Biomechanics and Improvements in Training

1. Principle of Specificity
2. Technical Training
3. Physical Training
4. Qualitative Anatomical Analysis

Specificity

In training, it is key to replicate: 1) angular displacements and velocities, 2) contraction types, and 3) force magnitudes. The best way to do this is to perform the skill.

ID physical and technical skill requirements; some skills are more physical, while others are more technical. These two facets of skill usually overlap.

Technical Training

Perform the technique correctly: check performance via qualitative biomechanical analysis (Chapter 13)

If you cannot perform the technique correctly, perform drills mimicking the technique; ensure that the drill is specific to the skill

Biomechanics can be helpful in quantitatively and qualitatively evaluating a drill

Physical Training

Improving physical condition:

- Muscular strength, power, and endurance
- Cardiovascular fitness
- Body composition

You should be able to identify what anatomy must be emphasized

Performing the skill also improves physical skill

Qualitative Anatomical Analysis

How can you identify predominant muscular activity during performance?

Some ideas:

- Touch
- Muscle Soreness
- EMG
- Motion Analysis/Inverse Dynamics

One Way: Qualitative Anatomical Analysis

1. Temporal phases of the skill
2. Joint motions during each phase
3. Muscular contraction type
4. High accelerations
5. Extreme ranges of motion

Table 14.1 Sample Qualitative Anatomical Analysis of a Wide-Grip Bench Press

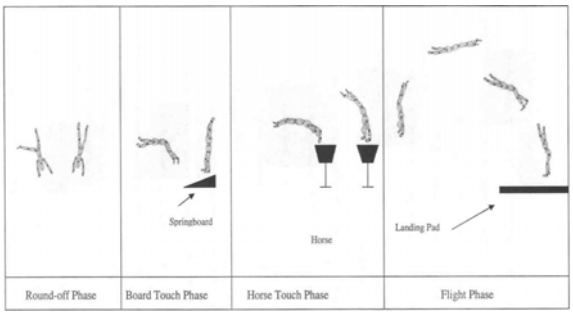
Joint	Phase of motion	Joint motion	Muscle contraction	Active muscle group	Rapid acceleration or impact	Extreme range of motion
Elbow	Down	Flexion	Eccentric	Extensors	At end of phase	Full flexion at end of phase
	Up	Extension	Concentric	Extensors	At beginning of phase	
Shoulder	Down	Horizontal extension	Eccentric	Horizontal flexors	At end of phase	Full horizontal extension at end of phase
	Up	Horizontal flexion	Concentric	Horizontal flexors	At beginning of phase	

1. Temporal Phase Division

- **Do it yourself, if you know the skill well**
- **A video camera may be helpful/necessary**
- **Study textbooks or coaches manuals**
- **Examples:**
  - **Tennis Serve**
  - **Yurchenko Vault**
  - **Baseball Pitch**

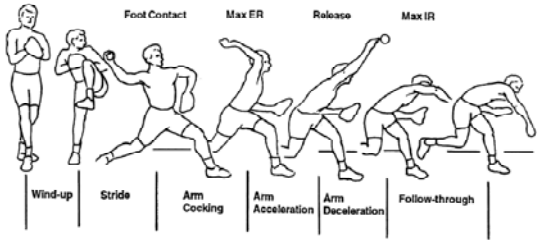
Phases	Description
Wind-up	Starts with ball and racket at rest in front of subject and finishes when ball reaches the level of shoulder height
Early Cocking	Cocking continues from ball at shoulder height until maximal shoulder external rotation. Early cocking makes up the first 75% of this motion
Late Cocking	Represented as the last 25% of the entire cocking motion
Acceleration	Initiates at maximal shoulder external rotation and ends at ball impact.
Early Follow Through	Follow through starts at ball impact and completes when the racket tip reaches its lowest vertical point. Early follow is the first 25% of this motion.
Late Follow Through	Late follow through represents the last 75% of the entire follow through motion.

YV Temporal Phases



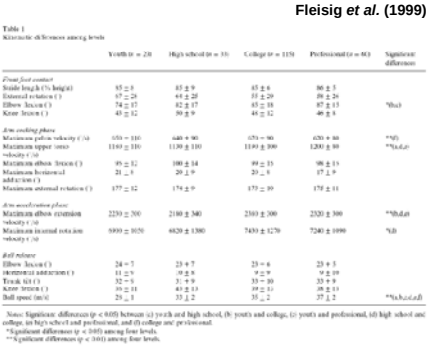
Baseball Pitch Temporal Phases

Fleisig *et al.* (1999)



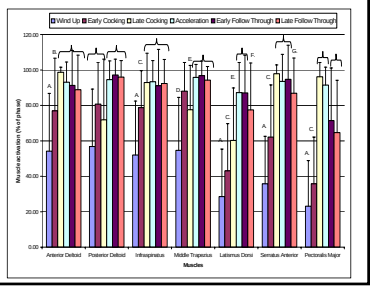
2. Identify the Joint Motions During Each Skill Phase

Fleisig *et al.* (1999)



3. Muscle Contractions

- **Identify which muscles are active, and when each muscle is active**
- **Identify contraction type for active muscles**

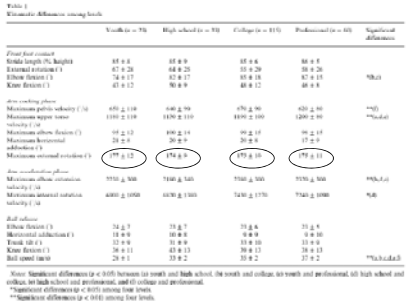


4. High Accelerations

- **Identify events that result in high accelerations…again, you can employ fancy instrumentation or common sense, or both.**
  - **Yurchenko Vault**
  - **Tennis Serve and Baseball Pitch**

5. Extreme Ranges of Motion

- **Identify events that results in extreme ranges of motion**



Your own training program:

1. **Qualitative anatomical analysis**
   1. **Identify temporal phases**
   2. **Describe motion**
   3. **Discuss muscle contraction types**
   4. **Extreme ranges of motion**
   5. **High accelerations**
2. **Training Program:**
   1. **What should have highest priority?**
   2. **Physical skill or technical skill? Why**
   3. **Drills that can be incorporated?**
   4. **Weekly schedule.**

Summary

- **Biomechanics can assist in improving training and performance**
- **Principle of specificity leads to performance of the skill or drills that mimic the skill**
- **Technical versus physical training**
- **Qualitative Anatomical Analysis**
  - **Temporal phases**
  - **Involved joints and motions**
  - **Involved muscle and type of muscular contraction**
  - **High accelerations and impacts**
  - **Extreme ranges of motion**