Epidemiology & Evidence in Sports Medicine

- distributions & determinants of injury rates to aid preventative procedures
- descriptive (how much, who, where, when)
- analytic (why, how)
- interventional (control, prevention)

Sports Injury Epidemiology

- 12,000 sport injury prevention articles since 1938 (Klügl et al., 2010)
- articles that examined preventive measures were only 10% of the total
- articles investigating implementation were a mere 1%.

Evidence in Sports Medicine (Update)

Levels of Evidence (Oxford)

<table>
<thead>
<tr>
<th>Evidence level</th>
<th>Study design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>Systematic review of homogeneous RCTs, individual RCT – narrow confidence interval</td>
</tr>
<tr>
<td>Level 2</td>
<td>Individual cohort study or low quality RCT</td>
</tr>
<tr>
<td>Level 3</td>
<td>Individual case-control studies, non-consecutive cohort study</td>
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<tr>
<td>Level 4</td>
<td>Case series</td>
</tr>
<tr>
<td>Level 5</td>
<td>Expert opinion</td>
</tr>
</tbody>
</table>

Evidence level: Study design.
Sports Injury Epidemiology & Prevention

Australian estimates:
30 - 50% injuries preventable
(90% chronic)
(25% acute)

Strategies
rule changes
modify environment / technique
protective equipment

Australian Epidemiological Data (Updated)

Descriptive
- ~5.2 million sports-related injuries annually
- sports injuries cost ~$2 billion annually
- ~5% hospitalisation

Descriptive Data on “Severe” Sporting Injuries (USA)

Traumatic Brain Injury (TBI)
33% sports / recreation related
300 000 new cases per year
deaths / long-term disability
Descriptive Data on “Severe” Sporting Injuries (USA)

Spinal Cord Injury (SCI)
10-15% sport / recreation related
$1 million lifetime cost
66% “recreational” diving

Descriptive Data on Estimated Season Sport Injury Rates

- Footballs 50%
- Soccer 20%
- Basketball, Cricket 15%
- Netball 10%
  - Knee (20%)
  - Ankle (40%)

Analytic Data on ACL Injuries
Factors Associated with Injury Risk
- Gender
  - F 4-8 greater injury rate in ovulatory phase in cycle
  - Increased ACL injuries in reviewed studies favored effect of first half (preovulatory phase) menstrual cycle
- Anatomical
  - Narrow stenosis ↑ injury risk
- Kinematics
  - 60-70% injuries non-contact
  - Knee extended + valgus loading “side-step”
Analytic Data on ACL Injuries

Factors Associated with Injury Risk
Tibial slope – Lateral Plateau

Analytic Data on Specific Injuries

Factors Associated with Injury Risk

- chronic TBI (boxers)
  - apolipoprotein E ε4?

Concussion & apolipoprotein E?

Tierney et al. (2006): collegiate male football (n=383) and female soccer (n=33) athletes, retrospective recall?

Carriers of all 3 APOE rare (or minor) alleles assessed in this study were nearly 10 times more likely to report a previous concussion and may be at a greater risk of concussion versus noncarriers.

Gordon (2010): small, significantly underpowered studies reporting modest to sizeable associations of the APOE promoter G-219T with concussion, where this genetic risk is present for a small proportion of 2 samples of experienced collegiate athletes.

Validity of self-reported concussion??

Findings remain tentative….
Factors Associated with Injury Risk

- pars stress fractures (cricket)
- shoulder-hip counter-rotation (extrinsic “risk factor”)

- quadratus lumborum asymmetry (intrinsic “marker”)

- ACL rupture (Aussie rules)
  - Hard grounds
  - Grass types (cooch vs rye)
Injury Intervention

Breakaway bases still have not been widely adopted and aside from Little League's recent action, no other organization, including the major and minor leagues, has mandated their use.

The American Academy of Orthopaedic Surgeons believes the deployment of breakaway bases at all levels of baseball and softball could dramatically reduce injuries to athletes improving the safety of both sports as well as reducing healthcare costs due to medical injuries. The AAOS recommends that breakaway bases be installed on all playing fields and further recommends that physicians involved with sports activities around the country actively promote the use of breakaway bases in their local community.

Injury Intervention

Examples:
- trampoline removed (gymnastics)
- 50% reduction in overall injury rate in female high school gymnasts
Injury Intervention

Examples:
- "Illegal" tackling banned (gridiron)
- Significant reduction in incidence of catastrophic neck injuries
- President Roosevelt - 1906
  - Flying wedge and other mass formations ban.

Injury Intervention

- "Spearing" banned in 1976 in American football
- Serious cervical spine injuries and quadriplegia diminished dramatically; effect has been sustained.

Injury Intervention

Examples:
- Rugby Union: Scrums / Props
- Reduction in catastrophic cervical spine injuries
- Retrospective (fatal injuries and head trauma excluded)
Injury Intervention

Examples:
- Spear tackling banned (gridiron)
- Significant reduction in incidence of catastrophic neck injuries

Post-Injury Intervention

Acute Shoulder Dislocations
- Significant injury in contact sports
- Painful / debilitating acute injuries
- Clinical goal is to restore stability / prevent redislocation or subluxation

Handoll (2004)

Acute Shoulder Dislocation: Surgery vs Conservative (young)

Outcome: Instability - redislocation / subluxation

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Surgery</th>
<th>Conservative (young)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instability</td>
<td>10%</td>
<td>5%</td>
</tr>
<tr>
<td>Redislocation</td>
<td>15%</td>
<td>20%</td>
</tr>
<tr>
<td>Subluxation</td>
<td>10%</td>
<td>5%</td>
</tr>
</tbody>
</table>
Post-Injury Intervention

Achilles Tendon Rupture
- significant injury in racquet-ball sports
- clinical goal is to optimise treatment for return to sport / reduce re-rupture rates

Khan et al. (2004)

Achilles Tendon Rupture: Operative v Non-Operative

Outcome: Re-Rupture Rate

<table>
<thead>
<tr>
<th>Study</th>
<th>Operative %R</th>
<th>Non-Operative</th>
<th>Follow-up Period</th>
<th>Sample Size</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Khan et al. (2004)</td>
<td></td>
<td></td>
<td>12 months</td>
<td>300</td>
<td>1.0%</td>
</tr>
<tr>
<td>Smith et al. (2010)</td>
<td></td>
<td></td>
<td>12 months</td>
<td>100</td>
<td>1.0%</td>
</tr>
</tbody>
</table>

Follow-up Systematic Review

Riaz JK Khan*, Richard L Carey
Smith 2010
Post-Injury Intervention

Stress Fractures

- common in military recruits / long distance runners
- painful / debilitating overuse injuries
- clinical goal is to optimise treatment for return to duties / training

Rome et al. (2005)

Stress Fracture Treatment: Pneumatic air brace vs control

Outcome: Time (days) to return to full activity / training

<table>
<thead>
<tr>
<th>Study</th>
<th>Brand</th>
<th>Control</th>
<th>Pneumatic Air Brace (Day 0)</th>
<th>Weighted Mean (days)</th>
<th>Weighted Mean Difference (days)</th>
<th>Weighted Mean Difference (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rome 2005</td>
<td>10</td>
<td>15</td>
<td>10</td>
<td>20</td>
<td>-20</td>
<td>(95% CI: 0, 40)</td>
</tr>
<tr>
<td>Rome 2006</td>
<td>12</td>
<td>14</td>
<td>12</td>
<td>24</td>
<td>-12</td>
<td>(95% CI: -2, 22)</td>
</tr>
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<td>Rome 2007</td>
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<td>14</td>
<td>12</td>
<td>24</td>
<td>-12</td>
<td>(95% CI: -2, 22)</td>
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Injection treatments for patellar tendinopathy (Update)

Platelet-rich plasma (PRP)

- “cocktail” of growth factors
- proposed - growth factor (PDGF), transforming growth factor (TGF-
  β) and vascular endothelial growth factor (VEGF) promote tissue healing
- PRP injection is “promising” treatment
Injection treatments for patellar tendinopathy (Update)

Sclerosis
- Injection of a chemical irritant (eg. polidocanol)
- Destroying neovessels and accompanying nerves chemically - prevent tendon pain
- Seems to be a promising treatment

Terminology - Getting Things Right?
Prevalence = total # (new / old) cases in pop. at given time
Incidence = # of NEW injuries occurring in pop. @ risk over period of time

Evidence Based Practice
- Number needed to treat or Number needed to harm express effectiveness and safety of intervention in a way that is clinically meaningful.
- NNT is computed with respect to two treatments A and B, with A typically a drug and B placebo (eg. A is 5-year treatment with hypothetical drug, and B is no treatment). A defined endpoint has to be specified (eg. appearance of colon cancer in the 5 year period). If the probabilities \( p_A \) and \( p_B \) of this endpoint under treatments A and B, respectively, are known, then the NNT is computed as \( \frac{1}{p_B - p_A} \).
- NNT for breast mammography is 285; that is, 285 mammograms need to be performed to diagnose one breast cancer.
- An NNT of 4 means if 4 patients are treated, only one would respond.
- An NNT of 1 is the most effective and means each patient treated responds, e.g., in comparing antibiotics with placebo in the eradication of *Helicobacter pylori*.
- An NNT of 2 or 3 indicates that a treatment is quite effective (with one patient in 2 or 3 responding to the treatment). An NNT of 20 or 40 can still be considered clinically effective.

*Helicobacter pylori* identified in 1982 by Barry Marshall and Robin Warren - awarded the 2005 Nobel Prize in Physiology or Medicine.