Techniques to Strengthen & Enhance Dynamic Shoulder Stability & Which Exercises are Best !

Kevin E. Wilk, PT, DPT, FAPTA

The Overhead Athlete

Introduction

- Goals of presentation:
  - Discuss specific exercises for the GH joint
  - *The **BEST** Exercises*
  - Describe several treatment strategies for the shoulder & upper quadrant:
    - ✓ depends on the GH joint & UE
    - ✓ dynamic stabilization concepts
    - ✓ activation exercises
    - ✓ dynamic stabilization exercises
    - ✓ strengthening exercises

Recent advances in the treatment of the overhead athlete

Electrical Stimulation- Shoulder

Reinold, Macrina, Wilk: AJSM '08

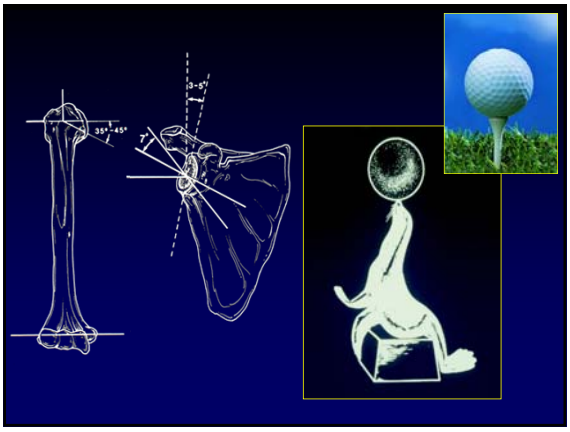
- 39 RTC repair patients
  - Mean 10 ± 7 days s/p
  - Range 2-19 days
  - Mean age 54 (23-76 yrs)
- Peak force of ER
- *Significantly greater force w/ NMES*
  - 3.27 kg with NMES
  - 2.49 kg without NMES
  - *> 22% increase*
  - *No difference based on age, size of tear, days postop, or STIM intensity*

The Glenohumeral Joint

Introduction

- GH joint inherently unstable
- Large humeral head/ small glenoid fossa
  - *Multi-axial ball & socket joint*
- Tremendous mobility but poor osseous stability
- *Dependent on ligamentous capsule & neuromuscular system functional stability*

Dynamic Stabilization



The Overhead Thrower

Introduction

- *Highly skilled athlete*
- *Requires flexibility, muscle strength, coordination, synchronicity & NM efficiency*
- Proper throwing mechanics
- Proper training program

Injuries Are Common to the Throwers Shoulder & Elbow

Tremendous stresses & velocities

Tennis Players Shoulder
Introduction

- *Highly skilled athlete*
- *Requires flexibility, muscle strength, coordination, synchronicity & NM efficiency- transfer energy*
- Proper serving mechanics
- Proper training program

Injuries Are Common to the Tennis players Shoulder & Elbow

Kinetic Chain Effect – Transfer Energy

The Overhead Thrower
Introduction

- Overhead throwing motion
- Extraordinary demands on shoulder & elbow joint
  - *Fastest human movement – 7,230 o/s*
  - *Late cocking to ball release 0.03sec*
- Tremendous forces generated
  - *Anterior displacement 0.5 x BW*
  - *Distraction forces 1 x BW at ball release*

Fleisig et al: Am J Spts Med '95
Fleisig et al: J Biomech '99

The Overhead Thrower
Introduction

- Overhead throwing motion
- Moderate to high levels of muscular activity
  - » *80-120 % of MVIC during acceleration phase ofpitch*

DiGiovine et al: JSES'92

- Effective transfer of kinetic energy
  - » *Over 60% of kinetic energy during pitch generated by legs*

Toyoshima et al: Biomech '86

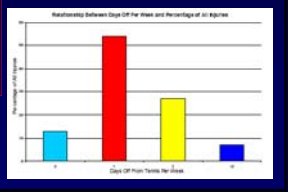
KINEMATIC VARIABLES

• GH ABD:	93°	96 °	83 °
• MAX GH ER:	173 °	164 °	154 °
• GH IR	7550 °/s	4950 °/s	2314 °/s
• ELB FLXN	22 °	36 °	35 °
• ELBOW EXT:	2340 °/s	1760 °/s	1700 °/s

FLEISIG ET AL, 1996, SHAPIRO & STINE, 1992

Kovacs, Ellenbecker et al, 2012

- USTA SPORT SCIENCE COMMITTEE INJURY TRACKING STUDY
  - » 861 JUNIOR TENNIS PLAYERS
  - *PRIMARILY OVERUSE INJURIES*
  - *41% OF ALL PLAYERS REPORTED AN INJURY*
  - *1/3 OF PLAYERS REPORTING ONE INJURY SUSTAINED A SECOND INJURY*



The Overhead Thrower
Introduction - Injuries

- Shoulder & elbow injuries are common in baseball – and appear to be increasing
- In professional baseball:
  - ✓ 28 % of all injuries occur to the shoulder joint
  - 22 % of all injuries occur to elbow joint
  - Length of injury time is increasing – days on the disabled list days

Conte et al: Am J Spts Med '01

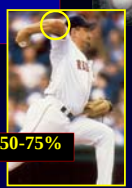
- ✓ In youth baseball – 50 % of players (9-14) complained of elbow or shoulder pain

Lyman et al: Am J Spts Med '02

- ✓ UE 75% time lost college baseball players

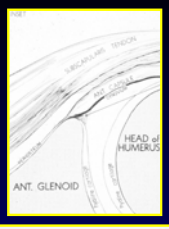
McFarland et al: Clin J Spts Med '98

50-75%



Underhand Softball Pitching

The Glenohumeral Joint
Introduction

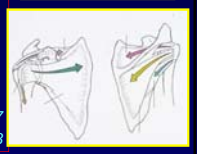


✓ **Dynamic functional stability**

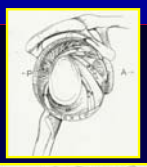
ligamentous system ⟷ ***neuromuscular system***

- Dynamic stabilizers compress humeral head into fossa
- Primary stabilizers combination capsule and muscles

Wilk, JOSPT 1997
Appreleva, JBJS 1998



SHOULDER COMPLEX BIOMECHANICS
Dynamic Stability



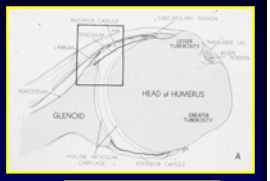
✓ ***Joint compression***
- muscular co-contraction
- compression of humeral head
- balance of muscular forces
- significant stabilizing effect
- centers humeral head within glenoid

Wilk et al: J Orthop Spts Phys Ther '97

SHOULDER COMPLEX BIOMECHANICS
Dynamic Stability

✓ ***Dynamic ligament tension***
- cuff blends with capsule
- muscular contraction - capsular tension
- reduces tension on capsule
- ER reduces anterior capsule strain

Cain et al: AJSM '87



SHOULDER COMPLEX BIOMECHANICS
Dynamic Stability

✓ ***Scapula - concavity effect***
- glenoid fossa - humeral alignment
- concavity stabilizes humerus
- scapular mobility / stability
- force couples around scapula

Kibler: Br J Spts Med '10
Kibler: AJSM '06
Davies:JOSPT '97

SHOULDER COMPLEX BIOMECHANICS
Dynamic Stability

✓ ***Neuromuscular control***
- proprioception & kinesthesia
- efferent response / afferent info
- reflexes, stereotypic & learned skills
- midrange vs. endrange stability

Lephart et al: J Ath Train '00
Wilk et al: JOSPT '93

SHOULDER COMPLEX BIOMECHANICS
Dynamic Stability

✓ ***Muscular Endurance***
- Necessary component to normal shoulder function
- Fatigue-injury
  - Little leaguers- #1 injury cause

  Lyman,Fleisig:Med Sci Spts Ex '99
- Muscle fatigue desenitizes muscle spindle

  Carpenter: AJSM '97

  Voight: JOSPT '98

Shoulder Exercises
Clinical Implications

✓ Train neuromuscular *early* (immed. post- inj)
✓ Train & exercise *bilaterally*
- » Neurophysiologic overflow !!!
- » Neurologic insult

✓ Perform *higher levels* proprioception & NM drills on contralateral extremity
✓ Enhance *dynamic stabilization* very early
✓ Train at *failure level*
- » *45-60% of drills unable to successful perform !!!*

✓ Emphasize *endurance*
✓ *Train proprioception at end of the program*

Shoulder Exercises
Clinical Implications

✓ ***Muscle Training:***
✓ Muscle activation: *need to be able to turn it on*
✓ No pain inhibition: *pain = no gain*
✓ No soft tissue inhibition: *tissue flexibility*
✓ Activation, enhanced recruitment *(EMS)*
✓ Strengthening exercises:
- ✓ *co-activation (stabilization)*
- ✓ *concentrics (acceleration – speed)*
- ✓ *eccentrics – (deceleration – hypertrophy)*
- ✓ *plyometrics – stretch shortening cycle*

Functional Exercises & Activities

Rehabilitation Program
Four Phase Approach

I. Proprioception and kinesthesia
Baseline dynamic stabilization

II. Dynamic stabilization

III. Neuromuscular control

IV. Functional movements & skills
Sport-specific training

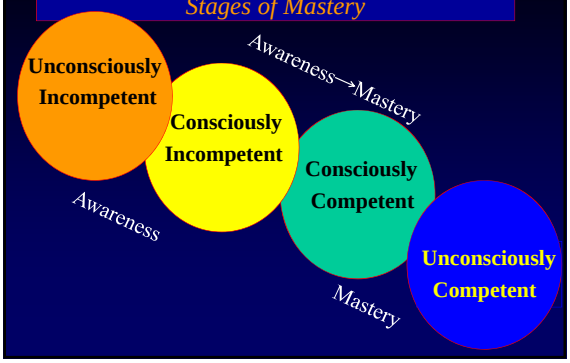
Dynamic Stabilization
Stages of Motor Control

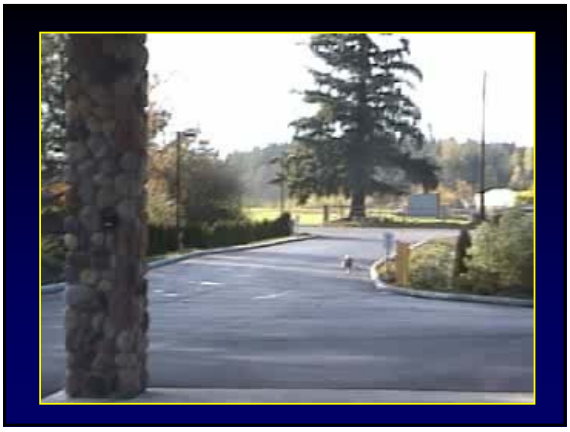
Fitts & Posner

COGNITIVE STAGE	ASSOCIATIVE STAGE	AUTONOMOUS STAGE
• Identify Objectives • Self-talk/ Questioning • ↑Errors/Variability • Instruction/ Feedback	• Associate with environmental cues • Refining/Consistent • ↓Errors/Variability • Identify/Correct Errors	• Subconscious/ automatic • Multiple tasks • ↓↓Errors/ variability • ↑↑Identify/Correct • Perfection

Beginner → Expert

Dynamic Stabilization
Stages of Mastery





Specific Shoulder Exercises

Video Time

Techniques to Enhance Dynamic Stabilization

I. Enhance Proprioception & Kinesthesia

- *» Passive/Active joint repositioning sense*
- *» Repositioning sense*
- *» Awareness of joint position*
  - *Static position*
  - *Dynamic position*

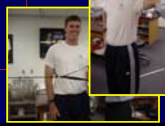
Proprioception Testing

Courtesy Univ Pittsburgh

Techniques to Enhance Dynamic Stabilization

I. Restoration of Proprioception

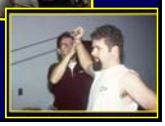
- *» Awareness of joint position*
- *» Eyes open & closed*
- *» Performed static/dynamically*
- *» Levels of proprioception*
  - *Progression through stages*



Techniques to Enhance Dynamic Stabilization

I. Re-establish Static/Dynamic Stability

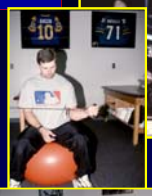
- » *Static stabilization*
  - *Hold stationary position*
  - *Low level control drill*
- » *Dynamic stabilization*
  - *Ability to move through space*
  - *Then stabilize*
  - *Moderate level control drill*



Techniques to Enhance Dynamic Stabilization

II. Dynamic Functional Stability

- » *Essential element in rehab*
- » *ROM with stability*
- » *Necessary step in progression*
- » *"Third stage" of rehab*



Scapular Stabilization & Control

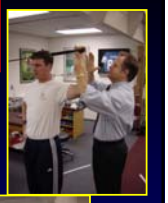
Scapular Stabilization & Control

Scapular Stabilization & Control

Techniques to Enhance Dynamic Stabilization

III. Perturbation training

- » *End range stability*
- » *Postural/positional disturbance*
- » *Critical rehab goal*
- » *Necessary component allowing athletes to return to overhead sports*



Techniques to Enhance Dynamic Stabilization

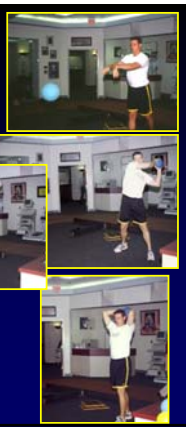
III. Improve Muscular Endurance

- » *Fatigue effects strength*
  - *28-72% decrease*
- » *Fatigue effects joint proprioception*
  - *45-78% decline**
- » *Critical rehab component*
- » *Exercise(time bouts)*

Techniques to Enhance Dynamic Stabilization

IV. Functional Sport Specific Drills – Skill

- *Plyometrics*
- *Sport specific drills*
- *Gradual progression*
- *Two hand drills ⟶ one hand drills*
  - *mid-range drills – full/end range drills*



Swanik,Lephart,Swanik;JSES '02

- Effectiveness of a 6 week plyometric program 24 female swimmers
- Tested proprioception, kinesthesia,strength
- Significant improvements in strength, kinesthesia, proprioception and amortization

Axial Compression Exercises
Progression

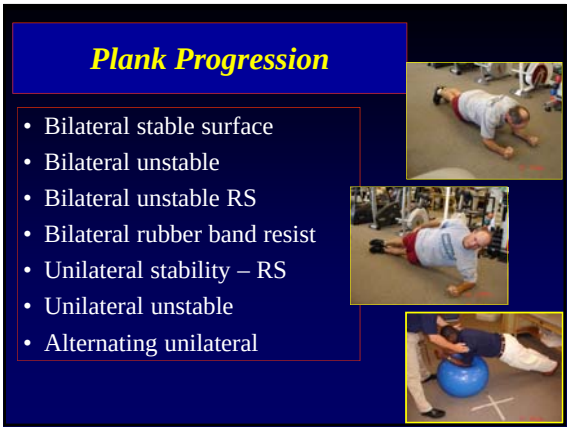
- Hand on Wall → Hand on Wall/*towel*
- Hand on Wall/*towel* → Hand on Wall/*ball*
- Wall → Table → Floor
- Stationary → Mobility
- Proximal Resist. → Distal Resistance
- Stable Surface → Unstable Surface
- Mid-Range Stabs → End-Range Stabs
- Continuous Contact → Plyometrics

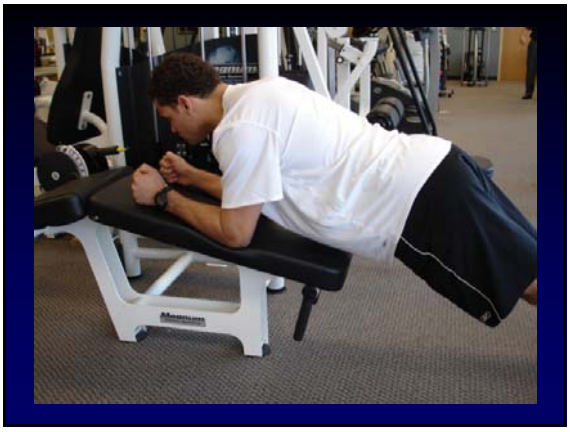
Push- Ups ⟷ *Planks*

Which is Better ???

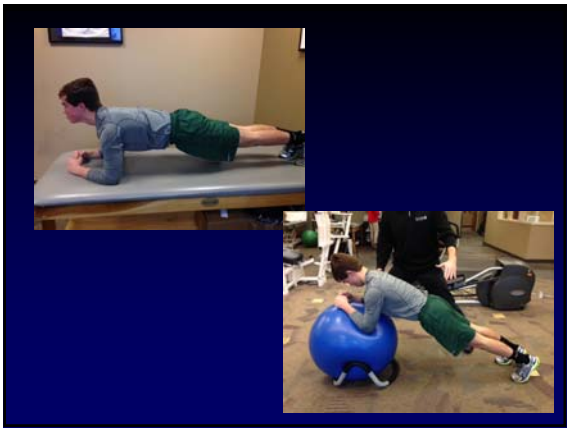
Push – Up Progression

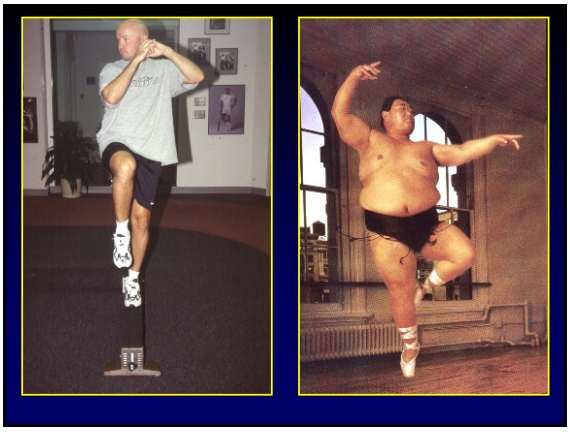
- Wall → Table
- Table → Chair/Bench
- Chair/Bench → Floor
- Stable Surface → Unstable Surface
- Unstable (tilt) → Unstable Floor
- Tilt Board → Medicine Ball
- Movements → Movts/Resistance
- Two Hand Drills → One Hand Drills


Plank Progression
• Bilateral stable surface
• Bilateral unstable
• Bilateral unstable RS
• Bilateral rubber band resist
• Unilateral stability – RS
• Unilateral unstable
• Alternating unilateral




HALO
halotrainer.com





Core Stabilization

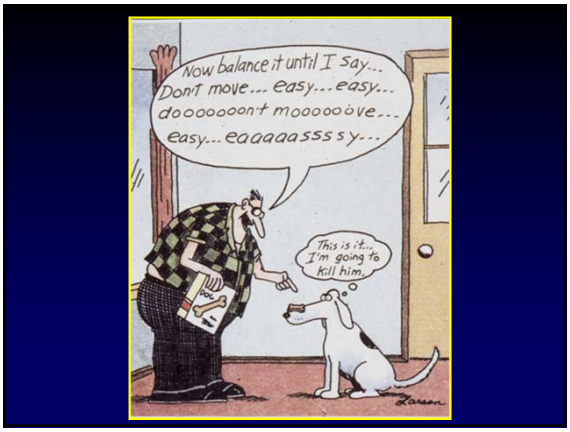
Scapular Muscle Training

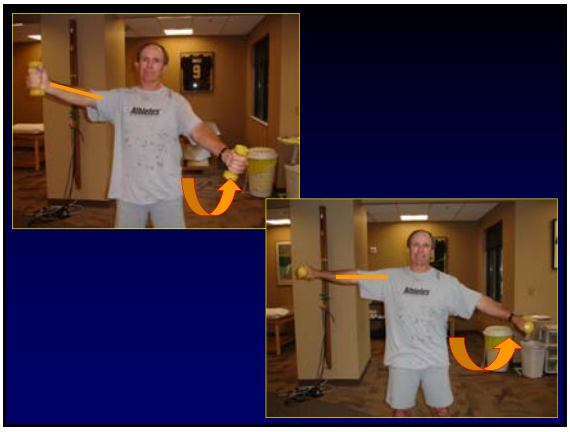
- Alternating day schedule:
  - » *Isotonic table exercises days-*
    Goal: strengthen/hypertrophy
    - traditional exercises
    - progress with dumbbells
    - neuromuscular drills
  - » *Manual & light isotonic days-*
    Goal: NM control & dynamic stab
    - Isotonic exercises on physioball
    - NM control drills

Scapular Muscle Training

- Alternating day schedule:
  - » *Isotonic table exercises days-*
  - » *Physioball – Manual NM drills*


WHERE CHAMPIONS ARE MADE


Now balance it until I say... Don't move... easy... easy... doooooooon't mooooove... easy... eaaaaasssssy...
This is it... I'm going to kill him.



Dynamic Stabilization Exercises

Dynamic Stabilization Exercises

Dynamic Stabilization Exercises

Dynamic Stabilization Exercises

Dynamic Stabilization Exercises

Bilateral Extremity Exercises

Advanced Throwers Ten Program

Dynamic Stabilization Exercises

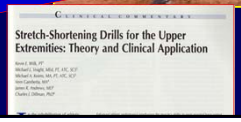
Dynamic Stabilization Exercises

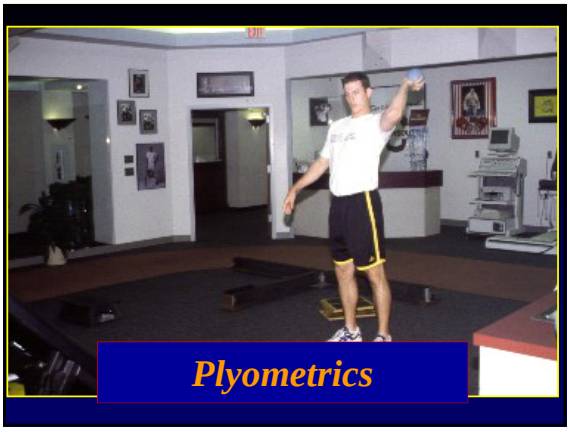
Lower Trapezius Exercises

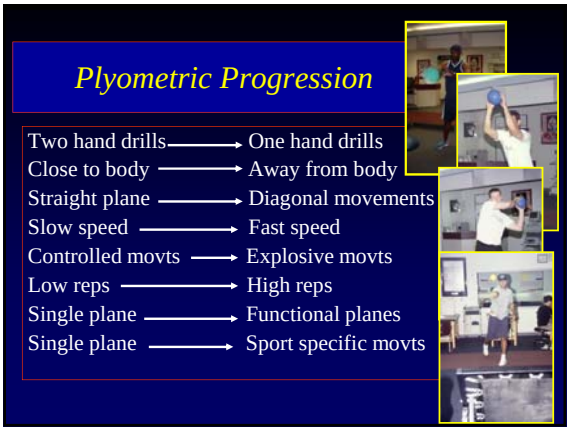
Rehabilitation of the Overhead Athlete
Typical approach in '86

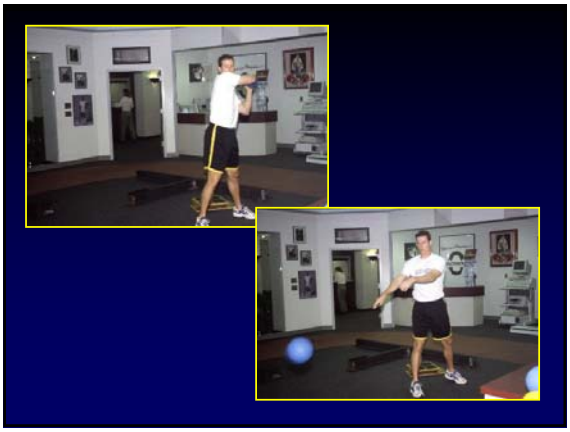
???

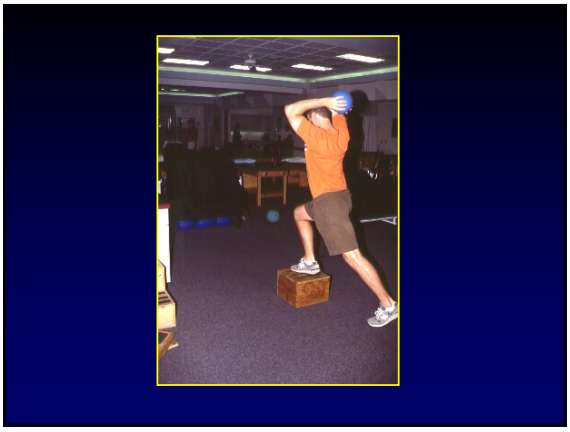
Missing an important step !!!



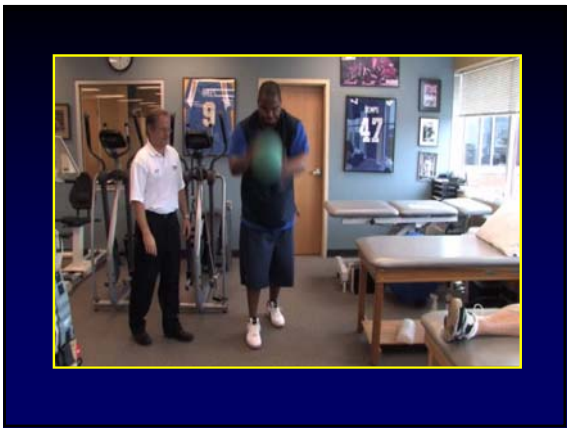

Plyometrics

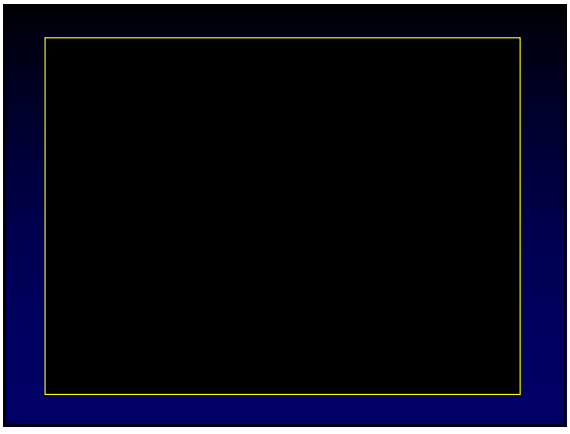

Plyometric Progression
Two hand drills → One hand drills
Close to body → Away from body
Straight plane → Diagonal movements
Slow speed → Fast speed
Controlled movts → Explosive movts
Low reps → High reps
Single plane → Functional planes
Single plane → Sport specific movts






Plyometrics
for the
Overhead Athlete





Effects of Fatigue



Throwers' Shoulder Injuries

Fatigue

Effects of shoulder fatigue:

- ✓ *Leads to injuries – little league pitchers*
  - *Lyman, Fleisig, Andrews: AJSM '02*
  - *Olsen, Fleisig, Andrews: AJSM '06*
- ✓ *Increase superior migration humeral head*
  - *Wickiewicz, Otis, Warren: JSES '91*
- ✓ *Fatigue effects performance & mechanics*
  - *Murray, Cook, Werner, Hawkins: AJSM '01*
- ✓ *Proprioception diminishes by 78%*
  - *Carpenter : AJSM '98*
- ✓ *Scapular position changes*
  - *Macrina, Wilk, Reinold: APTA CSM '06*



Techniques To Enhance Stability

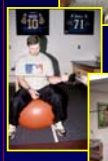
Key Points

- Dynamic stabilization is critical for functional shoulder activities

Neuromuscular System ⟷ *Capsuloligamentous*

- Proprioception & kinesthesia critical
- Train higher levels
- Train bilaterally – especially following injury
- Progress patient through phases of restoring/improving neuromuscular control
- *Challenge the system – progressive*
- *Must be functionally specific to the demands of the patient*






Thank You !!!

Waikiki Beach