

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.

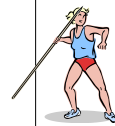
Examples of Biomechanical Studies

- “Timing of the lower limb drive and throwing limb movement in baseball pitching...”
- “The snatch technique of world-class weightlifters...”
- “Approach run strategies in the long jump...”
- “Biomechanical model of the press handstand in gymnastics...”



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

- **Teacher/Coach Technique Improvement:**
You want to improve the technique of a student doing the double somersault. You suggest 3 things: 1) Tuck tighter, 2) jump higher, 3) swing arms more vigorously before takeoff. These suggestions are based upon biomechanical principles. Jumping higher will give the student more time in the air to complete the somersault; tucking tighter will cause the student to rotate faster; swinging the arms more vigorously will generate more angular momentum, thus causing a faster rotation.

Goals of Biomechanics:

1. 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.



Goals of Biomechanics:**Performance Improvement**

- **Equipment Improvement:** Javelin throwing is an example where equipment design changed the event dramatically.
- Prior to 1953, the world record was just over 258 feet set in 1938. By redesigning the javelin and making it more aerodynamical and therefore able to “sail” farther, the world record by 1990 was over 300 feet and over 323 feet by the year 2000.
- Today, there are rules about design changes in the javelin.

Goals of Biomechanics:**Performance Improvement**

- **Training Improvement**
- An analysis of the technique deficiencies of an athlete can assist the coach or teacher in identifying the type of training the athlete requires to improve.
- For example, an athlete might lack sufficient upper body strength, or enough power in a certain sport. Prescribing the right exercises to correct these deficiencies could result in improvement in performance.

Injury Prevention & Rehabilitation: Techniques to Reduce Injury

- 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

Injury Prevention & Rehabilitation: Equipment Designs to Reduce Injuries

- The running shoe industry provides an excellent example of how changes in shoe design have reduced injuries. Nike established the Nike Sport Research Lab which used biomechanical principles to address common running injuries.

