

# INNOVATIONS IN BASIC SCIENCE TEACHING AND LEARNING

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## INTEGRATION IN THE BIOMEDICAL SCIENCE CURRICULUM

**T**he dictionary defines "Integration" as the act of bringing all parts together. All of us involved in basic medical science teaching, course management, and curriculum revision have integration as a goal of a particular course or teaching block. One important characteristic of excellent teachers is that they "integrate" the content and concepts they teach with other related concepts students have encountered in the past or will in the future. An integrated teaching encounter typically relates structure to function, the symptoms of disease to alterations of structure and function, or provides a practical example which applies knowledge of the content and concept under discussion. Useful integration in teaching demands depth and breadth in the teacher's knowledge of his/her field and significantly more time, energy and personal study to prepare a successful "integrated" teaching encounter.

Integration can take many forms. I have just described the most common form where a teacher reinforces learning and underscores its value by recognizing an opportune moment for integration; for example, the presentation of clinical laboratory patient data in relation to basic biochemistry content and concepts. Other forms of integration in basic medical science teaching are more elaborate and require a significantly greater investment in faculty time. This form usually involves the inclusion of a major component in a course to satisfy the goal of useful integration. Thus, a Gross Anatomy course might include an introduction to physical diagnosis or an introduction to imaging techniques. In this form of integration, evaluation of any positive outcomes of the integrating activities is very useful and important. Finally, the most elaborate form of integration is that which involves contributions from a team of teachers usually from different disciplines. A good example is the typical Neuroscience Course for medical students. Here strong leadership from the College Administration and the Course Director in support of faculty effort for preparation and sequencing of teaching/learning encounters is critical for success.

The theme of the series of articles to follow in this column is to examine some forms of integration in basic medical teaching, what works, how to evaluate the outcome, and what support is needed. E-mail addresses of authors are included, and your interaction is invited.

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## SURFACE ANATOMY AS A TOOL TO INTRODUCE FIRST YEAR MEDICAL STUDENTS TO PHYSICAL EXAMINATIONS

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### **Introduction**

The human gross anatomy course taught at the University of Kentucky Chandler Medical Center utilizes multiple teaching techniques including classroom lectures, dissection, computer assisted instruction, skeletons, cross sectional anatomy, sheet films (traditional X-ray, CT and MRI) and surface anatomy. Surface anatomy has been an important component of our teaching methodologies for a number of years for several reasons. First, it allows the student an opportunity to apply the anatomical knowledge they are acquiring in the laboratory and lecture formats to living

humans. Second, it provides an opportunity to introduce some basic concepts of physical diagnosis, such as interacting with patients and proper methods for palpation as they relate to anatomical structures. Third, it gives the first year student an opportunity to verbally demonstrate their knowledge on a one-on-one basis as a valuable skill for their clinical years.

## **Palpation Item List**

The organization and administration of the palpation experience is as follows. On the first day of their medical school classes, medical students are given two lists of anatomical landmarks and are told that they are responsible for identifying these anatomical landmarks on living individuals. The first list, consisting of approximately sixty items, is composed of palpation items from the regions of the back, thorax, upper extremity and abdomen. The second list, consisting of 84 items, covers pelvis, lower extremity, and head and neck. In addition to the palpation items of the first list, we include a complete list of terms of orientation and motion which the students are also required to learn. The palpation examinations precede their corresponding major examinations by one week. This earlier scheduling of the oral palpation examination actually motivates the student to begin preparation for each examination earlier than most typically would. The list of palpation items has been compiled over the past twenty years and consists of bony and cartilaginous landmarks, muscles, tendons, ligaments and vascular structures. The faculty has acquired considerable experience using all of these palpation items for the examinations. Although the palpation items are relatively straight forward identifications, they do require a working knowledge of anatomical relationships and provide experience for the student in presenting their knowledge in an oral examination setting. In addition to the requirement of identifying the palpation items, the students are expected to describe relationships of associated structures and demonstrate some associated clinical relevance of the palpation item. At the time the palpation lists are distributed the students are informed that no formal lectures or demonstrations will be offered by the faculty, rather it is expected that the students will learn these on their own. The students are encouraged to begin preparation for the palpation examination early and to meet with faculty to discuss any problems they might encounter with the palpation items. Students for the first palpation are then divided into teams of two and are assigned an instructor for their exercise. It is the responsibility of the students to coordinate with their instructor in selecting an appropriate examination time.

## **Palpation Examination**

At the time of the palpation the two students meet with the instructor for a half hour during which each student is examined for 15 minutes. Since it is not possible to test all items in the 15-minute period, examination questions are selected from a series of five items representing the subtopics of the assigned palpation items, thereby allowing the student to demonstrate their knowledge in each of the areas with minimal overlap. A typical five-item list for the first palpation would be as follows:

- Spine of the 7th Thoracic Vertebra
- Biceps Brachii

- Head of the Radius
- Sternal Angle
- Abduction of the Thumb

The first student is asked to palpate on his partner one of the structures from the list. Typically, the students are able to locate the required items but do not have an understanding of the proper methods of palpating an individual. For example, if they are asked to palpate the biceps brachii muscle, a student will typically touch the arm in the region of the biceps brachii muscle. The faculty member might ask how they know that is only the biceps brachii and not additional muscles such as the coracobrachialis. Faculty take the opportunity to interact with the student to convey the concept that they should first think about the expected

actions of the muscle they are palpating and then apply resistance to that expected action of the muscle by asking their palpation partner to perform that action. Immediately, the student understands that their partner or their patient is not a passive object but should be involved in the palpation or examination process. One other typical problem the students encounter during their first attempt at palpation is the tendency to palpate too aggressively, often resulting in discomfort for the subject.

The concept is that overly aggressive palpation actually leads to less tactile information. Once the item has been successfully palpated, the faculty member asks the student to describe any relevant facts about the palpation item. This is done to give the student a chance to demonstrate some of their knowledge, as well as giving them a chance to collect their thoughts before the examiner asks a series of specific questions of the student. The

specific questions are designed to ascertain if the student understands the anatomy of the palpated item, its relationship to other structures in the region and to apply this anatomical knowledge to some clinical situation. A typical list of questions and correct responses would be as follows:

### **Sternal Angle**

*Question:* Name the bony structures which comprise the sternal angle?

*Answer:* Manubrium and Body of the Sternum

*Question:* What type of joint is the sternal angle?

*Answer:* Diarthrosis initially, but often ossifies to become a synarthrosis in older individuals

*Question:* What other specific structure articulate at the sternal angle?

*Answer:* Costal cartilage of the second rib.

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- Question:** What type of joint is the articulation of the second rib's costal cartilage with the sternal angle?
- Answer:** Diarthrodial
- Question:** Name at least four items that are typically found associated with a diarthrodial joint?
- Answer:** Synovial fluid, synovial membrane, joint capsule, and hyaline cartilage
- Question:** What is the clinical relevance of knowing the location of the second rib's articulation to the sternal angle?
- Answer:** It allows the clinician to count intercostal spaces for locating heart valves, position of the anterior thoracic wall, locating heart valve sounds, or lung lobe auscultation.
- Question:** As an examining clinician of a 42-year-old patient, you suspect that the individual has a heart murmur associated with the bicuspid valve. Demonstrate its location on your partner. At this point the student will usually relocate the sternal angle and count intercostal spaces until they reach the left 5th intercostal space.
- Question:** Does this auscultation point differ from the actual location of the bicuspid valve?
- Answer:** It does differ since the actual valve is located at the left 4th chondrosternal junction.

***The palpation examinations precede their corresponding major examinations by one week.***

At this point the examiner moves to the next item and repeats the examination process again until the student has completed the list of five palpation items. While it may appear that the number of questions is large and would take longer than the allotted 15 minutes, the students typically answer the questions rapidly. It is not unusual to finish a palpation item in less than three minutes. The final item on the list for the first palpation is either a term of orientation or term of motion that the student has to demonstrate. Again the examiner is expected to go beyond the term of orientation or motion and question the student concerning relevant information of the orientation or motion item. Once the first student has completed the palpation examination, the second student chooses a new series of five items. This second palpation examination is conducted in a similar manner. The one difference is that usually the second examination requires individual students to identify palpation items on the examiner.

### ***Student Performance and Evaluation***

Each palpation item is worth 5 points, with one point from each item coming from the actual palpation or demonstration of terms of orientation or motion, and the remaining four points based upon the student's

answers to the follow-up questions. Thus, a total of 25 points are possible for each palpation examination. The two palpation examinations together represent 12.5% of the student's total grade. This form of testing allows for immediate feedback to be given students on their performance and suggestions, if any, for identifying areas of weakness.

The average point total of each palpation is 24.23 for the first palpation and 24.49 for the second palpation for a typical previous year. As can be seen by the point totals, students perform well in spite of their apprehension prior to the experience. These palpation examinations typically help students' grade average while allowing them to consolidate a large amount of anatomical knowledge prior to a major written examination. Surveys of students' opinions following completion of the course indicate that the majority of students rate this as an extremely positive experience, agreeing that it does help to consolidate their information. Most (88.57%) agree or strongly agree that the palpation exercise was a beneficial experience and should be retained.

### ***Conclusions***

Palpation examinations are a positive experience for both students and faculty. They offer an opportunity for the student to begin utilizing the recently learned anatomical knowledge in a format that resembles the process of physical examination, as well as allowing the student to demonstrate their anatomical knowledge beyond the usual written and laboratory examination process. Many times our students complain that they know

so much more than what they can demonstrate on traditional written examinations. They probably are correct, but it is nearly impossible in the standard multiple choice examination to test in depth the student's knowledge. The palpation examination solves a portion of this problem by allowing the students to demonstrate their knowledge in several regions to a greater depth than is possible in a more conventional testing situation. While the palpation experience is labor intensive for the faculty (it takes approximately 12 hours of committed time for each of the four faculty members to complete both palpation examinations for our present class size of 100 students), it allows the faculty to work with the students one-on-one and begin teaching the required techniques used in physical diagnosis which the students will take later in their first year of medical school.