Introduction to the Biomechanics of Sport & Exercise

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* 3 Definitions of Biomechanics

- **Biology** – Study of living organisms
- **Mechanics** – Branch of physics dealing with forces producing motion.

1. Biomechanics is the study of the structure and function of biological systems by means of the methods of mechanics.
2. Biomechanics is the study of the mechanics of the living body, especially of the forces exerted by muscles and gravity on the skeletal structure.
3. Biomechanics is the study of forces and their effects on humans in exercise and sport.

* Major Goals of Biomechanics

1. Performance Improvement
2. Injury Prevention & Rehabilitation

Goals of Biomechanics:

- * The ULTIMATE goal of exercise and sport biomechanics is Performance Improvement.
- * A Secondary goal is Injury Prevention and Rehabilitation.

To achieve these goals, biomechanists focus on:
- Technique Improvement,
- Equipment Improvement, &
- Training Improvement.

Goals of Biomechanics: Performance Improvement

- * Technique Improvement: Most common method for improving performance is to improve technique. Technique Improvement occurs through the application of biomechanics in 2 ways:
  1. Teacher and coaches use their knowledge of biomechanics...
  2. A biomechanics researcher discovers a more effective technique.

Goals of Biomechanics: Performance Improvement

- * Technique Improvement through research: Technique Improvement through research is rare because biomechanics is a relatively new discipline.
  - An example of technique improvement through research is in the area of swimming.
  - It was discovered that greater propulsion could be achieved by moving the hand back-and-forth in a sweeping motion during the back pull rather than just pulling straight back.
* Some believe that Injury Prevention and Rehabilitation should be the primary goal of exercise and sport. Biomechanics is useful to sports medicine professionals in identifying what forces may have caused an injury and how to prevent the injury from reoccurring.

- Changes in requirements for sticking a landing in gymnastics floor exercises has resulted in fewer injuries.
- In Tennis, tennis elbow injuries are reduced by keeping the wrist straight during the backhand.

* Qualitative analysis is the systematic observation and introspective judgment on the quality of human movement for the purpose of providing the most appropriate intervention to improve performance.

* Observation: is defined as the process of gathering, organizing, and giving meaning to sensory information about human motor performances

* Intervention in qualitative analysis is defined the administration of feedback, corrections, and other changes in the environment to improve performance.
* Performance in qualitative analysis is defined to mean both the short-term and long-term effectiveness of a person’s movement in achieving a goal.

* Qualitative analysis is by nature a subjective process, a judgment call about the quality of the movement. This does not mean that it is unorganized, vague or arbitrary in nature.

* Qualitative analysis requires extensive planning, information from many disciplines and systematic steps.

* The 1st task of qualitative analysis, preparation, the professional needs to gather knowledge from research and professional opinion, think about critically about key features of the movement, potential cues and common errors student/player/client exhibit.
* The 2\textsuperscript{nd} task, observation, involves systematically gathering appropriate sensory information about the performance.

* The 3\textsuperscript{rd} task, evaluation and diagnosis, involves both identifying strengths and weaknesses as well as prioritizing possible way to improve performance.

* The 4\textsuperscript{th} task, intervention, often involve providing feedback or changes in practice conditions that will lead to improved performance.

An Integrated Qualitative Analysis Overhand Throwing

HPS 472/572 Spring 2013

Dr. Joe G. Schmalfeldt

* By applying an integrated model of qualitative analysis, teachers/coaches/trainers can give students specific, helpful cues that will lead to improved performance

* In preparing for a qualitative analysis analysis of any sport skill, professionals (teachers/coaches/trainers) need to identify the critical features of the movement
* Critical features are key features of any movement that is necessary for optimal performance.

* Critical features are identified based on the segments of achieving the goal of the movement, efficiency or economy of effort and prevention measures of the performer.

* A good rule of thumb is to observe 5-8 trials from about 10 yards. Research has shown that it is important to have a systematic observational strategy to gather information for a qualitative analysis of human movement.

Methodology in Analyzing Sports Skills
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Dr. Joe G. Schmalfeldt

* Some of the greatest challenges you’ll face as a professional is watching your student/athlete/client performance is deciding which aspect of the skill needs to be corrected.

* Just as the critical features of each motor skill need to be determined, there are 6 steps that will help provide you information prior to correcting errors.
Step 1: Determine the objectives of the skill.

* The rules of the sport and the conditions that exist when a sport skill is performed determine skilled objectives.

Step 2: Note any special characteristics of the skills.

* Sports skills can be divided into different types based on the manner in which a person performs the skill and the conditions under which the skills are performed.

Step 3: Study top-flight performances of the skill.

* For example, when you watch top-flight athletes perform a skill, you get a picture of the speed, rhythm, power, body positions and other characteristics that make up the quality performance.

Step 4: Divide the Skill into Phases.

1. preparatory movements (set up) and mental set.
2. wind up (backswing)
3. force producing movements
4. follow through (recovery)

Step 5: Divide each phase of the key objectives.

* What are the key objectives of the preparatory movements, the wind up, backswing, force producing movements, and the follow-through or recovery.
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<th>Step 6: Understand mechanical reasons each key element is formed as it is.</th>
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<td>* Key elements are the finer, distinct actions that together make up a phase. Force-producing movements generally contain the most key elements.</td>
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* Analysis of skill technique can be done in real time, and a more complex analysis can be conducted after the performance. Complex analysis such as …?