THE ATHLETES' GUIDE TO PREVENTING AND TREATING PAIN AND INJURY

REHABILITATION

The best exercises to recover from the most frequent sports injuries

If your client, or you yourself, have been injured and are ready to start training again, the last thing in the world you want is for the injury to recur. What should you do?

Obviously, the answer is to carry out functional strengthening exercises (i.e. routines that mimic the demands of the sport) to bolster the part of the body which has been injured. Such exercises will shore up muscles and connective tissues that have been weakened by trauma and disuse, thus allowing the athlete to perform at his/her best and decrease the risk of future injury.

Below, we've listed some of the most common sports injuries, and provided you with a key "rehab" exercise to build the damaged part of the body back up again. Make sure the athlete has a medical "all-clear" before carrying out any of these exercises.

Problem: tight sore hamstrings, hamstring pulls strengthening
Solution: bicycle leg swings

To carry out bicycle leg swings, stand with your weight fully supported on your left leg (you may place your right hand on a wall or other support to maintain balance). Begin by flexing your right hip and raising your right knee up to waist height (your right thigh should be parallel with the ground). As you do this, your right knee should be flexed to 90° or more. Once your thigh is parallel to the ground, begin to extend your right knee (swing the lower part of your right leg forward, unflexing the knee) until your knee is nearly fully extended (i.e. your leg is nearly straight), with your right thigh still parallel to the ground.

As your right knee nears full extension, allow your right thigh to drop downwards and backwards until the entire thigh and leg are extended behind your body (as if following through on a running stride). Your right knee should be near full extension (your leg should be straight) until it reaches the peak of the backswing. As your right hip nears full extension (i.e. as you approach the end of the backswing), raise your right heel by bending your right knee; your heel should move closely towards your bottom as you do this. As this happens, move your right knee forward until it returns to the appropriate position in front of your body, with your right thigh parallel to the ground. Repeat this entire sequence of actions in a smooth manner such that the hip and leg move though a continuous arc without stopping or pausing. Once you are able to coordinate the movement, strive to perform the swings at a cadence of at least 12 swings every 10 seconds (slightly faster than one swing per second).

Begin with one to two sets of 15-30 repetitions with each leg. As you become more comfortable and skilled with this exercise over a period of several weeks, progress to one to two sets of 40-60 repetitions. To more closely mimic the specific action of running, it is important that you increase the speed and ballistic nature of the movement over time as well.

Once you are an accomplished bicycle leg swinger, carry out the exercise with a piece of rubber tubing attached to

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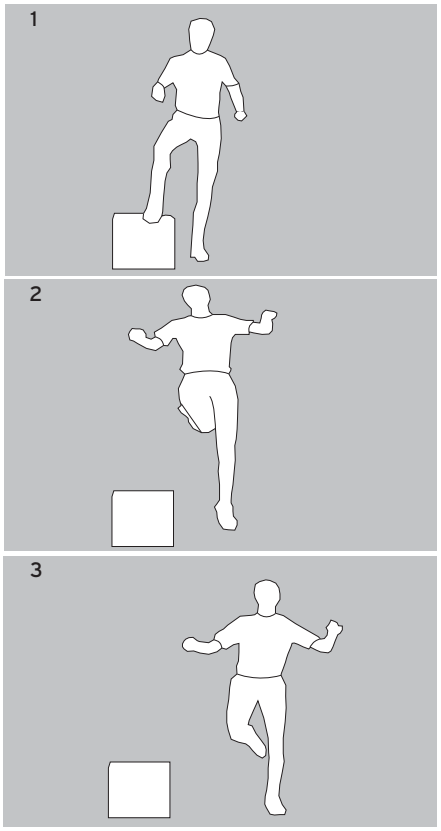
the ankle of your swing leg and anchored to a fixed point at knee level in front of you (such tubing can be purchased from athletic supply firms; start with beginner bands and work up to advanced models). The tubing should be stretched somewhat when you are standing in the starting position. In addition, the tension should be increased (by standing farther from the fixed point or increasing the strength of the tubing) as you gain more strength and coordination with the exercise. As is the case with all of the exercises recommended in this article, you should warm up with at least 10 minutes of easy jogging or cycling before performing the swings.

Problem: ACL (anterior cruciate ligament) tears/surgery
Solution: one-leg squats with lateral hops

Stand with your left foot forward and your right foot back, with your feet about one shin-length apart (your feet should be hip width apart from side to side). Place the toes of your right foot on a step or block which is about six to eight inches high (fig 1). Most of your body weight should be directed through the heel of your left foot. Then, bend your left leg and lower your body until the left knee reaches an angle of about 900 between the thigh and lower part of the leg. Then, hop upwards and laterally, so that your left foot lands about six to eight inches to the left of your takeoff point (fig 2). Upon landing, immediately descend into another squat and again hop upward, (fig 3) but this time hop back to your original take-off point (6- 8 inches back to the right).

Finally, hop to the right a distance of about 6-8 inches, descend into another squat, and then hop back to the starting, straight-ahead position. Be sure to maintain upright posture with your upper body as you do this, and hold your hands at your sides throughout the squatting and hopping movement. Complete a total of 12 lateral hops (to the left and to the right) with your left leg before switching over and doing the same thing with your right leg. Perform a total of three sets with each leg, with 30-60 seconds of rest in between. Make certain that you perform these one leg squats with lateral hops only on soft ground, an aerobics floor, a wooden gym floor, a grassy surface, a rubberised track, or some other resilient surface which offers some "give". Hopping repeatedly on concrete or asphalt may increase the risk of overuse injuries to the lower part of your leg. Why are the one-leg squats with hops important? Sudden changes in direction while running and jumping can re-injure your ACL, due to the increased stress placed on the knee. Lateral



hopping movements help prepare the ACL and muscles around the knee for these sudden (and often times unpredictable) movements in the frontal (side-to-side) plane. It's a great exercise!

Problem: Achilles tendinitis
Solution: the balance and eccentric reach with toes

To carry out the balance and eccentric reach with toes, start by standing on your right foot only as you face a wall, with your right foot about 30 inches or so from the wall (you may need to adjust this distance slightly). Your left foot should be off the ground and positioned toward the front of your body, with your left leg relatively straight.

Then, bend your right leg at the knee while maintaining your upper body in a relatively vertical position and nearly directly over your right foot. As you bend your right leg, move your left toes toward the wall until they touch, keeping the left leg relatively straight. End the movement by returning to the starting position.

Then, complete essentially the same motion, but move your left foot forward and to the left, again keeping your left leg straight and attempting to make contact with the wall. Your left foot may not quite reach the wall, since you are moving in a frontal plane (from right to left) in addition to the straight-ahead, sagittal plane. Notice that your right ankle pronates as you do this (i.e. rolls inward), simulating the natural pronation which occurs during the stance phase of the gait cycle in running and forcing your right calf muscles and Achilles tendon to eccentrically control both dorsiflexion and pronation, as they naturally do whenever you run.

Return to the starting position and then carry out essentially the same motion, but with your left foot crossing over the front of your body and going to the right as you attempt to touch the wall. As you do so, your ankle supinates, as it naturally does toward the end of the stance phase of the gait cycle. Then return to the starting position. Do a few (4-6) reps (the straight, left, and right motions make 1 rep) on your right foot, and then attempt the same exercise with your body weight supported only on the left foot and your right foot moving ahead. A useful feature of this exertion is that it also does a fine job of strengthening your knee and hip muscles and coordinating their activities with what is happening down at the Achilles and calves.

Never attempt the balance and eccentric reach with toes unless you have warmed up properly. If you've been prone to Achilles-tendon problems, here's a good routine to get into: at the very beginning of your workout, warm up by jogging easily for 10 minutes. Then, carry out the Balance and Eccentric Reach with Toes before continuing on with the rest of your session. To make sure you don't put too much stress on your Achilles at first, use slow speeds of motion, modest ranges of motion (not very much bending at the knee), low resistance (just your body weight), and very few repetitions (only 4-6).

Once you're comfortable with doing the exercise balance and eccentric reach with toes, you can begin incorporating greater speeds, larger ranges of motion at the knees and ankles, heavier resistances (starting with very light dumbbells held in the hands and moving up to heavier ones), and more repetitions (starting with 7-10 and gradually moving up to three sets of 20-30 reps). The idea is to progress in difficulty as you progress in strength and coordination.

Problem: Plantar fasciitis
Solution: toe walking with opposite ankle dorsiflexion and toe graspinq

To toe-walk with opposite-ankle dorsiflexion, stand as tall as you can on your toes while BAREFOOT. Balance for a moment and then begin walking forward with slow, small steps (take one step every one to two seconds, with each step being about 10-12 inches in length). As you do this, maintain a tall, balanced posture. Be sure to dorsiflex the ankle and toes of the free (moving-ahead) leg upward as high as you can with

each step, while maintaining your balance on the toes and ball of the support foot. Walk a distance of 20 metres for a total of three sets, with a short break between sets.

Toe walking with opposite-ankle dorsiflexion is important because the muscles of the feet require good strength to control the forces associated with landing on the ground as you run. This toe-walking exercise helps to develop the eccentric (support) strength and mobility in the muscles of the foot and calf, as well as the plantar fascia and Achilles tendon (eccentric strength means hardiness as these structures are being stretched out). The exercise also works the foot and ankle through a broad range of motion, especially the foot which is bearing weight on the ball and toes. The exercise also improves balance and stability, which are critically important for athletes in general.

To engage in toe grasping, stand barefoot with your feet hip-width apart. In an alternating pattern, curl the toes of your right foot and then your left foot down and under, as though you are grasping something with the toes of each foot. Repeat this action (right foot, left foot, right foot, etc.) for a total 50 repetitions with each foot. Rest for a moment, and then complete two more sets of 50 reps for each foot. Try pulling yourself across the floor (smooth surfaces work best) for a distance of three to six feet as you become more skilled at this exercise.

Toe grasping develops strength, coordination and flexibility in the muscles of the foot that run parallel to the plantar fascia and help support the longitudinal arch of the foot. This exercise also strengthens selected stabilising muscles of the calf and shin. Your range of motion during the "grasping" action will improve over time, as will the range of motion of the entire foot.

Problem: Shin splints (medial tibial stress syndrome)
Solution: heel step-downs

To carry out heel step-downs, begin with a standing, natural, erect body position, with your feet about shoulder-width apart, and then step forward with one foot. The length of the step should be moderate – as though you were walking in your normal manner. When your heel makes contact with the ground, stop the foot from fully plantar flexing, i.e. use your shin muscles to keep the sole of the foot from making contact with the ground. After heel contact, the ball of your foot should descend no more than an inch toward the floor or ground; your foot is held in check by the eccentric contractions of your dorsiflexors (shin muscles). Return your foot to the starting position (back by the other foot), and repeat this basic stepping action a total of 15 times. Then, shift over to the other foot and complete 15 steps. Progress to three sets of 15 reps over time.

Once you are the master of the basic heel step-downs, perform the same exercise – but with dramatically longer steps. Using lengthier steps will increase the accelerating forces placed on the dorsiflexors and force them to work more forcefully and quickly, as they must do during running. Start with one set of 15 reps of long steps per foot, and progress to 3 x 15 on each foot over time.

After you've become skilled with the long-step heel step-downs, you're ready to carry out the heel step-downs from a step or bench, which will increase the forces on your shin muscles to the greatest extent and build the greatest amount of strength. Use a bench or exercise platform which is about four inches off the ground to carry out your stepping. Except for beginning each step from a bench, your movements are the same as they are in the basic stepdowns; the idea is to land on the heel of the forward foot and then use the shin muscles to prevent the sole of the foot from making contact with the ground (again, don't let the ball of the foot move downward by more than an inch). The actual length of the step is moderate at first (you can progress to long steps later). As before, begin with 15 reps per foot, and progress to three sets of 15 reps as you gain strength and coordination.

Important point: while these exercises will help you come back from a performance-limiting injury, they can also be used to prevent injury in the future. If you have a weak area which is currently okay but is prone to trouble (hamstrings, Achilles tendon, plantar fascia, etc.), carry out the appropriate exercise described above on a regular basis to lower your injury risk.

PREVENTION TIPS

Here are 10 practical guidelines that will help an athlete avoid getting Injured

An athletes greatest strength is often his greatest weakness, and this is particularly noticeable among fulltime sportsmen and women. The compulsive streak in their character which drives them to practise hour after hour, day after day, is their worst enemy when it comes to handling injuries. The only way around this is to put "avoidance of injury" high on the list of priorities. When I am making out a training plan I always start with the objectives, such things as improving aerobic fitness, practising changes of pace or maintaining flexibility. Including "avoidance of injury" in this list brings it into the reckoning when planning a week's training. These are my guidelines:

I. Never train hard when stiff from the previous effort.
2. Introduce new activities very gradually.
3. Allow lots of time for warming up and cooling off.
4. Check over training and competition courses beforehand.
5. Train on different surfaces, using the right footwear.
6. Shower and change immediately afterthe cooldown.
7. Aim for the maximum comfort when travelling.
8. Stay away from infectious areas when training or competing very hard.
9. Be extremely fussy about hygiene in hot weather.
10. Monitor the athlete daily for signs of fatigue. If in doubt, ease off.

Never train hard when stiff

This seems obvious but it is seen all too often at the beginning of a season or in a training camp. Some people turn up very fit and set a fast pace in training and the others suffer for it the next day. But instead of waiting for the stiffness to go, they try to go on training as hard as the day before. The result is that running is awkward, movements are not coordinated and injuries are more likely.

Introduce new activities qradually

Ideally, one would never introduce anything new at all, but there is a first time for everything and there are bound to be changes of emphasis, the switch from indoor to outdoor training or from grass to a synthetic surface. The solution is to start switching well before it is necessary. In switching from crosscountry running to the synthetic track, for example, one might include a bit of running on the track whenever the opportunity arises, even if it is only three or four laps and a few strides. The first track session of the year would only be half a normal

session and it would be done mostly in trainers. The following week one might do most of one session on the track but only part of it in spikes, and for the next two weeks one increases the proportion done in spikes. After a month, we might be running three times a week on the track, with other sessions being done mostly on grass.

Warming up and cooling down

In the British climate this is particularly necessary. Warm muscles stretch much better than cold muscles. Ligaments and tendons are much more likely to tear when the muscles are cold and inflexible.

The warm-up procedure helps in several other ways, too, both physically in diverting the blood flow from nonessential areas to working muscles, and mentally, in focussing the athlete on the approaching event.

I would recommend at least 15 minutes and up to 30 minutes warm-up before hard training starts. In ball games this can often be done with a ball, carrying out various skill routines, but in all cases it should start with 5-10 minutes of gentle movement, gradually increasing in pace, followed by 5-10 minutes of stretching, still in warm clothing. After that, one moves to fast strides and eventually to short sprints, then stays warm and loose until the start. A sprinter might well take 45 minutes to warm up for a 10-second burst of energy. During the cool-down period, which should last for 10-15 minutes after a competition or a hard training session, the body temperature returns to normal and the fatigue products are flushed out of the muscles, which reduces the chances of stiffness the next day.

Check the course beforehand

In cross-country and road running there may be unexpected traps for the unwary, potholes in the road, sudden ups or downs, all of which could cause trouble if you are not prepared for them, and of course this is closely linked to the next rule.

Wear the right shoes

Wearing shoes which are too light or flimsy or which are unevenly worn are two very common causes of injury. If you turn up expecting a soft course and find that it is frozen hard, you could be in a lot of trouble. I once arrived for a so-called crosscountry race in Madrid to find that it was 90% road. Luckily I had brought my roadracing shoes, but my England colleague, who had only spikes, had to run the race in dance shoes strapped on with pink ribbon! (I won, but he came second.) At a higher level, Liz McColgan threw away a chance of winning the World crosscountry title in Boston because she had not checked out the length of spikes necessary on the snow-covered course. Perhaps the commonest cause of all injuries is training too much on hard surfaces. Running fast on roads and tartan tracks causes a lot of impact shock. I recommend getting off the road at least one day in three.

Shower and change after training

This reduces the likelihood of stiffening up and your chances of catching a cold. Ideally, a hard session or a race should always be followed by a massage if you want to recover quickly.

Travel in comfort

This sounds a bit cissy, but it is not at all uncommon for athletes to stay wedged into a minibus or a train, sitting awkwardly for several hours before an important event. I recommend that you get up, walk around and stretch once every hour while travelling, if possible. Apart from the muscles, the more you can keep down the stress, the better you will perform. It is best to get to the venue the day before the event for anything big, and if you have to deal with major changes in climate and/or time zones it is best to get there a week beforehand.

Avoid infection

After hard sessions, the immune system is definitely vulnerable. Athletes in hard training are particularly susceptible before a big event. They should stay away from crowded rooms, schools, and people with bad colds.

Be fussy about hygiene

All too often people in training camps or in Games villages pick up stomach bugs just before the big event, and the reason is often evident from the sloppy conditions in which they live, with food left around, dirty clothing, people sharing cups and glasses. Athletes, like most young people, have a sense of invulnerability which is positively dangerous.

Monitor fatigue

I have dealt with this before in earlier issues, but it cannot be too highly stressed. In hindsight it is usually possible to trace the cause of an illness or injury, and there is usually a point where the athletes should have eased off but didn't. It is a vital part of the coach's job to tell the athlete when to stop and the athlete must play his/her part by being aware of the early signs of over-tiredness. A raised resting pulse is a sure sign.

Attitude to injury

However careful you are, injuries can occur, particularly in the stress of competition, and illness can be picked up, often when the athlete is really fit. The first thing is damage limitation. The usual course of events is as follows:

1. The athlete feels a little pain during training and ignores it.
2. The pain recurs, and may even be felt after training, but is not bad enough to prevent training.
3. The pain is now bad enough to interfere with normal training, but the athlete can still compete, if he/she rests.
4. The pain is so bad that the athlete can neither train nor compete.

The time to report the injury and start treatment is at stage one. The procedure should be to switch right away from any exercise which makes the injury more painful and to get diagnosis immediately, certainly not later than the next day. At the same time, coach and athlete should work out what forms of exercise are possible, and redesign the programme so that the athlete is at least doing something to maintain cardiovascular fitness, constant body weight and muscle strength. An inactive injured athlete is a real "sick gorilla". It is as important to maintain his morale and confidence as it is to maintain his fitness, but in these days of leisure centres, gyms, static bikes and aquajoggers it is always possible to find some suitable exercise.

To take an example. I had a case where a runner was tripped and fell, tearing some fibres just below the kneecap, three weeks before the Olympic Trials. After icing it and protecting it for the first two days, he started on daily physiotherapy, and massaged the area before each session to stimulate blood flow. He couldn't cycle with it but he could walk, do some circuit training and swim front crawl. After three days of this he progressed to walking and jogging on grass, then to long uphill jogs, trying to avoid limping. Running uphill on grass means there is very little stress but the heart is working quite hard. By the 10th day he was doing long slow training, by the 14th day he was able to train hard, but still mainly uphill on grass. In the third week he was able to do part of the session on the track and at the end of the week he went into the trials with no knee problem at all and finished second, qualifying for the Olympic team.

The key is rapid action when the injury first appears and a lot of psychological support to back up the remedial treatment. It is when things are not going well that the athlete really needs his coach.

INJURY RISK MANAGEMENT

How likely are you to get hurt, and what steps can you take to reduce the risks?

Like most athletes, you undoubtedly want to lower your chances of incurring an injury while participating in your favourite sport. Injuries decrease the amount of time you can spend in leisure activities. lower your fitness, downgrade competitive performances, and can lead to long-term health problems such as arthritis and/or joint stiffness.

But are there general rules for injury avoidance which apply to all sports? Fortunately, yes: scientific investigations concerning the causes of injuries have yielded a number of important points about who gets injured – and why. Most of the studies have focussed on running, even though running is not the most injury-producing sport. In terms of the total number of injuries produced per year, soccer is actually number one with volleyball close behind and running in third place. Sports scientists suggest that injury rates could be cut by up to 25% if athletes took the proper preventative steps.

Common misconceptions

However, sports participants are confused about what to do about injury prevention and in fact there are many misconceptions about injuries. For example, coaches and athletes often believe that males have higher injury rates than females but male and female athletes actually have about the same injury rate per hour of training. Among runners, it's popular to believe that training speed is a critical cause of injuries ("Speed kills," according to one popular adage), but research actually indicates that there's no link between training velocity and injury risk.

Another common belief is that stretching before workouts helps to reduce one's chances of injury, but research again says no. In a very recent study, 159 Dutch athletes were taught how to stretch effectively before training sessions, while a second group of 167 similar athletes received no stretching instruction at all. Although the stretching did a good job of loosening up the athletes' calves, hamstrings, and quadriceps muscles, actual injury rates were identical in the two groups, averaging about one injury per 200 hours of training. The stretching had no protective effect at all!

Don't overdo it

On the other hand, the amount of training you actually carry out plays a key role in determining your real injury risk. Studies have shown, for example, that your best direct injury predictor may be the amount of training you completed last month. If May is a heavy training period, for example, watch out in June! This relationship may seem strange at first, but it simply reflects the fact that vigorous training produces tired muscles which may not be able to stand up to further training stresses. Fatigued muscles also do a poor job of protecting their associated connective tissues, increasing the risk of damage to bones, cartilage, tendons, and ligaments.

If you're a runner, the link between training quantity and injury means that total training mileage is an excellent indicator of your injury risk. The more miles you accrue per week, the higher your chances of damage. One recent investigation found a marked upswing in injury risk above about 40 miles of running per week.

The two best predictors of injury

However, it's important to bear in mind that many injuries are actually not new trouble areas; they are recurrences of previous problems. That brings to mind an important point: the absolute-best predictor of injury is a prior history of injury. In other words, if you've been injured before, you're much more likely to get hurt than an athlete who's been trouble-free. Again, this is logical: regular exercise has a way of uncovering the weak areas of your body. If you have slipshod hip muscles, for example, or knees that are put under heavy stress because of your unique biomechanics during exercise ("poor form"), your hips or knees are likely to be hurt when you engage in your sport for prolonged periods of time. After recovery, if you reestablish your desired training load without changing your biomechanics or strengthening your hip muscles, those areas are very likely to be injured again.

Strangely enough, the second-best predictor of injury, after total training time, is probably the number of consecutive days of training you carry out each week. Consecutive days are counted as follows: if you train on Monday, Tuesday, Wednesday, and Friday, you are training on three consecutive days each week (Friday doesn't count because it has a rest day before and after it). Scientific studies strongly suggest that reducing the number of consecutive days of training can lower the risk of injury. For example, instead of working out for one hour from Monday through Friday (five consecutive days), you could probably reduce your risk of injury by completing 75-minute workouts, four days per week (Monday, Wednesday, Friday, and Saturday, for example). Your total training time would be the same in each case, but the second strategy would reduce your consecutive days from 5 to 2, giving you much more average recovery time between sessions and lowering your risk of injury. Recovery time reduces injury rates by giving muscles and connective tissues an opportunity to restore and repair themselves between workouts.

Type A's should take care

Psychological factors seem to play a role in producing injuries, too. Some studies have shown that athletes who are aggressive, tense, and compulsive have a higher risk of injury than their relaxed peers. Such worried, "Type-A" individuals also have more multiple injuries and lose twice as much training time when an injury actually occurs. So, relax! Tension may make muscles and tendons tauter, increasing the risk that they will be harmed during workouts.

Almost finally, remember that many injuries are caused by weak muscles which simply aren't ready to handle the specific demands of your sport. This is why people who are starting a running programme for the first time often do fairly well for a few weeks but then – as they add on additional mileage suddenly develop foot or ankle problems, hamstring soreness, or perhaps low-back pain. Their bodies simply aren't strong enough to cope with the demands of the increased training load. For that reason, it's always wise to couple progressive resistance (weight) training with your regular training. Resistance exercises can fortify muscles and make them less susceptible to damage, especially if the strength-building exercises involve movements that are similar to those associated with the preferred sport. For example, runners who want to improve leg-muscle strength are probably better off performing "closed-chain" (weightbearing) exercises such as lunges and squats, instead of carrying out nonweight-bearing routines on weight machines while in a seated posi-

tion. The latter activities are as unlike running as exercises can possibly be!

Make it specific

Strength training should also be specific to your sport. If you play tennis or squash, for example, or participate in a sport which involves throwing an object, you should devote lots of time to developing the muscles in front of the shoulder (anterior deltoids, pectoralis major, pectoralis minor, etc.) which increase the force with which you can strike or throw the ball, but you should also work systematically on the muscles in the back of the shoulder, including the trapezius and "rotator cuff" muscles which control and stabilise the shoulder joint during ball-striking actions (and provide most of the force for "backhand" strikes). Finally, remember that the absolutebest predictor of future injury is a past history of injury, so if you were hurt sometime during 2002, be careful! Your chance of an injury in 2003 is about 25-50% greater, compared to the lucky athlete who managed to stay injury-free this past year.

Injury prevention tips

1. Avoid training when you are tired. Tired muscles provide inadequate support for tendons, ligaments, and bones, increasing the risk of strains, sprains, and stress fractures.
2. Make sure that you increase your consumption of carbohydrate during periods of heavy training. Muscles which are low on carbohydrate are tired muscles, leading to the problem mentioned in recommendation no.1. If you're an endurance athlete, you need about 200-225 calories of carbohydrate per stone of body weight during strenuous training.
3. Continuing to build on the "fatigue produces injury" theme, you should bear in mind that increases in training necessitate increases in resting, too. Anytime your training volume increases by more than 2-35%, you need to make sure that you're getting more sleep and taking more time to rest during the day. Otherwise, you're not really training; you're trying to tear yourself down.
4. Remember a key principle of training: total training time doesn't automatically build upon itself. If you've been training for three hours per week, for example, that does NOT mean that you're ready to step up to three and one-half hours per week. Any increase in training should be preceded by an increase in strengthening so that your body is really ready to take on the new load. Runners, for example, should go through a strengthening period emphasising drills to boost legmuscle power before they attempt a significant upswing in mileage. Tennis or squash players should work on their shoulders and legs before they upgrade their playing time.
5. Be especially careful if you're a relative newcomer to your sport. If you've only been participating in it for a few months, you're much more likely to be injured, compared to someone who's been active for several years, simply because the latter individual has had more time to strengthen the appropriate muscles and connective tissues.
6. Treat even seemingly minor injuries very carefully to prevent them from blowing up into big problems. Remember the time-honoured acronym RICE – rest, ice, compression, and elevation – when a small injury strikes. Rest gives the afflicted area time to heal, ice reduces inflammation and swelling, and compression and elevation lessen swelling, promoting healing.
7. Working with your doctor, take antiinflammatory medications to control pain and reduce inflammation and swelling which occur as a result of your sports activity.
8. If you experience pain during a workout, stop your training session immediately. A temporary loss in training time and fitness is far better than long-term damage to your body. Many athletes produce chronic deterioration of a knee joint or another anatomical region by insisting on training through pain. Remember that you're in sport for the long run; a lost month of training to rehabilitate a damaged knee is much better than having to quit your sport completely sometime in the future because of joint degeneration.
9. If you want to toughen your training without raising your risk of injury too much, another good strategy is to slightly raise your average training intensity (speed), instead of tacking on lots of additional volume (miles) of running, cycling, swimming, or walking.

EXERCISES

How to stay on form while injured

Raphael Brandon sets out some rehab regimes to safeguard athletes' baseline strength and conditioning

No one would wish injury on any athlete, but they are a reality for most, so it is extremely useful to learn to treat them in a positive way. The time an athlete spends recovering from injury can be turned to good advantage for conditioning training. In the course of normal training, athletes tend to concentrate on the specific aspects of fitness that have the most benefit and direct relationship to performance. Thus endurance runners spend the vast majority of their training hours running, and tennis players spend most of their training hours on court hitting balls.

Yet there are many elements of training that can be directly or indirectly beneficial to an athlete's performance. The runner may benefit from leg strength training, but has not had time to fit it in; the tennis player may need to increase speed but does not focus upon it. As athletes have to prioritise their precious training hours, many find it impossible to fit in everything that might be required of them.

Periods of rehabilitation from injury can be used as opportunities to follow conditioning programmes that focus on different training elements – those that the athlete would normally neglect for lack of time. The type of activity chosen must be one that will not adversely affect the injury. But even within this obvious limitation, there is usually an activity type and goal that the athlete can achieve during the rehab period.

Here we set out some types of conditioning work that can be carried out during injury rehabilitation. These training programmes are intended to run alongside the specific rehab exercises that the athlete will be undertaking for their injury.

The setting of alternative goals that improve overall athletic ability and conditioning levels is a sound method of keeping an athlete focused in times of injury and can be important for their

self-efficacy – their confidence that they are moving towards their sporting goal.

Injury: Lower limb fracture or joint sprain
Conditioning aim: Upper body strength

Sports in which higher levels of upper body strength arguably improve performance include: rugby, combat sports, water polo and swimming, rowing and canoeing. But this programme is also beneficial for individuals who have below average upper body strength for their event, regardless of sport.

The key principle of the programme is to develop balanced musculature, front and back of shoulder girdle and arms. Exercises for the rotator cuff are included to help prevent any shoulder-joint overuse type injury.

Three programmes are outlined:

- novice: suitable for those with a limited strength training history
- intermediate: for those with good strength training history
- hypertrophy: targeting the build-up of muscle mass.

Programme 1: Novice (Table 1)

Frequency: 2 to 3 times a week

Programme duration: 4 to 6 weeks (Thereafter, if the athlete's injury means they still have time to devote to upper body strength training, you will need to progress the programme)

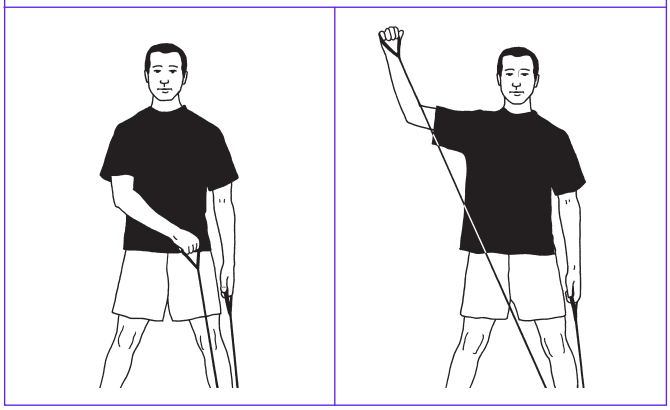
Resistance: The correct weight for any exercise will be the one at which the final set in the series is difficult to complete with good technique.

Programme 2: Intermediate (Tables 2 and 3)

Table 1: Upper body strength conditioning, novice

Exercise	Sets x reps	Rest between sets
Dumbbell bench press	3 x 8	2 min
Dumbbell single-arm row	3 x 8	2 min
Lat pulldown (wide grip)	3 x 8	2 min
Rear diagonal shoulder (pulley or band, see Figure 1, below)	2 x 15	Swap arms
Bicep curls	2 x 15	1 min
Tricep press	2 x 15	1 min

Figure 1: Rear diagonal shoulder pull



Frequency: 2 to 3 times a week, alternating between A and B programmes

Programme duration: 4 to 6 weeks

Resistance: Select weights that require some effort to complete the set, but without fatiguing until the last set.

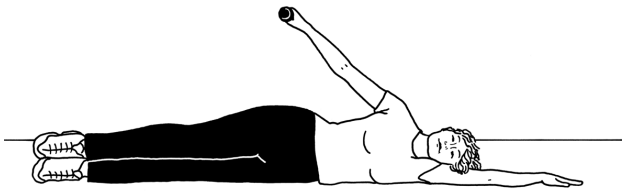
Table 2: Upper body strength conditioning, intermediate A

Exercise	Sets x reps	Rest between sets
Bench press	4 x 5	2 min
Shoulder press	4 x 5	2 min
Barbell row	4 x 5	2 min
Lat pulldown (wide grip)	4 x 5	2 min
Rear diagonal shoulder (pulley or band)	3 x 10	Swap arms
Upright row	3 x 10	1 min

Table 3: Upper body strength conditioning, intermediate B

Exercise	Sets x reps	Rest between sets
Dumbbell bench press	4 x 5	2 min
Incline press	4 x 5	2 min
Single-arm row	4 x 5	2 min
Chin-ups	4 x 5	2 min
Side-lying lateral raises (see Figure 2, below)	3 x 10	Swap arms
Tricep press	3 x 10	1 min

Figure 2: Side-lying lateral raise



Programme 3: Hypertrophy (Tables 4 and 5)

Frequency: Alternate between A and B, performing each programme 2 times a week

Duration: 4 to 6 weeks

Resistance: Set weights that result in complete fatigue (failure) by the final set of each exercise.

Use short rest periods between sets to limit muscular recovery in order to induce hypertrophy.

Injury: Any lower limb injury
Conditioning aim: Non-impact aerobic fitness

For most athletes it will be important to maintain baseline cardio fitness during any layoff for injury. This menu of workouts will be suitable for maintaining the endurance that all team and individual players require. Games players tend to have moderately well developed VO_2 max levels, eg 45 to 60ml/kg/min. It is feasible to maintain this level of fitness with non-impact or cross-training methods. Choose the workout most appropriate to the athlete's particular injury, fitness level and goals.

Specialist endurance athletes with VO_2 max levels greater than 60ml/kg/min will need more advanced and tailored maintenance training than given here.

Use the Miller formula[1] to estimate maximum heart rate:
HR max = 217 – (0.85 x age)
Use the score unamended for the Versaclimber (Table 6) but subtract 5bpm for the row (Table 7) and cycle ergometers (Table 8), as these exercise modalities invoke slightly lower maximum heart rates.

Table 4: Upper body strength conditioning, hypertrophy A

Exercise	Sets x reps	Rest between sets
Bench press	3 x 8	1 min
Incline dumbell press	3 x 8	1 min
Shoulder press	3 x 8	1 min
Lying tricep press	3 x 10	1 min
Rear diagonal shoulder (pulley or band)	3 x 10	Swap arms
Standing tricep press (dumbell or pulley)	3 x 10	1 min

Table 5: Upper body strength conditioning, hypertrophy B

Exercise	Sets x reps	Rest between sets
Bent-over barbell row	3 x 8	1 min
Chin-ups	3 x 8	1 min
Single-arm row (see Figure 3, below)	3 x 8	1 min
Side-lying lateral raises	3 x 10	1 min
Barbell bicep curls	3 x 10	1 min
Upright row	3 x 10	1 min

Figure 3: Single-arm row

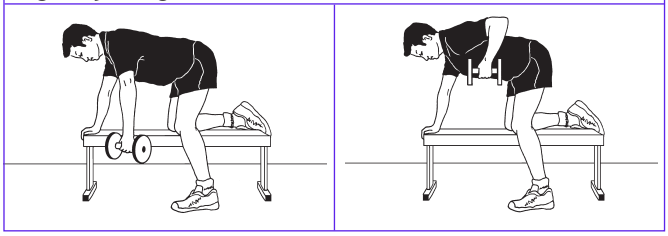


Table 7: Non-impact aerobic fitness, rowing machine

Level	Duration	Settings
Moderate, continuous	20 min	● Maintain 75-80% MHR ● Row tempo: 20-25 strokes/min ● Resistance: 5-6
Aerobic intervals	● 8 x 500m work intervals ● 2 min rest intervals	● Maintain 90-100% MHR ● Row tempo: aim to complete 500m interval in 1 min 40 sec ● Row tempo for rest intervals: easy ● Resistance: 5-6
Anaerobic intervals	● 10 x 200m work intervals ● 90 sec rest intervals	● Heart rate is irrelevant, pace is the target ● Row tempo: as hard as possible for 200m. Aim to maintain same completion time for all 10 intervals ● Row tempo for rest intervals: easy ● Resistance: 5-6

Table 6: Non-impact aerobic fitness, Versaclimber

Level	Duration	Settings
Moderate, continuous	20 min	● Maintain 75-80% MHR ● Adjust resistance to max 'step faster' ● 8-12in step height ● Step tempo of 100-120ft/min; or 120-140ft/min for well-trained athletes
Aerobic intervals	● 8 x 2 min work intervals ● 2 min active rest between each work interval	● Maintain 90-100% MHR ● Adjust resistance to maximum 'step faster' ● 10-15in step height ● Step tempo: 140-180ft/min (depending on fitness levels) ● Step tempo for rest intervals: 60-80ft/min
Anaerobic intervals	● 10 x 30 sec work intervals ● 90 sec rest between each work interval	● Heart rate is irrelevant, pace is the target ● Adjust resistance to maximum 'step faster' ● 10-16in step height ● step tempo: 150-200ft/min (depending on fitness levels). The pace should be very hard to sustain for the final 3 work intervals ● Step tempo for rest intervals: 60-80ft/min

Table 8: Non-impact aerobic fitness, cycle ergometer

Level	Duration	Settings
Moderate, continuous	30 mins	● Maintain 75-80% MHR ● Cycle tempo: 80-100rpm ● Resistance: easy enough to allow for fast rpm
Aerobic intervals	● 5 x 3 min work intervals ● 3 min rest intervals	● Maintain 90-100% MHR ● Cycle tempo: really hard cycle ● Tempo for rest intervals: easy ● Use watts counter to monitor and maintain effort on work intervals
Anaerobic intervals	● 10 x 30 sec work intervals ● 90 sec rest intervals	● Heart rate is irrelevant, pace is the target ● Cycle tempo: sprint ● Cycle tempo for rest intervals: easy ● Use watts counter to monitor and maintain effort on work intervals

Injury: Upper limb injuries that allow running
Conditioning aim: Speed

Upper limb injuries that keep an athlete out of their sport but still allow them to run (eg, a wrist fracture in a football or rugby player) offer the opportunity to develop speed.

You should note that to develop speed requires the athlete to practise technique as well as improve their general conditioning, so it really needs the input of a coach in addition to following a set programme such as given here.

There is good research supporting the use of resisted sprinting for the development of straight-line acceleration in games players[(2)]. Regular practice of maximal sprints over 20-40m, pulling a sled of 15-20% of bodyweight, seems to be effective in increasing speed over these distances.

It is likely that for the games player who needs to be fast, but who is not a sprint specialist, this kind of training provides a specific power development stimulus. From this research it seems that games players could derive some good improvements in speed, even without the input of a specialist coach.

Workouts must be performed fresh (not after endurance or heavy strength training) and must be preceded by a good dynamic warm-up and a number of easy strides (relaxed running at full stride, no sprinting) over 50-60m.

Frequency: 2 per week (1 each of A and B)

Duration of programme: 4 to 6 weeks.

Speed conditioning: A

Intervals: 8 x 40m maximal resisted sprints
Resistance: Pull a 10-15kg sled attached to a harness on the athlete's trunk
Rest intervals: 2 to 3 mins full recovery between sprints
Intensity: Maximum effort for each work interval.

Speed conditioning: B

Intervals: 4 x 30m maximal resisted sprints
Resistance: 10-15kg sled
Rest: 2 to 3 mins between sprints
Followed by:
Intervals: 4 x 30m max sprints
Resistance: None (bodyweight, standing start).

In this workout, the contrast between the resistance and body-weight will give the athlete a good sense of increased power.

References

1. Miller et al (1993) 'Predicting Max HR' *Medicine & Science in Sports and Exercise* 25(9):1077-1081
2. Zafeiridis et al (2005) 'The effects of resisted sled pulling sprint training' *J Sp Med Phys Fitness* 45(3):284-290

KNEE INJURIES

Common knee injuries and runners knee - Do your knees sometimes give you the blues? If so, you're in good company: common knee injuries are the curse of many athletes, especially runners.

If your knee injury pain is lateral (on the outside edge of a knee), then it's likely that you are suffering from one of the most common knee complaints - iliotibial band syndrome (ITBS). As you may have learned the hard way, ITBS may aggrieve your knee enough to drastically limit or even completely stop your training.

Iliotibial band syndrome has been around since man (and woman) first learned to run, but it wasn't actually described in the medical literature until 1975 (Sports Injuries and Their Treatment, p. 56, J. B. Lippincott Publishers, Philadelphia, 1975). The syndrome is often labelled an 'overuse' injury, but that's a very poor way to describe the origin of the problem, since it implies that the main source of difficulty is excess mileage. The truth is that runners can be afflicted with ITBS on a regime of just five to 10 miles per week, even though such volume would hardly constitute overtraining. The key source of iliotibial band syndrome disorders is actually a lack of strength and flexibility in the iliotibial band, sometimes combined with a perverse fondness for running either on the track or on crowned roads, as you'll see in a moment.

Abduction and adduction

What exactly is the iliotibial band? It's not a jazz group whose members tap in time to their music with their tibias. The central feature of the iliotibial band is a key muscle, the tensor fascia lata, which runs down the outside of the thigh just below the hip. Like all muscles, the tensor fascia lata has a band of connective tissue at each end which bind it to bone. The upper band merely ascends vertically a short distance to attach at the top of the hip (thus the name ilio-), but the lower one runs all the way down the side of the thigh before attaching to the lateral side of the tibia, just below the knee (hence the name -tibial).

Overall, the iliotibial band scoots down the outside of the leg from the hip to below the knee, kind of like a broad stripe in one's 'musculo-tendinous uniform'. If you're curious about the muscle's name, the word 'tensor' means 'makes tense', 'fascia' means 'band', and 'lata' signifies 'wide', providing a pretty accurate description of the characteristics of this key muscle.

If you do some digging in any human anatomy book, you'll find that the key action of the tensor fascia lata and its associated bands of connective tissue is supposedly to 'abduct the thigh' (in the patois of human anatomy, 'abduction' means moving a body part away from the midline of the body). At first glance, this 'key action' seems to make sense. If you activate a muscle which originates at the hip and runs down to the outside of the leg just below the knee, wouldn't it simply pull the leg outward, away from the other leg and from the imaginary centre line of the body, a bit like flapping a wing? Of course it would, but how useful is that motion during running? In fact, how instrumental is it to everyday life?

Someone who makes a habit of abducting his legs during movement should set his sights on the ballet stage, instead of athletic competitions. The real function of the iliotibial band during running is not to flap the leg outward but to control and decelerate adduction of the upper part of the leg. Adduction is the reverse of abduction; it's the movement of an anatomical structure toward the body's midline. And it's this very motion which requires constant control during running.

If that's not exactly crystal clear, picture yourself running for a moment. Let's say

that you have 'toed off' from you left foot, soared through the air for a fraction of a second, and have just landed on your right foot. As you do so, your right foot tends to pronate (the ankle joint rotates in a clockwise direction and the foot rolls to the inside), your tibia rotates in a clockwise direction, and - lo and behold! – your femur (the bone in the upper part of the leg) moves inward (goes through adduction). If you still can't picture this, see for yourself by going through your running mechanics in semi-slow motion.

The role of the iliotibial band is to control this adduction - about 90 times per minute per leg as you run and almost 22,000 times during a four-hour marathon! No wonder the ITB sometimes complains! What makes things especially tough for the tensor fascia lata is that when the right foot makes contact with the ground and the left leg begins to swing through there is a natural tendency for the left hip to drop temporarily, pulled down by the omnipresent force of gravity. As it does so, the pelvic girdle 'rocks' like a seesaw; the right hip goes up as the left hip goes down.

As you probably guessed, since the ITB runs from the hip down to the knee, the upward movement of the right hip stretches the tensor fascia lata and overall ITB at the precise time that it is trying to shorten and control adduction of the right thigh. That constitutes an 'eccentric' movement of the tensor fascia lata, and you no doubt know that eccentric actions are the ones which can be especially trauma-provoking to muscle tissues.

Of course, that's one reason why mere stretching of the ITB can never be the complete answer to real or potential ITB troubles. One also has to fortify the tensor fascia lata and its associated connective tissues - making them strong enough to withstand all that relentless eccentric yanking. We'll show you how to buttress your iliotibial bands in a moment, but for now let's make it clear how to tell when you truly have ITB syndrome and not some other condition.

How to diagnose ITB syndrome

As mentioned, a key aspect of ITB syndrome is lateral knee tenderness.

As often as not, the pain won't really hit home until the first one or two miles of a workout have been completed *('Iliotibial Band Friction Syndrome in Runners,' American Journal of Sports Medicine, vol. 8, pp. 232-234, 1980)*. Once it starts, the pain tends to be persistent if you keep going - and frequently gets worse during downhill running (and while walking down steps). The discomfort may radiate up and down the leg, but - strangely enough - the pain will often almost disappear if you stop running and begin to walk slowly and with short steps.

If you have iliotibial band syndrome, a unique examination called the Noble compression test will often be 'positive'. As you lie on your back, your doctor will place his or her thumb over the lateral epicondyle of your troubled leg (the lateral epicondyle is the hard knob on the bottom, outside part of your thigh bone). With the thumb on your epicondyle, you will actively flex and extend your knee. If maximal pain occurs at about 30 degrees of knee flexion, watch out! You probably have ITB syndrome.

The reason your knee 'cries out' during this test is very simple: when your leg is straight, the ITB lies in front of the epicondyle; as you flex your knee the ITB actually passes over the lateral epicondylar surface. As you repeatedly flex and extend your knee (as you would during running), the ITB keeps moving back and forth against the epicondyle; if the ITB is inflamed and swollen, the friction associated with this epicondylar 'rub' can produce quite a bit of pain, especially when your doctor is forcing the ITB to be in close contact with the bone. Similarly, if you have ITB and you stand with all your weight on your affected leg and flex the knee to about 30 degrees or so, you will probably feel a lot of pain if you apply pressure to the outside of your knee.

(As an aside, walking 'stiff-legged' with the affected knee locked in place will often eliminate most of the pain, because it keeps the ITB from rubbing back and forth against the epicondyle.)

In truth, though, ITB problems don't always occur at the knee. Pain may also be present below the knee, where the ITB actually attaches to the tibia, and discomfort may also occur much higher up - in the tensor fascia lata itself or in its tendinous connection with the hip. Many runners recall an especially intense or prolonged workout just before their ITB troubles started. Often, ITB strikes near the beginning of the cross-country or track season, when athletes are attempting to step up their training loads. Having 'bow legs,' excessive leg-muscle tightness, a leg-length discrepancy, or very pronounced foot pronation can all increase the risk of ITBS.

Traditional iliotibial band syndrome treatment

The widely accepted way of taking care of ITBS once it arises is certainly less than perfect. Usually, athletes are told to cut back on their intensity and volume of training and to work out only on smooth, non-hilly terrain. Icing and non-steroidal anti-inflammatory medications are recommended to reduce discomfort and inflammation, and athletes with ITBS are cautioned never to try to 'run through' the pain.

Obviously, those are decent and logical suggestions, but note that not one of these strategies actually addresses the true cause of the ITBS. The athlete who alleviates the symptoms of ITBS with reduced workouts, drugs, icing, and hill phobia and then returns to normal training is often destined for another serious ITB flare-up, with the second episode frequently worse than the first. Unfortunately, severe cases of ITBS can last for up to six months!

Of course, stretching the ITB is often recommended as an ITBS cure-all, and stretching is almost never a bad idea. However, it's important that the stretching routine you adopt actually improves the flexibility of the ITB in a functional way. That can hardly be said for the traditional, popular ITB stretches prescribed for runners, which never mimic the biomechanical patterns associated with running. An over-emphasis on stretching may also lull runners into thinking they are truly getting at the root of their ITB problems, when in fact their gains in flexibility must be combined with advances in strength in order to make the ITB highly resistant to injury.

How to strengthen your iliotibial bands

To truly strengthen your ITB area, simply perform 'Walt Reynolds's ITB Special' on a nearly daily basis. Walt's ITB-saver is easy to carry out. The only equipment you'll need will be a wall or railing for support and some kind of four- to six-inch elevation (a bench or aerobic step will work fine).

Here's exactly what to do. Stand on the aerobic step or bench with your involved leg (the 'involved' leg is the one with the ITB problem), holding on to a rail or the wall with the opposite hand for support. Your legs should be fairly straight as you do this.

Now, with both knees 'locked,' lower the opposite, non-involved foot and hip a few inches toward the floor (of course, the non-

involved leg is between the involved leg and the wall you are using for support. As you do so, your involved hip will move upward somewhat, so that it is actually higher than the non-involved hip. Your involved hip should also move a bit in a lateral direction (toward the outside). This 'swivel-hip' action is crucial to the exercise - and in fact is exactly what happens to the hips during the 'stance' phase of the gait cycle.

Next, attempt to shift most of your body weight to the inside part of the foot of the involved leg. This simulates the natural pronation of the foot which occurs during running, and it also engages and puts tension on your tensor fascia lata and iliotibial band, exactly as it would when you run. Make sure that a fair amount of your body weight is directed through your heel, not just your toes.

You've now come to a crucial part of the exercise. Bend your weight-supporting, involved knee slightly (about 10 to 20 degrees), but keep the non-involved foot off the ground or floor. Now, move the involved hip forward about four to six inches, while keeping the involved heel in contact with the step and your weight on the inside of your involved foot. As you do this, all of the action should be at the hip! Your knee angle should stay about the same throughout the exercise (eg, don't try to rock forward at the knee - do it from the hip). If you think of your pelvic girdle as a bowl of milk, that 'bowl' is rocking backward (ie, the bottom of the bowl is coming up and toward the front as the top of the bowl goes back slightly). As your involved hip moves forward, your upper body should move backward.

Very key points: as your involved hip moves forward, make sure that it stays in a lateral position (if it's your left hip, your left hip should be shifted to the left), and also be certain that your involved hip is higher than your non-involved hip. After you've moved your hip forward, move it straight backward - making sure it goes back four to six inches beyond the straight-up, starting position (the total hip-movement distance in this exercise is around eight to 12 inches, four to six inches toward the front and four to six inches back).

As your hip moves backward, your upper body will tend to bend forward. This action may seem strange to you, especially when you realize that in effect your hip is swinging back and forth over your foot in two different planes of motion – front to back (the sagittal plane) and also sideways (the frontal plane). Most runners envision the biomechanics of running quite differently - and tend to think that the key action during running is the swinging of the foot back and forth around the 'anchor point' of the hip.

However, the truth is that when the foot is on the ground, the foot is the anchor point, and the hip essentially rotates around the foot, not vice-versa. It's this action which puts mega-stress on the ITB, and that's why Walt has rather brilliantly designed this exercise to mimic the hip rotation involved in running and maximally fortify your iliotibial bands. It is this same back-and-forth motion which occurs 85 to 90 times per minute at each hip when you run - and which can turn one of your iliotibial bands into a tattered, complaining mass of red-hot tissue.

As you do the exercise, you should feel the burn - or if not the burn at least some pretty heavy-duty pulling and stress - up toward the side of your hip. If you don't feel anything happening, go back to the basic position and try again, making sure that your involved hip ends up in a lateral position and higher than the other hip - and also making certain that your weight is shifted to the inside of the involved foot. As your weight shifts to the inside of the foot and your hip moves laterally, your thigh is adducted, exactly as it is when you run, and your iliotibial band must work hard to control this adduction as your hip moves back and forth.

Try these advanced versions

Once you get really good at doing the exercise, you can try the advanced versions of Walt's Special, getting the arm on the involved side of the body into the act.

First, move the involved arm laterally and forward as your hips swing forward. Then, try moving the involved arm forward and over the front of the body as the hips begin to swing forward.

Of course, if your iliotibial band syndrome is red-hot right now, you'll have to wait a bit before you try Walt's Special. Otherwise, the remedial exercise itself might exacerbate your flare-up. If you're on the road to recovery from an ITBS setback, do the exercise as your symptoms allow, being careful not to overextend your iliotibial bands (start with just a few reps).

If you're basically symptom-free now but have had trouble with ITBS in the past, you can be fairly aggressive with this exercise. Start with 10 reps per day on each leg, and gradually build up to a set of 20 to 30 reps - carried out at two different times during the day. If you do so, your ITBS problems will become distant memories.

If you've never suffered from the agony of ITBS, do 10 to 15 reps of the exercise three to four times per week, anyway. And always use the exercise as an injury prophylactic during the weeks leading up to a major increase in your training (remember that ITBS tends to occur when the volume and/or intensity of training increase).

For example, if you are in a 'base' period of training but are planning to sharply increase your miles as you begin preparing, say, for a marathon, do at least one set of 15 reps of Walt's Special twice per day on each leg during the last three weeks before your training volume begins to rise significantly (this should be done almost daily). The same would apply to a shift from high-volume, 'aerobic' running to an emphasis on speed work.

Walt's unique exercise will keep you out of ITBS trouble in the future; as it bolsters your iliotibial bands, it will enhance your ability to control the adduction and rotation of your thigh bones (femurs) during running, reducing both fatigue and muscle soreness. As you gain greater control of your hips and thighs, there's also a good chance that your running economy will improve. Remember that you do not want to carry out the exercise only on the leg which has given (or is giving) you trouble. To balance your strength properly, do the same number of reps on each leg, even though one leg may be trouble-free.

Special risk factors

If you love to run on crowned roads, watch out! You are at increased risk for ITBS, compared to the runner who prefers flat surfaces, and your ITB troubles are likely to strike on the 'down' leg, the one positioned toward the outside of the road. That's why runners who run with the traffic tend to have ITB troubles in their right leg; those who run against traffic get the flare-ups in their left appendage. The reason for this, of course, is that the outside foot and leg are moving downward at a faster speed when they strike the pavement, compared to the inside foot and leg, because they have fallen a slightly greater distance. It's as though the outside leg is always running downhill. Thus, the total force on the outside leg will be greater, and there will be an increased need for 'thigh deceleration' by the tensor fascia lata and its associated iliotibial band. The tensor fascia lata will be shortening and generating more force at the same time that the 'pull' on it is unusually great. That's a recipe for injury! It's best to get off the

'crown' and run on the usually flatter shoulder – or else to choose a different, non-sloped location for your workouts.

It's an unwritten law of the universe that runners must run on a track counter-clockwise (anti-clockwise), rather than clockwise. This means that for the person who trains excessively on the track, ITBS will almost always strike in the left (inside) leg, because the left tensor fascia lata and its bands must control a greater deceleration of adduction than the right (outside) hip.

As Walt Reynolds puts it so eloquently, 'When a person runs on a curve to the left, he/she will compensate for the outward-pushing centrifugal force by leaning slightly to the left. The faster they run, the greater the lean must be (that's why very fast track sessions pose an increased risk for ITBS). You see the same thing in flop high jumpers' approach runs; they run fast and lean far to the inside – toward the bar. This lean with the upper torso can drastically change what happens biomechanically. As you lean into a left curve and your left foot hits the ground, pronation is exaggerated compared to running straight ahead, since the left foot tends to land more toward the outside and thus must roll to the inside to a greater extent than usual (there is more frontal-plane - side-to-side - movement than usually occurs). As this happens, the left thigh accelerates inward (adducts) to a greater extent than normal, creating a need for greater deceleration than usual by the iliotibial band and stressing the ITB considerably more, compared to running straight ahead. If you must run on the track, you should alternate back and forth between clockwise and counter-clockwise intervals.'

Get a longer leg!

Having a leg-length discrepancy also increases the risk of ITBS. When the two legs are unequal in length, the shorter leg receives greater stress in much the same way that the outside leg takes in more force during running on a crowned road. The momentum and ground reaction forces are higher for the shorter leg because that leg falls a greater distance before the foot makes impact with the ground. This increases ankle pronation and thigh-bone adduction - and thus the stress placed on the iliotibial band.

Women should suffer from ITBS more frequently than men, since their wider hips promote greater thigh-bone adduction and thus greater stress on the ITB. However, the research doesn't support this idea – and in fact suggests that men may actually be plagued by ITBS more often, perhaps because of their greater muscle tightness and inflexibility.

Speaking of inflexibility, it's important to stress once again that traditional stretches don't work very well at preventing or relieving ITBS. In one of the most popular ITB stretches, if the right leg is the afflicted leg, the left leg is crossed over in front of the right one, and the upper body is inclined to the right (a wall is usually used for support), placing a fair amount of stretch on the right iliotibial band.

One problem with this 'venerable' move is that it is not very functional (it doesn't replicate the movement patterns associated with running), but the other key drawback is that it does not strengthen or increase the resiliency of the ITB. It gives the ITB a little bit of a pull, but the tensor fascia lata and its associated bands don't have to control a blessed thing. The best exercises always bolster both flexibility and strength, and Walt's special exertion certainly does that!

If you've already got a severe case of iliotibial band syndrome, stay in shape by swimming and aquarunning: they will keep you fit without aggravating your condition. Cycling and stair climbing are usually out, because they can produce considerable rubbing of an inflamed ITB band on the outer edge of the femur, potentially delaying recovery.

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