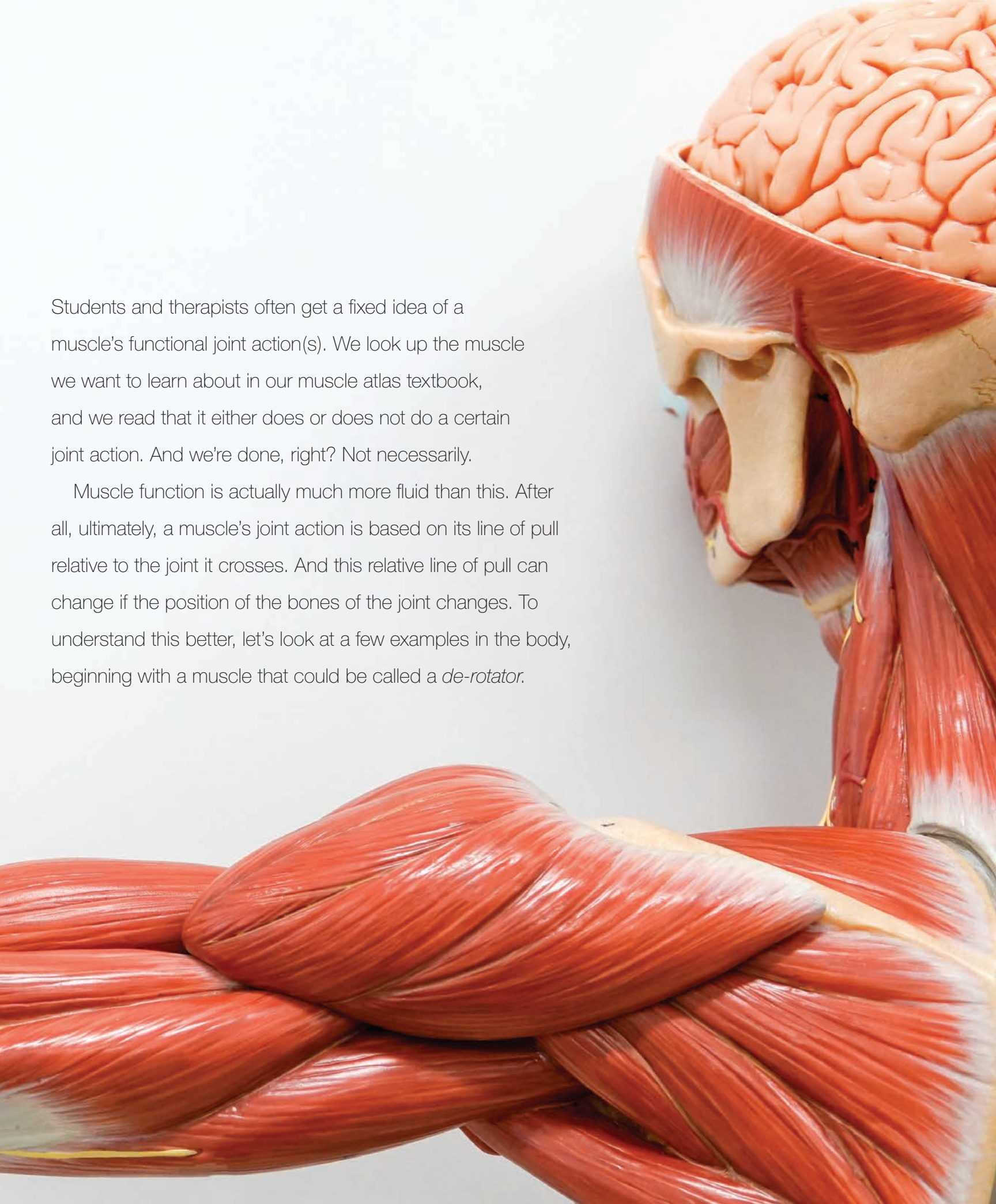
DE-ROTATORS

AND OTHER MUSCLES THAT CHANGE THEIR JOINT ACTIONS

By Joseph E. Muscolino, DC

Students and therapists often get a fixed idea of a muscle's functional joint action(s). We look up the muscle we want to learn about in our muscle atlas textbook, and we read that it either does or does not do a certain joint action. And we're done, right? Not necessarily.

Muscle function is actually much more fluid than this. After all, ultimately, a muscle's joint action is based on its line of pull relative to the joint it crosses. And this relative line of pull can change if the position of the bones of the joint changes. To understand this better, let's look at a few examples in the body, beginning with a muscle that could be called a *de-rotator*.



CORACOBRACHIALIS—A DE-ROTATOR

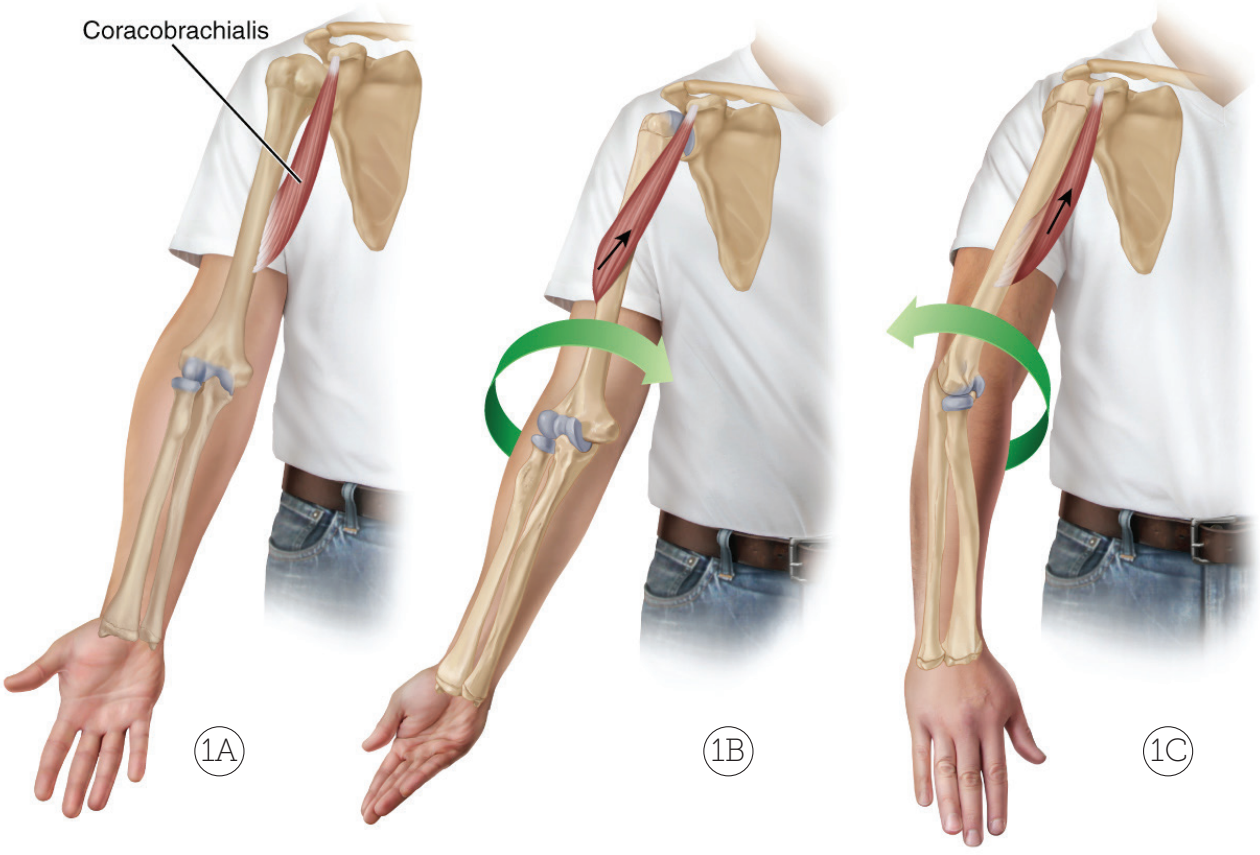
The coracobrachialis attaches from the coracoid process of the scapula to the medial side of the shaft of the humerus (Image 1A). Because it crosses the glenohumeral (GH) joint anteriorly and medially, it flexes and adducts the arm at the GH joint. But because it attaches on the medial side of the humeral shaft, it does not have the ability to rotate the humerus at the GH joint. Or at least, it does not have the ability to create rotation when the body is in anatomic position, which is the position we usually use to state a muscle's joint action(s).

However, if the humerus is first laterally rotated, then the coracobrachialis wraps around the shaft of the humerus, and its humeral attachment ends up instead being located more anterolaterally relative to the trunk. If the coracobrachialis contracts and shortens from this position, it will pull on the humerus, rotating it medially back to anatomic position (Image 1B). So, the coracobrachialis is a medial rotator of the arm at the GH joint, but only if the arm is first in a position of lateral rotation.

If, instead, the humerus is first medially rotated relative to anatomic position, then the coracobrachialis has to wrap around the shaft of the humerus in the opposite direction, and its humeral attachment ends up being located more posterolaterally relative to the trunk. If the coracobrachialis contracts and shortens from this position, it will pull on the humerus, again rotating it back to anatomic position. But this motion is lateral rotation of the humerus at the GH joint (Image 1C). So, the coracobrachialis can also be a lateral rotator of the arm at the GH joint, but only if the arm is first in a position of medial rotation.

Because the coracobrachialis medially rotates a laterally rotated arm back to anatomic position, and laterally rotates a medially rotated arm back to anatomic position, it can be called a de-rotator. It eliminates the position of arm rotation regardless of whether the arm is laterally or medially rotated. So, is the coracobrachialis a medial rotator, a lateral rotator, or not a rotator at all? The answer is yes, yes, and yes, depending on the position the humerus is in when the motion starts.

This is an important concept to understand, because our clients do not always begin motions from anatomic position. So, when we try to understand if the coracobrachialis of the client is being used, and perhaps overused and injured during a motion of their body, we have to consider the fact that the coracobrachialis might have engaged for medial rotation or lateral rotation, even though our textbook might not state that it can rotate the arm. And certainly, this concept can be widened to all muscles that can change their joint action when there is a change in the posture of the body. So, let's look at a few more examples.



Anterior view of the right coracobrachialis. 1A: In anatomic position, the coracobrachialis has no rotation capability at the glenohumeral joint. 1B: In a position of lateral rotation of the arm, the coracobrachialis can medially rotate the arm back to anatomic position. 1C: In a position of medial rotation of the arm, the coracobrachialis can laterally rotate the arm back to anatomic position. *Illustration by Giovanni Rimasti. Permission Joseph E. Muscolino.*

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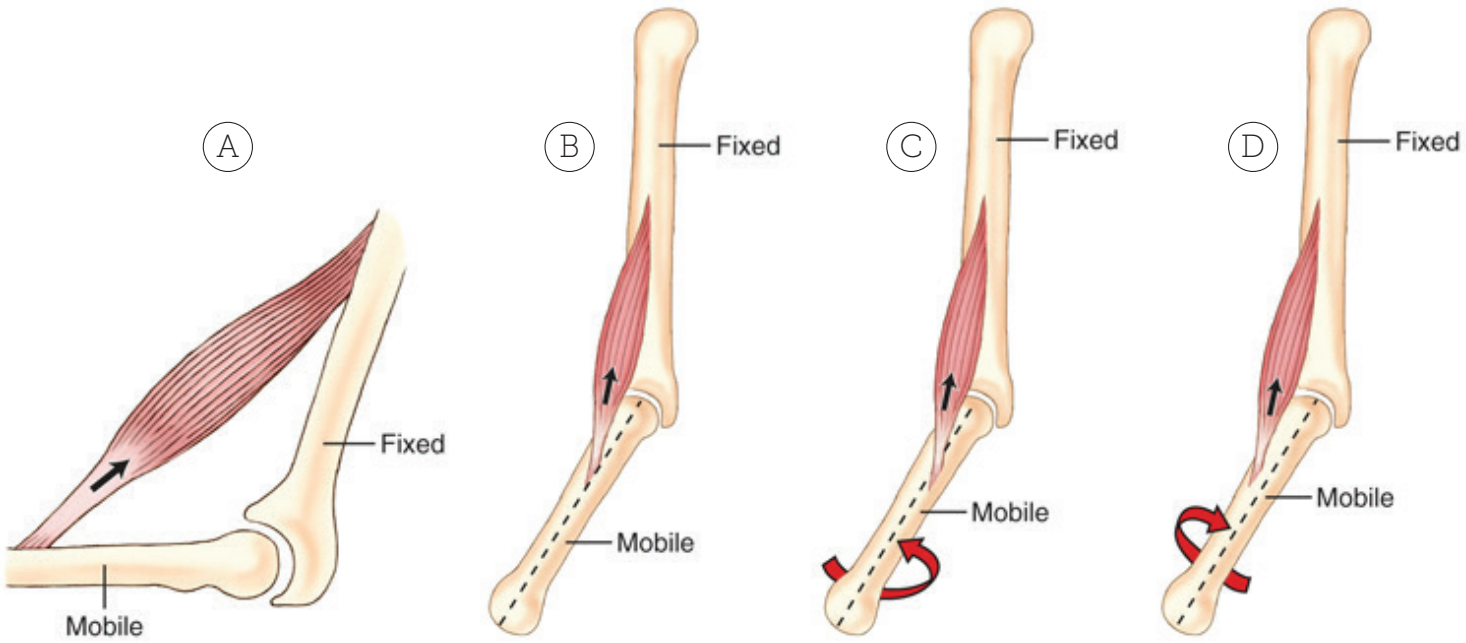
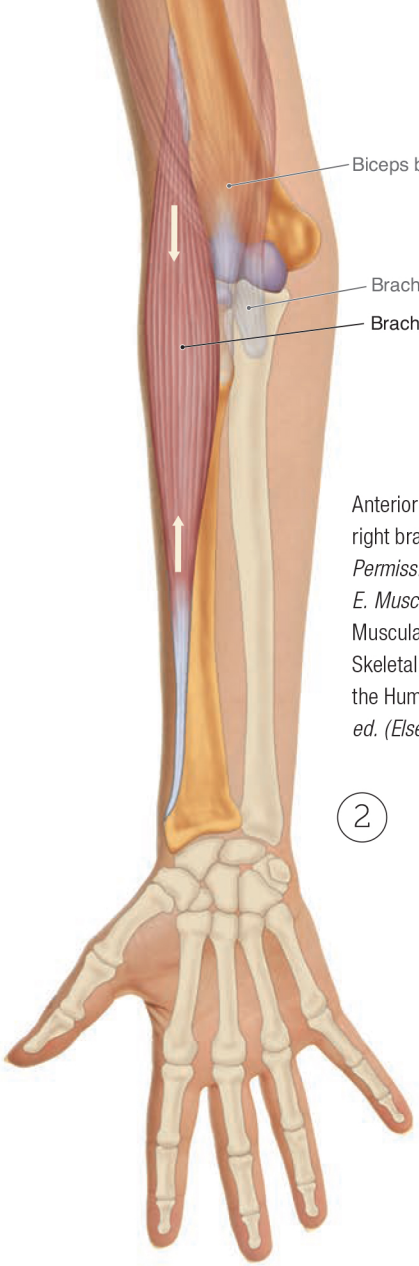


ON-AXIS AND OFF-AXIS ATTACHMENTS OF A MUSCLE

In order to understand the concept of whether a muscle can or cannot create rotation (long axis rotation), we need to see where the muscle attaches relative to the axis of motion for rotation. Images A and B show a generic muscle that crosses a hypothetical joint. Image B shows this muscle attaches from one bone (designated as fixed) to the other bone (designated as mobile), and attaches ("on-axis") directly over the axis of motion for rotation. Therefore, when this muscle contracts and shortens, it would pull the mobile bone toward the fixed bone, but it would not create any rotation. But in Image C, the muscle is instead shown attaching "off-axis," to one side. Now, the muscle would pull the mobile bone toward the fixed bone but would also rotate the mobile bone, as represented by the arrow seen in the figure. And in Image D, the muscle is now seen attaching "off-axis" on the other side, and the arrow in the figure shows that the muscle now has the opposite rotation motion. The ability to create rotation, or any motion for that matter, is based on whether the muscle in question attaches over the axis of motion—in other words, on-axis—or whether the muscle attaches off-axis. *Permission Joseph E. Muscolino*, Kinesiology: The Skeletal System and Muscle Function, *3rd ed. (Elsevier, 2017)*.



Anterior view of the right brachioradialis. *Permission Joseph E. Muscolino,* The Muscular System: The Skeletal Muscles of the Human Body, *4th ed. (Elsevier, 2017).*

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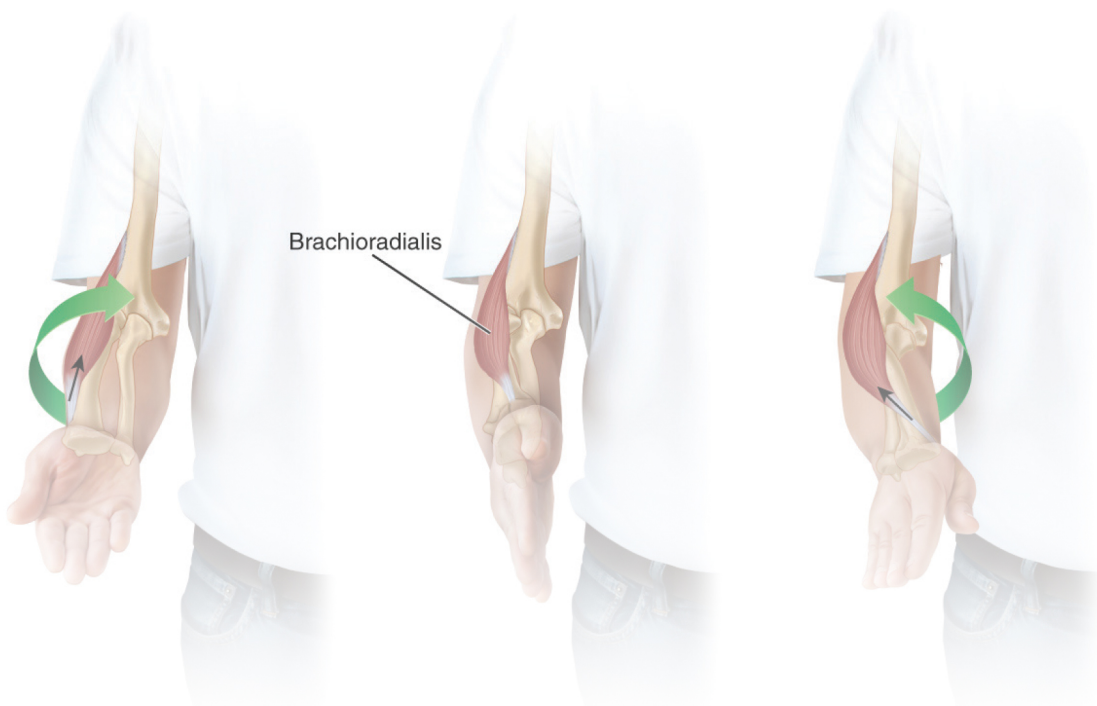
BRACHIORADIALIS—PRONATOR AND SUPINATOR

The brachioradialis attaches from the lateral supracondylar ridge of the humerus (immediately proximal to the lateral epicondyle) to the styloid process of the radius (Image 2). Therefore, it crosses the elbow joint anteriorly and can flex the forearm at the elbow joint.

But can it also pronate or supinate the forearm (at the radioulnar joints), or does it have no pronation/supination capability? The answer again is yes and yes, depending on the position of the forearm when the motion started. From anatomic position (Image 3A), which is a position of full supination, the brachioradialis can pronate the forearm, but only to a position that is approximately halfway between full supination and full pronation (Image 3B). Why? Because this is the position that brings the radial styloid as close as possible to the lateral supracondylar ridge of the humerus. After all, fundamentally, a muscle's joint action is its concentric contraction, which means that it shortens and brings the muscle's attachments as close to each other as possible.

But if the forearm begins in a position of full pronation (Image 3C), then the brachioradialis would have the ability to supinate the forearm, once again to a position that is approximately halfway between full supination and full pronation, bringing the radial styloid as close as possible to its humeral attachment (Image 3B).

So, the brachioradialis can be a pronator or it can be a supinator. Or, if the forearm were to start in the position that is approximately halfway between full supination and full pronation, then the brachioradialis would have no pronation/supination capability at all.



Brachioradialis. 3A: From a position of full supination, the brachioradialis can pronate the forearm to a position that is approximately halfway between full supination and full pronation. 3B: The brachioradialis with the forearm halfway between full supination and full pronation. 3C: From a position of full pronation, the brachioradialis can supinate the