Integrating Aspects of Two Systems of the Shoulder Joint in an Introductory Anatomy and Physiology Course

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The inherent instability of the articulation of the glenoid cavity of the scapula and the head of the humerus has been likened to that of a golf ball perched atop a golf tee. This visual image of vulnerability of the shoulder joint (at the expense of allowing the great freedom of range of motion - the most for any human skeletal joint) is proposed as a starting point for students to develop not only an appreciation of synovial joints and in particular, the uniqueness of the shoulder gleno-humeral joint, but an opportunity to integrate study of the skeletal and muscular systems.

Prior to studying articulations, the muscle system, and movement, students learn about three of the six levels of structural organization of the human body including the chemical, cellular and tissue levels of organization. Students also learn some of the factors that influence the ability of an injured tissue to repair itself. Study of the skeletal system also proceeds the study of articulations. The study of the skeletal system is broad reaching in the sense that students must apply previous knowledge of chemical elements and cell biology while acquiring an appreciation for the arrangement and dynamic nature of osseous tissue as well as the organization of osseous tissue into the amazing array of bones. Students must memorize names, features and surface markings, and learn that surface markings are adapted for specific functions. Aligning the surface markings of an individual disarticulated bone to that of another, as well as moving the component parts of a suspended articulated skeleton can make for exciting preparation for study of articulations, especially when students are encouraged to engage in comparative study using their own body as an additional resource!

In the study of muscle tissue and the muscular system, students are also challenged to make the transition from microscopic to macroscopic details of structure, function, and relationship of structures. While the assigned list of muscles (including origin, insertion and action) to identify is usually presented to the student as organized by region, the advantage of learning by region may be lost on the student who is preoccupied with the monumental task of mastering all of the new vocabulary.

The study of articulations is logically wedged in between study of the skeletal system and the muscular system. While an introductory course of human anatomy and physiology is just the spring board for advanced study of kinesiology, there is an opportunity to raise a student’s appreciation for the muscular system by deepening their grasp of muscle function as both moving the skeletal components and providing stability for the joining of those skeletal components. Students are also expected to learn the flexible connective tissue components of a freely movable synovial joint, and they should also learn the basic role that those components play in stabilizing/allowing movement of a joint.

The knee joint is the most complex joint but rather straightforward to study because of its size and because knee motion is basically limited to movement in one plane. The shoulder on the other hand, has an almost infinite number of movements, and students can quickly recognize that maximal shoulder motion confers maximal use of the hand to explore and manipulate the environment. A lesson plan on the gleno-humeral joint is proposed as a means of assisting anatomy and physiology students’ understanding of synovial joint components and function as
well as appreciation for the integration of the skeletal and muscular systems in a specific body region. Shoulder dislocation and rotator cuff injury, diagnosis and treatment are also briefly explored.

Objectives include:
1. Identify key skeletal and connective tissue features of the glenohumeral joint.
2. Demonstrate movements of the shoulder joint.
3. Identify a role for the scapulo-humeral “joint” in shoulder movement.
4. Name, locate, palpate, and describe and demonstrate actions of muscles of the shoulder.
5. Compare and contrast the shoulder joint’s movement and stability.

Proposed progression in lesson plan for integration of skeletal and muscle systems at the shoulder (gleno-humeral joint):

This activity can progress from individual work to pairs and to group work, allowing for students who are less confident in contributing in group work to explore their own idea(s) and sharing with one other student prior to participating in a group. The students will describe/propose a solution to a series of problems.

1. Students will be asked to look at a golf ball on a golf tee and to describe what they see in the relationship between the two objects. They can be guided to comment about comparative size, shape of the contacting surfaces.
2. Next, students will be asked to imagine a force that would change the relationship of the golf ball to the tee by rotating the golf ball, but not allowing it to slide off the tee. What would be required in order to allow the golf ball to rotate but still stay on the tee.
3. If the students are having a difficult time making the observations for #3, then the tee can be inserted into a thick block of styrofoam so that they can attach something as a “handle” to rotate the golf ball.
4. Now they should be able to come up with an idea that while one force is applied to rotate the golf ball on the tee, another force is at work to maintain the golf ball in contact with the tee.
5. Direct the students to substitute the golf ball and the tee with a humerus and a scapula. They can then write down any comparisons.
6. Have students compare the skeletal elements of the shoulder, knee and hip in terms of stability/instability afforded by related skeletal elements alone.
7. Review the connective tissue components of a synovial joint and their functions.
8. Direct the students to approach the articulated skeleton to make observations of glenohumeral movement. Certainly this is artificial due to the nature of attaching the skeletal components.
9. Have one student demonstrate the variety of movements possible with their own shoulder while another student moves the skeleton arm.
10. Using their textbook, have students list the prime mover for each shoulder action, including identifying the rotator cuff muscles and their function.
11. Now that they have an appreciation for skeletal movement at the gleno-humeral joint, describe the scapulo-humeral “joint” and the importance of the scapular movement in terms of increasing the excursion of the shoulder to maximize position of the hand. Have a student reach for an object with their hand with/without scapular movement along the thorax.
12. Shoulder dislocations and rotator cuff injury are relatively common injuries. Discuss rotator cuff injury including demographics and treatment. Include a discussion of how exercise of these
muscles is vital to shoulder motion, protection, and rehabilitation in the case of an injury. Compare regenerative capacity of tissues that support the shoulder joint. Show web link to photo demonstration of exercises. Briefly discuss indications for/advantages of arthroscopic surgery. Show clip of video of arthroscopic repair.

12. Develop a class concept map of the shoulder using a list of words including motions, joint components, functions, and common injuries (dislocation, rotator cuff tear)

13. Have students provide feedback about the activity in two ways –
   a. ask by show of hands how many can describe movement, uniqueness of glenohumeral joint?
   b. ask by show of hands how many can state the function of the rotator cuff muscles?
   b. ask the student to write down one other new thing they learned about the shoulder joint

Bibliography


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