated knee bending can also lead to other problems such as those related to instability or softening of the under surface of the kneecap (or patella). Again thigh strengthening exercises which help control the movement of the patella, should be introduced preferably of the functional, 'closed-chain' type (i.e. mini-squats) rather than leg extension machines of multigyms. Typically treatment is with physiotherapy but occasionally surgery may be required for marked instability of the patella. Sometimes part of the lining of the knee joint (a synovial plica) may become inflamed as it rubs over the thigh with repeated knee bending. The possibility of a meniscal (or 'cartilage') injury should be borne in mind not because they may be caused by swimming, but swimmers often take part in many other sports where typically this type of injury may occur.

## **Butterfly Back**

Lower back pain is not uncommon in elite swimmers accounting for about 10% of all orthopaedic problems. Butterfly and the recently developed 'undulating' technique of Breaststroke typically result in repeated arching over (or hyperextension) of the lower back. This action can cause excess strain on the bony structures of the spinal column resulting in a stress fracture. Kicking drills, where the upper body remains relatively stationary due the use of an arm float, are felt to exacerbate symptoms by focussing the 'whip' in the lower spine. Caution in using such drills should therefore be exercised in those with back problems. Most problems are minor and are likely to be muscle or mild ligament sprains. Treatment is with rest followed by a stretching and strengthening programme with a physiotherapist and tends to improve fairly readily. However, persistent pain, impairing training and not improving after 3 weeks should ideally be investigated further to rule out stress

Fracture. In favourable circumstances, avoidance of sporting activity for 3months will allow complete healing and return to full activity. Continuing activity, however, will prolong symptoms and may lead to a vertebral slippage, a much more serious problem.

## **Overtraining Syndrome**

A 'tired' athlete is not an uncommon problem within an elite swimming programme. At the heart of sporting success is the ability and desire to push one's body to the limits in both training and competition. This leads to a physiological training response that allows a more demanding workload and improved physical performance. In the correct circumstances, all coaches like seeing their swimmers 'tired'!

The overtraining syndrome is a term that has been used when this 'tiredness' or fatigue seems excessive and prolonged leading to a period of poor performance. It can be confusing as it infers that it is only caused by the excess demands of hard training on the body and does not acknowledge the body's ability to cope with such demands. Although it is important to look at the training volume, but it is also essential to recognise the importance of sufficient rest,

adequate diet, an appropriate level of 'fitness', mental status, lifestyle stresses and the effects of recent illness. When understanding the overtraining syndrome, it is better to regard it as a breakdown in the balance between the demands placed on the body and its ability to cope with them. It is essentially an 'overuse injury' affecting the whole body.

Little is known about what exactly causes the overtraining syndrome. There is, unfortunately, no simple warning sign or diagnostic test and so coaches need to keep an open mind. There is, however, an association with the high intensity, interval training of endurance sports and so is seen relatively commonly in swimmers. The symptoms are often vague but include fatigue, aching heavy muscles, poor sleep and depression.

When presented with a 'tired' athlete, close inspection of their training history, diet and recent general health is indicated in the first instance as this may highlight an obvious precipitant. The training programme should be assessed for any sudden or large increases in volume or intensity and whether there is adequate periodisation (i.e. in-built rest periods). Does the swimmer appear to be having sufficient carbohydrate and calorie intake or are they chronically dehydrated? Has the swimmer had a recent viral-type illness, a sore throat or glandular fever that might suggest a post-viral fatigue syndrome? Are there other external pressures such as school exams or are they playing other sports all day?

Often it is a combination of factors that leads to this syndrome. There are, nevertheless, many other medical conditions that may impair performance and an experienced sports doctor, who may wish to perform laboratory tests, best assesses these. Established 'overtraining' requires an approach looking at the 'whole' athlete. Periods of rest from 6-12 weeks, Very light aerobic exercise, communication and reassurance will generally result in a favourable long-term outcome.

## **Diving**

Diving, perhaps, has more in common with gymnastics and trampolining than swimming but remains firmly as an aquatic sport. At major international competitions, there are two events, the 3m springboard and the 10m platform, although the 1-m springboard and other lower platforms are used at other major events. Divers are scored on the skill of execution of the dive and the degree of difficulty as a combination of twists and somersaults etc. In an appropriate diving pool, water depth is not a problem but injury occurs when the board is struck, while performing particularly the inward and reverse dives. Fatal injury has occurred when the diver hit his head on the concrete platform following take off. 'Hitting' the water from 10m also generates large forces and can put strain on the neck. Much of the impact can be diverted by the 'flat-hand' technique of entry. Here the hands are held firmly together to take the impact and open a 'hole' into the water. Indeed, shoulder dislocation has also been reported when this has not been done and the arms have been violently thrown apart. Because of this, the chronic injuries sustained by the diver are typically around the wrists and hands, resulting in tendon and joint sprains. Taping of the wrists and thumbs is commonly used as a preventive and treatment measure. The extreme flexibility in the lower back required by the diver makes problems similar to the 'Butterfly back' also common. Further techniques to allow accurate 'spotting' of the water, such as splashing, will allow correct timing of water entry. The use of wetsuits and compressed air jets from the pool floor will also lessen water impact when performing new and complex dives.

## **Water Polo**

Despite being a non-contact sport, water polo remains a very physical game. Male and female teams of 6-a-side play matches of 7-minute-play quarters. They combine the skills of the swimmer and throwing athlete and understandably also carry the problems associated with both. Acute shoulder problems are more common than in speed swimmers with muscle strains and tears occur while attempting to throw the ball at high speeds. Muscle imbalances of the rotator cuff muscles of the shoulders are common and seem to be associated with overuse shoulder pain. Polo players should also perform strengthening exercises as part of their injury prevention. Finger injuries such as dislocations, fractures and tendon ruptures are commonly seen following

accidents in ball catching. Ball impact can result in nasal fractures and air pressure injuries to the eardrum. Despite the use of ear protectors. Knee problems are seen for similar reasons as the synchronized swimmers. Unfortunately a certain amount of illegal activity goes on beneath the water level suffice to say that a water polo 'box' is usually worn inside male players' costumes!

### **Synchronized Swimming**

Synchronized swimming began as an art form in the early 1900's, becoming a competitive sport in 1946 and an Olympic sport in 1984. The competition consists of a series of four figures and a free routine lasting up to 3.5 minutes. The events may be solo, duet or teams of eight swimmers. The precision of the technique, flexibility, rhythm senses and the ability to perform extreme exercise underneath the water requires a demanding training programme. Injuries that limit performance is fortunately rare but are usually overuse in nature and most commonly are related to the knee. The 'eggbeater' leg kick, as in polo players, is a modified breaststroke kick but with each leg moving independently and following a smaller, more circular action. Again this can result in chronic ligament sprains, exacerbate patella instability and result in knee pain. More recently, concerns have addressed the occurrence of very low oxygen levels during underwater routines. In international competition, dives of up to 75 seconds have been recorded and these have, on occasions, resulted in blackouts. In the light of the medical concerns regarding this, there is a current review of the sport's laws suggesting a 45 second limit to underwater sections in international competition.

### **Long Distance**

These events take place in open water, either the sea or lakes, and vary in distance between 2.5 and 25 kilometres. The large amount of endurance training that has to be performed puts similar stresses on the shoulders as the distance 'speed' swimmers. In addition there is the problem of cold immersion and hypothermia following long periods in the water. Depending on the location, there are also hazards of unseen sharp objects and even jellyfish and sharks!

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