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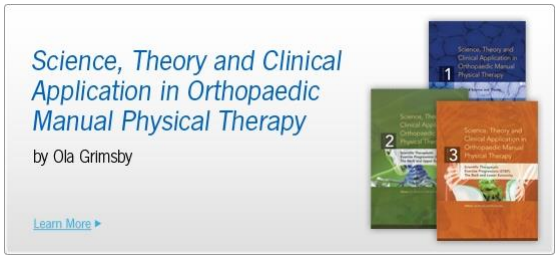
EXERCISE PRESCRIPTION
PART 1

Michael McMurray, PT, DPT, OCS, FAAOMPT

Orthopaedic Manual Physical Therapy Series
Charlottesville 2017-2018

HOLTEN INSTITUTE
MEDICAL EXERCISE THERAPY



What is MET?

- An active rehabilitation system based in the biopsychosocial philosophy
- Emphasis placed on optimal grading in order to increase tolerance for tissue loading to normalize muscle imbalance and coordination
- Developed by Oddvar Holten in early 1960's
  - Formed the Holten Institute in 1965
- Utilizes Global, Semi Global and Local Exercises

Global Exercises

- Full body exercise
  - General and not specific to injured area
  - Aerobic exercise
    - Bike
    - Treadmill
    - Elliptical

Semi Global Exercise

- Multi Joint Exercise
  - Includes painful joint or involved tissue indirectly
    - Marching
    - Total gym
    - UBE

Local Exercise

- Joint or tissue specific
- Specific to involved joint or tissues
  - Shoulder ER
  - Wrist extension
  - Ankle inversion
  - Lumbar rotation

Criteria for MET (Holten)

- MET is a branch of exercise therapy where the patient performs exercises using specially designed apparatus without manual assistance but with constant supervision from the physical therapist

Criteria for MET (Holten)

- MET is a branch of exercise therapy where the patient performs exercises using specially designed apparatus without manual assistance but with constant supervision from the physical therapist
- The apparatus is designed to optimally stimulate the relevant functional properties (neuro-muscular, arthrogenic, circulatory, respiratory)
- To obtain this effect, the patient carries out the exercises from a specific starting position, in a specific movement direction, against a graded resistance
- The grading makes it possible to exercise pain free

Criteria for MET (Holten)

- MET is based on a minimum 1 hour of effective treatment (excluding dressing/undressing/showering, etc)
- Prior to the treatment, a thorough assessment is carried out based on past and present PMHx, active and passive tests, specific joint tests and functional tests
- From the medical history and physical assessment a treatment diagnosis is established and an individual exercise program is carried out

Goals of MET

- Decrease tissue irritability
- Increase nourishment to the injured tissues
- Reduce perceived threat of movement
- Reduce catastrophizing thoughts
- Restore joint motion/mechanics
- Increase tissue integrity, endurance and strength

Positive Effects of Moderate Exercise on Glycosaminoglycan Content in Knee Cartilage

A Four-Month, Randomized, Controlled Trial in Patients at Risk of Osteoarthritis

Ewa M. Roos[1] and Leif Dahlberg[2]

ARTHRITIS & RHEUMATISM
Vol. 52, No. 11, November 2005, pp 3507–3514

- GAG's
  - Building blocks of proteoglycans
- All participants with past medial menisectomy
  - Exercise group and control group
- Moderate exercise atleast 3x per week supervised by a PT
  - Moderate = producing a sweat
  - Exercises: Step up, lunges, squats, bike, jump rope, jogging on trampoline
  - Mean of 19 sessions
- Increased GAG content in knee cartilage following moderate exercise via MRI in exercise group
- Human cartilage responds to loading in a similar way to that of bone and muscle

The Effect of Medical Exercise Therapy on a Patient With Chronic Supraspinatus Tendinitis. Diagnostic Ultrasound—Tissue Regeneration: A Case Study

JOSPT • Volume 20 • Number 6 • December 1994

Tom Arild Torstensen, BSc HON, PT, MNFF[1]
Helge Dyre Meen, MD[2]
Morten Stiris, MD[3]

- 73 yom with 1 year hx of shoulder pain
- MET x 2 ½ months
- Diagnostic ultrasound at 5 months showed resolution of the chronic inflammatory findings
- Pt reported resolution of pain and return to prior function

Medical exercise therapy, and not arthroscopic surgery, resulted in decreased depression and anxiety in patients with degenerative meniscus injury

Håvard Østerås, MSc, PT [a,*], Berit Østerås, MSc [a], Tom Arild Torstensen, MSc (Hons) PT [b]

- 2 groups: MET and meniscetomy
- Pain, function, anxiety and depression measured at start and after 3 months
  - via self report questionnaires
- No difference in pain and function
- Significantly less anxiety and depression in MET group

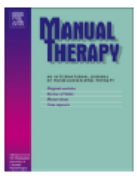
Journal of Bodywork & Movement Therapies (2012) 16, 456–463

It's Not Just Physical

Exercise therapy for chronic musculoskeletal pain: Innovation by altering pain memories

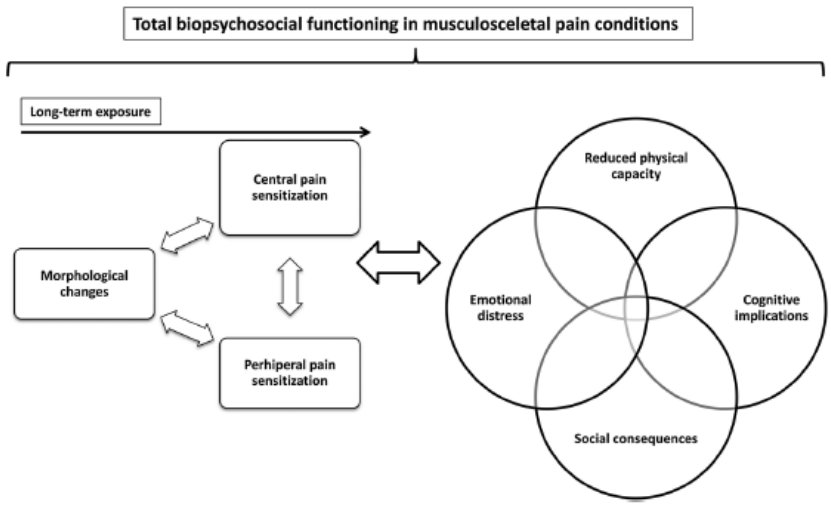
Jo Nijs [a, b, c, *], Enrique Lluch Girbés [a, d], Mari Lundberg [e], Anneleen Malfliet [a, b, c], Michele Sterling [f]

Even though nociceptive pathology has often long subsided, the brain of patients with chronic musculoskeletal pain has typically acquired a protective (movement-related) pain memory. Exercise therapy for patients with chronic musculoskeletal pain is often hampered by such pain memories. Here the authors explain how musculoskeletal therapists can alter pain memories in patients with chronic musculoskeletal pain, by integrating pain neuroscience education with exercise interventions. The latter includes applying graded exposure in vivo principles during exercise therapy, for targeting the brain circuitries orchestrated by the amygdala (the memory of fear centre in the brain).



Medical Exercise Therapy for Treating Musculoskeletal Pain: A Narrative Review of Results from Randomized Controlled Trials with a Theoretical Perspective

H. Lorås[1]*, B. Østerås[1], T. A. Torstensen[2,3] & H. Østerås[1]



Medical Exercise Therapy for Treating Musculoskeletal Pain: A Narrative Review of Results from Randomized Controlled Trials with a Theoretical Perspective

H. Lorås[1]*, B. Østerås[1], T. A. Torstensen[2,3] & H. Østerås[1]

- Individual status and treatment effects are the result of the interactions among physiologic, psychological and social factors
- MET effective at reducing pain experience while improving impaired functions, enhancing positive coping strategy and increasing level of self efficacy
- Range of motion, repetitions and load are chosen by PT and patient

High-Dosage Medical Exercise Therapy in Patients with Long-Term Subacromial Shoulder Pain: A Randomized Controlled Trial

Håvard Østerås[1]*, Tom Arild Torstensen[2] & Berit Østerås[3]

- Both groups performed individualized exercise program prescribed and supervised by a PT
  - HD group performed 3x30
  - LD group performed 2x10
- High dosage MET superior to low dosage exercise program
  - Improved pain on VAS and improved self reported functional questionnaire

Expected Outcomes of MET

The patient should be healthier after the treatment than they were before

Improved tolerance to load and resistance

Improved tolerance to general movement

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Exercise Prescription

Choosing Wisely
An initiative of the ABIM Foundation

APTA
American Physical Therapy Association

Five Things Physical Therapists and Patients Should Question

1. **Don't employ passive physical agents except when necessary to facilitate participation in an active treatment program.**
There is limited evidence for use of passive physical agents to obtain clinically important outcomes for musculoskeletal conditions. A carefully designed active treatment plan has a greater impact on pain, mobility, function and quality of life. While there is some evidence of short-term pain relief for certain physical agents, the addition of passive physical agents should be supported by evidence and used to facilitate an active treatment program. There is emerging evidence that passive physical agents can harm patients. Communicating to patients that passive, instead of active, management strategies are advisable exacerbates fears and anxiety that many patients have about being physically active when in pain, which can prolong recovery, increase costs and increase the risk of exposure to invasive and costly interventions such as injections or surgery.

2. **Don't prescribe under-dosed strength training programs for older adults. Instead, match the frequency, intensity and duration of exercise to the individual's abilities and goals.**
Improved strength in older adults is associated with improved health, quality of life and functional capacity, and with a reduced risk of falls. Older adults are often prescribed low dose exercise and physical activity that are physiologically inadequate to increase gains in muscle strength. Failure to establish accurate baseline levels of strength limits the adequacy of the strength training dosage and progression, and thus limits the benefits of the training. A carefully developed and individualized strength training program may have significant health benefits for older adults.

3. **Don't recommend bed rest following diagnosis of acute deep vein thrombosis (DVT) after the initiation of anti-coagulation therapy, unless significant medical concerns are present.**
Given the clinical benefits and lack of evidence indicating harmful effects of ambulation and activity both are recommended following achievement of anticoagulation goals unless there are overriding medical indications. Patients can be harmed by prolonged bed rest that is not medically necessary.

4. **Don't use continuous passive motion machines for the postoperative management of patients following uncomplicated total knee replacement.**
Continuous passive motion (CPM) treatment does not lead to clinically important effects on short- or long-term knee extension, long-term knee flexion, long-term function, pain and quality of life in patients undergoing total knee arthroplasty (TKA). With rehabilitation protocols now supporting early mobilization, the use of CPM following uncomplicated total knee arthroplasty should be questioned unless medical and/or surgical complication exist that limit or contraindicate rehabilitation protocols that foster early mobilization. The cost, inconvenience and risk of prolonged bed rest with CPM should be weighed carefully against its limited benefit. As members of interprofessional teams involved in post-operative rehabilitation of patient following total knee replacement, physical therapists have a responsibility to advocate for effective alternatives to CPM for most patients.

5. **Don't use whirlpools for wound management.**
Whirlpools are a non-selective form of mechanical debridement. Utilizing whirlpools to treat wounds predisposes the patient to risks of bacterial cross-contamination, damage to fragile tissue from high turbine forces and complications in extremity edema when arms and legs are treated in a dependent position in warm water. Other more selective forms of hydrotherapy should be utilized, such as directed wound irrigation or a pulsed lavage with suction.

APTA 2014

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Exercise Prescription

- Apparatus
- Starting Position
- ROM
- Dosage
- Type of Exercise

Apparatus

- Type used depends on patient's pathology, goals, accessibility and cost
- No one piece of equipment or type of equipment is perfect for every person

Exercise Apparatus

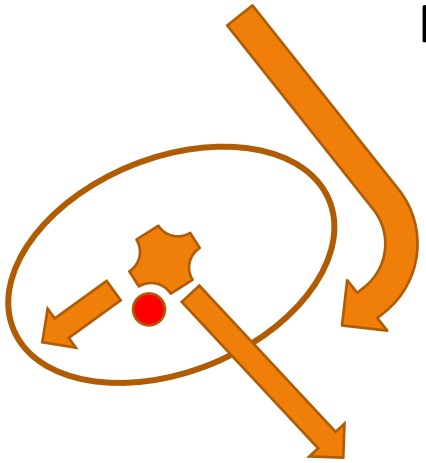
Type	Coordination/Motor Control	Assisted Training	Endurance Training	Strength Training	End Range Stabilization Training	Functional Training	Home Program
Pulley	Excellent: can facilitate specific fiber directions within patterns	Excellent: can perform zero resistance exercises	Excellent	Excellent	Excellent: can perform eccentric, isometric and concentric end range resistance	Excellent: can duplicate most motions	Poor
Free Weight	Good	Poor	Good: can be specific with dosage	Excellent	Excellent for specific ROM resistance	Fair-Good	Good
Resistance Bands	Poor: does not follow length tension curve	Poor: tension of band decreases as increased assistance is needed	Poor: does not give even work load through ROM	Fair-Good: emphasizes end range only	Good-Excellent: highest resistance at end range	Fair: elastic resistance not functional in most cases	Excellent

Pulley Set Up

- Max influence from pulley will be when rope from the pulley is perpendicular to the body part

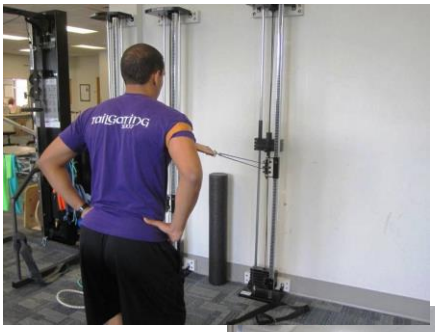
- Extremities
  - Resistance in line of muscle
- Spine
  - Resistance must be triplanar to effect the deep stabilizers

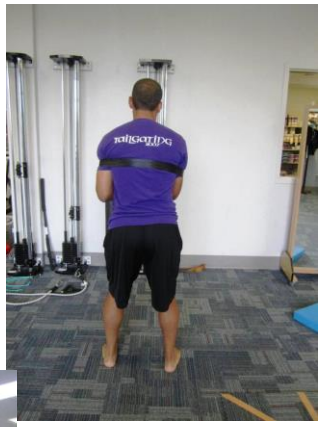
Pulley Set Up



- Directions of resistance for lumbar multifidus

Pulley Set Up





Starting Position

- The position of the body, an individual limb or the range of a specific joint during exercise
- Depends on irritability, body region, pathology
  - Lower quarter pathologies typically start non weight bearing
  - Lumbar pathologies more dependant on type of pathology
    - Acute disc may start in non weight bearing
    - Stenosis may start in sitting or flexed position
    - Hypermobility may start standing

Range of Motion

- Should not exercise in a range of motion that is not around the correct axis due to loss of coordination and/or tissue damage
- Hypomobile joint
  - Passive mobility must be returned first
  - Exercise in available range where correct axis is maintained
- Hypermobile joint or motor control dysfunctions
  - Exercise in beginning or mid ranges and progress to outer ranges once control improves
- Supervision is critical

Dosage

- Exercise must be dosed specifically for the injured tissue and healing state.
  - Too aggressive will be destructive
  - Too conservative will have no effect
- Must match the patient's health state and pathology
- Must be able to self administer in the clinic or at home
- Can be for the purpose of pain inhibition, decreasing muscle guarding, reducing edema, increasing tissue tolerance to tension/compression and improving joint mobility

Tissue Healing Times

Soft Tissue Injuries	Meniscal injuries Herniated disc- conservative treatment	3 months
Fractures	Upper limb/hand/simple vertebral, body compression Spine, fracture or dislocation Pelvis no reduction Pelvis with reduction Femur and hip Tibia Complex/complicated fractures Major joint fractures or dislocations	3-6 months 6 months 3 months 12 months 6-12 months 6-9 months 6 months 6 months
Infections	Osteomyelitis	4-8 mo
Nervous System Injuries	Peripheral nerve Minor head injuries Brain with persisting neuro deficit Spinal cord and cauda equina injuries	3-12 months 3 months 1 year 1 year
Shoulder	Acromioplasty Rotator cuff repair	3-6 months 6 months

Knee	Arthroscopy -operative -arthrotomy Ligament repair	 6 weeks 3 months 3-6 months
Ankle	Ligament repair	3-6 months
Spine	Herniated disc-operative Spinal fusion -1 level -multiple level Spinal stenosis decompression -single level -multiple level	3 months 3 months 6 months 3 months 6 months
Tendon	Flexor tendon repair or tendon transfer Extensor tendon repair Tendon release	3-6 months 3 months 3 months

Dosage

- Tendon and Ligament
  - Training load recommended at 40-60% of 1 Rep Max 100-200 reps per set
  - Exercise must be painfree
  - Avoid or minimize eccentrics in order to keep tensile and shear forces low

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Dosage

- Muscle
  - Strength
    - 80-90% 1 RM for 1-5 reps and 5 sets
  - Strength and Endurance
    - 70-80% of 1 RM for 15-30 reps and 3-5 sets
  - Endurance
    - 60% 1 RM for 30-50 reps and 3-5 sets
  - Train as functionally as possible

Dosage

- Cartilage
  - Stimulus is compression/decompression in a weightbearing or functional position for thousands of reps
  - 20% of 1 RM for 1000 reps or more, slow speed

Type of Exercise

- Determined by irritability, goal of exercise, pathology
- Isometric, concentric or eccentric
  - Combination
  - Assisted

Phases of MET

- Phase 1
  - Pain free phase
  - Focus is coordinated mobility and stability
- Phase 2
  - Restoration of function phase
  - Focus on increasing tissue tolerance

Phase 1

- Goal is to remove symptoms and increase circulation
- Utilize shortened range of motion, rest breaks between sets, altered starting positions, unloading/unweighting
- Generally begin with low resistance and 30-150 repetitions per set

Phase 2

- Goal is to restore and enhance function
- Increase strength, endurance, range of motion, speed, weightbearing capacity, coordination
  - Depending on findings from physical exam
- Exercises should be relevant to the patients needs for daily function

Barriers

- Equipment
  - "I don't have pulleys"
- Math
  - 1 RM calculation
  - Counting for number of repetitions
- Time
  - Set up
  - Number of repetitions
  - Other treatments
  - Too much for patient HEP

Overview

- Exercise is our medicine
- Dosage is dictated by type of tissue and goal of exercise
- Load is dictated by irritability and type of tissue and goals
- Typically want as much dosage and load as possible
- Strength is an eventual goal, not the primary goal
- Consider sequencing of exercises
  - Be creative with mix and order of global, semi global and local exercises
- Supervision is critical

Lumbar MET

Which Exercises?

- Irritability
- Directional Preference
- Target Tissue

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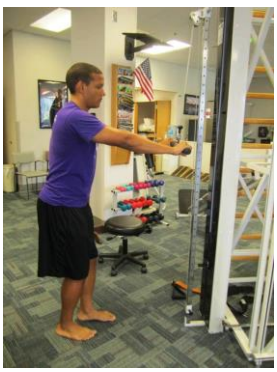
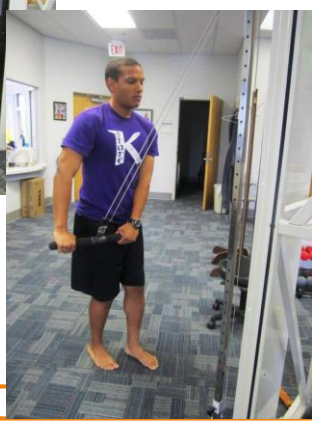
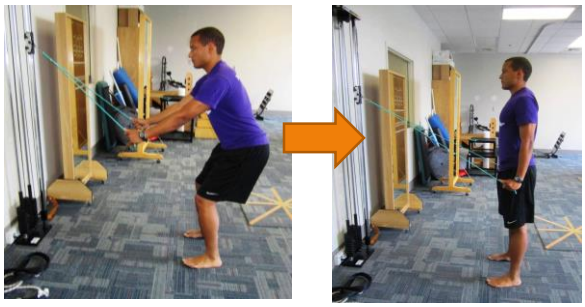
Extension Bias Progression

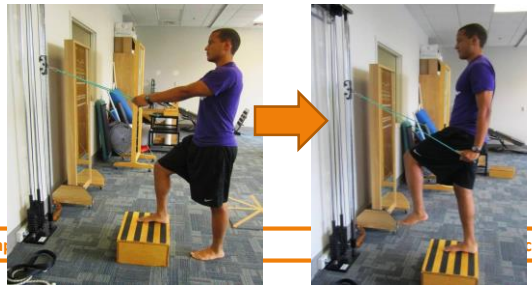
Extension Bias Progression





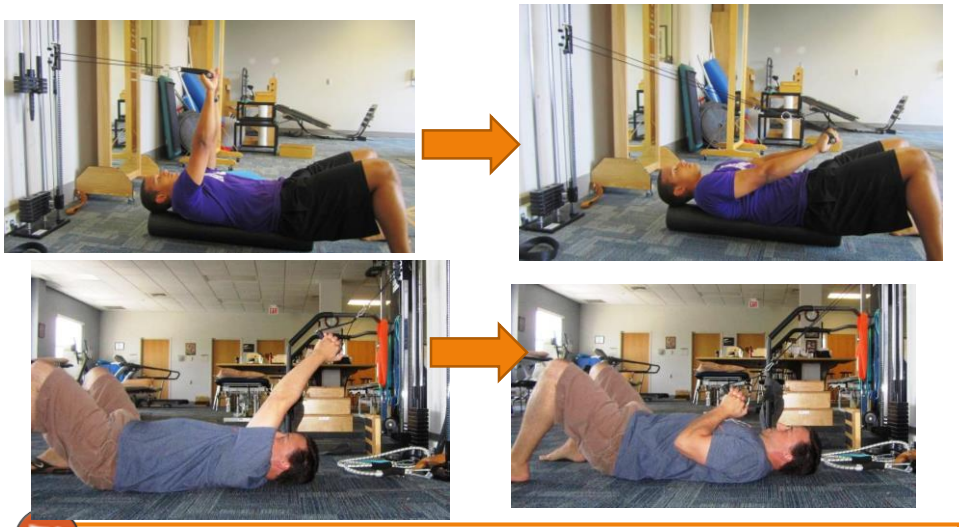
Extension Bias Progression



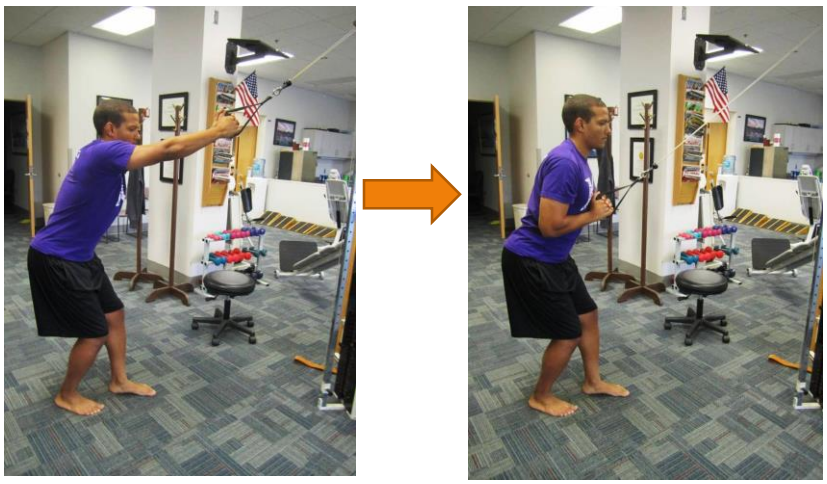


Extension Bias Progression

Flexion Bias Progression



Flexion Bias Progression



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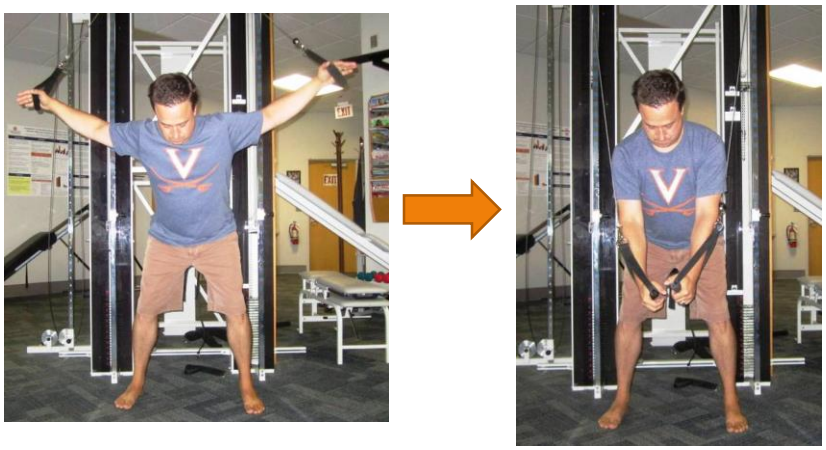

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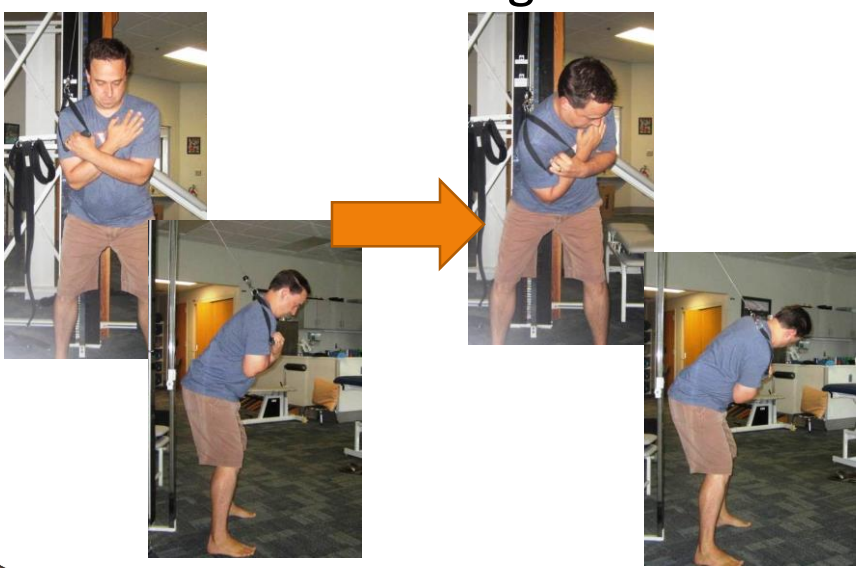
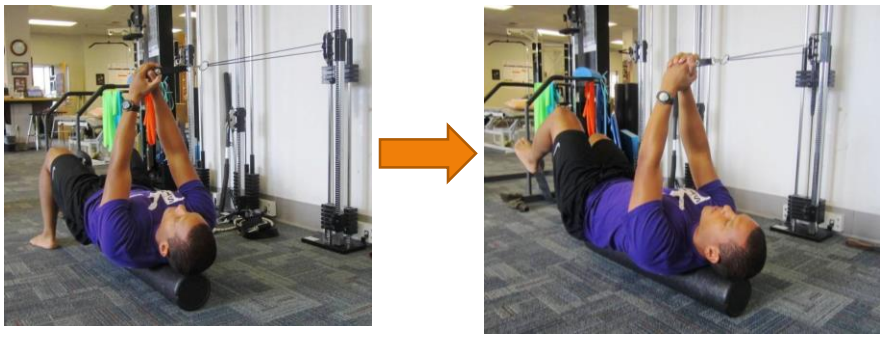


Rotational Bias



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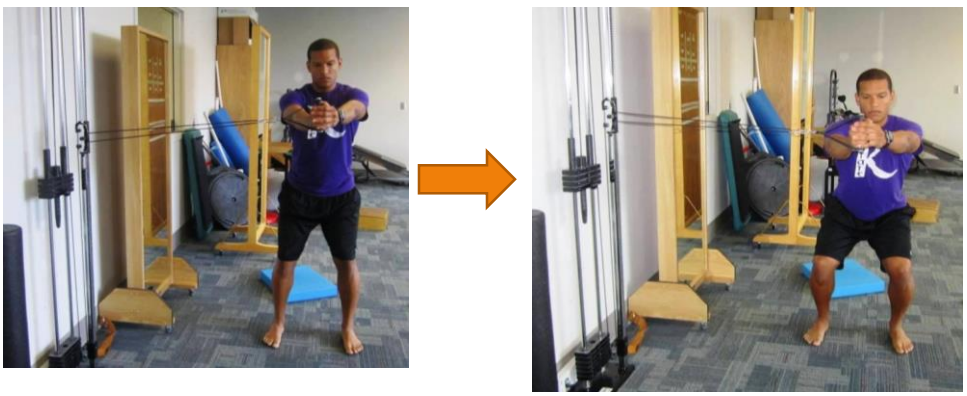

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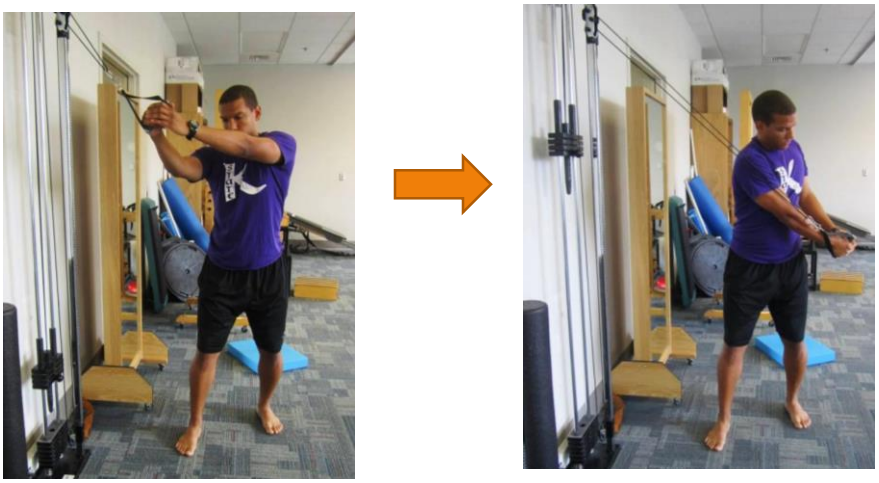
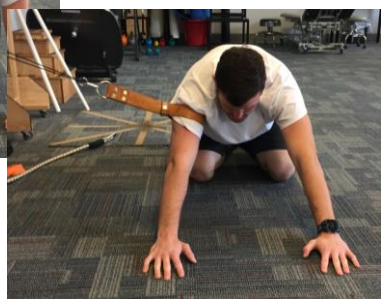


Other Types of Pulley Exercises

Shoulder Lateral Glide

- With B ER

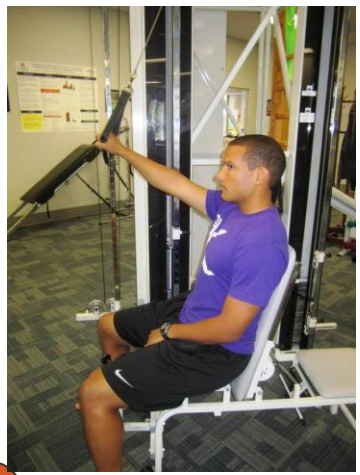


- Quadriped Rocking

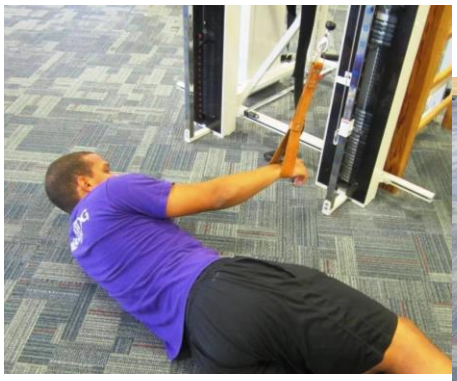
Shoulder Posterior Glide

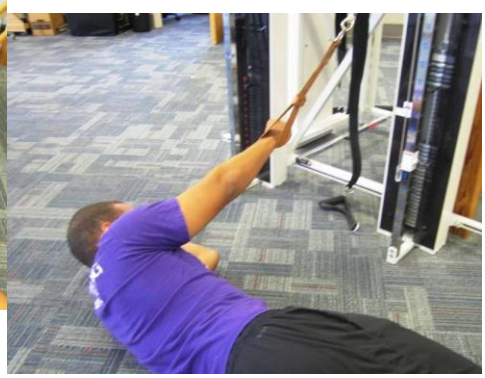
Assisted Shoulder Elevation

- Beginning of Range
- End of Range



Gravity Eliminated Shoulder Elevation





Lateral Elbow Glide
Humeroulnar Distraction