Sports Injury and Its Prevention

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Types of Injury Prevention

• Primary prevention: e.g. ankle braces without previous ankle sprain

• Secondary prevention: e.g. early RICE treatment of an ankle sprain

• Tertiary prevention: e.g. wobble board exercises after initial treatment for sprain
Sequence of Injury Prevention (By van Mechelen et al)

1. Establishing the extent of the injury problem:
   - Incidence
   - Severity

2. Establishing the aetiology and mechanisms of sports injuries

3. Introducing a preventive measure

4. Assessing its effectiveness by repeating step 1
Meeuwisse’s Injury Causation model

Internal risk factors:
- Age (maturation, aging)
- Sex
- Body composition (e.g. body weight, fat mass, BMD, anthropometry)
- Health (e.g. history of previous injury, joint instability)
- Physical fitness (e.g. muscle strength/power, maximal O₂ uptake, joint ROM)
- Anatomy (e.g. alignment, intercondylar notch width)
- Skill level (e.g. sport specific technique, postural stability)
- Psychological factors (e.g. competitiveness, motivation, perception of risk)

Exposure to external risk factors:
- Sports factors (e.g. coaching, rules, referees)
- Protective equipment (e.g. helmet, shin guards)
- Sports equipment (e.g. shoes, skis)
- Environment (e.g. weather, snow and ice conditions, floor and turf type, maintenance)

Inciting event:
- Playing situation
- Player/opponent behaviour
- Gross biomechanical description (whole body)
- Detailed biomechanical description (joint)
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The model can be used to identify potential causes of injury.

• The key questions:
  • Who is at increased risk?
  • Why?
  • How do injuries typically occur?
  • Systematic risk management approach for a defined group of sportsperson
Biomechanics

• Faulty Biomechanics: static (anatomical) abnormality or functional (secondary) abnormality.

• Functional Abnormality: occurring after injury or because of poor technique

• Examples:
  • Running with excessive anterior pelvic tilt and lumbar lordosis results in hamstring strain
  • Poor throwing technique can lead to shoulder instability.
  • Faulty backhand drive technique in tennis causes extensor tendinopathy at elbow.
Normal Gait Cycle

(A) Heel strike (initial contact)
(B) Loading response (foot flat)
(C) Midstance
(D) Terminal stance (heel off)
(E) Preswing (toe off)
(F) Initial & Mid-swing
(G) Terminal swing

Stance Phase (60%)
Push Off
Swing Phase (40%)

Double support (10%)
Single support (40%)
Double support (10%)
Single support (40%)
Biomechanics of Running

- Follow-through swing phase (left leg)
- Forward swing
- Stance phase (right leg)
- Heel strike
- Midstance
- Toe-off

- Walking
- Jogging
- Short-distance running
- Middle-distance running
- Sprinting
Strategies of Primary Prevention
Warm-Up

• Prepares for exercise
• General exercise like jogging and specific exercises
• No data for intensity and duration
• Mild sweating without fatigue.
• Effect lasts approximately 30 minutes
• Clinical studies show 50% reduction in injury risk
Warm-Up

Benefits:

- increased blood flow and oxygen delivery to muscles
- Increased circulation.
- smoother muscle contraction and increased mechanical efficiency
- increased range of motion
- decreased stiffness of connective tissue
- Increased cardiovascular response to sudden strenuous exercise
- increased relaxation and concentration
Stretching

• The ability to move through full range of joint

• Hereditary component

• Improves performance in gymnastics and diving
Stretching

Two types:

• Static flexibility: passive movement to end points of range

• Dynamic flexibility: due to muscle contraction.

• Low static or dynamic flexibility may be an Intrinsic Risk Factor for some injury types.
Stretching

Basic principles:

- warm-up prior to stretching
- stretch before and after exercise
- stretch gently and slowly
- stretch to the point of tension but never pain
Taping and Bracing

• Taping (or Strapping) and Bracing are used to restrict undesired, potentially harmful motion and allow desired motion.

• 2 main indication:
  
  • prevention - in high-risk activities, for example, basketball players' ankles
  
  • rehabilitation - protective mechanism during healing phases
Taping and Bracing

According to research,

• not effective for primary injury prevention in the shoulder, elbow, knee and spinal joints.

• *good evidence for* preventing re-injuries
Tape vs Brace
Taping

• Many different tapes and bandages

• To restrict undesired motion: adhesive, non-stretch (rigid) tape.

• Good tape: adhesive, strong, non-irritant, easily torn by therapist.

• The joints most suitable for taping are the ankle, wrist, finger, acromioclavicular joint and first metatarsophalangeal joint.

• Provides mechanical support and enhances proprioception.
Taping

• Complications:
  • reduced circulation from tight taping
  • skin irritation due to mechanical or allergic phenomena
  • decreased effectiveness of tape with time

• Necessary to reapply tape at a suitable break during the athletic activity, for example, at half-time.

• Tape application requires practice to perfect technique.
Bracing

• Advantage:
  • Applied by self
  • Durable
  • Cheaper than repeated taping.
Bracing

• Disadvantages:
  • possible slipping of brace during use
  • weight of the brace
  • problems with exact sizing
  • risk of the brace wearing out at an inopportune moment

• Sometimes it may be necessary for braces to be custom-made.
Protective Equipment

• To shield various parts of body

• Used on return to activity after injury in situations where direct contact may aggravate injury
Suitable Equipment

Running Shoes:

- Heel counter: upper rear part of shoe
- Rigid, firm plastic to assist in rear foot stability.
- Adequate forefoot flexibility to allow easy motion of foot flexing at toe-off.
- With a rigid sole, calf muscles to plantar flex more during propulsion

- *No optimal running shoe*
Suitable Equipment

Summary of recommended features of running shoe for different foot types:

• a rigid heel counter for all foot types
• forefoot flexibility for all foot types
• midsole density should be hard dual density for excessive pronators, intermediate for normal and soft for excessive supinator
• shape of last should be straight or slightly curved for excessive pronators, slightly curved for normal and curved or slightly curved for excessive supinator
(b) Midsole: this is the part between the upper and the outsole

Figure 6.10 Characteristics of a running shoe
(a) Forefoot flexibility

Figure 6.11 Running spikes with negative heel (left) compared with modified heel lifted with EVA material (right)

(d) Last shape. Shoe on the left is straight while shoe on the right is curved
Running Spikes

• Running spikes modified to provide more stability by increasing heel lift and balancing the shoe.
Ideal football boot:
• adequate foot depth in the upper part
• have a rigid heel counter
• have sufficient forefoot flexibility
• have a wide sole
• be slightly curved in shape
• the 'stops' or cleats should be placed to allow adequate forefoot flexibility.
Figure 6.12 Football boots

(a) Midsole cushioned boot

(b) Thermoplastic outsole with cleats designed to enhance rotation
Appropriate Surface

• The surface where sportspeople play contributes to injury risk through excessive shoe-surface traction.

• Significant role of shoe type and floor maintenance
Appropriate Surface

• Studies on Australian and American football suggest that type of grass itself and, thus, the tightness of the thatch, may influence ACL risk.

• These studies suggest that rye grass generally offers a safer surface with respect to ACL injuries for football than some other grasses.
(d) Annual blue grass surface, showing a moderate thatch layer

(b) Kikuyu grass, also showing a thick thatch layer

(c) Rye grass surface, showing a minimal thatch layer. This is probably a safer surface than the others as the blades or cleats of the football boot are less likely to be 'gripped' by the surface
Appropriate Surface

• To consider surface hardness because of its association with overuse injuries such as stress fractures, shin pain and tendinopathy.

• A hard surface such as concrete generates greater force through musculoskeletal system than a forgiving surface such as grass.

• Sporting activities can generate extremely high loads that may, or may not, be modulated by the surface.

• Maximal impact forces during walking have been shown to approach twice body weight, during running three to four times and during jumping five to 12 times.
Nutrition

• Intense training causes skeletal muscle breakdown, which can be exacerbated by inadequate dietary protein.

• Inadequate hydration may compromise blood flow to working muscle, which may increase susceptibility to injury.

• Hydration is thought to influence the amount and composition of joint fluid, which helps to nourish articular cartilage.
Nutrition

• Calcium is the major mineral component of bone but inadequate dietary intake does not appear to be directly associated with bony injury, such as stress fracture.

• Because of the role of micronutrients in bone and/or muscle metabolism, deficiencies in nutrients such as potassium, iron, zinc, magnesium, chromium, copper and various vitamins may increase susceptibility to injury.

• However, at present no data demonstrate this to be the case.
Psychology

Diagram:

- High anxiety level
  - Commits more errors
    - Negative thought patterns
      - Distracted by internal thoughts (e.g., consequences of losing, overanalysis of technique)
  - Disruption in skill performance (due to muscular tension and/or reduced capacity to make fast accurate decisions)
    - Increased number of errors
Psychology

• control of arousal level for optimal performance
• mental imagery
• progressive muscle relaxation
• following a routine
• positive self-talk
• goal setting
• modification of harmful psychological characteristics
Appropriate Training
Learn about training schedule

• Obtaining full training history is essential to identify and prevent possible cause of injury.

• Helps to define long term training goals for coach.
Principles of Training

Periodization

Specificity

Overload

Individuality
Periodization

• Important component of training program

• 3 DISTINCT PERIODS

1. **Preparatory phase** - involves anaerobic and aerobic fitness, plyometrics, weight training. Not ideal phase for competition due to ‘training tiredness’.

2. **Transitional / precompetition phase** - more importance to anaerobic over aerobic fitness. More importance on technique training than strengthening.
Periodization

3. Competition phase- maintain basic conditioning with maximum emphasis on competitive performance.

- The athlete must target for peak performance in the predetermined time in a competitive season.

- Adequate rest between end of one season and start of next season necessary to minimize /prevent injuries.
Periodization

• **Easy weeks**- Lower down the intensity of training program, check athlete’s progress in form of time trial, mini competitions etc. Must be optimally spaced.

• Combine aerobic with weight sessions and anaerobic with technique sessions.
Overload

• Apply stress on body over and above what it normally encountered.

• Increased stress which is not excessive with adequate time to adapt leads to ‘supercompensation’ i.e. increased work capacity.

• Adequate recovery time necessary for training effect.
Overload

• Increase training load by increasing volume or intensity of training.

• Increase in volume precede increase in intensity.

• New training activities should be slowly progressed to prevent injuries.

• Monitor athlete to look for decreased performance or overtraining.
Specificity

• Identify the specific demands of a sport and train accordingly.

• Mis-match can lead to decreased performance and increase chances of injury.
Individuality

Athletes differ in individual parameters like
1. tolerance to training and overload
2. speed of recovery
3. psychological makeup
4. nutritional intake
5. lifestyle habits.

Training history and current state of the athlete helps to predict chances of injury.
Aerobic training

• Increases capacity to use the glycogen stores via aerobic metabolic pathway.

• $V_{O_{2\max}}$ is the measure of maximum oxygen consumption in one minute per kilogram body weight.

• This is also measure for aerobic capacity of an individual.
• Alternatively, heart rate is also used to determine. 70% to 85% of max heart rate which is calculated by subtracting age of athlete from 220 should be targeted to increase aerobic capacity.
Anaerobic training

• Improves capacity to provide high rate of energy for a short duration of exercise at very high intensity.

• Does not use oxygen for generating energy. Rather depends on ATP which provides lesser every per molecule of glucose.

• Improves lactic acid tolerance and hence improves anaerobic ability in training.
Anaerobic training

• Ability of the heart to supply sufficient blood determines the exercise performance.

• Lack of muscle oxygen secondary to cardiac output plateau explains lactic acidosis.

• Mitochondrial adaptation (power house of the cell) explains increased performance.
Anaerobic training

• Noak’s postulate- ‘Central governor’ regulates the number of motor units which can be recruited in high intensity exercises. Neither the heart suffers not the muscle performance.

• Interval training is the best mode to improve anaerobic capacity
Strength and Power training

• Strength in maximum amount of force a muscle can exert whereas power in maximum amount of work an individual can perform in a given period of time.

• Isotonic strengthening is preferred over isometric and isokinetic but has higher incidents of injuries.
Plyometric training

• Uses natural elastic property of muscle and neurological stretch reflex.

• Quick and forceful alternate concentric and eccentric contraction against a resistance are used. Exercises require minimum contact time with ground.

• Has high injury rates.
Other major training types

• Flexibility training- increases range of motion must be accompanied by muscle strengthening in the newly achieved range to prevent injury.

• Speed training- helps to improve running speed by improving strength and power. Improves stride length, cadence and improved running techniques.

• Cross-training- It has benefit of reducing stress on weight bearing joints while still maintaining the aerobic capacity. Hence prevents injury.
Shoulder joint anatomy
Anterior Shoulder Dislocation

• One of the most common sports injuries associated with forceful abduction – external rotation i.e. baseball pitchers, javelin throwers, swimmers and tennis players.

• Injures the attachment to anterior glenoid margin, at times fractures the anterior glenoid rim or even involve the glenohumeral ligament.
• Athlete reports of popping out of shoulder with pain. Loss of sensation in the lateral aspect of shoulder and increased joint space are typical findings.

• Once reduced, the limb must be placed in abduction and external rotation for for 3 weeks is necessary.

• Isometric strengthening for internal rotators is initiated early. Active external rotation is started after 3 weeks of casting.
• Return to full sport is achieved by 3 to 4 months from injury.

• To prevent repetitive dislocation, sports requiring combined abduction and external rotation should be stopped for at least 6 weeks.

• Repeated dislocation can result in anterior instability (dead arm syndrome)
Prevention of shoulder subluxation

• Strengthening the muscles of your rotator cuff
  1. Supraspinatus,
  2. Infraspinatus,
  3. Teres minor
  4. Subscapularis

• Minimize chances of this painful injury.
Elbow joint anatomy
Lateral Elbow pain- Extensor tendinopathy

- Pain caused just below the lateral epicondyle due to collagen disarray.
- Tennis elbow or lateral epicondylitis are unsatisfactory and inappropriate terminologies which are commonly used for this condition.
- Tendinosis of the tendon of ECRB muscle, 1-2 cm distal to its attachment on the bone.
Tendinosis is a chronic injury caused by an accumulation of small tears in the tendon that have failed to heal properly over time.
Figure 18.3 Processes leading to the development of ECRB tendinopathy
• Acute or insidious pain localizing to the extensor tendon with varying severity in response to work of light to heavy intensity may be clinical pointer.

• Pain associated with activity level is usually mechanical (gripping, wrist extension) whereas pain which is unpredictable may be referred in nature (prolonged sitting posture).
Combined rehabilitation protocol

• Control of pain

• Electrotherapeutic modalities - encourages healing using ultrasound, laser and high voltage galvanic stimulation. Heat may be helpful.

• Soft tissue therapy - transverse friction with flexed wrist, digital ischemic pressure.

• Trigger point release
• Stretching of ECRB and associated wrist extensors should be performed.

• Strengthening – as soon as pain permits. Start with isometric contraction of wrist extensor. Gradually proceed to concentric exercises and then to eccentric exercises.

• Counterforce bracing – used 10 cm below elbow join to evenly distribute the force on the extensors.

• Identify and correct predisposing factors.
Ankle anatomy
Commonly involved ligament
Acute ankle sprain

• Lateral ligament injuries occur more in sports requiring frequent change of direction specially in sports played on uneven surface.

• They are also common in sports where the player having jumped lands on another players feet.

• Commonly seen in basketball, volleyball, netball.
Acute ankle sprain

• Inversion injuries are more common than eversion injuries. Eversion injuries take more time to rehabilitate.

• History of able to weigh bear after an ankle injury with subsequent swelling and pain differentiates sprain from fracture.

• Functional loss and severity of pain determines severity of injury.
Rehabilitation for lateral ligament injuries

• Initial management- use PRICE treatment with gradually increased weight bearing.

• Pain and swelling reduction- analgesic to reduce joint inflammation to reduce risk of joint synovitis. Soft tissue manipulation after 48hrs.

• ROM restoration
• Strengthening of the everters of foot in planer flexed position help to prevent further injuries.

• Proprioceptive training after pain subsides and strength is restored prevents future injuries.

• Functional training in full range of motion and technical training reduces risk of injury.
Protective measures

• Use a protective taping or bracing after a significant injury for at least 6 to 12 months post injury.
• Grade 3 injuries must be managed conservatively for at least 6 weeks before proceeding towards surgical reconstruction of ligament.

• Comprehensive rehabilitation is must post surgery before return to sport.
Anatomy of Groin Area
Factors leading to pubic bone overload
(Brukner & Khan, 2006)
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Adductor related Longstanding groin pain

• Localised medially

• Maximal tenderness at adductor insertion site

• Weakness of muscle and palpation may reveal increased muscle tone with trigger points along the adductor longus
Adductor related Longstanding groin pain

Early warning signs:

• Tightness or stiffness during or after activity with nil relief from stretching
• Loss of acceleration
• Loss of maximal sprinting speed
• Loss of distance with long kick on run
• Vague discomfort with deceleration
Iliopsoas related Longstanding groin pain

• Overuse injury resulting from excessive hip flexion such as kicking

• Clinical signs: tenderness of muscle in lower abdomen on deep palpation and below inguinal ligament lateral with passive hip flexion
Iliopsoas related Longstanding groin pain

• Pain free exercise is absolutely crucial
• Correction of hip joint abnormality, stiff intervertebral segments, poor core stability, shortened adductor, iliopsoas, gluteus muscle is necessary.
• Core stability programme helps to reduce adduction related groin pain
• Once, pain free, pre-season adductor muscle strengthening programme reduce incidence of adductor muscle strain.
• Progress the patient’s level of activity on the basis of regular clinical assessment
Hamstring Muscle Strain

- Common injuries in sprinters, hurdlers and long jumpers and hockey.
- Majority injuries occur in biceps femoris muscle
# Predisposing factors

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<td>Race</td>
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<td>Lumbo-pelvic stability</td>
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<td>Joint dysfunction</td>
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### Intrinsic Factors:
- Age
- Previous injury
- Race
- Flexibility
- Strength
- Neuro-myofascial
- Lumbo-pelvic stability
- Joint dysfunction

### Extrinsic Factors:
- Inadequate Warm up
- Fatigue
- Inadequate pre-season training resulting in low fitness levels
- Imbalance between aerobic training and high intensity running drills
- Abrupt increase in training volume and intensity
Prevention of hamstring muscle injury

• Warm up and stretching program
• Pre-season hamstring strengthening sing open chain exercise

Combined multifactorial programs –

• Increase anaerobic interval rather than aerobic training, stretch while the muscle is fatigued, sports specific training drills.
• Program combining general interventions such as improved warm up, regular cool down, series of exercises to improve stability of ankle and knee joints, flexibility and strength of trunk, hip and leg muscle, to improve coordination, reaction time and endurance in reducing soccer player
• Pre-season conditioning programme consisting of sport specific cardiovascular conditioning plyometric work sport cord drills, strength training and flexibility exercises in group of soccer group

• Eccentric strength is particularly important in prevention of recurrence of hamstring strain.
Progressive running program

• Starts 48 hrs after injury
• 10 minutes of gentle hamstring stretching, jogging with short stride and  20 mins running session twice a day
• Patient is encouraged to increase stride length and pace gradually over sessions.
• Interval running over 10mts( acceleration- maintenance – deceleration)
• Finish with 10 mins of gentle hamstring stretching and apply ice.
• Slight pulling sensation in hamstring –session must cease, apply ice and attempt again after next 12hrs.
Thank You