Active and passive range of motion

Complete patient relaxation is necessary to obtain an accurate judgment of the range of motion. Tension will cause considerable motion restriction. As in all range of motion tests, passive motion should not be attempted if there is any possibility of fracture, dislocation, severe tears, advanced bone pathology, etc. If active motion is normal, there is usually no need to test passive motion unless unusual circumstances exist that make active motion difficult. It is important during all tests that the examiner form a mental picture of the underlying anatomy and normal motion.

Spasm, contractures, fracture, and dislocation are the common causes of motion restriction and muscle weakness. In uncomplicated muscle weakness, a joint may move through its normal range passively but not actively. Active and passive restriction is likely from a bony or soft-tissue blockage, and the atrophy present will be most likely from disuse. Upon passive movement, bone blocks will feel as abrupt inflexible stops in motion, while extra-articular soft-tissue blocks will be less abrupt and slightly flexible upon additional pressure.

SHOULDER MOTION

Elevation, depression, abduction (180°), adduction (45°), extension (45°), flexion (90°), internal rotation (55°), and external rotation (45°) are the basic movements of the shoulder girdle. Other movements normally tested are scapular retraction (military position of attention) and shoulder protraction (reaching). The patient may be in either the standing or sitting position during testing.

Elevation and depression are checked by having the patient hunch the shoulders and return to the normal position. Active external rotation and abduction are easily tested by having the patient reach up and over the shoulder and attempt to touch the spinal border of the opposite scapula. External rotation and abduction can be tested bilaterally at the same time by having the patient place both hands behind the neck with interlocking fingers, then the elbows, which are initially pointing forward, are moved laterally and posteriorly in an arc.

If the examiner wishes to check solely glenohumeral joint passive abduction, the stabilizing hand should firmly anchor the scapula while the examiner's active hand passively abducts the patient's arm with the forearm horizontal. The shoulder blade will normally not be felt to move until about 20° of abduction has occurred. Abduction should normally continue in this position to about 120° where the surgical neck of the humerus meets the tip of the acromion. The examiner should next turn the patient's forearm to externally rotate the humerus and move the surgical neck away from the acromion, then continue abduction to its maximum. For every 3° of humeral abduction, 1° occurs at the scapulothoracic articulation for every 2° at the glenohumeral joint.

Internal rotation and adduction are checked by having the patient reach across his chest, keeping the elbow as close to the chest as possible, and touch the opposite shoulder tip. A more extreme method is to have the patient reach behind the back and attempt to touch the bottom angle of the opposite shoulder blade. In each of these tests, both upper limbs may be tested at the same time, if desired, to compare bilateral action.

Test full active bilateral abduction by having the patient abduct the arms horizontally to 90° while keeping the elbows straight and the palms turned upward then continuing abduction in an arc until the hands meet in the middle over the head.

KINESIOLOGY OF THE SHOULDER GIRDLE

The major muscles of the shoulder, their primary function, and their innervation are listed below:

Flexion. Shoulder flexion is conducted primarily by the anterior deltoid (C5-C6) and coracobrachialis (C5-C6) with assistance by the clavicular head of the pectoralis major (C5– T1) and biceps (C5-C6). Strength of flexion can be tested from the back of the patient by placing the stabilizing hand on the patient's shoulder so that the anterior deltoid may be palpated during testing. The examiner's active hand grips the patient's anterior lower arm. With the patient's elbow flexed to 90°, resistance is increased as the patient is asked to flex the shoulder. Muscle strength is recorded by grade or in a percentage and compared bilaterally.

Extension. Extension of the shoulder is controlled by the latissimus dorsi (C6– C8), teres major (C5-C6), and posterior part of the deltoid (C5-C6). Assistance is offered by the teres minor (C5-C6) and long head of the triceps (C7-C8). Strength of extension is judged from the back of the patient with the stabilizing hand in nearly the same position so as to palpate the posterior deltoid while the palm of the active hand grips the patient's lower arm at the posterior. The patient's elbow is again flexed, and he or she is asked to slowly extend the shoulder against increasing resistance.

Abduction. When the hand is abducted horizontally, the forces created at the shoulder joint have been calculated to approximate total body weight. Shoulder abduction is conducted by the middle deltoid (C5-C6) and supraspinatus (C5-C6) with assistance by the serratus anterior (C5– C7). Strength of abduction can be tested at the side of the patient by placing the stabilizing hand on the lateral shoulder tip so that the middle of the deltoid may be palpated. The examiner applies increasing resistance laterally above the flexed elbow of the patient as abduction is attempted.

Adduction. Adduction of the shoulder is controlled by the pectoralis major (C5– T1) and latissimus dorsi (C6– C8). Assistance is offered by the teres major (C5-C6) and anterior deltoid (C5-C6). Strength of adduction is measured from behind the patient with the stabilizing hand still on the shoulder tip. The patient's arm is abducted and the elbow is flexed. The examiner then applies increasing resistance medially above the flexed elbow of the patient as the patient attempts adduction.

Internal Rotation. Internal rotation of the shoulder is controlled by four muscles: the subscapularis (C5-C6), pectoralis major (C5– T1), latissimus dorsi (C6– C8), and teres major (C5-C6). The anterior deltoid assists. Strength of the internal rotators is tested with the examiner's stabilizing hand and active hand in the same position. An increasing pulling resistance is applied to the patient's wrist as the patient attempts internal rotation of the arm by moving the hand toward the abdomen.

External Rotation. External rotation of the shoulder is conducted by the infraspinatus (C5-C6) and teres minor (C5), with assistance by the posterior part of the deltoid. Strength of external rotation is judged at the side of the patient by placing the stabilizing hand on the patient's flexed elbow with the examiner's thumb in the angle of the patient's elbow. The active hand, gripping the patient's wrist, applies an increasing pushing resistance to the patient's attempt to externally rotate the arm by moving the hand away from his body.

Scapular Elevation. Shoulder elevation is conducted by the trapezius (XI, C3-C4) and levator scapulae (C3– C5) with assistance from the major and minor rhomboids (C5). Strength is judged by the examiner standing behind the patient and applying increasing resistance with both palms on the patient's shoulders as the patient attempts to shrug his shoulders.

Major Muscles of the Shoulder

Muscle	Major Function	Spinal Segment
Biceps brachii	Flexion, adduction (short head)	C5-C6
Coracobrachialis	Flexion, adduction	C5-C6
Deltoid		
Anterior fibers	Flexion, internal rotation, abduction, horizontal adduction	C5-C6
Dorsal fibers	Extension, external rotation, horizontal abduction	C5-C6
Middle fibers	Abduction	C5-C6
Infraspinatus	External and lateral rotation, extension (lower fibers), horizontal abduction	C5-C6
Latissimus dorsi	Extension, adduction, medial rotation, depression, downward rotation	C6-C8
Levator scapulae	Elevation, downward rotation	C3-C5
Pectoralis major	Adduction, flexion, depression	C5-T1
Clavicular head	Flexion, medial rotation, adduction	C5-C7
Sternal head	Extension, depression, medial rotation	C6-T1
Pectoralis minor	Adduction, medial/downward rotation, flexion, depression, extension	C7-C8
Rhomboids	Retraction, elevation, adduction, downward rotation	C5
Serratus anterior	Protraction, abduction, upward rotation, depression (lower fibers)	C5-C7
Subscapularis	Medial rotation and adduction	C5-C6
Supraspinatus	Abduction	C5-C6
Teres major	Extension, adduction, medial rotation	C5-C6
Teres minor	External/lateral rotation, extension	C5-C6
	horizontal abduction	C5
Trapezius	Retraction	C3-C4, XI
Upper fibers	Elevation, adduction, upward rotation	
Lower fibers	Depression, adduction, upward rotation	
Triceps	Adduction, extension (long head)	C7-C8

Scapular Depression. Shoulder retraction is controlled by the major and minor rhomboids, both of which are usually innervated solely by C5. The trapezius assists. To evaluate the strength of scapular depression, the examiner stands in front of the patient with his hands grasping the patient's shoulder tips over the upper deltoids. The doctor's thumbs are braced under the patient's clavicles, and the fingers are behind the deltoids. The patient is instructed to slowly "throw his shoulders back and down" while the examiner applies increasing resistance; ie, forward toward the thumbs.

Shoulder Protraction. Protraction of the shoulder is conducted by the serratus anterior (C5– C7). In determining strength of protraction, with the examiner behind the patient, the patient is asked to flex the arm so that it is parallel to the floor with the elbow at a right angle to the arm. The examiner's stabilizing hand is placed in the midscapular area to stabilize the patient's spine from rotating, and the active hand is cupped around the patient's flexed elbow. Increasing resistance is applied as the patient attempts to slowly thrust the arm forward as if to touch a forward wall. During this movement, the examiner observes the scapula for possible winging.

Range of motion

Range of motion (or **ROM**), is the linear or angular distance that a moving object may normally travel while properly attached to another. It is also called **range of travel** (or **ROT**), particularly when talking about mechanical devices and in mechanical engineering fields. For example, a sound volume control knob. As used in the biomedical field and by weightlifters, range of motion refers to the distance and direction a joint can move between the flexed position and the extended position. The act of attempting to increase this distance through therapeutic exercises (range of motion therapy—stretching from flexion to extension for physiological gain) is also sometimes called range of motion.

Measuring range of motion

Each specific joint has a normal range of motion that is expressed in degrees. The reference values for the normal ROM in individuals differ slightly depending on age and gender. For example, as an individual ages, they typically lose a small amount of ROM. Analog and traditional devices to measure range of motion in the joints of the body include the goniometer and inclinometer which use a stationary arm, protractor, fulcrum, and movement arm to measure angle from axis of the joint. As measurement results will vary by the degree of resistance, two levels of range of motion results are recorded in most cases. Recent technological advances in 3D motion capture technology allow for the measurement of joints concurrently, which can be used to measure a patient's active range of motion.

Limited range of motion

Limited range of motion refers to a joint that has a reduction in its ability to move. The reduced motion may be a problem with the specific joint or it may be caused by injury or diseases such as osteoarthritis, rheumatoid arthritis, or other types of arthritis. Pain, swelling, and stiffness associated with arthritis can limit the range of motion of a particular joint and impair function and the ability to perform usual daily activities. Limited range of motion can

affect extension or flexion. If there is limited range of extension, it is called "**Flexion Contracture**" or "**Flexion Deformity**". If the flexion is deficient, it is called "**Limited Range of Flexion**" or "**Limited Flexion Range**".

Range of motion exercises

Physical and occupational therapy can help to improve joint function by focusing on range of motion exercises. The goal of these exercises is to gently increase range of motion while decreasing pain, swelling, and stiffness. There are three types of range of motion exercises:

- **Passive Range of Motion** (or **PROM**) - Therapist or equipment moves the joint through the range of motion with no effort from the patient.
- **Active Assisted Range of Motion** (or **AAROM**) - Patient uses the muscles surrounding the joint to perform the exercise but requires some help from the therapist or equipment (such as a strap).
- **Active Range of Motion** (or **AROM**) - Patient performs the exercise to move the joint without any assistance to the muscles surrounding the joint.

Range of Motion (exercise machine)

Range of motion (**ROM**) is when a person has become injured in some way, most times the doctor's advice the patients to exercise and stretch the back muscles. For this purpose, a form of exercises called range of motion exercises which are used to keep the muscles and joints in the patients back strong and flexible. These exercises can be done by the patient himself, or with a physical therapist. If these exercises are done alone, they would be called active range of motion (AROM) exercises and if they require assistance, they would be called active-assisted range of motion (AAROM) exercises.

ROM Therapy Users

ROM therapy is used largely for two distinct subgroups: temporary users and long-term users.

Temporary ROM Users

Typically, a temporary user of ROM therapy is affected by a cause that will be resolved in the short term. These causes can be varied but mainly fall into three categories.

1. Injury
2. Surgery
3. Temporary Immobility

In each case the user is expected to make a full recovery, and over time will no longer need ROM to ensure the proper function of their musculoskeletal structure.

Long Term ROM Users

A long-term ROM user will usually need ROM therapy for life. These are users affected by permanent disability that ROM will not resolve. In large part long term users continue ROM therapy daily for the quality-of-life improvements they see. Users typically suffer from,

1. Spinal Cord Injury
2. Multiple Sclerosis
3. Parkinson's Disease
4. Arthritis
5. Wheelchair Users
6. TBI
7. Stroke
8. Daily ROM exercise

One of the major benefits of ROM therapy for those users confined to wheelchairs is the daily movement of their limbs. This movement helps circulate the blood to extremities helping reduce the risks of blood clots, sores, and muscle tone reduction. With the help of ROM therapy, quality of life for such users can be greatly improved. For elderly users, a ROM therapy program will help improve their quality of life though exercise.

Range of motion exercises

Range of motion exercise refers to activity aimed to improving movement of a specific joint. This motion is influenced by several structures: configuration of bone surfaces within the joint, joint capsule, ligaments, tendons, and muscles acting on the joint. Range of motion exercises are also called "ROM" exercises. There are three types of ROM exercises: passive, active, and active assists. *Passive range of motion* is movement applied to a joint solely by another person or persons or a passive motion machine. When passive range of motion is applied, the joint of an individual receiving exercise is completely relaxed while the outside force moves the body part, such as a leg or arm, throughout the available range. Injury, surgery, or immobilization of a joint may affect the normal joint range of motion. Active range of motion is movement of a joint provided entirely by the individual performing the exercise. In this case, there is no outside force aiding in the movement. Active assist range of motion is described as a joint receiving partial assistance from an outside force. This range of motion may result from the majority of motion applied by an exerciser or by the person or persons assisting the individual. It also may be a half-and-half effort on the joint from each source.

Types of passive ROMs

- Head and neck exercises
- Shoulder and elbow exercises
- Forearm and wrist exercises

- Hand and finger exercises
- Hip and knee exercises
- Ankle and foot exercises

ROM Medical Devices

There are several Range of Motion medical devices on the market. Designed with the goal of facilitating repetitive ROM therapy, they are mainly employed by users who require long term ROM therapy in a home setting where access to a Physiotherapist for daily ROM therapy is not feasible. In the context of Long-Term users, there are a small variety of ROM Therapy devices on the market designed for home use. Not all devices seen on the market are Medical Devices, something prospective users should be aware of before purchasing their new ROM device. Due to the niche market of ROM therapy devices, the manufacturing market is rather small. These ROM therapy devices are designed to be either *Active*, *Passive*, or *Active/Passive* in nature.

ROM Therapy and COVID-19

The global COVID-19 Pandemic has introduced more people to Range of Motion therapy. Due to the varying global lockdowns, many people became significantly less mobile and began to lose their ROM. This was especially prevalent in Long Term Care homes where elderly residents where confined to their rooms, there by losing the ability to actively move. This new sedentary lifestyle has led to an increase demand for ROM therapy in the hopes of getting elderly patients their range of motion back.

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