

## **Motor Examination of the Upper Limb (Part 1)**

**Dr. Vimalendu Brajesh** (drvbrajesh@yahoo.co.in)

Consultant- Medanta Hospital, Gurugram

**Dr. Dhruv, Dr. Deepika, Dr. Saurabh, Dr. Vishal, Dr. Milind**

Medanta Hospital, Gurugram

(Photographs- **Mr. Rajendra Joshi**)



Motor examination is an integral part of the examination for any nerve pathology. In peripheral nerve injuries of the upper limb, motor examination is decisive in localizing the level of lesion and to assess the recovery. Hence, it is essential for any surgeon dealing with upper limb injuries to be thorough with the motor examination of the upper limb. To be precise in examination some basic principles should be followed:

- Proper technique of examination is a must because more than one muscles could produce same movement complicating its examination. Moreover, patient learn some trick movements over period of time which could mask the motor deficit.
- Remove all clothings over the muscle examined, to visualize and palpate the muscle belly.
- Test for passive full range of movement to exclude any restriction of joint movement and take it into consideration in final evaluation.
- Stabilization of the joint to ensure other muscles do not provide assistance.
- Examiner should start with examination of the normal side (provided its unaffected) to get a preliminary idea of the maximum strength of the patient, the strength is taken as M5 for the patient.
- Any muscle to be examined should be first tested in a position where the effect of gravity on the muscle is eliminated, this is usually achieved by positioning the patient in such a way that the direction of movement is perpendicular to the gravitational force.
- If the patient demonstrates full range of movement with gravity eliminated the test is repeated in a different position (for full range of movement) so that the force of gravity acts against the direction movement.
- After successfully passing the above tests patient is subjected to moderate and maximum resistance to assess M4 and M5 power.

In essence, to be accurate one must practice the muscle examination well. The steps of examination technique should include-

- Explain the patient the movement you are going to examine
- Look and feel the muscle contraction
- Check the power against resistance

For Muscle grading a Modified form **Medical Research Council Scale** is recommended.

Grade	Definition
5	Normal strength (Opposite normal of the patient taken as reference, provided its healthy)
5-	Barely detectable weakness
4+	Same as grade 4, but muscle holds the joint against moderate to maximal resistance
4	Muscle holds joint against combination of gravity and moderate resistance
4-	Same as grade 4 but muscle holds the joint against minimal resistance
3+	Muscle moves the joint fully against gravity and is capable of transient resistance, but collapses abruptly
3	Muscle cannot hold the joint against resistance, but moves the joint fully against gravity
3-	Muscle moves the joint against gravity, but not through full range of movement
2	Muscle moves the joint when gravity is eliminated
1	Flicker of movement seen or felt in the muscle
0	No movement

## SUPRASPINATUS

### ***Prime Function- Initiator of Shoulder Abduction***

Nerve supply to the supraspinatus is **Suprascapular nerve** which arises from the upper trunk of the brachial plexus at the Erb's point.

**Root Value:** C5,6

### Examination of grade M3-M5 (Fig-1a)

Patient is asked to sit comfortably on a stool with his upper limb hanging by the side. Patient is asked to keep his neck flexed towards the examined side and face turned towards the opposite side. This relaxes the overlying trapezius and reveals the underlying supraspinatus for palpation. The examiner stands behind the patient with his palpating fingers on the supraspinous fossa. Patient tries to initiate abduction.

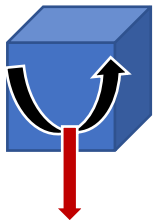
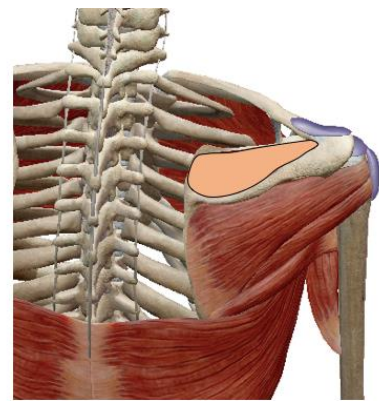


Fig-1a  
*(black arrow) represents direction of limb movement*  
*(red arrow) represents direction of gravitational pull*

#### Examination of grade M0-M2 (Fig-1b)

Patient lies in supine position with arms by his side supported on the bed. This eliminates the effect of gravity on the examined muscle. Examiners palpating fingers are on the supraspinous fossa.

Patient tries to initiate abduction.

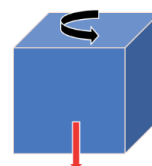


Fig-1b  
*(black arrow) represents direction of limb movement*  
*(red arrow) represents direction of gravitational pull*

## INFRASPINATUS AND TERES MINOR

### ***Prime Function- External rotation at shoulder***

While infraspinatus is supplied by **suprascapular nerve** the teres minor is supplied by the **posterior division of axillary nerve**.

**Root Value: C5,6**

Individual examination of these two muscles is difficult because teres minor is not available for palpation and both induce similar movement. However, external rotation in adduction is considered to be mainly by infraspinatus and external rotation in abduction is more a teres minor function. For purpose of motor function, both muscles are examined in combination.

### Examination of grade M3-M5(Fig-2a)

Patient sitting with shoulder abducted to 90 degree and elbow flexed 90 degree with his palm facing down and resting on the table adjusted to height. The examiner stands behind the patient, with his palpating hand lying over the infraspinatus fossa. Patient tries to lift his hand up keeping elbow in contact with table to simulate shoulder external rotation.

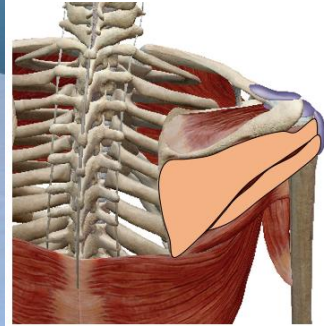


Fig-2a

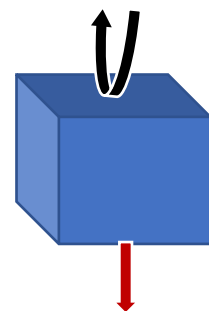


Fig-2b  
(black arrow) represents direction of limb movement  
(red arrow) represents direction of gravitational pull

### Examination of grade M0-M2(Fig- 2c)

Patient lies in prone position on the bed with examined limb hanging by the side and his palm facing the bed. This eliminates the effect of gravity on the examined muscle. Examiners palpating hand is placed on the infraspinatus fossa.

Patient asked to externally rotate the shoulder

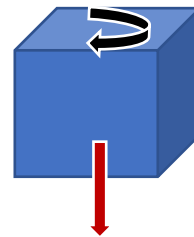


Fig-2c

*(black arrow) represents direction of limb movement  
(red arrow) represents direction of gravitational pull*

## **DELTOID**

***Prime Function- Abduction of shoulder from 30-120 degrees***

Nerve supply to the deltoid is **axillary nerve** which arises from the posterior cord.

**Root Value: C5,6**

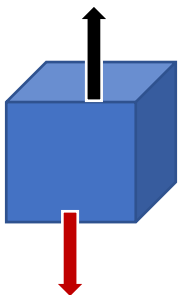
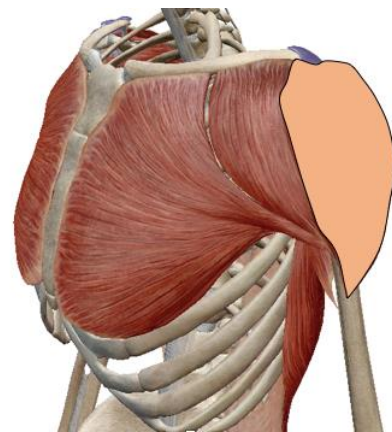
The three bellies of deltoid can be checked individually.

### **MIDDLE BELLY EXAMINATION**

Examination of grade M3-M5 (Fig- 3a)



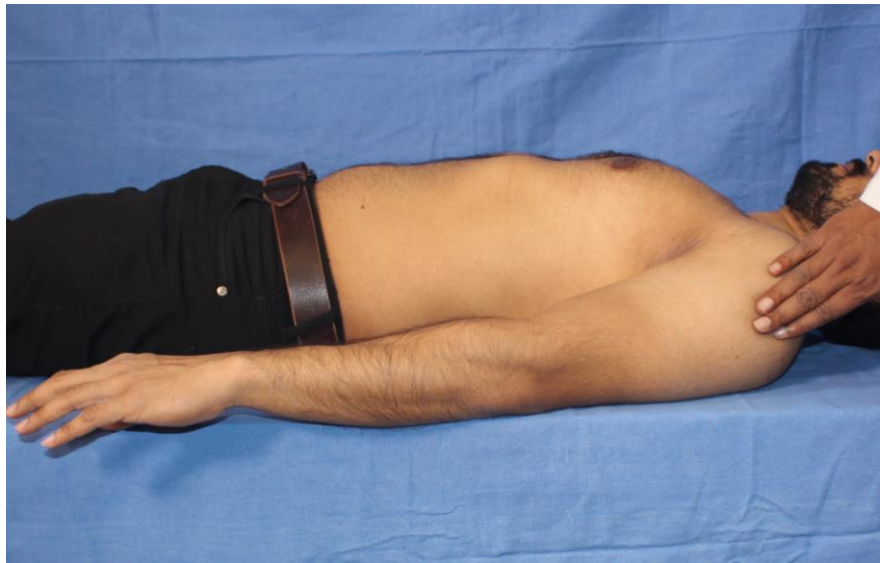
Patient is made to sit on a stool, with his shoulder abducted to 90 degree and elbow flexed 90 degree, both the elbow and palm rest on the side table adjusted to height. Examiner stands behind the patient with his hands palpating the muscle belly of deltoid. Patient asked to abduct shoulder.



(Fig- 3a)  
(black arrow) represents direction of limb movement  
(red arrow) represents direction of gravitational pull

#### Examination of grade M0-M2(Fig- 3b)

Patient is asked to lie down in supine position with his limb resting on the bed in 30-degree abduction. This eliminates the effect of gravity on the examined muscle. Examiners hand palpates the muscle belly and patient asked to abduct his shoulder.

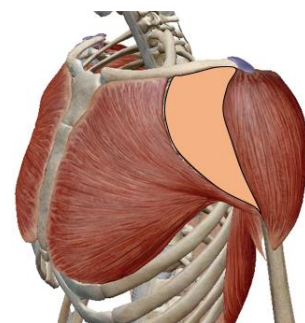


(Fig- 3b)  
*(black arrow) represents direction of limb movement*  
*(red arrow) represents direction of gravitational pull*

## ANTERIOR BELLY EXAMINATION

### Examination of grade M3-M5(Fig- 3c,3d)

Patient is made to sit on a stool, with his shoulder abducted to 90 degree and elbow extended. The elbow and palm are rested on the side table adjusted to height. Examiner stands behind the patient with his hands palpating the muscle belly of deltoid. Patient is asked to abduct shoulder.

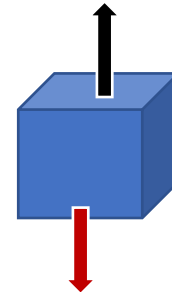


(Fig- 3c)





(Fig- 3d)



*(black arrow) represents direction of limb movement  
(red arrow) represents direction of gravitational pull*

#### Examination of grade M0-M2(Fig- 3d)

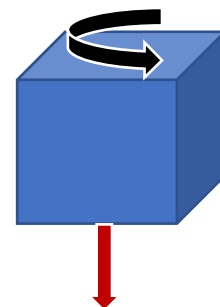
Patient is asked to lie on the bed in lateral position opposite to the limb being examined. This eliminates the effect of gravity on the examined muscle.

Shoulder is flexed and elbow supported in extended position by examiners hand

Other hand of examiner palpates the muscle belly. Patient is asked to flex his shoulder.



(Fig- 3d)

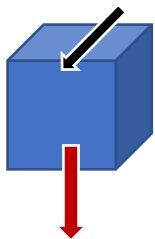
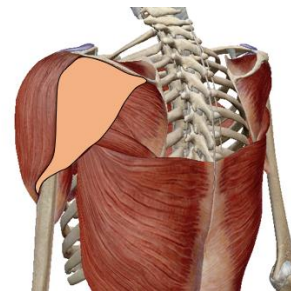


*(black arrow) represents direction of limb movement  
(red arrow) represents direction of gravitational pull*

## POSTERIOR BELLY EXAMINATION

### Examination of grade M0-M5 except M3(Fig- 3a)

Patient is made to sit on a stool, with his shoulder abducted to 90 degree and elbow flexed 90 degree, both the elbow and palm rest on the side table adjusted to height  
Examiner stands behind the patient with his hands palpating the muscle belly of posterior deltoid. Patient asked to slide his elbow behind.

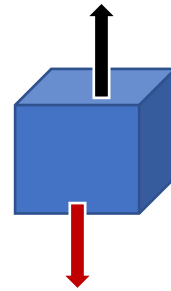


(Fig- 3a)

*(black arrow) represents direction of limb movement*  
*(red arrow) represents direction of gravitational pull*

### Examination of grade M3(Fig- 3b)

Patient lies on the bed in prone position with the arm of examined limb supported on the bed and forearm hanging by the side of the bed. This eliminates the effect of gravity on the examined muscle. Hand of examiner palpates the muscle belly  
Patient is asked to abduct shoulder



(Fig- 3b)  
*(black arrow) represents direction of limb movement*  
*(red arrow) represents direction of gravitational pull*

## SERRATUS ANTERIOR MUSCLE

### ***Prime Function- Protraction and stabilization of the Scapula***

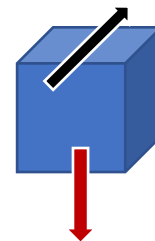
Nerve supply to the serratus anterior muscle is from the **long thoracic nerve** which arises from the C5,6,7 roots. Its origin from the root level is an important consideration as it allows one to differentiate if the brachial plexus injury is pre-ganglionic or post-ganglionic. Preservation of the serratus anterior function in a case of brachial plexus injury indicates that the injury is post ganglionic and one is likely to get at least one of the C5-7 roots available for repair.

***Root Value: C5, C6, C7***

Examination of grade M0-M5 except M3(Fig- 5a)

Patient is made to sit on a stool. His both arms are outstretched and shoulder abducted and flexed to 90 degree resting on the table adjusted to height. The examiners thumb and fingers

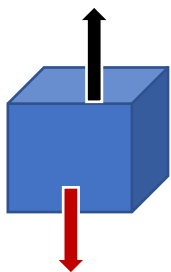
are used to track the movement of scapula with one hand and the other hand is used to palpate the muscle. Patient is then asked to propel both the extremities forward. Movement of scapula away from midline and muscle contraction are noted.



(Fig- 5a)  
*(black arrow) represents direction of limb movement*  
*(red arrow) represents direction of gravitational pull*

#### Examination of grade M3(Fig- 5b)

Patient is asked to lie in supine position with shoulder flexed to 90 degree and elbow extended. The examiners one hand supports the forearm of the patient and the other hand feels for the scapula. Patient is asked to do a forward movement of the upper limb.



(Fig- 5b)  
(black arrow) represents direction of limb movement  
(red arrow) represents direction of gravitational pull

## LATISSIMUS DORSI

***Prime Function- Adduction at the shoulder, also an extensor & internal rotator.  
Termed as 'Swimmer's Muscle'***

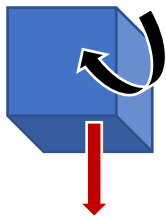
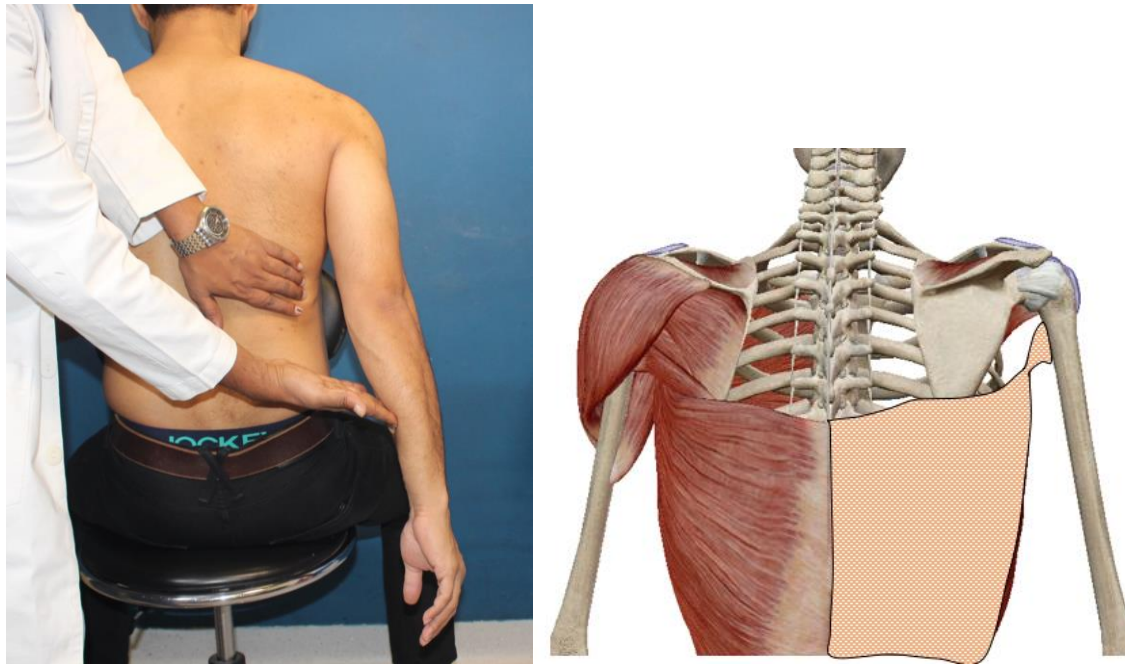
Nerve supply to the serratus anterior muscle is from the **thoracodorsal nerve** which arises from the posterior cord.

***Root Value: C5,6,7 roots***

Patient is asked to sit on a stool comfortably with his arm hanging freely by the side and palm facing backward. The examiner stands behind the patient with his one hand feeling the muscle belly just above the waist on the lateral thoracic wall. The other hand of the examiner offers resistance on the forearm. Patient is asked to extend and adduct his arm.



### Examination of grade M3-M5(Fig- 6a)

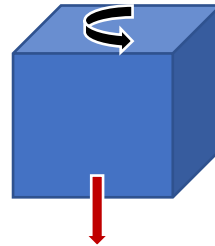


(Fig- 6a)  
*(black arrow) represents direction of limb movement*  
*(red arrow) represents direction of gravitational pull*

### Examination of grade M0-M2(Fig- 6b)

Patient is asked to lie on the non-examined side with arm by the side and shoulder adducted with palm facing backward. This eliminates the effect of gravity on the examined muscle. The examiner supports the arm with one hand and palpates the muscle belly of the examined muscle with the other hand. Patient is then asked to extend his shoulder





(Fig- 6b)  
*(black arrow) represents direction of limb movement*  
*(red arrow) represents direction of gravitational pull*

### ***Differentiation of LD from Teres Major:***

Clinically, it is often challenging to independently check these two muscles as they have a similar action. However, the differentiation is very crucial because LD is a commonly used muscle for transfer to restore function at the elbow or the hand and ascertaining its power is must for the success of its transfer. The location of the teres major is superior as it originates from the scapula (Fig 7- Blue arrow) whereas the LD is located even inferior to the scapula (Fig 7- Yellow arrow). The palpation of the two muscle allows for reliable differentiation. Also, the LD becomes prominent with coughing and helps one to ascertain that the tendon palpable at the posterior axillary fold is that of LD in ambiguous situations.

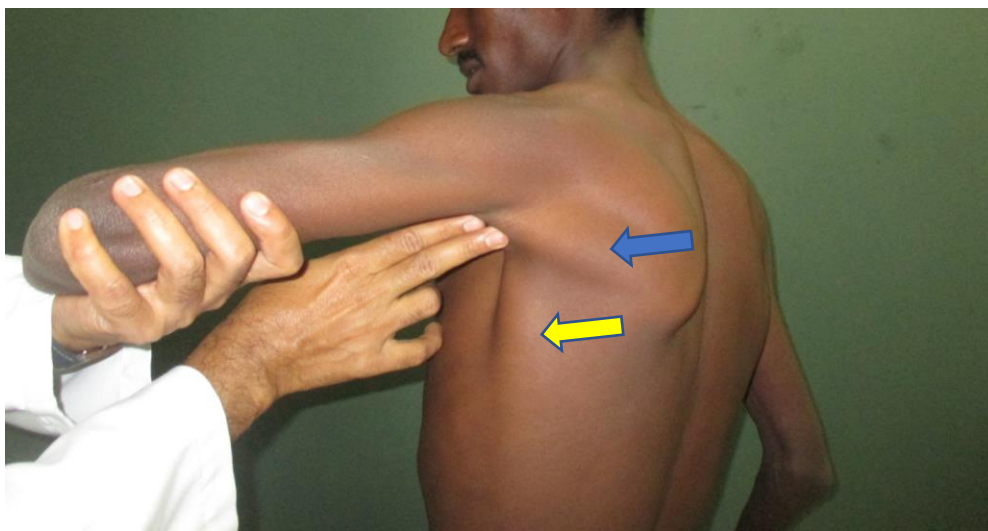


Fig. 7- The Yellow arrow points to the LD which can be palpated below the level of scapula whereas the teres major is seen originating from the scapula (Blue arrow) and can be palpated at that level.

## PECTORALIS MAJOR (PM)

**Prime Function- Flexion, adduction and internal rotation of the shoulder.**

Nerve supply to the pectoralis major muscle is from the lateral/medial pectoral nerve which arises from the lateral and medial cords.

**Root Value: C5,6,7,8, T1**

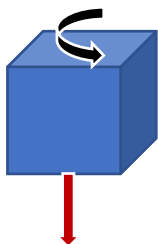
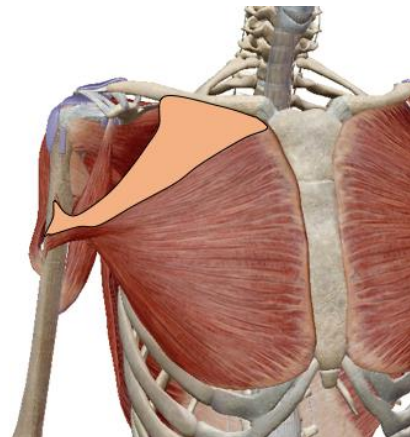
*\*Interesting to note that PM gets contribution from all the roots of the brachial plexus.*

Hence, a total paralysis of the PM almost assures a global brachial plexus injury.

### Examination of the CLAVICULAR HEAD:

Examination of grade M0-M5 except M3(Fig- 8a)

Patient is asked to keep his shoulder in 90-degree abduction and elbow in 90-degree flexion. The palm of the patient faces the front and the examiner stands by the side and with one hand feels for the muscle belly and his other hand gives resistance against forward movement of the elbow.



(Fig- 8a)

*(black arrow) represents direction of limb movement  
(red arrow) represents direction of gravitational pull*

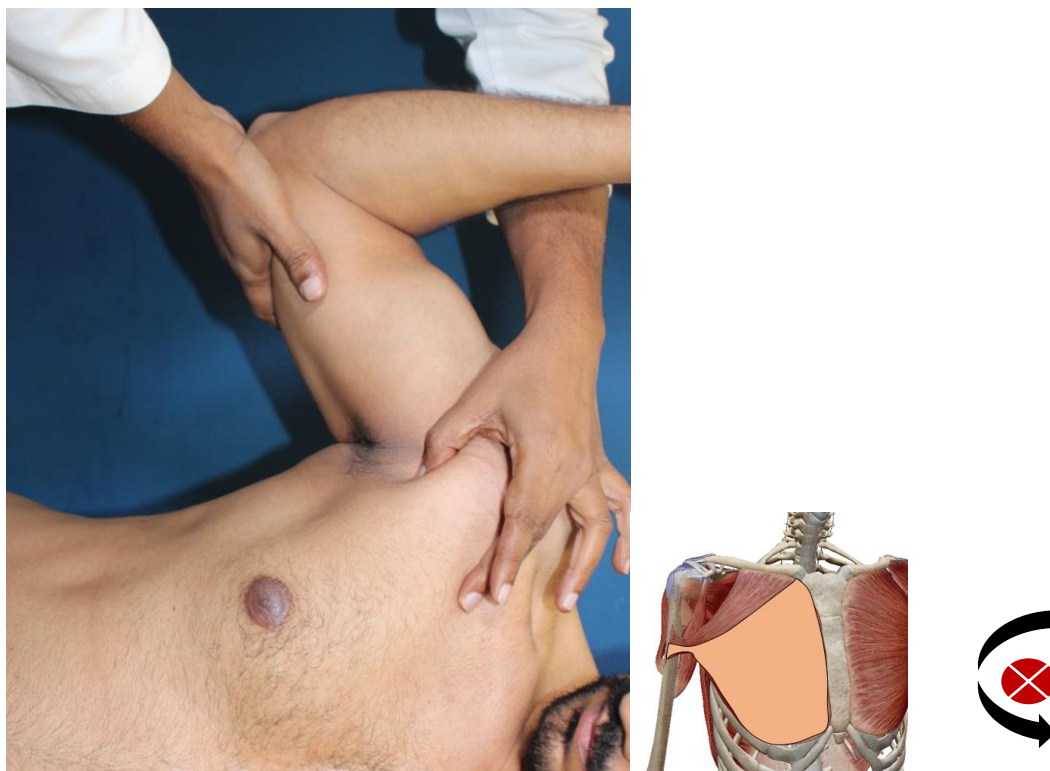
### Examination of grade M3

Patient asked to lie down in supine position with his shoulder in 90-degree abduction and 90 flexion of elbow. Patient is asked to lift his elbow off the bed for internal rotation.

## **PECTORALIS MAJOR (STERNAL HEAD)**

### Examination of grade M0-M5 except M3 (Fig- 8b)

Patient lies in supine position with shoulder in 70-90degree abduction, elbow in 90-degree flexion. Examiner stands by the side of the patient and with one hand tries to palpate the muscle belly and with the other hand gives resistance at the level of elbow against the adduction movement of the shoulder. Patient is then asked to adduct his shoulder.



(Fig- 8b)  
*(black arrow) represents direction of limb movement*  
*(red cross) represents direction of gravitational pull*

### Examination of grade M3 (Fig 8c)

Patient is asked to lie supine and keep his shoulder in 70-degree abduction and 90 flexion of elbow. The examiner stands by the side and with one hand feels for the muscle belly and with his other hand supports the forearm. Patient is asked to move his elbow towards the opposite hip.



Figure 8c

## **TRICEPS (ELBOW EXTENSORS)**

### ***Prime Function- Elbow extension***

Nerve supply to the triceps is via the lateral, long and medial branches of the radial nerve arising from the posterior cord.

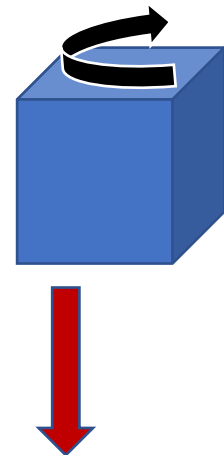
***Root Value: C6,7,8, nerve roots***

### Examination of grade M0-M5 except M3 (Fig 9a)

Patient is asked to keep his shoulder in 90-degree abduction and elbow in 90-degree flexion. The examiner stands behind the patient and one hand of the examiner palpates for the muscle belly and the other hand gives resistance against the forearm. Patient is asked to extend his elbow. (Fig- 9a)

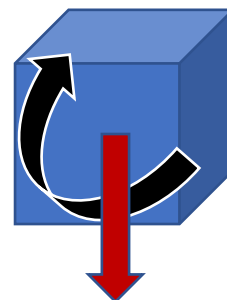


Examination of grade M0-M5 except M3  
(Fig- 9a) (black arrow) represents direction of limb movement  
(red cross) represents direction of gravitational pull



#### Examination of grade M3 (Fig- 9b)

Patient is asked to bend forward. Shoulder is abducted to 90 degree and internally rotated, so that the triceps muscle belly lies parallel to the floor. Elbow is flexed to 90 degree, and patient asked to extend his elbow while the examiner palpates the triceps and feels for the extension movement.



(Fig- (9b))



## BICEPS BRACHII and BRACHIALIS (ELBOW FLEXORS)

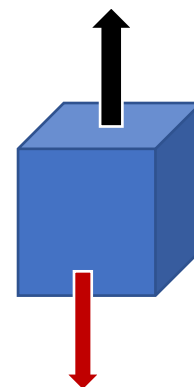
### Prime Function- Elbow Flexion

Biceps and brachialis are both innervated by the musculocutaneous nerve which originates from the lateral cord of the brachial plexus.

**Root Value: C5,6**

#### Examination of grade M3-M5(Fig- 10a)

Patient is asked to keep his shoulder in adduction and elbow flexed to 90 degree. The examiner stands by the side of the patient and holds the forearm with one hand and the other hand is used to palpate for the muscle belly. Patient is asked to flex his elbow.

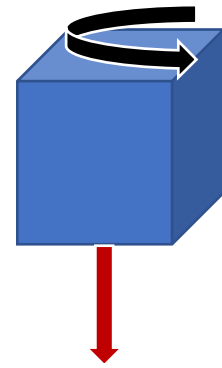


(Fig- 10a) (black arrow) represents direction of limb movement  
(red cross) represents direction of gravitational pull

#### Examination of grade M0-M2(Fig- 10b)

Examiner stands in front of the patient and supports the elbow of the patient. The patient's shoulder is in 90-degree abduction and flexion, elbow in 90 flexion. Patient is asked to do flexion of his elbow and examiner feels for the flexion of the elbow.





(Fig- 10b)  
*(black arrow) represents direction of limb movement*  
*(red cross) represents direction of gravitational pull*

The independent action of the biceps and brachialis for the elbow flexion achieved is difficult to segregate for clinical evaluation. However, the palpation of the muscle contraction on either side of the distal most tendinous part of the biceps tendon is a good sign to assure that the brachialis is functional.

There may be subtle differences in the technique of muscle examination among surgeons but the techniques mentioned herein are the widely practiced and considered standard. As the clinician's experience increases, they tend to find easier ways to examine the muscles and tweak the standard technique to their benefit. However, mastering the standard way of examining and interpreting it accurately is a skill one must nurture.