Injury Prevention: Welcome to the grind!!

Principle of injury prevention:

To minimize activity-related injury: improve the benefit: risk ratio associated with physical activity and sport.

Injury prevention can be characterized as being primary, secondary and tertiary.

- Primary: Biomechanics, health promotion, protective gear, group practice.
- Secondary: early diagnosis and intervention, reduce the risk of re-injury, future planning
- Tertiary: rehabilitation to reduce and/or correct an existing problem.

Factors that Assist in injury prevention:

1. Warm up
2. Stretching
3. Taping and bracing
4. Protective equipment
5. Suitable equipment
6. Appropriate surfaces
7. Appropriate training
8. Adequate recovery
Systematic injury prevention:

1. Establish the extent of the injury:
   * incidence
   * severity

2. Establish the etiology and mechanism of the injury

3. Introduce a preventive measure

4. Assess its effectiveness by repeating step 1

**Figure 6.1** The sequence for prevention of sports injuries

**Predisposition:**

**Swimming:** insufficient body roll: low elbow recovery: insufficient external rotation of shoulder. (Rotator cuff tendinopathy)

**Cycling:** Incorrect handlebar and seat height: Toe in/Toe out on cleats. (Thoracic/Lumbar spine injuries, Iliotibial band/patellafemoral syndrome)

**Running:** Anterior pelvic tilt: Poor lateral pelvic control. (Hamstring injuries, Iliotibial friction syndrome).
Korkia et al 1996:

- There is an association between experience in triathlon and the incidence of injury.
- Frequency of injury has been found to increase in athletes' during the spring and summer when training and competition are more intense.
- Elite athletes training up to 800 hours per year, an average of 5.4 injuries per 1000 hours is very high. Injuries varied from minor to major.
- Overuse was the mechanism of injury that has been reported the most:
  - 65% running/ 16% cycling/ 11% swimming
- Further studies have indicated that previous injury is predictive of future injury in the triathlete.
- Williams et al reported that athletes with a cycling background had less chance of injury compared to those of a swimming or running background. This can be linked to the fact that an increase in mileage rather than the actual mileage can contribute to injury.
- Running speed has been linked to an increased incident of injury in athletes; this did not affect ultra-distance athletes.
Warm up:

Why do you warm up?

- Enhanced performance
- Injury prevention

Effects of a warm-up

- Cardiovascular changes
  - 15-20% of your blow flow goes to the skeletal system at rest: after: 10 minutes of general exercise 70-75% goes to the skeletal system
  - Warm up will give the cardiovascular system time to respond to a sudden increase in demand.

- Tissue Temperature
  - Muscle contraction is more rapid and forceful
  - Oxygen release from myoglobin is greater at higher temperature

- Mobilization Hypothesis
  - In initial phase of intense exercise high amounts of energy is required.
  - The Anaerobic reserves are quickly used up and the aerobic system has not yet become fully functional.
  - The difference between the energy available and that is required is the oxygen deficit.
  - Therefore a warm-up should be strenuous enough to cause a mild sweat and a rest period afterwards should be incorporated to replenish the oxygen deficit.

- Biomechanical effects
  - Prepared to move
  - Muscles now require a greater force and length to tear an isometrically preconditioned muscle.

- Psychological effects
  - Rehearsal
    - Specific warm up- visualisation, imagery
    - Beware of Warm up decrement WUD( Adams 1961, Schmidt 1982)
  - Arousal
    - A large relationship between arousal and performance
    - Explained by inverted U-hypothesis.
Warm up Techniques:

Pulse raising: aerobic activity – timing and intensity needs to be considered
Mobility: movement throughout range
Rehearsal: specific to sport and activity

The reliable rule is 10-15 minutes warm-up at 50-60% of maximum threshold.

Stretching:

Advocated and shown to us since we were kids, very limited scientific basis and to whether it improves performance or prevent injuries.

Note: it takes a long time and a lot of work to get even a small adaptation.

There are two elements to stretching: the muscle and the neural system.

Stretching as in static stretching should be approached as a stand-alone work out and note as part of a warm up. However the Psychological impact of stretching must not be forgotten due to the years of use and practice.

Flexibility is a functional thing: We only need enough flexibility to be functional and prevent injury: more is not necessary better.
**Tapping:**

There are a lot of different tapes out there at the moment. If the purpose is to use restrict undesired movement, only adhesive, no-stretch tape is appropriate and effective.

Ideally tape is applied over joints where skin sliding can be limited to one direction. The joints most suited to taping are ankle, wrist, finger, and Acromioclavicular (in the shoulder) and first metatarsophalangeal joint (in the foot).

Tape provides mechanical support and can also improve proprioception.

**Kinesiology Tape:**

K-tape isn't designed for significant stabilization (for that, stick with white ankle tape or strapping tape), but for pain management. It can provide long-term benefits over the 24 to 48 hours following application.

Most athletes use kinesiology tape during the acute stage of an injury and combine it with other modes of therapy. Also, the specifics of tape application matter: When applied in a partially stretched state, the direction of pull acts as a communication system on muscle receptors. It should be applied from the muscle origin towards its insertion point to work in the direction of the muscle fibers. The athlete feels the tape on his/her skin during activity, causing the underlying muscles to respond and reminding the body what it's supposed to do. If the muscle begins to overstretch, the tape provides a cue for the muscle to back off and avoid further injury.

Another method is to apply the tape in an unstretched state while stretching the skin. This creates a gaping effect between the dermis and the muscle, which is believed to aid in drainage of lymphatic fluid and to enhance blood circulation. Theoretically, the additional space allows greater contraction of the muscle and better overall function.

**Protective equipment:**

Any protective equipment that is used through the season will need to fit appropriately.

**The Running shoe:**

The optimum shoe for a runner is the one that matches the runners’ specific mechanical features. Take a close look at American army study on shoe biomechanics and footwear design.
What to look for:

Heel counter: the upper rear part of the shoe. The heel counter should be made of rigid, firm plastic to assist in rear foot stability.

Forefoot flexibility: this must be adequate to allow easy motion of the foot flexing at toe off. Side note: if suffering from metatarsalgia a less flexible forefoot can help.

The Midsole of the shoe: usually made from EVA which is light and a good shock absorber. Here is where the gels and air pads are housed to act as shock absorbers. Midsoles that are too soft allow excessive mobility, where firmer midsoles allow stable platforms and often extend the wear. Midsoles that are flared promote rapid and excessive pronation of the foot and should be avoided.

There is no optimal running shoe; it’s truly based on the individual.

**Appropriate Training:**

Training is the pursuit of activity that will ultimately lead to an increase in performance in a given sport.

The key principles apply

- Periodization
- Specificity
- Overload
- Individuality

**Periodization:** this is a very important component of all training programs, both in long term and short term goals. We can divide it up into 4 phases for a tri-athletes season.

1. Conditioning
2. Pre-competition
3. Competition
4. Rest.

**Conditioning:** This phase emphasizes developing aerobic, anaerobic fitness, strength and power. This is a period where athletes will probably be training tired. They would probably perform poorly if they were to compete.

**Pre-competition:** switches from pure conditioning to technique work.

**Competition:** emphasis is purely on performance while maintaining basic conditioning.

**Rest:** To ensure complete recovery from the physical and mental stress of competition, adequate time should be allowed between each season. 4-6 weeks.
This does not mean you can lie on your sofa; a non-structured program can be introduced, taking on other forms of exercise that is not competitive = Active rest!

Points of importance: Intermediate time frame, very important to introduce easy weeks into a training program; this allows adequate recovery and diminishes risk of injury. During these weeks volume and intensity is decreased and the opportunity for athlete’s progress can be taken: time trial, mini comps. Optimal spacing every 4 weeks is best advised.

Short term time frame, must allow recovery between training sessions. Split sessions, body part sessions, and variable intensity sessions.

**Overload:** This is a variable that athletes and coaches manipulate to allow the athlete to perform work at a greater intensity or to perform a greater volume of work at a given intensity. It can also be to decrease the recovery time between efforts of a given volume and intensity.

**Principles of overload:**

- Apply stress to the body over and above that which is normally encountered.
- Super compensation- Catabolic break down with adequate rest, anabolism occurs and tissue repair and growth occurs. Coping with stress.
- Allow adequate recovery time to produce a training effect
- Increase training load by changing volume or intensity of training
- Only increase volume or intensity at any particular time with percentage increase
- Titrate overload to maximally improve performance without incurring fatigue (This is an art!!!)
- Monitor athlete closely for signs of decreased performance or overtraining.

**Specificity:**

Refers to directing training to enhance the performance in the athletes given sport. Identify the most important components of fitness for each particular discipline and race type.

- Body size composition
- Muscle strength
- Muscular endurance
- Power
- Speed/Quickness
- Agility
- Flexibility
- Balance and Co-ordination
Cardiovascular fitness

**Individuality:**

Individual differences between athletes are great. Programs must be tailored to the athlete’s needs and levels. Factors such as previous training history, age, occupation, current fitness levels and genetic makeup should all be considered.

**Training Methods:**

- Aerobic training
- Anaerobic training
- Strength
- Power training flexibility
- Speed and quickness
- Agility
- Specific skills training
- Cross training

**Aerobic Training:**

Aerobic capacity of an individual is the ability to utilize the body’s glycogen via the metabolic aerobic pathway. Measured via VO2 max - the max amount of oxygen an individual is able to utilize in one minute per kilogram of body weight.

How do we measure it out in the field?

- Heart rate: example 70-80% heart rate to get an aerobic training effect. Max heart rate minus your age and take your percentage. 30 year old male (200-30) x 70%-85% = range of 135-160 beats per minute.
- Rating of perceived exertion (RPE) measured out of units of 20.

**Anaerobic Training:**

Anaerobic training utilizes the anaerobic metabolism of glucose to produce energy without oxygen. This produces less energy per molecule than aerobic activity.

However anaerobic training improves the capacity to maintain a high rate of power production for short durations of exercise at very high levels of intensity.

I will leave the theoretical background on anaerobic physiology and talk about the most efficient method of increasing anaerobic fitness is to undertake a form of intermittent exercise or interval training.

The principle of such training is to achieve a level of lactic acidosis with one individual effort and allow the body to recover from its effects before embarking on another bout of exercise.
This is part of the training program undertaken alongside aerobic training. It needs to be noted that with increased intensity the potential for injury will increase and accelerate chronic fatigue. This type of training is best avoided during competition time.

**Strength and Power Training:**

Muscular strength: is the amount of force that may be exerted by an individual in a single maximum muscular contraction.

Power: is the maximum amount of work an individual can perform in a given unit of time.

Isotonic Strength training:
- Same rate of contraction
- Resistance to movement is constant and the speed of movement is varied.

Isokinetic:
- Same speed of movement
- A muscle group moves through a range of motion at a constant speed with varied resistance

Isometric:
- Same length
- Maximal muscular contraction against immovable resistance

Olympic-type weightlifting:
- Power moves
- Multi range
- Multi muscle

Plyometric training:
- Uses the natural elastic recoil elements of human muscle and the neurological stretch reflex to produce a stronger, faster muscle response
- Combines a rapid eccentric muscle contraction followed by a rapid concentric contraction to produce a fast forceful movement.
- High risk of injury
- Only performed 1-2 times per week when the athlete is fresh and not fatigued.

Speed training:
- Argued to be a largely inherited ability.
- To develop speed by improving muscular power and strength.
- Technique, stride pattern and cadence

Agility training:
- Sports specific
- Able to train and develop
Cross training:

**Adequate Recovery:**
The aim of recovery is to maximise performance and minimise potential for injury.

- Restoration of function
- Neuromuscular recovery
- Tissue repair
- Resolution of muscle soreness
- Psychological recovery

**Recovery the truth and the myths:**

Who here take ibuprofen to train or during an event:

- 7/10 runners at the western states 100 ultra-endurance marathon took painkillers before the race hoping to prevent sore legs.
- 60% of racers at the Brazilian Ironman planned to take ibuprofen tablets, before, during and after the race.
- **MYTH: Ibuprofen will prevent muscle soreness after prolonged exercise**
  - The Truth:
    - Increases inflammatory markers in the blood
    - Mild kidney impairment
    - Low level endotoxemia- bacteria leaks from the colon to the blood.
    - Slowed the healing of tendons, ligament and muscles
      - Prevents the production of prostaglandin

**Massage therapy:**

- It does not increase blood flow to the muscles it actually decreases it
- It also does not remove lactic acid
- This does not mean that a massage is totally useless after a race, the studies conducted have yet to truly find out what its benefits are.
- I have one after every race if I can!!!!!

**So what is the best form of recovery?**

- Refuel
- Rehydrate
- Rest 1 day is enough; studies found that 2 days together caused a decrease in performance.
- Strategically placed rest days or easy weeks throughout your training program will keep you injury free and help performance