

Chapter 8 Muscular Analysis of Upper Extremity Exercises

Manual of Structural Kinesiology R.T. Floyd, EdD, ATC, CSCS



- Upper extremity often one of body's weakest areas
- · Strength & endurance in shoulder area
 - Essential for improved appearance & posture
 - More efficient skill performance
 - Specific conditioning exercises & activities should be intelligently selected

Upper Extremity Activities

• Upper extremity

raw-Hill Higher Education. All rights reserved

- Limited use in modern culture
- Weakness can impair skill development & performance in common recreational activities
- Appropriate base of muscular strength & endurance essential for injury prevention & adequate skill development

Upper Extremity Activities

- Typical weight room exercises concentrate onnly on anterior shoulder
- Without balanced approach may lead to strong & tight anterior muscles with weak & flexible muscles posteriorly
- Analysis of exercises is critical to appropriate exercise prescription

McGeny Hill Higher Education All sight

Concepts for Analysis

- Important to understand
 - Muscles are usually grouped together according to their concentric function
 - Muscles work in paired opposition to an antagonistic group
 - Aggregate muscle grouping activity example

 Elbow flexors work together as an agonist group to cause flexion in opposition to the triceps brachii & anconeus (elbow extensors)
 - In this example elbow extensor are cooperating in their lengthening to allow the flexors to perform their task

HEILING LUPETIOTTI LITEIT LASK



Concepts for Analysis

- · From viewing an activity
 - Determine which muscles are performing the movement
 - Know what type of contraction is occurring
 - Know what kind of exercises are appropriate for developing the muscles

Analysis of Movement Analyzing various exercises & sport skills Break down all movements into phases Number of phases varies, usually 3 - 5 All sport skills will have at least Preparatory phase Movement phase Follow-through phase Many begin with a stance phase & end with a recovery phase

Analysis of Movement
Phase names varies from skill to skill to fit the various sports terminology
Names may vary depending upon body part involved
Major phases may also be divided even further

• Ex. Baseball pitching preparatory phase is broken into early cocking & late cocking

Analysis of Movement Stance phase Allows athlete to assume a comfortable & balanced body position from which to initial

- balanced body position from which to initiate the sport skill
- Emphasis is on setting various joint angles in correct positions with respect to one another and to sport surface
- Stance Relatively static phase with fairly short ranges of motion involved

87 McGraw-Hill Higher Education. All rights reserved

Analysis of Movement Preparatory phase Often referred to as cocking or wind-up phase Used to lengthen the appropriate muscles so

- Used to lengthen the appropriate muscles so that they will be in position to generate more force & momentum when concentrically contract in next phase
- Most critical phase in leading toward the desired result of activity
- Becomes more dynamic as need for explosiveness increases

iraw-Hill Higher Education. All rights reserved

w-Hill Higher Education. All rights res









Analysis of Movement
Recovery phase

used after follow-through to regain balance & positioning to be ready for the next sport demand
To a degree, muscles used eccentrically in follow-through phase to decelerate the body or body segment will be used concentrically in recovery to bring about the initial return to a functional position





- · Baseball pitch skill analysis
 - Immediately following, movement phase begins with forward movement of arm & continues until ball release
 - Follow-through phase begins at ball release as arm continues moving in same direction established by movement phase until velocity decreases to point that arm can safely change movement direction
 - Deceleration of body & especially the arm is accomplished by high amounts of eccentric activity





The Kinetic Chain Concept An extremity may be seen as representing an *open kinetic chain* if the distal end of the extremity is not fixed to any surface Allows any one joint in the extremity to move or function separately without necessitating movement of other joints in the extremity Upper extremity examples include a shoulder shrug, deltoid raise (shoulder abduction), or a biceps curl Lower extremity examples include seated hip flexion, knee extension, & ankle dorsiflexion exercises

The Kinetic Chain Concept





represents a closed kinetic chain

kinetic chain through analysis of skilled movements Most sports involve closed-chain lower extremity activities & open-chain upper extremity activities

In determining appropriate conditioning

exercises, consider open versus closed

The Kinetic Chain Concept

Many exceptions

w-Hill Higher Education. All rights reserved

w-Hill Higher Education. All rights reserved

Open-chain exercises generally isolate only one segment, while closed-chain exercises work all segments in the chain, resulting in conditioning of muscles crossing each joint



Conditioning Considerations

- · Overload principle
 - A well trained person will see relatively minor improvements in the amount of weight that can be lifted over a much longer period of time
 - Amount & rate of progressive overload is extremely variable and must be adjusted to match the specific needs of the individual's exercise objectives

Conditioning Considerations

- · Overload principle
 - Overload may be modified by changing any one or a combination of 3 different exercise variables - *frequency, intensity,* or *duration*
 - Increasing the speed of doing the exercise, the number of repetitions, the weight, & more bouts of exercise are all ways to modify these variables in applying this principle

8-26

8-28

Conditioning Considerations

- Overload principle
 - Overload is not always progressively increased
 - In certain periods of conditioning, the overload should actually be prescriptively reduced or increased to improve the total results of the entire program
- Periodization

w-Hill Higher Education. All rights reserved

- Intentional variance in a training program at regular intervals
- Done to bring about optimal gains in physical performance
- Designed so that the athlete will be at his/her peak level during the most competitive part of the season

Conditioning Considerations

- · Overload principle
 - Exercise variables which may be manipulated include
 - · number of sets per exercise
 - · repetitions per set
 - · types of exercises
 - · number of exercises per training session
 - rest periods between sets & exercises
 - resistance used for a set
 - · type of muscle contraction
 - number of training sessions per day & per week

4cGraw-Hill Higher Education. All rights reserv

Conditioning Considerations

SAID Principle

w-Hill Higher Education. All rights res

- Specific Adaptations to Imposed Demands
 - the body will gradually, over time, adapt very specifically to the various stresses & overloads to which it is subjected
 - applicable in every form of muscle training, as well as to the other systems of body

8-29



Conditioning Considerations

SAID Principle

- To achieve specific benefits, exercise programs must be specifically designed for the desired adaption
- Adaptation may be positive or negative, depending on whether or not correct techniques are used and stressed in conditioning program design & administration
 - Inappropriate or excessive demands placed on the body in too short of a time span can result in injury

007 McGraw-Hill Higher Education. All rights reserved.

Conditioning Considerations

SAID Principle

- Adaptation may be positive or negative

 If demands are too minimal or administered too
 infrequently over too long a time period, less than
 desired improvement will occur
- Conditioning programs & the exercises included should be analyzed to determine if they are using the specific muscles for which they were intended in the correct manner

Conditioning Considerations

Specificity

raw-Hill Higher Education. All rights reserved

- Muscular strength, muscular endurance, & flexibility are not general body characteristics
 They are specific to each body area & muscle group
- Specific needs of the individual must be specifically addressed when designing an exercise program

 Often it is necessary to analyze an individual's exercise & skill technique to specifically design an exercise program to meet his/her needs

8-33

Conditioning Considerations

Specificity

- Addressing specific needs in designing an exercise program
 - Exercises for use in conditioning programs must be analyzed to determine their appropriateness for the individual's specific needs
 - Exercise program goals should be determined regarding specific areas of the body, preferred time to physically peak, & physical fitness needs such as strength, muscular endurance, flexibility, cardiorespiratory endurance, body composition, etc.

4cGraw-Hill Higher Education. All rights reserved

w-Hill Higher Education. All rig

Conditioning Considerations

Specificity

v-Hill Higher Education. All rights res

- Addressing specific needs in designing an exercise program
 - After establishing goals a regimen incorporating the overload variables of frequency, intensity, & duration may be prescribed to include the entire body or specific areas in a manner to address the improvement of the preferred physical fitness components
 - Regular observation & follow-up exercise analysis is necessary to ensure proper adherence to correct technique

8-35



- One does not necessarily develop adequate muscular strength, endurance, & flexibility through participation in sport activities
- One needs to develop muscular strength, endurance, & flexibility in order to be able to participate safely & effectively in sport activities
- Adequate muscular strength, endurance, & flexibility of the entire body from head to toe should be developed through correctly employing the appropriate exercise principles

8-32

Muscular Development

- Development should start at an early age & continue throughout the school years
- Fitness tests results indicate there is need for considerable improvement in this area
- Adequate muscular strength & endurance are important in the adult years for the activities of daily living, as well as job-related requirements and recreational needs
- Many back pains and other physical ailments could be avoided through proper maintenance of the musculoskeletal system

7 McGraw-Hill Higher Education. All rights reserved.



• Exhale during lifting & inhale during lowering

7 McGraw-Hill Higher Education. All rights reserved



Shoulder Pull						
Joint	Action	Agonists	Action	Agonists		
Wrist & hand	Extension	Agon wrist & hand extensors Ant wrist & hand flexors	Flexion	Agon wrist & hand flexors Ant wrist & hand extensors		
Elbow	Extension	Agon triceps brachii, anconeus Ant biceps brachii, brachialis, brachioradialis	Flexion	Agon biceps brachii, brachialis, brachioradialis Ant triceps brachii, anconeus		
Shoulder joint	Abduction	Agon deltoid & supraspinatus Ant teres major, latissimus dorsi, pectoralis major	Adduction	Agon teres major, latissimus dorsi, pectoralis major Ant deltoid & supraspinatus		
Shoulder girdle	Adduction & depression	Agon rhomboid & trapezius Ant serratus anterior, pectoralis major, trapezius (upper & middle)	Abduction & elevation	Agon serratus anterior, pectoralis minor, trapezius (upper & middle) Ant rhomboid & trapezius		



		Arm	Curl	
Joint	Action	Agonists in Lifting	Action	Agonists in Lowering
Wrist & hand	Flexion	Wrist & hand flexors (isometric contraction)	Flexion	Wrist & hand flexors (isometric contraction)
		Flexor carpi radialis Flexor carpi ulnaris		Flexor carpi radialis Flexor carpi ulnaris
		Palmaris longus		Palmaris longus
		Flexor digitorum profundus		Flexor digitorum profundus
		Flexor digitorum superficialis		Flexor digitorum superficialis
		Flexor pollicis longus		Flexor pollicis longus
Elbow	Flexion	Elbow flexors Biceps brachii	Extension	Elbow flexors (eccentric contraction)
		Brachialis		Biceps brachii
		Brachioradialis		Brachialis
				Brachioradialis

Triceps Extension

- Use opposite hand to assist in maintaining full shoulder flexion
- Subject begins with elbow in full flexion
- Elbow is extended until fully straight with dumbbell overhead
- Return to starting position

Hill Higher Education. All right

Joint	Action	Agonists in Lifting	Action	Agonists in Lowering
Wrist &	Flexion	Wrist & hand flexors (isometric contraction)	Flexion	Wrist & hand flexors (isometric contraction)
hand		Flexor carpi radialis		Flexor carpi radialis
		Flexor carpi ulnaris		Flexor carpi ulnaris
		Palmaris longus		Palmaris longus
		Flexor digitorum profundus		Flexor digitorum profundus
		Flexor digitorum superficialis		Flexor digitorum superficialis
		Flexor pollicis longus		Flexor pollicis longus
Elbow	Extension	Elbow extensors	Flexion	Elbow extensors (eccentric
		Triceps brachii		contraction)
		Anconeus		Triceps brachii
				Anconeus



Joint	Action	Agonists in Lifting		
Wrist & hand	Flexion	Wrist & hand flexors (isometric contraction)		
		Flexor carpi radialis		
		Flexor carpi ulnaris		
		Palmaris longus		
		Flexor digitorum profundus		
		Flexor digitorum superficialis		
		Flexor pollicis longus		
Elbow	Extension	Elbow extensors		
		Triceps brachii		
		Anconeus		
Shoulder	Flexion	Shoulder joint flexors		
		Pectoralis major (clavicular head or upper fibers)		
		Anterior deltoid		
		Coracobrachialis		
		Biceps brachii		
Shoulder girdle	Upward rotation &	Shoulder girdle upward rotators & elevators		
	elevation	Trapezius		
		Levator scapulae		
	1	Serratus anterior		

Barbell Press					
Joint	Action	Agonists in Lowering			
Wrist & hand	Flexion	Wrist & hand flexors (isometric contraction) Flexor carpi radialis Flexor carpi ulnaris Palmaris longus Flexor digitorum superficialis Flexor digitorum superficialis Flexor policis longus			
Elbow	Extension	Elbow extensors (eccentric contraction) Triceps brachii Anconeus			
Shoulder	Flexion	Shoulder joint flexors (eccentric contraction) Pectoralis major (clavicular head or upper fibers) Anterior deltoid Coracobrachialiis Biceps brachii			
Shoulder girdle	Upward rotation & elevation	Shoulder girdle upward rotators & elevators (eccentric contraction) Trapezius Levator scapulae Serratus anterior			



	Chest Press (bench press)						
Joint	Action	Agonists in Lifting	Action	Agonists in Lowering			
Wrist & hand	Flexion	Wrist & hand flexors (isometric contraction) Flexor carpi radialis Flexor carpi ulnaris Palmaris longus Flexor digitorum profundus Flexor digitorum superficialis Flexor policis longus	Flexion	Wrist & hand flexors (isometric contraction) Flexor carpi radialis Flexor carpi ulnaris Palmaris longus Flexor digitorum profundus Flexor digitorum superficialis Flexor digito longus			
Elbow	Extension	Elbow extensors Triceps brachii Anconeus	Flexion	Elbow extensors (eccentric contraction) Triceps brachii Anconeus			
Shoulder	Flexion & horizontal adduction	Shoulder flexors & horizontal adductors Pectoralis major Anterior deltoid Coracobrachialis Biceps brachii	Extension & horizontal abduction	Shoulder joint flexors & horizontal adductors (eccentric contraction) Pectoralis major Anterior deltoid Coracobrachialis Biceps brachii			
Shoulder girdle	Abduction	Shoulder girdle abductors Serratus anterior Pectoralis minor	Adduction	Shoulder girdle abductors (eccentric contraction) Serratus anterior Pectoralis minor			



	Chin-up (pull-up)				
Joint	Action	Agonists in Pulling up			
Wrist & hand	Flexion	Wrist & hand flexors (isometric contraction)			
		Flexor carpi ulgaria			
		Palmaria longue			
		Elevor digitorum profundus			
		Flexor digitorum superficialis			
		Flexor pollicis longus			
Elbow	Flexion	Elbow flexors			
		Biceps brachii			
		Brachialis			
		Brachioradialis			
Shoulder	Extension	Shoulder joint extensors			
		Latissimus dorsi			
		Teres major			
		Posterior deltoid			
		Pectoralis major			
		Triceps brachii (long head)			
Shoulder	Adduction,	Shoulder girdle adductors, depressors, & downward rotators			
girdle	depression, &	Trapezius (lower & middle)			
	downward	Pectoralis minor			
	Iotation	Rhomboids			

	Chin-up (pull-up)				
Joint	Action	Agonists in Lowering			
Wrist &	Flexion	Wrist & hand flexors (isometric contraction)			
hand		Flexor carpi radialis			
		Flexor carpi ulnaris			
		Palmaris longus			
		Flexor digitorum profundus			
		Flexor digitorum superficialis			
		Flexor pollicis longus			
Elbow	Extension	Elbow flexors (eccentric contraction)			
		Biceps brachii			
		Brachialis			
		Brachioradialis			
Shoulder	Flexion	Shoulder joint extensors (eccentric contraction)			
		Latissimus dorsi			
		Teres major			
		Posterior deltoid			
		Pectoralis major			
		Triceps brachii (long head)			
Shoulder	Elevation,	Shoulder girdle adductors, depressors, & downward rotators (eccentric			
girdle	abduction, &	contraction)			
	upward	Trapezius (lower & middle)			
	Iotauoli	Pectoralis minor			
ļ		Bhomboids			



	Latissimus Pull (lat pull)				
Joint	Action	Agonists in Pull down			
Wrist & hand	Flexion	Wrist & hand flexors (isometric contraction)			
		Flexor carpi radialis			
		Flexor carpi ulnaris			
		Palmaris longus			
		Flexor digitorum profundus			
		Flexor digitorum superficialis			
		Flexor pollicis longus			
Elbow	Flexion	Elbow flexors			
		Biceps brachii			
		Brachialis			
		Brachioradialis			
Shoulder	Adduction	Shoulder joint adductors			
		Pectoralis major			
		Posterior deltoid			
		Latissimus dorsi			
		Teres major			
		Subscapularis			
Shoulder	Adduction,	Shoulder girdle adductors, depressors, and downward rotators			
girdle	depression, &	Trapezius (lower & middle)			
	downward	Pectoralis minor			
		Rhomboids			

	L	atissimus Pull (lat pull)
Joint	Action	Agonists in Return
Wrist &	Flexion	Wrist & hand flexors (isometric contraction)
hand		Flexor carpi radialis
		Flexor carpi ulnaris
		Palmaris longus
		Flexor digitorum profundus
		Flexor digitorum superficialis
		Flexor pollicis longus
Elbow	Extension	Elbow flexors (eccentric contraction)
		Biceps brachii
		Brachialis
		Brachioradialis
Shoulder	Abduction	Shoulder joint adductors (eccentric contraction)
		Pectoralis major
		Posterior deltoid
		Latissimus dorsi
		Teres major
		Subscapularis
Shoulder girdle	Abduction, elevation, &	Shoulder girdle adductors, depressors, & downward rotators (eccentric contraction)
	upward	Trapezius (lower & middle)
	rotation	Pectoralis minor
		Bhomboids



Push-up (fingertip)					
Joint	Action	Agonists in Lifting	Action	Agonists in Lowering	
Wrist & hand	Flexion	Wrist & hand flexors (Isometric contraction) Flexor carpi radialis Flexor carpi ulnaris Palmaris longus Flexor digitorum profundus Flexor digitorum superficialis Flexor policis longus	Flexion	Wrist & hand flexors (isometric contraction) Flexor carpi radialis Flexor carpi ulnaris Palmaris longus Flexor digitorum profundus Flexor digitorum superficialis Flexor digito longus	
Elbow	Extension	Elbow extensors Triceps brachii Anconeus	Flexion	Elbow extensors (eccentric contraction) Triceps brachii Anconeus	
Shoulder	Horizontal Adduction	Shoulder joint horizontal adductors Pectoralis major Anterior deltoid Biceps brachii Coracobrachialis	Horizontal abduction	Shoulder joint horizontal adductors (eccentric contraction) Pectoralis major Anterior deltoid Biceps brachii Coracobrachialis	
Shoulder girdle	Abduction	Shoulder girdle abductors Serratus anterior Pectoralis minor	Adduction	Shoulder girdle abductors (eccentric contraction) Serratus anterior Pectoralis minor	

Prone Row	To
 A.K.A. as bent-over row Subject is kneeling on a bench using contralateral arm to support the body 	
 Involved arm is free from contact with floor With dumbbell in hand, arm & shoulder hanging straight to the floor, subject adducts shoulder girdle & horizontally abducts shoulder joint 	
 Then slowly lower dumbbell to the starting position 	B
0 2007 McGraw-Hill Higher Education. All rights reserved.	8-58

Prone Row				
Joint	Action	Agonists in Pulling up	Action	Agonists in Lowering
Hand	Flexion	Hand flexors (isometric contraction) Flexor digitorum profundus Flexor digitorum superficialis Flexor pollicis longus	Flexion	Hand flexors (isometric contraction) Flexor digitorum profundus Flexor digitorum superficialis Flexor pollicis longus
Elbow	Flexion	Passive flexion occurs as the arm becomes parallel to the floor due to gravity	Extension	Passive extension occurs as the arm becomes perpendicular to the floor due to gravity
Shoulder	Horizontal abduction	Shoulder joint horizontal abductors Posterior deltoid Infraspinatus Teres minor Latissimus dorsi	Horizontal Adduction	Shoulder joint horizontal abductors (eccentric contraction) Posterior deltoid Infraspinatus Teres minor Latissimus dorsi
Shoulder girdle	Adduction	Shoulder girdle adductors Trapezius (lower & middle) Rhomboids	Abduction	Shoulder girdle adductors (eccentric contraction) Trapezius (lower & middle) Rhomboids



Web Sites

 National Council of Strength & Fitness

 www.ncsf.org

 Personal Training Certification & Continuing Education for the fitness Professional

 muscle Strength and Conditioning Association

 www.nsca-lift.org

 Information on the profession of strength and conditioning specialists and personal trainers

 NECA Certification Commission

 www.nsca-corg

 The certifying body for the National Strength and Conditioning Association

 www.fitness.gov

 Information and links from the U.S. government on fitness

Web Sites ExRx.net www.exrx.net/Lists/Directory.html - A resource for the exercise professional, coach, or fitness enthusiast consisting of over 1500 pages of exercises and anatomy illustrations National Academy of Sports Medicine www.nasm.org - Offers specific certifications for health and fitness exercise specialists and a valuable resource for continuing education on exercise techniques, etc. Upper Extremity Conditioning Program www.eatonhand.com/hw/nirschl.htm - Shows strengthening exercises for the upper body 8-62 -Hill Higher Education. All rights

Web Sites

Rehab Team Site: Passive Stretching

http://calder.med.miami.edu/pointis/upper.html – Passive Range of Motion Exercises

Body Map

McGraw-Hill Higher Education. All rights reserved

<u>http://www.athleticadvisor.com/Injuries/general_injuries.htm</u> – Describes specific injuries and how to properly rehab with weights

Physician and Sports Medicine: Weight Training Injuries

www.physsportsmed.com/issues/1998/03mar/laskow2.htm - Article that is about upper body injuries and how to strengthen the upper body

8-63

Web Sites

NISMAT Exercise Programs

www.nismat.org/orthocor/programs/

 Step by step instructions of strengthening exercises along with diagrams

Runner Girl.com

 www.runnergirl.com
 Strengthening and stretching exercises as well as other health and fitness information for women

McGraw-Hill Higher Education. All rights reserved.