

# Rehabilitation after operation

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## 서 론

견관절의 안정성은 상대적으로 접촉면이 적은 골조직과 관절낭인대복합조직을 통한 정적 안정성과, 회전건 개 및 견갑근육 등으로 이루어진 동적안정성을 바탕으로 넓은 범위의 운동성을 가지고 있으며, 운동성과 안정성 사이의 균형을 효과적으로 잘 유지함으로써 다양한 기능을 수행할 수가 있다. 견관절부의 질환은 관절의 불안정성을 유발하는 질환과 관절의 구축을 통해 운동성이 제한되는 질환, 그리고 견봉하 공간의 회전건 개의 손상으로 운동성이 제한 받는 질환 등으로 대별할 수 있으며, 질환의 정도나 환자의 상태 및 운동능력에 따라 보존적 치료나 수술적 치료를 선택할 수 있다. 수술적 치료를 시행할 경우의 재활치료는, 기본적으로 보존적 치료 방법의 원칙을 따르게 되나, 수술적 치료를 시행한 병변 부위에 재손상을 주지 않으며 생 역학적으로 안정된 상태에서 재활치료를 시행함으로써, 보다 빨리 정상적인 견관절 기능을 회복시키는 데 중점을 둔다. 재활치료의 원칙은 통증을 느끼지 않는 범위 내에서 시행하며, 치료 시 반응을 지속적으로 관찰하며 진행해야 한다는 것이다. 또한

운동의 방향은 견갑면을 따라 견갑근의 균형을 유지한 채 시행하여야 하며, 운동의 강도는 submaximal intensity, short arc의 운동에서 시작하여 maximal intensity, full arc의 운동으로 서서히 증가 시켜가야 하며, 이러한 재활치료는 환자의 증상과 기대수준에 따라 각자에게 적합한 치료방법을 선택하여야 한다.

### A. Shoulder function

Link in a kinetic chain of sequentially activated body segments  
Local & distant function affect each other

#### 1. Distant functions

Normal shoulder function needs restoration of the normal linkage system

##### 1) Sequence of activation:

biomechanically efficient to allow generation of large force  
and large accelerations to the arm

54% of the force & 51% of the kinetic energy

: created by the lower kegs, hip, and trunk

##### 2) Two types of motor activation:

(1) Length-dependent pattern: controlled by muscle spindle receptors  
co-contraction force couple  
maintain the stability of the joint

- (2) Force-dependent pattern: controlled by golgi tendon receptors
  - Agonist-antagonist force couple
  - Efficient at faster speeds of activation
- 3) Link breakage cause “catch-up”
  - : distal link try to make up for deficits in more proximal links
  - ⇒ inefficient adaptation
  - ⇒ decreased performance or increased injury risk

## 2. Local functions

: balance between mobility & stability

### 1) Mobility

ROM need in athletic activities:

Swimming: 180° of abd., Baseball: 120° of ER, Tennis: 80° of IR

Unconstrained joint: Bony anatomy-large ball-small socket configuration

Cartilaginous-like labrum

Capsule taut at extreme of motion

Flexible muscle

### 2) Stability

: instant center of rotation(ICR) remains in a specific path  
 midrange-minimal or no movement of instant center  
 end range-translations of 4~10 mm

#### (1) Midrange stability(Concavity-compression)

Anatomic curvature of humerus & glenoid

Extra depth of labrum

Negative articular pressure

Muscle contraction

#### (2) Muscle coactivation force couples

#### (3) Proper glenohumeral orientation

Angle between glenoid & humerus- safe zone of 30°

Actively positioned scapula: stable base of muscle origin

## B. Principles of rehabilitation

1. Onset of pain during rehabilitation program needs reevaluation of modalities.
2. Effective treatment program needs through evaluation of
  - 1) pathology
  - 2) tissue reactivity
  - 3) functional deficits
3. Rehabilitation program advanced based on symptoms & functional demands of the patient

- 1) motion: isometric, short arc to full arc
- 2) resistance: submaximal to maximal
- 3) movement plane: nonprovocative to provocative
4. Balanced scapular muscle function
  - : rotator cuff exercise to sports-specific manual resistance & isokinetics
5. Individualized program based on
  - 1) reactivity
  - 2) hyperelasticity/hypoelasticity
  - 3) personality
  - 4) goals
  - 5) surgical concerns
  - 6) complications

### C. Guidelines for shoulder rehabilitation

Extent of the alterations in the tissue or in the biomechanics are more important than specific anatomy based diagnosis  
 ex) subacromial pathology vs.  
 GH instability, scapular dyskinesis, lumbar hyperlordosis

#### 1. Make a complete & accurate diagnosis

Principle: Complexity of the factors that determine shoulder function  
 Practice:

- 1) Diagnosis include anatomic & biomechanical deficit
  - : Local deficit & Distant deficit
- 2) Accurate diagnosis
  - : clinical symptom, overloaded tissues, subclinical adaptation
- 3) Role of rehabilitation: normalization of all components

#### 2. Early pain reduction

Principle: Pain is major source of alteration in shoulder joint function  
 Controlled early in the stage of rehabilitation  
 Practice: Relative rest, Cryotherapy, Ultrasound, Galvanic stimulation  
 Mediations, Injections, Surgical relief  
 Rehabilitation: therapy modalities & exercise  
 should be kept within pain-free arc

#### 3. Integration of the kinetic chain into rehabilitation

Principle: Bases for shoulder activity and shoulder strength  
 Restored early in the rehabilitation process  
 Practice: 1) Rehabilitation of the legs & hips

- 2) Sports-specific force & velocity
- 3) Closed chain fashion
  - (1) Eccentric patterns: integration of hip & trunk with the scapula
  - (2) Extensor pattern: Trampoline exercise for coordinating extensor activity of hip, trunk, and shoulder
  - (3) Endurance activities: aerobic - recovery from exercise  
anaerobic - agility & power work

#### 4. Scapular stabilization

Principle: ball on a seal's nose

- Four main role: (1) retraction & protraction in throwing motion  
 (2) elevation of acromion in abduction  
 (3) socket for GHJ  
 (4) base of intrinsic & extrinsic muscles

Practice: closed chain rehabilitation

- (1) Scapular pinch
- (2) Isometric activity: retraction toward the midline
- (3) Integration of scapular retraction with RC co-contraction

#### 5. Early achievement of 90° of abduction

Principle: Throwing & service motion: 85° to 110° of abduction

Skilled length-dependent & force-dependent motor patterns  
 : need 90° of abduction

Practice: 1) Achievement of 90° of abduction

: pain from impingement should be reduced

- 2) Specific exercise: (1) active assisted wand maneuvers  
 (2) Gentle joint mobilizations  
 (3) PNF patterns  
 (4) Passive stretching
- 3) Pace of progression: vigorous after 3-6wk

#### 6. Closed chain rehabilitation

Principle:

- 1) Closed chain activity needs co-contraction force couples at the STJ & GHJ
  - (1) proper scapular position & stability
  - (2) compression cuff: concavity compression & stable ICR
  - (3) simulate normal proprioceptive pathway
  - (4) replicate normal ball and socket kinematics

: minimize translation in the mid ranges of motion  
 ⇒ stable scapular base & early RC strength  
 ⇒ allow open chain activities

- 2) Open chain activities: agonist-antagonist force couples
  - (1) need deltoid & other extrinsic muscle activation
  - (2) shear force at GHJ & large ROM
 ⇒ later phase of rehabilitation

Practice:

- 1) Progression of closed chain activities
  - (1) Early phase: started at 45° of abduction & 60° of flexion  
 ⇒ proceed to 90° of abduction
  - (2) After 90° of abduction: scapular stabilization  
 ⇒ retraction & protraction in single plane  
 elevation & depression of entire scapula  
 selective elevation of acromion
  - (3) rotator cuff activity: "clock" exercise  
 ⇒ fixed resistance(wall) and movable resistance(ball)
- 2) Effectiveness of closed chain exercise
  - (1) Early in rehabilitation protocol  
 : Do not put shear on the joint  
 RC activity without pain or deltoid overactivity
  - (2) Smoother transition from below-shoulder to above shoulder activities
  - (3) Later phase of rehabilitation  
 : various type of pushups & scaption exercise

## 7. Plyometric exercise

- Principle: 1) Most appropriate open chain exercises  
 : develop the athlete's ability to generate power  
 after complete anatomic healing & full ROM gain
- 2) Two phase of exercise
    - (1) Pretensioning phase: eccentrically stretched & slowly loaded
    - (2) Concentric phase: develop large amount of momentum & force

- Practice: 1) all body segments: hip rotation, knee flexion/extension, trunk rotation
- (1) lower extremity: early phase
  - (2) upper extremity: later phase
- 2) activities & devices  
 : Rubber tubing, Medicine ball

Light weights, caution with heavier weights

### 8. Rotator cuff exercise

Principle: Important in creating concavity/compression

Overpowered & inhibited by deltoid activity

Practice: 1) Rehabilitated as an integrated unit

2) Closed chain fashion:

Stabilized scapula

strengthening without inducing shear force

Not allow deltoid overactivity

3) Clinical sign for deficiencies in RC rehabilitation

: exacerbation of clinical symptom

abnormalities in kinetic chain: most commonly scapular stabilizers

### D. Principles of accelerated postoperative shoulder rehabilitation

: Early, safe return to athletic and activity function

1. Proper preoperative preparation
2. Anatomic surgical restoration
3. Assurance of biomechanically appropriate motion at surgery
4. Early assisted or active assisted motion
5. Closed chain axial loading rehabilitation
6. Functional joint positions during rehabilitation
7. Physiologic progressions as improved functions are required

## 요 약

최근 견관절 질환 치료의 발전에 힘입어 술 후의 유병율을 줄이고, 보다 견고한 조직 복원이 가능해 짐으로써 운동사슬(kinetic chain)의 생리적이고 생 역학적인 복원을 위한 재활치료를 조기에 시행할 수 있게 되었다. 이러한 조기재활 치료는 술 전 적절한 준비, 해부학적인 수술적 치료, 술 중 적절한 운동범위의 회복, 술 후 조기 보조 및 능동 보조운동, closed chain-axial loading rehabilitation protocol, 재활치료 중 기능적 관절위치 유지 및 기능회복에 따른 생 리적 호전 등의 원칙을 통해 견관절의 여러 질환의 재활치료에 적용할 수 있다. 견관절의 조기 재활치료 시 통증은 근육의 조화운동을 저해하게 되며 관절의 안정적인 운동과 기능을 방해하게 된다. 따라서 시각 측정표를 이용한 4 이하의 통증범위에서, 관절의 위치와 팔 및 몸의 운동 그 리고 근육의 작용을 잘 관찰하는 가운데 운동을 함으로써 통증으로 인한 근억제 효과를 줄이며, 보다 조기에 안전하게 일상생활 및 운동복귀를 할 수 있다.

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