

Exercise & Sports Biomechanics
Dr. Viswanath Sundar
Department of Physical Education & Sport Science
Visva-Bharati University, Shantiniketan (WB)
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Lecture 08

Muscle Origin, Insertion & Action

[Hello, everyone! Welcome back to this course. In this video, we will explore the muscle origin, insertion, and action. First, we will understand what is meant by origin and insertion].

What is meant by origin and insertion?

For this, we will take the bench press as an example. In both origin and insertion the muscle will attach to the bone. In most cases, the origin of the muscle will attach to the stable bone, whereas the insertion will attach to the movable bone. In this example, you can clearly see that the trunk is more stable, and only the arms are moving. But, practically, in some situations, this action will be reversed. For example, in a push-up, the hands are fixed. The trunk is moving. In both cases, the chest muscles are working.

[Let us understand all the major muscles in the body. For this, we are introducing the first tool called Z-anatomy. So, just go to Google and type Z Anatomy, and you will find it called **zanatomy.com**. So open that.]

Z Anatomy is an open-source web application, and it is developed using Unity software. In this, I will explain the graphical user interface of this application so that you can practice and learn along with me. So, let us dive in.

The first step is you need to understand how to select a single segment or multiple segments in this model. For that, you need to use a left mouse click one time on any segment. For example, now I have chosen one segment, femur. If I double-click that particular segment, it will zoom in automatically, and the model will be very clear for you.

In addition, you can see a small orange-coloured line outside a segment that has been selected. If you wish to deselect a particular segment, you can select outside anywhere from the model, and it will be deselected. If you want to select a group of segments, there is a button at the top left corner called Selection. If you click that, there are multiple options there.

The first one is called **Box Selection**.

If I draw a box, now I have drawn a box by selecting a trunk, pelvis, and femur. Now, you can see all the selected segments over there. So, again, I am deselecting it.

The next option is called **Brush**. So, it is a kind of painting on the wall.

So, I am using a **brush selection**. So, whatever segment I require, I am going to use the brush selection, and then I am selecting it. To identify whether I have made the selection right or wrong, I can use the function called eye. The eye button is to isolate the particular segment which I have chosen. Now, if you look very closely, the hand segment is not completely brushed in both hands, and the same goes for the trunk. So, when you do that, you should be very clear in identifying the segments.

The next one is the **lasso selection**. As you wish, you can draw a line where you want to identify a segment. After you draw a line in that particular area, whatever segment it covers will be selected automatically. So, that is the advantage of lasso selection.

So, again, I am going to use the box selection. So, if I am going to choose a particular segment up here. So, watch very carefully. I have chosen the upper limb with the pelvis. And if I go to the selection button, there is another option called invert selection.

Now I have chosen only the upper limb. Once I select that button, it automatically chooses the lower body segments. So, that is the advantage of using this invert selection. And finally, the last one is the select all function, where it will select the entire model for visualization.

The second one is to move the entire model to the left or right as you wish. So, I am going to use the mouse scroll button. [I am pressing the scroll button and then moving it to the left or right. So, now if I press the button C on your keyboard, it will automatically come to the middle of the screen. There is a second option: if I drag the model to the left, then there is an option called the centre on the left-hand side. So, once I press that, the entire model comes to the middle of the screen again].

The next option is called **section**. If I select the section, it automatically shows whether the x-axis, y-axis, or z-axis. So, we will discuss that later.

I will explain to you in detail about these three sections. Now, if I want to zoom in on a particular segment, I can use the scroll button with the control. So, I am pressing the control and then scrolling up to zoom in particularly if it is a hand. You can zoom out by scrolling down.

Next, to rotate the entire model, you can use the right click by selecting that. You can rotate the entire model using the keyboard arrows, such as the right arrow. Multiple times, it will rotate, and if you want to make the top view, it is the up arrow and coming back with the down arrow. If you want to go for the bottom view, we can still do that. The same functionality occurs with both the right click and the keyboard arrow buttons. On the right-hand side, there is a function called **lexicon**. Once you click that, you will be able to see there are different systems available in the Z-Anatomy. Like the skeletal system, muscular insertion, joints, and muscular system. If I want to see all the muscles, I will just click on the eye button so that you can see the entire muscular system in the Z-Anatomy visualization. If I do not want to, again, I can uncheck that, so it will be back to the skeletal system. In the description function, if I want to work on a particular muscle, in the search bar, if I wish to know about the deltoid muscle, if I double click that particular muscle, now you can see in the visualization the particular deltoid muscle has popped up on both the

right and left sides. Press the help button. Under the user interface, you will find a button called show **UI help**.

This will guide you to the entire Z anatomy interface and its functions. At the bottom, you will also see all the mouse controls and keyboard shortcuts for specific functions. For example, to isolate a muscle or a joint. And finally, we will explore the settings button. If you observe the model very carefully, you can see the shadows behind it. To remove the shadows, under the screen and graphics, there is a button called **shadow**. If you uncheck that, it will disappear. In addition, there is an option called ambient occlusion. If I uncheck that, you can see the model is a bit brighter than before.

Next, we move on to the second tool called **Muscle Wiki**.

Go to musclewiki.com. This application will give you the complete exercise library. On the homepage, you can see the interactive images. If you move the mouse over the image to the specific muscle, it will be highlighted in a different colour. By clicking that, you can explore all the exercises related to that. The advantage of this application is that you can filter out the exercises based on the muscles or based on the fitness tools. In addition, if you click the advanced button, you will get more specific exercises compared to the previous ones.

Lastly, there is an option called joints. It will help us to filter out the exercises based on the joints. We will understand all the major muscles' origin, insertion, and action with the help of these two applications.

To start with, we will take biceps brachii. What is meant by that? If you divide the term biceps- Bi means two, ceps means heads, which is a two-headed muscle. One is the long head, and the other is the short head. The long head originates from the supraglenoid tubercle of the scapula. The short head originates from the coracoid process of the scapula. And it inserts at the radial tuberosity. In the scapula, where is the supraglenoid tubercle? Do not memorize this information. Rather, try to understand these concepts so that you can apply them in real-time.

From the previous lectures, you have understood the different jargon related to anatomical positions and directions, such as:

Supra means above. Glenoid, which means socket, is the glenoid cavity where the humerus bone will come and attach to it. Tubercle means a small, rounded projection or a kind of bump on the bone. So, you can see the origin point in the orange colour, which is the supraglenoid tubercle. This is the origin for the biceps long head. When it comes to the short head originates from the coracoid process. So, this is the coracoid process. If you look into it, it is a projection that comes outside the bone, and it looks exactly like a crow's beak. That is why it is known as the coracoid process. Process means it is a projection from the bone, and it inserts at the radial tuberosity. Radial means it is the radius bone and tuberosity means a large, rough projection on the bone. So, in the biceps brachii, the long head originates from the supraglenoid tubercle, and the short head originates from the coracoid process. It inserts at the radial tuberosity. When it comes to action, you know that

this is the origin and this is the insertion. Always, the insertion will move towards the origin.

Again, I will repeat. All the movements will take place from insertion to origin. When it comes to action, the biceps brachii aims to flex the elbow. The second one is the supination of the forearm, and the third one is the flexion of the shoulder.

Next, we move on to the brachialis. The word brachialis comes from the Latin word which means arm. It originates from the anterior distal half of the humerus and inserts at the coronoid process and tuberosity of the ulna. So, where is the brachialis? It is deep to the biceps brachii. So, in the model, I am trying to hide the biceps brachii, both the long head and short head, so that you can see the brachialis muscle. If I right-click that and then press the button called 'show insertion,' you can see the origin and insertion of the brachialis. The brachialis originates from the anterior distal half of the humerus.

What is meant by anterior?

It means the front part of the body. It is in the front part of the body.

What is the distal half of the humerus?

If we are considering the humerus, this is proximal, and this is distal. So, it originates from the half of the humerus, which is the distal half of the humerus. It inserts at the coronoid process. Coronoid means it is a hook-like structure. I will change the orientation so that you can visualize it better. You can see the hook-like structure, and it is projected from the bone. That is why it is known as the coronoid process.

The other one is the tuberosity of the ulna. This is the ulna bone, and you can see the green colour, which is distinct as the tuberosity of the ulna. Tuberosity means, as we discussed before, it is the large, rough projection of the bone. This is where the brachialis muscle gets inserted. When it comes to action, the brachialis muscle will facilitate only the elbow flexion movement.

Next, we move on to the brachioradialis. What is meant by that?

If we divide the term brachio and radialis, brachio means arm, and radialis means radius bone. This muscle connects the arm and the radius, and it acts like a bridge muscle between these two bones. It originates from the lateral supracondylar ridge of the humerus and inserts at the styloid process of the radius. The brachioradialis originates from the lateral supracondylar ridge. So, what is meant by that?

From the anatomical reference, you know that if the segment is closer to the midline, it is medial, and if it is away from the midline, it is lateral. The next word is the supracondylar ridge. Supra means above. Supra means above. Condylar means it is a knuckle or a rounded bony prominence known as condylar.

The ridge is the raised elongated structure. So, you can see here this is the raised elongated structure which is known as the ridge. That is why it is clearly defined as Lateral

Supracondylar Ridge. This is the origin point of the brachioradialis. Lateral Supracondylar Ridge, and it inserts at the styloid process.

What is meant by styloid?

It is the pen-like bony projection at the distal end of the forearm. It is a pen-like structure. That is why it is termed the styloid process. Similarly, in the brachioradialis, only the flexion movement occurs at the elbow joint. In all three muscles, the major component of action is elbow flexion. If we connect with a real-world example, you can do either a dumbbell curl or a biceps curl where only flexion and extension movements take place at the elbow joint. Which targets our biceps muscle. All three muscles which we have discussed so far are the anterior part of the muscle in the forearm.

[Now, we move on to the posterior side]

The first one is the triceps brachii. So, we know tri means three, ceps means head. Which means the triceps is the three-headed muscle. One is the long head, medial head, and lateral head. The long head originates from the infraglenoid tubercle of the scapula. The medial head originates from the inferior and posterior part of the humerus, and the lateral head originates from the proximal portion of the humerus, superior to the radial groove. All three muscles insert at a single point called the olecranon process.

What does olecranon mean?

If you divide the term olecranon, ole means elbow, and cranon means head, which is the elbow head. We will look into the model. The tricep, as we discussed before, has three heads, and the first one is the long head of the triceps, which originates from the infraglenoid tubercle. In the biceps, we have learned about the supraglenoid tubercle.

So this is the glenoid cavity where the humerus is attached, and above is the supraglenoid tubercle, and the bottom one, the lower one, is the infraglenoid tubercle. This is where the long head of the triceps originates. The medial head originates from the inferior two-thirds of the humerus, and the lateral head originates from the proximal portion of the humerus in the posterior view. So, in the humerus, the proximal part is at the top. The reference of this humerus bone is that the bottom part is the distal part, and it is attached superior to the radial groove.

This is the radial groove, and it is attached superior to it. So, what is meant by radial groove? The groove means it is a kind of shallow depression which you can see in the model. That is why it is known as the radial groove. So, the long head originates from the infraglenoid tubercle.

The medial head originates from the inferior part of the humerus, and the lateral head originates from the proximal part of the humerus and above the radial groove. All three muscles insert at a single point called the olecranon process, which is known as the elbow head. You can see that in the green color. When it comes to action, all three muscles perform a single movement, which is known as elbow extension.

The next one is the **Anconeus muscle**, which is one of the small muscles in the forearm. It is a Greek word that means the bend of the arm. This muscle originates from the lateral epicondyle of the humerus and inserts at the olecranon process, like the triceps. We will look into the model. You can see how small the Anconeus muscle is. It is originating from the lateral epicondyle. So, this is the medial side, and the outer part is the lateral side of the humerus.

There are two terms called epicondyle. We have already discussed that condyle means a kind of knuckle. Epi means above, which means the muscle originating from above the condyle and inserts at the olecranon process of the ulna. When it comes to action, it is similar to the triceps, as only the extension movement occurs at the elbow joint by this muscle. Now, let us apply this in the exercise. For example, if you are doing box dips, you can clearly see that from the elbow flexed position, the athlete is trying to extend his elbow to activate the target muscle, the triceps.

[So, thank you, and see you in the next video.]