ONLINE ARTICLE

Teaching "Not So Exact" Science: The Controversial Pectineus

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Anatomy scholars agree that the pectineus muscle adducts and flexes the hip joint. While some scholars have reported that the pectineus muscle acts as a lateral rotator (Behnke, 2001; Crouch, 1978; Gray, 1977; Spense & Mason, 1992; Totora & Anagnostakos, 1984), others have reported that this muscle acts as a medial rotator (Clemente, 1997; Hall, 2003; Hollinshead, 1985; Moore & Agur, 1996; Quiring & Warfel, 1967; Thompson & Floyd, 1994). This problem is further complicated because a group of scholars does not specify the pectineus muscle's role in hip rotation (Bowden & Bowden, 2002; Hoppenfeld, 1976; Jenkins, 1998; Kendall et al., 1993; Kreigbaum & Barthels, 1996; Levangie & Norkin, 2001; Stone & Stone, 2000). The role of the pectineus muscle as a hip rotator, therefore, is not clear to the learner.

Gray's Anatomy (Gray, 1977) describes the pectineus and three adductor muscles (brevis, longus, and magnus) collectively. "In consequence of the obliquity of their insertion into the linea aspera they rotate the thigh outward, assisting the external rotators." The external (lateral) rotation is easy to understand. As a rule, lateral rotators of the hip and shoulder joints have posterior insertions. The attachment site of the pectineus muscle is on the posterior aspect of the femur. Therefore, the muscle appears to qualify as a lateral hip rotator.

In *The Extremities* (Quiring & Warfel, 1967), the pectineus is listed as a medial rotator. The authors caution, however, that the rotator action of the adductors is "controversial." *Manual of Structural Kinesiology* (Thompson & Floyd, 1994), now in the 15th edition, specifies medial rotation. *Kinetic Anatomy* (Behnke, 2001) describes the pectineus as "a strong adductor and lateral rotator of the hip because of its angle of pull." *Atlas of Skeletal Muscles* (Stone & Stone, 2000) observes that the role of the pectineus in hip rotation depends on the position of the hip. Stone is supported by Reimann et al., who suggest that the rotating function of the pectineus depends on the specific position of flexion/extension and abduction/adduction of the hip joint. "Flexion and abduction intensify the lateral rotating function of these muscles, extension and adduction intensify the medial rotating function" (Reimman et al.,1996).

Muscles, Testing and Function (Kendall et al., 1993) does not specify the rotational action of the pectineus, but offers some reasons why the controversy exists:

> *... it is important to note that in anatomical position, and from anterior view, the femur extends obliquely with the distal end more medial than proximal. From lateral view, the shaft of the femur is convexly curved in the anterior direction. The anatomical axis of the femur extends longitudinally along the shaft. If rotation of the hip took place along this axis, there would be no doubt that the adductors, attached as they are posteriorly along the linear aspera, would be lateral rotators.*
>
> *However, rotation of the hip does not occur about the anatomical axis of the femur, but rather about the mechanical axis, which passes from the center of the hip joint to the center of the knee joint. ...*
>
> *The muscles or major portions of muscles that insert on the part of the femur that is anterior to the mechanical axis will act as medial rotators of the femur. On the other hand, the muscles or major portions of muscles that insert on the part of the femur posterior to the mechanical axis will act as lateral rotators.*

The controversy is further documented in Table 1, which reports findings from some popular textbooks in the anatomy/kinesiology field of study. Of the 18 sources, six specify medial rotation and five lateral rotation. Seven do not specify one or the other, possibly because the author chose not to address the rotation issue.

In addition to the "reason for controversy" offered by Kendall, there are other possible explanations for the discrepancies:

- Positions other than standard anatomical might be used in describing muscle action.
- Only primary actions of muscles might be considered, omitting those actions that are secondary or "weak."
- The pectineus is a relatively deep hip muscle that is difficult to study using standard EMG techniques.

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- The insertion of the pectineus is on the pectineal line, which is technically posterior femur. However, this attachment is occasionally interpreted as "medial" femur.
- Description of muscle action might vary according to the intended application of the information. For example, a clinical evaluation text might differ slightly from a basic anatomy text. Both might differ from a strength training text.

It is common practice in teaching anatomy for teachers to encourage students to set their frame of reference as anatomical position. This is a plausible approach from a structural standpoint, yet from a functional standpoint, the position of the limb must be considered.

In *Gray's Anatomy*, the action of the pectineus is discussed as an external rotator based on its anatomic position. However, when the position of the hip is placed in a functional position, the action of the pectineus is that of adduction or medial rotation. Herein lays the controversy. To further demonstrate the importance of a functional frame of reference, as opposed to a structural one, the educator can refer students to the gastrocnemius and rectus femoris muscles. These two muscles are commonly known to have more than one function based upon the position of the limb. The students can be given an assignment that examines the roles of each of these muscles based on the position of the limb. For example, how is the functional role of the gastrocnemius changed based on the position of the knee? The same question can be explored by examining the functional role of the rectus femoris based on the position of the knee and hip.

Table 1. Rotation action of the pectineus muscle described in some popular anatomy/kinesiology texts.

SOURCE	MEDIAL ROT.	LATERAL ROT.	NOT SPECIFIED[a]
Gray's Anatomy		X	
The Extremities	X		
Structural Kinesiology	X		
Basic Biomechanics	X		
Physical Examination of the Spine & Extremities			X
Kinetic Anatomy		X	
Principles of Anatomy and Physiology		X	
Human Anatomy and Physiology		X	
Biomechanics			X
Skeletal Muscles			X
Muscles: Testing & Function			X
Anatomy	X		
Essential Clinical Anatomy	X		
Joint Structure & Function			X
Hollinshead's Functional Anatomy of the Limbs & Back			X
Functional Human Anatomy		X	
Textbook of Anatomy	X		
Atlas of Skeletal Muscles [aa]	X	X	

[a] not addressed or specified in text
[aa] depends on position of the hip

Explanations for inconsistencies, while plausible, do not change the reality of what one knows about the pectineus. The source of information clearly can confuse the learner and be problematic for those in professional preparatory curricula. It becomes the responsibility of the instructor to appropriately guide the students through application activities to facilitate student learning and understanding.

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