



Injury Prevention

Draft

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Note; This should be read in conjunction with The Safe Stroke – © Australian Canoeing 2004

1 Introduction

The best prevention against injury is just that, prevention. Most injuries are avoidable. While paddling appears to be a relatively low impact and intensity sport, it does require a certain amount of fitness and technique to master. Naïve paddlers will experience more frustration from injury than the paddler who takes some simple precautions. The following information is an introduction to the measures that can be taken to prevent injuries from occurring.

2 Warm-up/cool down

Paddling, no matter how relaxed, is aerobic exercise and should always be treated as such. Any aerobic exercise must be balanced with a period of warming up prior to exertion and followed by a period of cooling down. Often these sessions are overlooked or missed entirely from an exercise program. However, extensive research into injury prevention has demonstrated its significance in muscle recovery and prevention from injury.

Any paddler will know that the first couple of strokes are difficult and require a lot more effort to start moving compared to strokes conducted a ½ hour later. It is

because our muscles require a transition stage of warming up before they are capable of high demanding activities or a range of flexible movements.

A warm-up period can vary greatly between 15-40 minutes, depending on the activity.¹ A general rule for the average paddler is 20 minutes, which includes a gradual increase in the range of movement and intensity. The warm-up should include gentle movement of the main muscle groups similar to the activity. This movement promotes an increase in blood flow, which in turn, carries dissolved oxygen to and carbon dioxide away from the muscles.

Do not try to create a complex warm-up session with different activities each day, obstacle courses or a strict schedule. Just keep it simple and a little creative and it should naturally become part of the paddling agenda.

An example of a warm-up program is a 5-10 minute jog along the launching site followed by quicker movements such as light skips, jumps and sideways running. This will effectively work the leg muscles.

To warm-up the upper body and trunk consider practice strokes on land with or without the paddle. Focus on the full rotation and flexing of the muscle groups. Consider forward, backward and sweep strokes. Only after warming up the muscles are they ready to be stretched.

The cooling-down period after paddling is vital for muscle recovery. Slowly cooling down the muscles prepares them for general use and prevents stiff, tight muscles. This step is important for removing the muscle by-products, lactic acid and carbon dioxide, and continues to carry oxygen to the active muscles. The activity may be similar to the warm-up activity such as a light paddle. Make sure that movement uses the whole muscles in a range of directions, but at a substantially lower intensity, and consists of both extension and contraction of the muscles. Again, stretching should follow the cool-down.

Note; if you are doing an activity that begins and ends with a surf landing (for example), which is of high paddling intensity, it becomes more important that you warm up before and do not simply stop when you hit the safety of the beach.

3 Stretching

After warming-up or cooling-down, the muscles are warm and can be stretched. Stretching eases the muscles to extend in a similar manner to that experienced during the activity. It promotes flexibility and increases the gas exchange between the working muscles and the blood.

A stretch should feel like a gentle pulling sensation on the muscle. If there is any pain involved or discomfort then back off and try a softer approach. There are a couple of different forms of stretching; the most practical is the static stretch.

¹ (Powell, 2004).

Static stretching extends the joint to the end of its range of movement¹ and holds the stretch for a minute before slowly coming out of the stretch. It is a good idea to repeat the same stretch a couple of times and stretch each side. Remember that when you are paddling; the legs, torso and upper body are used in each stroke; it is therefore essential to stretch all these areas.

Ballistic stretching bounces the joint beyond the normal range of movement to increase flexibility. There is a high level of risk associated with this kind of stretching, including muscle tear and strains. Many physiotherapists discourage this kind of stretching except in cases of elite flexible athletes such as a gymnast².

4 Muscle groups

Moving in any direction, shape or form involves at least two muscle groups. The first is the agonist, these are generally the larger muscle groups, they take all the pressure and provide the movement. The second is the antagonist, which acts as the opposing muscle to the primary muscle. There are also stabilizer muscles, which act as the name suggests³ and have less involvement in the actual movement. Each movement in any exercise is performed with the agonist and the antagonist and as a result when stretching, both muscle groups must be considered.

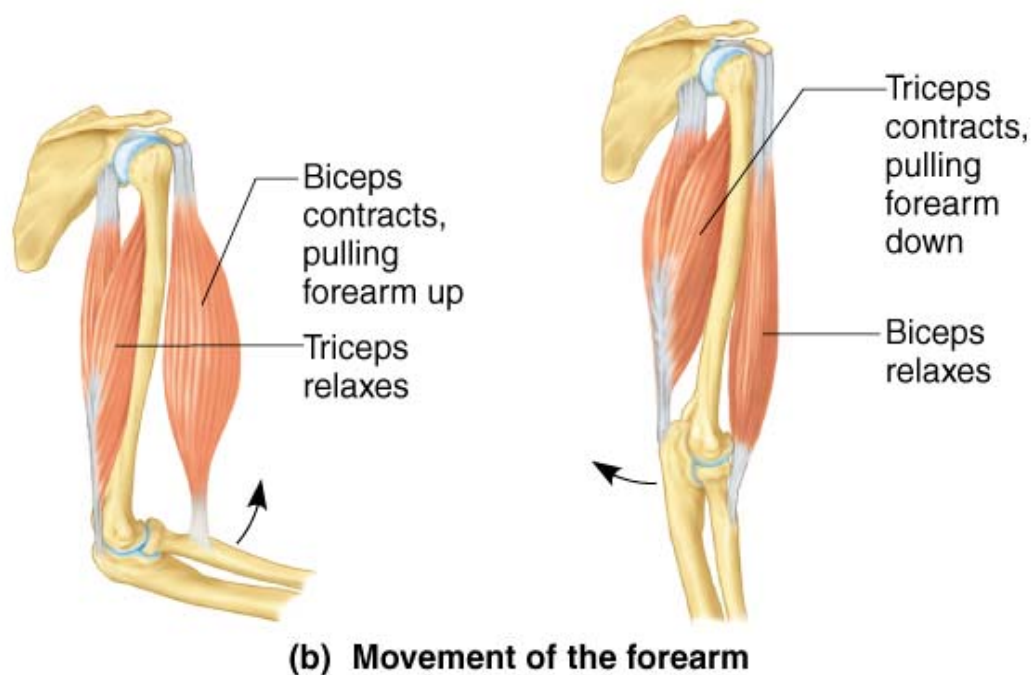
For example, when doing a bicep curl, the biceps are the agonist, that is they contract. The triceps relax therefore they are the antagonist and the deltoids form the stabilizer muscles. When the arm is straightened the muscle groups change roles. The Triceps act as the agonist and the biceps that antagonist. Refer to Fig 1 below.

It is important to stretch both muscle groups. Concentrate on the muscles that will be used in the activity and pay special attention to stretching the agonist and antagonist muscles.

¹ (Powell, 2004)

² (Drozd, 1999)

³ (IFA, 2004)



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Figure 1 Movement of the biceps and triceps as the Agonist and Antagonist muscle

There is often a tendency to overdevelop some muscle groups⁴. This leads to the overcompensation of some main muscles and develops complications in the style of the stroke, increasing the probability of injury. Self-assessment of the strokes aids in the correction of overused muscles. Think through each stroke as you undertake them and note what muscles you are using and what muscles are controlling the movement. There may be a need to consider a weight-training program to strengthen these minor muscles. Do not hesitate to consult a professional Physiotherapist, or equivalent if in doubt about what stretches are good to use, or talk to fellow paddlers and coaches.

5 Correct Paddling Techniques

It is important to have a correct paddling technique right from the start. This will prevent potential injury and the problems of unlearning bad habits. Unlearning or the breaking of habits is far harder than beginning new habits. Feedback from experienced paddlers, resources and video feedback are possible ways to improve stroke technique.

⁴ (Ford, 2003)

Poor posture is one of the primary causes of back injury. There may be several reasons for poor posture. Firstly, check whether the seat and foot bar (or foot pegs) are correctly fitted to paddler; the legs should be slightly bent with light pressure on the foot bar.

Then consider the sitting position of the paddler. A slumped position, where the pelvis is a 'C' shape (looking from the side) indicates that the back is not straight and will potentially cause back problems. A good position is where the paddler sits upright and leans slightly forward. The body is in an 'S' shape, the ball of the foot rests comfortably on the footrest. Be careful with kayak seats that incorporate a backrest or support. It is better not to use these during paddling, leave them for periods of rest.

Balance is another important issue to consider even before conducting the first stroke. It is advisable to customise your seat so that it has a slight forward tilt, the added use of foam can increase the comfort. The correct balance in the craft will help even the use of the muscles in the stroke. For people who have developed an uneven stroke a simple weight and strength building exercises can assist.

After extended exercise there is a normal tendency to slump. Slumping is an easy habit to fall into but it is more complex habit to break, so resist the temptation. Be very careful about picking your kayak up immediately after paddling. Your muscles are tired, stretched and very vulnerable.

One of the common misconceptions is the production of 'power' for the movement of the craft. The arms aid in the delivery of the direction (they stabilise the paddle) but do not distribute the power. It is the larger muscles from the trunk of the paddler, through torso rotation, that provides the strength for the movement. The winding and unwinding effect simulated in the torso rotation responds in a similar pattern to a rubber band as it is twisted, it provides an explosive force when it unwinds. Proper technique prevents strain to weaker joints, such as the shoulder cuff, whilst producing optimal acceleration.

The stroke can be broken down into three basic components (a full description of the stroke can be found in The Safe Stroke).

The Catch

The body is rotated to bring the bottom arm shoulder right forward (do not extend the shoulder joint itself, keep it compact). The blade enters the water in a spear like fashion near the toes. The head remains facing straight ahead. The leading elbow is extended but not locked; the forward arm should not be higher than the face before it brings the blade to the water. Emphasis should be placed on reaching forwards in the stroke with a body that is set up in a fully rotated position. Do not bob forward.

Power Phase

The power of the stroke is produced at the beginning of the stroke. There are no benefits in trying to produce power in the latter stages of the stroke. The power phase involves holding the blade in the water but moving the craft

through torso rotation. The top hand remains fixed relative to the shoulders as they rotate.

Exit Phase

The final stage is the exit of the blade. It is important to note that the body begins to wind up for the next stroke at the exit of the blade. The blade should exit the water at the waist/hips of the paddler and clear the water smoothly. Exit is to the side and not underneath the arm. Excess water on the blade indicates the blade has not been exited to the side or it has been tilted. This produces drag, wastes your energy and slows the movement of the craft and creates more effort for each stroke.

Table 1 Common mistakes to consider in forward stroke analysis, abstracted from Farrance and Jericho, 1998 skills resource.

Mistake	Correction
Entry late or behind feet	Full rotation and "spearing" the entry
Bottom arm bent at entry	Extend bottom arm at entry – not locked straight
Body upright or backwards	Lean forward – straight back
Top arm low, hence end up doing a wide (sweep) stroke	Top arm around eye height
Blade taken behind hip (results in blade lifting water on exit)	Life blade out to the side, rather than back and up
Recovery hand moves in large vertical arc above head (possible causes; paddle too long, blade too big, lack of strength, elbow tucked in)	Lift blade up with elbow, not wrist
Not twisting wrist	Practice left hand pivot

In between paddling sessions it is a good idea to consider complementary exercises and training. Resistance training can assist in the development of supporting muscles and prevents injury to joints. Resistance training can be a simple exercise such as using a fixed bungy cord¹ or thermal band and pull your arm towards your body slowly. Strength training can be performed with no equipment and in the comfort of your own home¹.

To ensure that the stroke is correct; have an experienced paddler watch or record your strokes. Recording the stroke allows you to view the stages of entry and exit of the blade. The video can be viewed away from distractions and often provides a greater source of personal or third party feedback.

A brief look at the major points for injury prevention during paddling

As a starting point, remember that we are homo erectus, our bodies are designed for upright use. As a paddler this means that you should sit upright, straight back (do

¹ (Powell, 2004)

⁵ (Quinn, 2004)

not slouch or hunch). We are also designed to be most effective when we do things close to our core – not extended.

Secondly "always extend the limb and not the joint". You may notice paddlers extending the shoulder joint forward to make a good catch (entry point of the paddle). This is wrong. The shoulder joint should remain "compact" with the arm extending out. Similarly do not extend the shoulder joint back.

Thirdly "restrict that extension"; do not extend limbs to the point that joints are straight. Even at the full forward reach for a forward stroke or sweep, the arm should be slightly bent at the elbow.

Fourthly "the bigger the job, the smaller the extension" In sea kayaks and larger boats, sweeps and draws should be kept close to the body. It will make the effect of the stroke less efficient, however it will protect your body. A fully extended bow draw in a heavy boat can do major damage to shoulders. Similarly reaching way back behind you to perform a stern rudder makes the rudder more effective but dangerously exposes your shoulder. The bigger the seas, the closer the paddle needs to come to you.

Fifth; the good old "paddlers box". This is the concept of keeping all strokes within a range directly in front of your chest. DO NOT reach back or sideways, rotate the torso to bring the action in front of you.

Finally a word of warning in this brief look at injury prevention; always be very wary of the person who says "this works for me". Due to the incredible adaptability of the human body it is possible to do wrong things without damage, if the build up to the wrong action is gradual. A gradual build up gives the body time to develop coping strategies. This is why some people seem to be able to effortlessly perform extended shoulder actions that immediately dislocate the shoulder joints of others. Before you trust anything that comes out as "this works for me", check if it fits with the basic mechanics of the human body.

See The Safe Stroke – © Australian Canoeing 2004 for further details

6 DOMS

Delayed
Onset
Muscle
Soreness

DOMS sets in after intensive exercise above the individual's usual program. This may be a competitive event for an athlete or a beginner attempting a new activity. DOMS is the result of fatigued muscles and may cause tight or sore muscles for a day or even 6 days, until the muscles have recovered. DOMS is not from injury, but a symptom from excessive use and is the first step for the muscle to adapt to a new rate of exertion. Stretching and a warm-up/cool-down program will reduce DOMS, but DOMS can still be expected. It is best to reduce activities while the muscles are recovering for the following 24- 48 hours¹. However, light exercise will aid in the rehabilitation by increasing the blood flow. A nutritious diet and by replacing the loss of carbohydrates, protein and muscle glycogen will also benefit the recovering muscles.

7 Warning signs of injury

There are several obvious signs of injury whether through overuse or extension of a joint beyond the natural range of movement. These can be used as warning sign for potential injury.

Pre-injury signs can be an indication that the muscles are tighter than normal (the reason may be unknown). This sign is important to consider when training; tight muscles are prone to cause greater damage by muscle tear or strain. When muscles are tight, alter your approach to the exercise, do not be scared to take it easy or even sit out of the exercise.

A strain is from a muscle or tendon that is stretched or torn and is commonly referred to as a 'pulled' muscle⁶. It occurs when the muscle is required to contact under a pressure or suddenly or twisted. Strains can also occur from excessive use of the muscle⁷. Muscles that have not been warmed and stretched are particularly vulnerable to strains⁶. Symptoms include swelling and inflammation, cramping and muscle weakness⁷.

Unlike the strain, which is primarily muscular based, a sprain is an injury of the ligament⁷. The ligament is stretched or torn from a sudden movement such as a trip. There is usually swelling, bruising and limited movement at the site of the injury.

⁶ (Penn State Milton S Hershey Medical Center, 2004)

⁷ (Quinn, 2004b)

A cramp is essentially an involuntary muscle contraction; it is common after high intensive activities or sudden inactivity after an exercise program. A muscle cramp can be caused from a variety of different sources. The most common is the depletion of fluids including water and electrolytes (important for cell functions)⁸ after exercise. To prevent cramps from occurring, ensure that sufficient water is taken before, during and after exercising¹, replace lost proteins by eating a nutritious meal within 30 minutes after exercising. Remember to warm-up and cool-down after the activity. It is strongly advised that a cramp is stretched and lightly massaged. Do not try to continue when a muscle is cramped, as it will cause the muscle to extend when the muscle has contracted from the cramp and result in serious injury.

Other examples of pre-injury signs include any discomfort, tightness or soreness of joints, muscles, ligaments or tendons. Do not dismiss muscle soreness to DOMS, acute muscle soreness will occur during or immediately after the exercise and requires rest and rehabilitation.

Another way to prevent the occurrence of an injury is to set aside at least one full day of rest to recover from exercise¹. A day of full rest will also improve the immune systems response against cold and flu¹. Rest is also essential for mental recovery. Prolonged and intensive training has the ability to drain a paddler physically but also mentally. The activity becomes a routine rather than enjoyment. Lethargic and lack of motivation¹ are classic signs of overtraining.

8 Major Sources of Injury

Common sites of injury include the shoulders, wrists, knees and lower back. The most common cause is poor technique or poor muscle condition. Fatigue will likely lead to poor paddling technique. Another source of injury is rushing into an exercise or pushing your body beyond its capacity. After a prolonged absence from paddling one cannot expect to be able to reach full potential in a short amount of time. Regular training will help keep the muscles active and strong.

⁸ (Betterbodz, 2004)

¹ (Powell, 2004)

9 Rehabilitation

R.I.C.E.R

Rest – reduce movement to the injury to limit further damage

Ice – the first hours are crucial, apply a cold pack on the injury 20 minutes every 2 hours for the next 48-72 hours.

Compression – reduces internal bleeding and swelling and aids in the promotion of healing

Elevation – elevation draws the fluids away from the injury, which reduces bleeding, swelling and pain

Referral – consult a professional, ie. Doctor or physiotherapist to give a professional opinion and treatment

ICE

Swelling is caused from bleeding of the internal muscle from the injury⁹. A cold pack or ice is placed on the injury to prevent any further bleeding and reduces the swelling⁹. A cold pack should never be transferred from a freezer to skin. It is recommended that a wet towel be used as an insulating layer and even a sprinkle of vegetable oil on unbroken skin⁹. A cold pack can be applied 20 minutes every 2 hours for then next 48-72 hours¹ to relieve the pain and relax the muscles⁹.

HEAT

Heat treatment is used on the muscles when the bleeding has been stopped and the healing has begun. Heat should never be applied to a new injury⁹ this will cause an increase in the bleeding and other complications. This includes hot baths, heat packs and especially heat creams⁹. Heat is ideal for muscle rehabilitation when there is a need to increase the blood flow and movement.

⁹ Patient UK, 2004

¹ Powell, 2004

CREAMS AND GELS

Creams and gels come in cold and heat active ingredients. The benefits of creams are to reduce the pain but many lack any anti-inflammatory agents¹⁰. Creams have the ability to numb the nerve pain receivers, this gives the individual a false sense of muscle recovery and will utilise the muscle instead of resting leading to nagging injuries. There are far greater advantages in applying ice and then heat treatments to the injury than any creams.

When an injury has been sustained it is highly recommended that you rest the injury until full movement and strength can be generated without pain. Slowly introduce strength training and movement to the area. If there is still no pain then continue to increase these exercises until full rehabilitation. If pain does occur reduce use, rest and consult a professional physiotherapist.

10 Nutrition and fluids

If we stretch our minds back to our PE/health days, or the last time we studied the cereal box, we will remember the Nutrition pyramid (Fig. 2). This diagram visually demonstrates the recommended daily food priorities in our diet. This will change according to individuals' activities and nutritional needs. Such as a vegetarian, who requires more legumes and foods rich in iron to compensate for the nutrients usually acquired from meat.

The nutrition pyramid is a useful guide to the number of servings in each food category on a daily bases. However, the food intake may be adjusted according to the level of activities and health for the individual. When we are ill it is highly recommended that we consume more fresh fruits and vegetables in the form of soups and salads. Drink plenty of water and juices but keep away from fats, and dairy products, alcoholic drinks and coffee.¹¹

During the cold season it is also a good idea to not eat sweets. An American study on the effects sugar on the Neutrophils (special white blood cells that attack viruses) found that after consuming 100grams of sugar (ie. 2 cans of coke drinks) the neutrophils activity levels were only 50% of working capacity before the sugar was ingested¹¹. As a precaution against colds it is best to steer clear of sweets.

According to the nutrition pyramid the greatest proportions of the daily foods are from complex carbohydrates. Carbohydrates are the long lasting energy foods, they provide glucose to red blood cells¹². They are not as bad as they are labelled. Carbohydrates are only a concern if the level of consumption is greater than the level of energy expelled; carbohydrates are then stored as fat¹². As a paddler carbohydrates are not a concern as paddling requires endurance and burns plenty of energy.

¹⁰ The Arthritis Society, 2003

¹¹ Holisticonline, 2004

¹² Holisticonline, 20004b

The best way to get the most out of the day, whether you plan to do any exercise or not, is to start with a good breakfast full of fruit, cereal and milk. It is better to continue munching on healthy snacks, such as fruits and veggies throughout the day then chow down on a big meal. When exercising it is essential that your body has had a super dose of carbohydrates, but do not try exercising on a full stomach. Allow a minimum of 2 hours before exercising. When finishing exercising be sure to replenish the loss of carbohydrates, water and electrolytes within 1 hour.

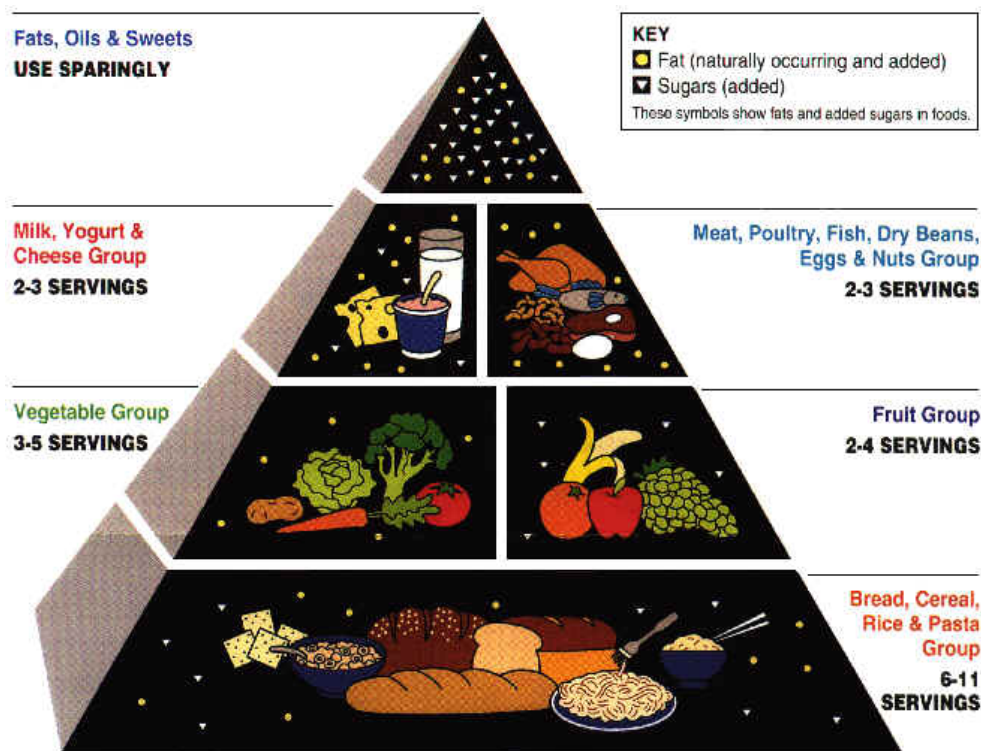


Figure 2 Nutrition pyramid of the recommended daily intake, Campbell, Louisiana Dietetic Association, 2004

Dehydration is the loss of water and electrolytes from the body and prevents vital organ function¹³. Symptoms vary with the degree of dehydration.

Symptoms include;

Mild dehydration -dry lips, thirst

Moderate – dry throat, skin loses elasticity

Severe – weak pulse, cold hands and feet, delirious

Dehydration can occur from perspiration, the type of clothing worn, humidity, the weather and the amount of water and diet recently consumed¹⁴. Severe dehydration will cause muscles and organs to stop function and can have fatal effects.

Drink at least 500ml 2 hours before considering partaking in any physical activity to allow complete hydration of the cells. The 24 hours leading up to a big event, say a race, expedition or long paddle, is an important time to start hydrating. Drink plenty of water before, during and after any exercise. The recommended daily intake is 2 litres of water as a minimum, but this will greatly increase with exercise.

Electrolytes are ions or “salts” that regulate the intake and export of materials into the cells. The concentration of these ions is important for the maintenance of the cells health and function. Sodium (Na^+), outside the cell, and Potassium (K^+), inside the cell¹⁵, are the most important ions in the body. The balance of electrolytes are important as too much of one ion or too little will cause cells to malfunction, cause the break down of organ metabolic processes or be fatal¹³. Electrolytes are lost through perspiration, especially sodium, which reduces the amount of ions available in the blood stream. Sweat can remove between 2.25 – 3.2g of sodium chloride¹⁴. Drinking plenty of water will not replace electrolytes. Electrolyte drinks have been specially formulated to replace the necessary water and salts lost through endurance sports¹⁶. Electrolyte drinks can be taken for activities greater than 1 hour of intensive exercise¹⁷. However, these drinks are not for everyday use.

¹³ Protocare Corporation

¹⁴ Sports Med Web, 2004

¹⁵ Medicine.net.com, 2004

¹⁶ Burke, 2004

¹⁷ Quinn, 2004c

11 Conclusion

Whether you are an athlete or recreational paddler it is vital that you consider your health to enjoy the sport. We all take our health for granted until we pull a muscle. Following a few quick and easy guidelines can dramatically reduce the potential of an injury.

Incorporating a simple warm-up/cool-down program followed by stretching into your paddling schedule. Adjust your diet and hydration before and after paddling will improve metabolic processes and the recovery rate from exercise. Protect your joints from strain by strengthening the less dominant muscle groups through strength training. Have an expert point out any errors in your stroke technique and constantly review whether you are still following the correct stroke techniques. These are some preventive measures in looking after the continual health of your body.

If you have ever sustained an injury you will understand the frustration of not been able to participate in any sports. But relax, keep to the R.I.C.E.R principles and full recovery should come swiftly. Always remember that the prevention against injury is far better than the cure.

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