Sport injuries of upper extremity in tennis players

Reporter: Jeng-Ming Tsai
Adviser: Lin-Hwa Wang
Li-Chieh Kuo
Outlines

- Introduction
- Biomechanics Mechanism
- Common Injuries: shoulder, elbow and wrist
- Prevention and Rehabilitation
- What’s New?
Introduction

- **Tennis**
- Global sport, more than 200 countries affiliated with the International Tennis Federation
- Professional sport
- Differences in equipment, biomechanics, and physical demands result in injury profile that differs from other sports (Pluim, et al., 2006)
Injury incidence varied from 0.05 to 2.9 per player per year; 0.04 to 3.0 injuries/1000 hours.

Tennis elbow prevalence varying from 14% to 41% (Pluim, et al., 2006)
Health benefits (Marks, 2005)

- Enhanced aerobic capacity
- Greater bone density in specific regions
- Lower body fat
- Greater strength
- Maintain reaction time performance
- Reduce 50% from death from any causes (3 times/week)
- 41% lower risk of death from coronary heart diseases (3 hr/week)
FIGURE 1—Measurement technique used for glenohumeral joint internal rotation with 90° of abduction and scapular stabilization.

(Tood, et al., 2002)
Biomechanics Mechanism II

- No significant difference in ER, IR ↓ (Tood, et al., 1996)
- IR + ER ↓ in dominant arm (Tood, et al., 2002)
- ER ↑ IR ↓ (Chandler, et al., 1990)
- GH joint instability with ER ↑ (Warner, et al., 1990)
- Shoulder impingement with IR ↓ (Warner, et al., 1990)
Biomechanics Mechanism III

- Glenohumeral joint (GH) repeat external rotation in abduction (abd) position, lead to subtle anterior instability and ultimately rotator cuff and labral pathology (Burkhart, et al., 2000; Jobe, et al., 1989)

- Ant.-sup. humeral head migration (Masten, et al., 1990; Jobe, et al., 1990)

- Fibrous tissue formation in post. capsule as well as musculoskeletal tightness of post. rotator cuff (Pappas, et al., 1985; Chandler, et al., 1990)
Due to bony constraints, very little muscle activity is need to stabilize the elbow joint. Shoulder joint require much muscle activity to stabilize (Kibler, 1994).
23 male & 13 female
Dominant shoulder is significantly stronger in Peak torque (PT)
PT in relation to body weight (PT/BW)
Total work (TW)
Abductors weaker than adductors
(Silva, et al., 2005)

Horizontal abd. (pectoralis major)
Horizontal add. (mid deltoid )
Cybex 6000
Two speed: 60° & 180°/s
32 female Cybex 6000 90° and 180°/s
Significant greater dominant arm wrist flexion, extension and pronation is measured at both speeds.
Significant less dominant side forearm supination is measured at both speeds (Ellenbecker, et al., 2005).
Tennis players often have mild supination and flex. contractures (Kibler, et al., 1992)
Common injuries: shoulder

- Rotator cuff inflammation
- Shoulder instability
- Tennis shoulder (Joseph, et al., 1998)
- SLAP lesions
- Impingement
- Subacrominal bursitis

(Sports injuries, 3rd edition)
Common injuries: elbow
Common injuries: elbow

- **Lateral** tendon injury (lateral epicondylitis)
- **Medial** tendon injury (medial epicondylitis)
- **Valgus** overload triad (ulnar nerve entrapment, medial collateral lig. Injury)
- Osteochondral injury
- **Posterior** impingement
  (Kibler, 1994; Brian, et al., 2003)
Common injuries: wrist & hand

- **Tendon** injuries
- Ulnar wrist pain
- Ulnar carpal impingement
- **Triangular** fibrocartilage injuries
- Triquetrolunate or scapholunate lig. Tears
- **Hook** of the hamate fractures (Rettig, 1994)
Prevention & Rehabilitation I

- Prevent injuries by using appropriate racquets design to reduce impact, speed, and vibration on the arm.
- Wearing protective athletic braces, sunglasses, sunblock, cushioned supportive shoes.
- Maintaining good biomechanics, stretching to improve flexibility, and having a more balanced training schedule (Marks, 1998; Swank, et al., 1998; Spector, et al., 1996; Leach, 1991).

Racket grip size: mid-line of palm and tip of middle finger
Prevention & Rehabilitation II

- Most common type of injuries are muscle strains and lig. sprains secondary to overuse.
- Evaluation: player’s physical condition, previous injuries, skill level and intensity of training and the string tightness, grip, racquet, footwear and course surface (Joseph, et al., 1998).
- Education of players, parents, and coaches about sport injuries, interval screening of players to identify problem areas before injuries occur (Pluim, et al., 2006).
<table>
<thead>
<tr>
<th></th>
<th>Acute phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complexes involved</td>
<td>Tissue injury</td>
</tr>
<tr>
<td>Therapeutic activities</td>
<td>Clinical symptom</td>
</tr>
<tr>
<td></td>
<td>Active rest</td>
</tr>
<tr>
<td></td>
<td>Conditioning of other areas</td>
</tr>
<tr>
<td></td>
<td><strong>Nonsteroidal anti-inflammatories</strong></td>
</tr>
<tr>
<td>PT modalities</td>
<td></td>
</tr>
<tr>
<td>Protected ROM exercises</td>
<td></td>
</tr>
<tr>
<td>Muscle activity</td>
<td><strong>isometric</strong> and <strong>isotonic</strong></td>
</tr>
<tr>
<td>Criteria for advancement</td>
<td>Resolution of swelling</td>
</tr>
<tr>
<td></td>
<td>Decreased pain</td>
</tr>
<tr>
<td></td>
<td>Tissue healing</td>
</tr>
<tr>
<td></td>
<td>Improved ROM</td>
</tr>
<tr>
<td>Complexes involved</td>
<td>Recovery phase</td>
</tr>
<tr>
<td>--------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Therapeutic activities</td>
<td>Tissue overload</td>
</tr>
<tr>
<td></td>
<td>Functional biomechanical deficit</td>
</tr>
<tr>
<td></td>
<td>Appropriate loading</td>
</tr>
<tr>
<td></td>
<td>Protected ROM exercises</td>
</tr>
<tr>
<td></td>
<td><strong>Resistive exercises</strong> (local, balance and kinetic chain)</td>
</tr>
<tr>
<td></td>
<td>Functional exercises</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Criteria for advancement</th>
</tr>
</thead>
<tbody>
<tr>
<td>No pain</td>
</tr>
<tr>
<td>ROM equal to opposite side</td>
</tr>
<tr>
<td>No remaining pathology</td>
</tr>
<tr>
<td>Strength 75% of normal</td>
</tr>
<tr>
<td>Smooth kinetic motion</td>
</tr>
</tbody>
</table>
| Complexes involved | Functional biomechanical deficit
| Subclinical adaptations
| Strength and flexibility balance
| Plyometrics
| Functional progressions (throwing, running, kicking) |
| Therapeutic activities | |
| Criteria for advancement | Full ROM (essential)
| Normal strength and balance
| Normal mechanics
| Sport-specific progression |
What’s New?

- The biomechanical investigation on the hand during backhand stroke.
- Aim at adolescent & adults with different experience.
- Estimate a measure of association between risk factors and occurrence of tennis injuries.
- To assess the relationship between ergonomic factors (e.g. the racquet and the player) and performance.
- To evaluate improvements of performance using biomechanical viewpoints after a specific training protocol.
- To investigate causative factors which may result in a specific injury (carpal tunnel syndrome, tennis elbow) by using the kinematical and kinetic analysis.
Thanks for your attention