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The purpose of this project was to create and test a novel curricular model integrating anatomy, osteopathic principles and practice, and clinical skills. The curricular model was created through collaborative effort with a multi-discipline advisory group. The model's effectiveness was assessed in two separate learning events involving medical students and pre-medical students. Knowledge assessments and opinion surveys distributed pre and post-learning event demonstrated a positive trend toward knowledge acquisition and support of the curricular model. Implementation of the novel curriculum was successful, producing desired learning outcomes and demonstrating the value of integrating clinical context with basic sciences. Further research and implementation of a more complete version of the model is warranted.

A NOVEL CURRICULUM: INTEGRATING ANATOMY, OSTEOPATHIC PRINCIPLES AND PRACTICE, AND CLINICAL SKILLS

THESIS

Presented to the Graduate Council of the

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For the Degree of

MASTER OF SCIENCE

By

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

RESEARCH PROJECT SUMMARY

Introduction

This thesis project is focused on osteopathic medical education. The project was aimed at determining the benefits of a novel curricular model integrating osteopathic principles and practice (OPP), basic sciences, and clinical skills. The project's original goal was to enhance the manner in which anatomy is taught by integrating OPP and clinical skills but what resulted was a change in the way I think about medical education as whole. This project redefined "integration" and "context" as they are related to medical education reform. These two terms have been integral to medical education reform since the 1910 Flexner Report, however medical educators continue to urge better integration and context in medical education.(1,2)

Rationale for this project

A desire to find a better way to integrate and instill clinical context led to a series of meetings with leaders in medical education and the formation of an informal advisory committee. Frank Willard, PhD, a neuroanatomist and course director from the University of New England College of Osteopathic Medicine (UNECOM), was recruited to participate in this committee because of his previous work at the University of North Texas Health Science Center (UNTHSC) campus. Previously, Willard led a series of anatomy seminars in which selected musculoskeletal topics were revisited from a clinical perspective. These seminars involved gross lab dissection and group discussions on the clinical relevance of the examined structures. These seminars were well received and provided the inspiration for this project.

The resulting meetings led to the beginnings of an idea that would become a novel curricular model. That idea was to use basic science material to understand and teach clinical medicine. While not a novel concept, it is a fresh perspective. Basic science information in the preclinical years has always been in preparation for learning clinical medicine. There has been a movement to place clinical context into the basic science material using clinical correlates or case presentations as evidenced by the development of the problem-based curriculum and the clinical-presentation model.(3) This represents an infusion of clinical information into the required basic science knowledge. This model proposes the exact opposite approach. A concept that there is no specific background basic science knowledge required other than that required to understand clinical medicine. This model infuses basic science information into the clinical training of medical students. All educational activities in this model are directed at understanding and learning basic science content relevant to the clinical presentation, physical exam, clinical reasoning, problem solving, and treatment of patients.

Background

The proposed model's focus on clinical medicine is a fundamental change from the current focus of the first two years of medical school in which basic science knowledge serves as the foundation for later clinical years. This shift in focus leads to two questions. The first being is this model more effective than current models in use? The second question is what benefit is it to the student? Answering the first question requires an understanding of the current models in use.

A search of the literature revealed two articles discussing medical education reform over the last 100 years.(3,4) The most current models (organ-system model, problem-based learning (PBL), and clinical-presentation model (CPM)) are advances on earlier models but have little evidence to support their models as superior to other existing models.(5,6) I have evaluated the strengths and limitations of these three models and discussed this in more detail in Chapter II of this thesis.

The second question produced three guiding categories of competencies that hypothetically would benefit the students. These are

A. Deficiencies of musculoskeletal system competencies.(7-10)
B. Decreasing use of osteopathic manipulative medicine.(11-15)
C. Need for improved clinical skills.(14,16)

These issues are also discussed in chapter II of this thesis. Therefore I hypothesized that better integration and clinical context with a focused on structure and function would improve learning in all three categories.

Specific Aims

With our concerns in mind and the foundational basis for the novel curricular model established, four specific aims were created to guide this thesis project. These four aims are as follows.

AIM 1. Develop a curricular methodology around a clinical-case presentation that infuses basic science information with clinical skills and OPP.

AIM 2. Create a novel syllabus incorporating relevant learning objectives and competencies in clinical skills, OPP, and anatomy.

AIM 3. Evaluate the curricular model with two learning events: one involving medical students and the other with post-baccalaureate medical science students.

AIM 4. Produce a technical manual to guide the implementation of the curricular model and provide direction for further research.

The first aim was to develop a curricular methodology that integrated anatomy, OPP, and clinical skills in the context of a clinical case-based framework. Curricular methodology outlines the philosophy and manner in which this concept is implemented with regards to curricular content and teaching strategies. To achieve this complex and challenging aim, I organized a multidisciplinary advisory group of anatomists, neuroanatomists, musculoskeletal medicine specialists, and research educators. The faculty advisory group includes:

- des Anges Cruser, PhD, MPA, Associate Professor, Medical Education, TCOM, UNTHSC
- Bruce Dubin, DO, JD, Associate Professor and Dean, Rocky Mountain Vista COM, Colorado
- Russell Gamber, DO, MPH, Professor, Manipulative Medicine, TCOM, UNTHSC
- Kendi Hensel, DO, PhD, Associate Professor, Manipulative Medicine, TCOM, UNTHSC
- Harold Sheedlo, PhD, Associate Professor, Cell Biology & Anatomy, Graduate School of Biomedical Sciences, UNTHSC
- Frank Willard, PhD, Professor, Neuroanatomy, UNECOM

The diversity of this group reflects the novel nature of this project. Advisory group meetings occurred throughout the project to ensure continuous improvement of the methods and content. Initial meetings established the goals and outcomes of the model and created optimum teaching strategies. The product of this process was structure and methods to achieve the desired curricular reform.

The second aim was to create a novel syllabus incorporating relevant learning objectives and competencies in clinical skills, OPP, and anatomy. The syllabus provided the framework for the learning activities. The syllabus incorporated learning objectives to support the educational goals and promote the acquisition of competencies in musculoskeletal medicine. A universal syllabus has been created that can be tailored to suit each individual module. Learning modules are discussed in chapter II of this thesis. The syllabus is included in Appendix B.

The third aim was to evaluate the curricular model with two learning activities.

1. Seminar – the topic was piriformis syndrome, participants were pre-doctoral OMM fellows and the structure of the seminar emphasized integrating OPP and gross anatomy and the use of research literature in the educational process.
2. Graduate school course – the topic was clinical anatomy of the upper and lower extremity, participants were graduate school students completing a master's of science degree and the structure of the course emphasized the incorporation of gross dissection into the evaluation of a clinical case and incorporated clinical skills education in the gross lab.

The development, implementation and results of these learning activities are discussed in Chapter III of this thesis.

The fourth aim was to produce a technical manual to guide the implementation of the new curricular model and provide direction for further research. This thesis combined with all materials included in the appendix will serve as the preliminary technical manual. This thesis describes the learning theory, the methodology, and the resources needed to replicate the curricular model. The curricular model could eventually include other basic sciences such as histology, physiology, and cell sciences. However, this is beyond the scope of this master's thesis project.

Methods

This research project required multiple methods to achieve the four specific aims. These methods were directly and indirectly related to the learning activities. Since this curriculum model was novel and required innovative teaching strategies, I created new syllabi, pretest and posttest evaluation tools, and educational materials (power point presentation, clinical-case scenarios, and a research literature guide for example).

Briefly, between the seminar in the summer of 2009 and the graduate course in 2010, another learning activity was created as an honors course for second year medical students for the spring of 2010. The course was created with two separate learning groups for comparison of learning outcomes. Students would be divided equally into an experimental group, using the novel curricular model, and a control group, using the existing curricular model for this institution. The course was ultimately withdrawn due to insufficient numbers of students. However, arrangements had already been made for certain elements of the course so it was decided to continue with the dissection and gross lab portions of the course to informally evaluate the dissection process and the integration of clinical components. The informal experience proved to be very valuable and led to the development of a web based dissection guide used in the graduate school course. The materials created for this course are included in Appendix B.

In addition to the work directly related to developing and executing the previously described learning activities, several other indirect endeavors played a role in the evolution of this thesis project.

One of these endeavors was meeting with leading medical educators from other colleges of osteopathic medicine (COMs). West Virginia School of Osteopathic Medicine (WVSOM) was the first school I visited because of a recent curricular reform project focused on integrating osteopathic principles and practice into the entire curriculum.(17) While on the WVSOM campus I talked with first and second year students to assess their experiences and personal opinions regarding the OPP integration project on their campus. I also met with Karen Steele, DO, FAAO, Associate Dean of Osteopathic Medical Education, to discuss the OPP integration project and how it has changed the school's curriculum and students. This experience was very positive and supported the concept of integrating OPP, anatomy, and clinical skills.

I also visited the UNECOM campus because of their efforts to incorporate OPP into the anatomy curriculum. The medical students raved about the clinical correlates in the dissection guide and commented on the value of the case presentations at the end of each module to tie the anatomy back into clinical context. Both UNECOM and WVSOM seemed more advanced in their curriculum compared to UNTHSC but were still limited in their integration and contextual learning.

In addition to visiting others COMs, I also attended several national conferences and seminars. The American Academy of Colleges of Osteopathic Medicine annual meetings in 2009 and 2010 provided great insight into the current state and the future of osteopathic medical education. I also attended the national American Osteopathic Association meeting in 2009, a seminar on evidenced-based osteopathic medicine, and seminars on developing learning objectives and assessments for medical education. These conferences and seminars allowed me to have a broader perspective on medical education and the profession as a whole and helped shaped my ideas and beliefs about the role of osteopathic medical education which in turn guided this project.

The last component I would like to mention here is the creation of a photo library essential to the development of the web-based dissection guide. It was my responsibility to supply the clinical skills images for use in this guide. Over 250 images were created to demonstrate physical exam techniques and osteopathic manipulative techniques. A professional photographer and student models volunteered for this project.

Results

The results from this thesis project are described in two manuscripts which form Chapters II and III but will briefly be reviewed here. Chapter II reviews and discusses the theoretical framework of medical education reform that provided the basis for this thesis project and will be submitted to *Medical Education*, published by Wiley-Blackwell.

Chapter III describes the results of the two learning events. The results of the piriformis seminar were improved scores on the knowledge assessment, increased confidence in diagnosis and treating piriformis syndrome, and increased confidence in evaluating a research article. The results of the graduate course were improvement in all knowledge questions, increased confidence in diagnosing, examining, and treating shoulder complaints, and increased confidence in examining the lower extremity. This manuscript will also be submitted to *Medical Education*.

Conclusion

Medical education reform has been occurring for the last 100 years and will likely continue for the next 100 years. Future reform should be grounded in current education theory and build on previous model. However, these models should be tested and proven to be an improvement over previous models. Unfortunately this model was never tested in a completed form but did confirm some important milestones for continuing this project. This project was successful in implementing the novel curriculum, producing desired learning outcomes, and demonstrating the value of integrating clinical context with basic sciences. Further research and implementation of more complete version of this novel curricular model is warranted.

CHAPTER II

INTEGRATION AND CONTEXT: EVALUATION OF MEDICAL EDUCATION REFORM AND THE PRESENTATION OF A NOVEL CURRICULAR MODEL

Introduction

The basic structure of medical education has been stable for over a century. Since the 1910 Flexner report "Medical Education in the United States and Canada: A Report to the Carnegie Foundation for the Advancement of Teaching" most medical schools have used the 2+2 design, two years of basic science instruction (pre-clinical years) and two years of clinical sciences.(1,2) The core concepts of medical education, including basic science knowledge, clinical experience, and the development of clinical reasoning and problem solving skills, have stood the test of time, however a continued emphasis on better integration and contextual learning has led to changes in the curricular model aimed at implementing those concepts.(3,4) This paper briefly describes the history of curricular reform and why there is still a need for further reform. We also offer a theoretical model of integration and contextual learning that retains the strengths of previous models while improving on their limitations.

Medical education is continuously evolving with new information, new learning theories and new technology shaping the way future physicians are trained. Kassier also includes trial and error and past experiences as influences on medical education reform.(18) Since the publication of the Flexner Report, the principles of “integration” and “context”, defined below, have been integral to medical education reform.

Integration

"Integration" in medical education typically refers to the interdigitation of basic and clinical sciences and sometimes the social sciences.(19,20) Integration may also be described as the simple coordination of timing of material as it is taught, or an organized team approach to discussing what material will be taught and in what order. However, to be truly "integrated" a curriculum must reflect a true melding of the clinical components (case presentation, history taking, differential diagnosis, clinical reasoning, physical exam, and disease/health management) with all of the basic sciences (such as anatomy, cell biology, physiology, histology, and pharmacology). In a recent article calling for continued medical education reform, Irby et al. included the following recommendations regarding integration: “Connect formal knowledge to clinical experience, including early clinical immersion and adequate opportunities for more advanced learners to reflect and study; integrate basic, clinical, and social sciences.”(20)

Context

“Context” is an essential companion to “integration”. Context in medical education usually refers to the environment in which the learning material is presented or the use of additional information to aid further understanding.(21) Context should also be a fluid and ever changing aspect of medical education aimed at a final competency or knowledge goal that may be changing as well.(21) This may be a confusing statement but it is profound because context can seem artificial or compartmentalized, implying that context can be controlled or directed. Context is an experience. Rather a moment in time, where context influences the learning process and the participants involved in the learning activity. For example, a group of students are given a learning objective, but the process (or contextual component) to achieve that objective may be different for each group and furthermore each individual learner. Each group may reach a different conclusion or stopping point but still achieved the desired learning objective. This emphasizes the importance of creating the opportunity for contextual learning but limits the ability to direct or measure its effect on the learning process. Kassier astutely pointed out that learning cannot be separated from the context in which it was acquired, emphasizing the importance of how the information is acquired and de-emphasizing the necessity for the learner to make these connections in the future.(18)

Why has there been nearly continuous medical education reform since the Flexner report in 1910? Early changes were most likely from public outcry, and a lack of accountability and standardization. But medical education reform continues as students are performing well on national board exams and found competent in practice. The evolution of educational theory and adult learning models have certainly been an impetus for change with medical education theory tending to lag behind general educational theory. Today medical educators are becoming more conversant with adult learning theory, contemporary learning methods and frameworks, and teaching styles. Fluctuating resources such as fewer educators, increasing numbers of schools and class size, and the pressures put on faculty in areas of clinic and research all affect teaching time and funding. Advances in technology such as the internet and distance learning have influenced the curriculum structure as well. Each curricular change led to more clinical context and better integration, but these curricular models still had short comings.

Medical education reform

In an article discussing medical education reform initiatives through 1992, the authors discussed the major initiatives and reviewed their recommendation. Their consensus was a lack of major reform continued to exist even with numerous initiatives. They also noted the "…continued failure of individual medical schools to integrate basic science and clinical medicine."(4)

In 1999, Papa et al. reviewed the key evolutionary models of medical education and discussed their strengths and weaknesses.(3) In the following sections we discuss three of the five curricular models directed at the pre-clinical years presented by Papa. They are the organ-system model, the problem-based learning model, and clinical-presentation frameworks.

Organ-system

The organ-system based curriculum encouraged interdigitation of clinical and basic sciences and was therefore an improvement on the discipline-based model, but it did not lead to integration by the students and also led to limited ability to perform differential diagnoses.(3) This model also limits the ability to process and understand non-organ specific complaints or consider conditions that involve multiple organ systems (like diabetes or cancer).(16) An organ-system based curriculum is limited in clinical context, and thus medical educators developed a problem-based curriculum.

Problem-based

The problem-based curriculum attempted to emphasize clinical complaints as a focal point for learning, utilizing self-directed, small groups around selected clinical issues. The problem-based learning (PBL) curriculum represented major strides in the incorporation of clinical context and active learning methods into the curriculum, however PBL encountered obstacles to complete success. Students tended to have problem specific knowledge and general problem solving skills but could not translate that into clinical problem solving skills necessary for the clinical years. The use of small groups and limited expert interaction have also been criticisms of the model. Finally, PBL seems to cause some backward reasoning that is not an intended component of clinical problem solving.(3) Research has not demonstrated that this curricular model improves students' knowledge or clinical skills beyond existing models.(22) Clinical problem solving involves inductive or hypothesis generated thinking and would lead to the next curricular model.(3)

Clinical-presentation

The clinical-presentation model (CPM) is currently the most advanced, well-formed model for medical education. The CPM was an improvement over PBL because of its ability to engage a broader range of clinical presentations and knowledge. This curriculum began at the Faculty of Medicine at the University of Calgary (U of C) in the 1990s. The faculty and curriculum committee wanted to update their body-system approach curriculum and examined the existing curricular models. They too found advantages and disadvantages with existing models, resulting in the decision to create their own unique curricular model based on "clinical presentation". This model would use the small groups and active learning components of PBL but would rely on schemes and thorough terminal and enabling objectives to drive the learning process.(23) While CPM is strong in integration and clinical context, it has limitations. The basic science information is still presented as background information in CPM, and the use of schemata may limit the free thinking and problem solving processes necessary in unusual presentations. CPM relies on small groups and practice in resolving cases to integrate the clinical and basic science information.(3) An evaluation of CPM at U of C found that students' response had been favorable but there were still concerns about faculty implementation and the difficulties with the scheme approach.(6) CPM is still relatively new and has limited research to support or refute its benefits. This model does provide an encouraging direction in medical education that focuses on clinical relevance.

Need for further reform

With all of these curricular models and published support for better integration, context, and clinical relevance, is there a need for new models and further reform? While there is value in each of these existing models, they lack complete integration and the clinical focus needed in modern medical education. Furthermore, there are no published reports on the existence of new curricular models being instituted at osteopathic medical schools.

The novel curricular model discussed here is specifically intended and directed at osteopathic medical education, but we envision this curricular model to be applicable to all forms of medical education including other forms of manual therapies like chiropractic and physical therapy.

There are three primary reasons for recommending a new model: perceived inadequacy in musculoskeletal system education, decreased use of osteopathic manipulative treatment (OMT), and the need to improve medical students' clinical skills. In the following sections we describe the concerns listed above and explain how our model addresses those concerns.

Musculoskeletal system education

There is evidence to indicate an inadequacy of musculoskeletal system (MSS) knowledge from medical students to residents in both allopathic and osteopathic training institutions. Freedman et al. published two articles addressing orthopedic and internal medicine residents' MSS knowledge and found both groups of residents to be underprepared when compared to a validated level of competence.(7,8) Stockard used the same measure on graduating osteopathic medical students and also came to the same conclusion that even with the increased emphasis on structure and function in an osteopathic school, the students were still inadequately prepared.(9) Another study found that medical students felt inadequately prepared and lacked cognitive mastery and clinical confidence regarding the MSS.(10) The proposed curricular model is based upon a belief that a focus on structure and function from the beginning encourages understanding and retention of knowledge while fostering clinical confidence, especially regarding the MSS.

Osteopathic principles and practice education

The third edition of Foundation of Osteopathic Medicine defines osteopathic medicine as "A complete system of medical care practiced by physicians with an unlimited license that is represented by a philosophy that combines the needs of the patient with the current practice of medicine, surgery, and obstetrics. Emphasizes the interrelationship between structure and function, and has an appreciation of the body's ability to heal itself."(24) Osteopathic principles and practice (OPP) has been defined as "A core set of facts, theories, and values that are built on the osteopathic concept. The osteopathic concept asserts that (1) the body is a unit; (2) the body has its own self-protecting and self-regulating mechanisms; (3) structure and function are reciprocally interrelated; and (4) rational medical treatment is based on the understanding of the above."(25) Osteopathic Manipulative Medicine (OMM) is defined as "The application of osteopathic philosophy, structural diagnosis and the use of Osteopathic Manipulative Therapy (OMT) in the diagnosis and management of the patient."(26)

Concerns have been noted about a decrease in the use of OMM and students' OMT skills.(11-15) There are many proposed causes for this decline, but no definitive study has described one factor or group of factors as responsible. The West Virginia School of Osteopathic Medicine chose to address these concerns by reintegrating OPP into their entire curriculum from the 1st year medical student curriculum through residency.(17) Aspects of this reintegration project are discussed in more detail later. Boulet stated "The practice of osteopathic medicine requires competence in a number of domains, including biomedical knowledge, diagnostic reasoning, and clinical skills."(27) We hypothesize that students' OMT skills and incorporation of OPP into clinical practice should improve with better understanding of structure and function that comes from complete integration of OPP in all aspects of the medical school curriculum.

Clinical skills education

The last area of concern is clinical skills. Clinical skills are defined as history taking, physical exam, clinical reasoning, and communication skills. This is a simplistic definition but seeks to encompass the major areas pertinent to undergraduate medical education. Two studies have indicated medical students may not be achieving up to their potential with respect to clinical skills.(14,16) Our curricular model would attempt to improve on this by tying in structure and function more fully to improve students' abilities to think clinically, perform and interpret physical exams more thoroughly, and therefore increase their confidence and competence in the clinical years and residency.

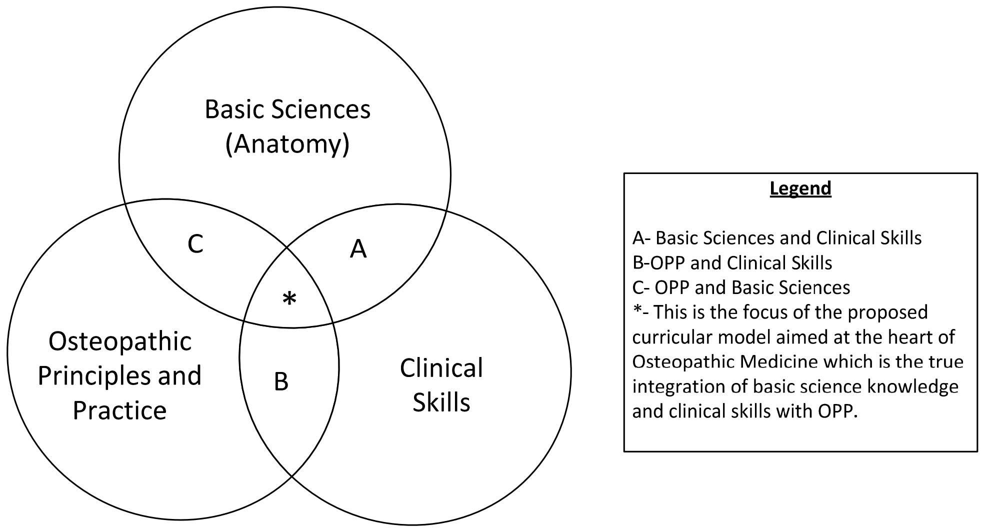
Developing a novel curriculum

With these concerns in mind we began developing our curriculum with focus on the pre-clinical years. The curricular model described below uses a clinical case, similar to CPM. Some models have focused on bringing clinical sciences into the basic science curriculum, or infusing basic science information into the clinical years. Our model focuses on using the basic sciences to understand a clinical case. This simple statement emphasizes three key features of this model. First, the curricular model is integrated into all educational elements of the pre-clinical years. When all learning activities are focused on the clinical case, the process must integrate all of the information. Second, the emphasis is on clinical content and clinical relevance rather than basic science knowledge. And lastly, with all activities directed at the same clinical case, contextual learning is inherent in the process of learning clinical skills and OPP.

For the purposes of discussion, the curriculum was divided into three primary components: basic sciences, clinical skills, and OPP. The International Association of Medical Science Educators (IAMSE) study group came to a consensus on the basic science information that should be covered in the medical school curriculum with anatomy, physiology, pharmacology, pathology, and biochemistry being fundamental and microbiology, immunology, genetics, biostatistics, and neuroscience deemed necessary.(2) The ultimate scope of this curricular model is to include all areas of basic science education, but this paper and future research project will use anatomy to represent the basic science component. Anatomy was chosen because of the intimate relationship between anatomy and osteopathic medical education as structure and function are integral to understanding OPP as well as developing clinical skills.

The concepts of "integration" and "context" can be better visualized in a Venn diagram that includes the three primary components: basic sciences, OPP, and clinical skills (Figure 1). The three areas of overlap between the primary components represent opportunities for integration and contextual learning. Each of these overlapping areas are discussed below including a review of published literature. At the center of the Venn diagram is a section (*) that represents the essence of this novel curricular model and is discussed in detail later.

Figure 1. Visual representation of curricular integration



Integrating basic sciences and clinical skills

Integrating basic sciences and clinical skills is one of the most important and most studied aspects of modern educational reform. In 2010 the IAMSE group published a study that identified core concepts in the basic sciences for medical education and emphasized the importance of including clinical relevance in the basic sciences curriculum, rather than only in the clinical practice component.(2)

Integrating basic sciences and clinical skills is not merely infusing clinical content into basic science lectures using clinical correlates or clinical cases to facilitate the application of basic science concepts, nor is it having a basic science review course during the clinical years. While these are valuable endeavors they do not represent the level and intensity of integration described in our novel curricular model.

Several schools have curricular components using case presentations and aspects of the clinical encounter to teach basic science components. Studies of these models have shown promise, but there are minimal data to support the effectiveness of their efforts.(28-31) These studies have shown that clinical content can be incorporated early into the medical education curriculum which refutes another study that emphasized “Students cannot be expected to adeptly apply basic science concepts to clinical decision making until they have had some degree of clinical training.”(32) In fact, Klein et al. wrote “The clinical challenge led them to a deeper understanding of the [basic] science material.”(29) One program successfully incorporated clinical material into the anatomy curriculum, but the results of this curricular model are limited in that many of the activities were not required and the primary learning events only used cadaveric prosections.(30) The authors emphasized the importance of “longitudinal” learning but the voluntary nature of many of these events may limit the effectiveness. The majority of students volunteered to go through an additional dissection component which seems to emphasize the importance of dissection and the desire of students to learn through dissection. The importance of dissection has been confirmed in other studies.(33,34) Another study demonstrated the value of the clinical component when learning basic science information at the resident level, but again there are little data to support this curricular model.(35) These schools and curricular models have shown promise but all leave room for improvement within the structure of the curriculum.

Integrating osteopathic principles and practice and clinical skills

Integrating OPP and clinical skills harkens back to the roots of osteopathic medicine. Initial learning activities in anatomy and physiology were created to understand the clinical condition and to formulate rational treatment regimes. It appears that colleges of osteopathic medicine (COMs) vary in their integration of OPP and clinical skills as evidenced by their organizational structure. Some COMs have one department that encompasses OPP and clinical skills whereas other COMs have separate departments for each. OPP and clinical skills may be integrated through clinical correlates in the OMM curriculum or osteopathic findings included in case presentations teaching clinical skills. Some schools may include teaching orthopedic exams while learning upper and lower extremity during OMM courses. Again, these are valuable learning activities but underscore and limit the possible integration and contextual learning opportunities. Every diagnosis and case presentation can be evaluated from the osteopathic perspective and should become second nature to all osteopathic physicians. This can only occur through practice and deliberate integration of these components. Published evidence of integrating OPP and clinical skills is very limited. The West Virginia School of Osteopathic Medicine (WVSOM) published the results of their curricular revision that focused on the reintegration of OPP into all of WVSOMs curriculum.(17) One aspect of this curricular revision was early clinical exposure with the inclusion of osteopathic diagnosis and treatment in addition to teaching clinical skills during clinical encounters. Students also presented case reports in third year rotations to emphasize the importance of OPP in the practice of medicine.(17) That model advanced and improved on the existing curriculum, however more evidence is needed to support the benefits of such a model.

Integrating osteopathic principles and practice and basic sciences

Integrating OPP and basic sciences has been poorly represented in the literature and yet should be one of the highest priorities of osteopathic medical schools. OPP distinguishes the osteopathic profession yet the medical education curriculum is more similar than dissimilar between COMs and other medical schools. OMM is often the only distinguishing feature in osteopathic medical curriculum. Again, WVSOM is the only school to publish a study to support a curricular revision in this aspect. WVSOMs "…approach was to 'build a bridge' for osteopathic medical students to relate knowledge and skills learned in OPP courses to their general medical knowledge learned in the organ systems-based curriculum." This led to significant changes in their basic science curriculum.(17)

In an article published in 2009, Gevitz states "If osteopathic medicine wishes to maintain its independence, it will need to strengthen its distinctive educational elements in its college and residency programs…"(36) The basic sciences, especially anatomy, are essential to osteopathic medical students as they provide the foundation for understanding osteopathic principles and practice. The integration of OPP and basic sciences is a particularly unique feature of our curricular model by taking OPP and specifically OMT into the gross lab.

Integrating basic sciences, clinical skills, and osteopathic principles and practice

Integrating basic sciences, clinical skills, and OPP is the focus of our novel curricular model. This model provides a learning environment that directly and intentionally integrates all of these components, simultaneously, while emphasizing clinically relevant content in a contextual manner. This curriculum is organized around regional pain syndromes and common complaints that represent a broader scope of diseases and conditions. Common complaints, such as dizziness, would be used when pain as the presenting symptom is not reasonable. Each one of these regional pain syndromes or common complaints is a separate module. Each module has a distinct beginning and ending but has many opportunities for parallel connections to be made. This may be easier to understand with an example module.

Example module

This example module is not intended to be exhaustive and all inclusive of the material to be covered, but to illustrate the concept of this curriculum. Chest pain is the regional pain syndrome for this example. First the students would participate in an exercise/discussion led by a clinician to discuss the chief complaint of chest pain. The students would be guided through an interactive exercise in which they develop a general list of differential diagnoses by body system (emphasizing anatomical structures) but not specific diagnoses or known diseases. This initial exercise would lead to differential diagnoses like heart, lungs, upper gi tract, and musculoskeletal system (ribs for example). This would lead to an exploration of the normal anatomy and how pain could be generated by each of these areas. Physiology, histology, cell biology, and other basic science points would be included in a completed version of this curricular model to explain how these organ systems work and generate clinical problems in addition to anatomy.

These learning activities can and should involve gross lab dissection, prosection, lecture, discussion groups, and interactive feedback (quizzes and online activities). Students would work in the gross lab performing dissection and evaluating prosections depending on the best approach and use of time. Another novel aspect of this curricular model is the judicious use of dissection to learn functional anatomy and develop a macro understanding of the relevant structures as well as the use of detailed prosections to visualize key structures and areas deemed too cumbersome or time consuming to dissect. All student activities are concentrated more on learning the most important information and less on uncovering and finding structures on a list. This curricular model focuses on ensuring all information presented is clinically relevant and serves only to elucidate an understanding of structure and function as it is related to a clinical presentation.

Students will learn about the role of osteopathic principles with respect to normal anatomy (and other basic science components). For example, students would learn how the autonomic nervous system affects the cardiovascular system and furthermore how they would assess and treat impediments to healing related to these osteopathic principles. It is our intention to take OMT to the gross lab so students can directly see the structures and functional connections they are diagnosing and treating. Gross dissection allows the students to see below the surface anatomy they are palpating and encourages them to visualize the anatomy when they are treating in the future. It is our belief this will ultimately lead to an entirely different dissection/prosection learning environment that emphasizes a functional understanding of anatomy rather than a conglomeration of parts.

Learning the anatomy and organ systems in this fashion would encourage students to generate pertinent questions and concepts to cover while taking a patient's history of present illness. These questions are generated from an understanding of structure and function and not a memorized list of pertinent facts for a list of differentials. This is also a critical time to learn physical exam skills. For example, when the students are learning about congestive heart failure they would also learn the physical exam skills necessary to evaluate this disease process, such as jugular venous distention, edema, and heart murmurs. In existing curricular models this may involve drawings and practice on fellow students. In this novel curricular model, students would discover an anatomic connection that can be visualized in the gross lab. By learning in clinical context and integrating the basic science components, the students would know what to examine in a given disease but they would also know why they are looking for it.

At the conclusion of the module the students refine a differential diagnosis based on the history and physical exam findings in conjunction with their understanding of structure and function. This type of learning would encourage problem solving and clinical reasoning from the outset. This model would also allow for a layering or spiraling of information so that more detailed and disease specific information can be presented again in the future while emphasizing pathophysiology and pharmacology as well as increasing the clinical complexity of problem solving and decision making. For example, when chest pain is introduced again in the second year the students would learn about myocardial infarction with atherosclerosis as the primary cause of the disease. This allows for a pathophysiologic discussion about the generation of atherosclerotic plaques and excess cholesterol in the circulatory system. It also allows for the discussion of how a healthy diet and exercise could affect this disease process and eventually lead to the discussion of medical interventions such as medications. This would lead to a discussion of statin drugs and the pharmacology behind these medicines as well as the biochemical pathways involved in cholesterol synthesis and usage in the body. Learning in this sequential yet integrated fashion would allow students to continually build on existing knowledge while learning more complex material. Students will learn information in a manner similar to how it will be used in future practice.

Conclusion

Our hypothesis is that learning basic science material in a clinical context and learning the structure and function related to clinical skills and OPP will yield a greater understanding and retention of information. Furthermore, this model provides students with a rational approach to new or unusual clinical presentations, but also includes learning objectives focused on the most common and clinically relevant patient presentations. This curriculum would move beyond cookbook and algorithmic problem solving and foster understanding, knowledge, and free thinking. "To best achieve the development of such thinking skills [logical reasoning, critical appraisal, problem solving, decision making, and creativity], the sciences must be seamlessly integrated within the context of clinical education and involve purposeful, deliberate practice throughout the entire medical education experience…"(2)

CHAPTER III

LEARNING OUTCOMES OF A NOVEL CURRICULAR MODEL: TWO CASE EXAMPLES OF INTEGRATING BASIC SCIENCE, OSTEOPATHIC PRINCIPLES AND PRACTICE, AND CLINICAL SKILLS

Introduction

Medical education has changed greatly since Abraham Flexner provided his report to the Carnegie Foundation in 1910. That landmark study has endured as a guiding set of principles for over a century.(1) In the U.S., the core medical school curriculum continues to evolve and change to meet the demands of new information, changing health care principles, and to encompass global health issues. As medical education evolves, novel approaches to teaching and learning emerge. Curricular reform has led to the creation of multiple curricular models. The most recent models are organ-based, problem-based, and clinical-presentation.(3) These models represent the current trend to improve on integration and contextual learning. Among the most important skills medical students need to acquire to meet current and near-future standards is the ability to integrate basic science knowledge into a clinical scenario. This integration enables the student to advance from declarative knowledge to procedural understanding and critical thinking in patient care.

Integration and clinical synthesis is the focus of a novel curricular model, the framework for which has been previously described in Chapter II “Integration and context: evaluation of medical education reform and the presentation of a novel curricular model." That novel model was built on historical curricular advances in medical education and redefines integration and contextual learning for the 21st century. Briefly, the model provided a platform for two pilot learning events integrating anatomy and clinical presentations of two musculoskeletal topics. The first was a seminar on piriformis syndrome. The second was a graduate course covering the clinical anatomy of the upper and lower extremities. This paper presents the results of these two learning events using that novel model. The model emphasized the value of clinical relevance while learning basic science concepts and elucidated the value of understanding structure and function as it related to the clinical presentation.

Both learning events took place at a health science center; the seminar in the medical school, and the graduate course in the graduate school. Content was based on a previous series of three applied anatomy seminars provided to third and fourth year medical students in a pre-doctoral osteopathic manipulative medicine fellowship. Those seminars were aimed at reviewing and expanding anatomy knowledge in the clinical context for carpal tunnel syndrome, back pain, and neck pain. Anecdotally those seminars were well received and emphasized the value of having a clinical component to teaching basic science information like gross anatomy. However, no formal assessment of learning outcomes was taken for those earlier seminars.

In the following sections we describe the methods, participants, and outcomes for each of the learning events using the novel curricular model. First we describe the seminar on piriformis syndrome, and second we describe the graduate course "Clinical Anatomy of the Upper and Lower Extremity." IRB exempt approval was received for both projects.

These learning events were novel in that they utilized a different approach from the traditional methods of teaching anatomy in medical schools. Traditional methods essentially involve identifying and locating anatomical structures from a list of required structures. There are limited opportunities for learning anatomy in a clinical context. For example, students may be able to identify multiple hip muscles but are not expected to understand how facial planes run together and how they relate under certain conditions. Students learn what function an anatomical structure has in the body, and learn what is “normal” versus what is “pathological.” If a clinical context is presented it typically is in a disease model. Structure and function in a clinical context requires both declarative and procedural knowledge, and a foundation in critical thinking.

Seminar: piriformis syndrome

Piriformis syndrome was chosen for the first seminar for several reasons. First, piriformis syndrome is a condition that is conducive to a unique clinically oriented dissection that differs from traditional gross dissection. Second, there is sufficient research and clinical literature to support the learning objectives of the seminar. Third, piriformis syndrome clinical presentation and exam findings are clearly defined. Fourth, piriformis syndrome is amenable to osteopathic treatment modalities.

Seminar participants

The four student participants in the piriformis syndrome seminar were third and fourth year medical students, all of whom were pre-doctoral osteopathic manipulative medicine (OMM) fellows at UNTHSC Texas College of Osteopathic Medicine. The seminar aimed to enrich and expand their clinical integration skills while evaluating the feasibility and value of this novel curriculum. These students had completed the first two years of basic science medical education and some clinical rotations.

Faculty who participated in the seminar included Frank Willard, PhD, Kendi Hensel DO, PhD, des Anges Cruser, PhD, MPA, Harold Sheedlo, PhD, and Rusty Reeves, PhD. Other instructors included a graduate student assistant from the Department of Anatomy and an OMM resident.

Seminar content and materials

A syllabus was created that incorporated the goals of the curricular model to completely integrate anatomy information, research literature, and clinical presentation and treatment including OMM, and to provide a multi-method contextual learning experience. To create the syllabus, we first evaluated the current syllabi for the musculoskeletal systems course, the clinical medicine course, and the OMM course for material relevant to piriformis syndrome that a first or second year student is expected to learn. Next, we conducted a literature search for published clinical research and basic science articles on piriformis syndrome. Two articles were selected for inclusion in this seminar. One article was a review of piriformis syndrome from an osteopathic perspective(37), and the other was a study of piriformis syndrome and the use of a diagnostic test.(38) The articles were evaluated for consistency with the formal curriculum and once compatibility was confirmed, we created learning objectives that could be tested and evaluated. The syllabus, dissection guide, and form for critical evaluation of a research article are provided in Appendix A.

Frank Willard, PhD led the previous applied anatomy lectures and was instrumental in the development of this curriculum. He served as the lead instructor for the seminar and created the dissection guide for use in the gross lab. Dr. Willard is a neuroanatomist and Professor of Anatomy at University of New England College of Osteopathic Medicine. This dissection guide was designed specifically to instruct the student in a dissection format that followed structure and function, thus supporting the principle of integrating basic and clinical sciences. The guide provided the opportunity to explore the clinical and osteopathic nature of the piriformis muscle and the related anatomy.

With all of the components assembled, instructional methods and content were sequenced to facilitate an iterative and incremental learning process. The sequencing of materials and activities emphasized the integration and contextual aspects of this curriculum. This curriculum was designed to make the students think about the clinical perspective and the structure and function of the body before they began dissecting.

Learning was sequenced in the following way:

1. Prior to the first instructional class, students were required to read the review article on piriformis syndrome as this was the primary reference for the course beyond the dissection guide. Students also conducted a critical evaluation of the research article "Piriformis Syndrome: Diagnosis, treatment, and Outcome – a 10-Year Study." (38) Incorporating a research literacy skill into this model was essential to enrich the learning experience. Students were given the "Critical Evaluation of a Research Article" form as a guide to facilitate the review of the research article. This form was adapted from a similar form used in a research literacy course for second year medical students at the same school. The guide leads the reader systematically through a research article such that they produce a critical review and reinforce understanding of research design and methods.
2. The first instructional class included discussions of the two articles, a review of the clinical presentation of piriformis syndrome, and then a brief discussion concerning osteopathic principles and practice related to piriformis syndrome.

The students were encouraged to develop research questions relevant to the presentation, diagnosis, or treatment of piriformis syndrome and then devise an anatomical study to evaluate that question. This exercise was designed to get the students to relate clinical medicine into basic science components, specifically anatomy in this case, before going into the gross lab. This exercise was particularly important for this seminar because the students had been previously exposed to anatomical dissection and this material, thus it was important to remove any habits or preconceived notions regarding this information.

3. Students then completed a dissection of the area related to the piriformis muscle focusing on functional anatomy and clinical context. This was accomplished by first evaluating the surface anatomy of the cadaver like a patient. Students were to reflect on their research question as they proceeded through the dissection. An example of this would be one student's question as to the accuracy of the method taught to locate the piriformis myofascial tender point on a patient. Students referenced the figure in *Osteopathic Principles in Practice* by Kuchera on page 260 and, after locating this point, inserted a needle into the muscle at this point. (39) As the students dissected they kept the needle in place and verified its location when they reached the piriformis muscle. This exercise reinforced a visualization of the anatomical structures for students to reference when palpating this point in the future.

4. The students then participated in an exercise where they described the dissection process and the key clinical points they uncovered during this process. The

students elaborated on this component when they prepared and presented a grand rounds lecture at the completion of the seminar.

There were several other important aspects to organization of the seminar that should be mentioned here. The use of experts while learning the material was essential to the design of this curriculum. This required the use of state of the art technology by streaming Sky Eye images over the internet to Dr. Willard in New England while the dissection was occurring in Texas. Also important was the presence of OMM faculty and resident in the gross lab during dissection. This led to important discussions and the opportunity for immediate feedback to clinical questions.

Seminar assessments

Pre and post-seminar assessments of students' knowledge of piriformis syndrome and a survey of opinions were developed in consultation with the anatomists and clinical and research instructors. The knowledge questions were designed to be challenging so as to discourage guessing and to assess specific declarative knowledge of piriformis syndrome. The knowledge assessment and survey were identical for both pre and post-seminar assessments. Assessment answers and results were not discussed at any time with the students. The knowledge assessment and survey of opinions documents are provided in the appendix.

Seminar results

Five students were enrolled in this seminar, but one student did not complete the seminar due to a conflict in schedule. The remaining four students completed all pre and post-seminar assessments. These students scored, on average, 53% (4.25 of 8 total points) in the pre-test and 78% (6.25 of 8 total points) on the post-test. On a scale of 0 to 4, with 4 representing most confidence or agreement, all four students reported increased confidence in diagnosing piriformis syndrome, and two reported an increased confidence in treating piriformis syndrome. Two students reported increased confidence in their ability to critically evaluate research literature. Due to the small numbers statistical analysis was not performed, however the results and feedback from the students indicate that this curriculum could work, though more research with a larger group of students is required to determine its effectiveness.

Seminar strengths and limitations

There are several limitations to this seminar that should limit conclusions drawn from this experience. As stated before only four students were able to participate in this pilot seminar. The low number limited our ability to evaluate statistical significance of these data. The small number of participants did, however, allow for a favorable faculty to student ratio and limited the number of students dissecting on the same cadaver at the same time.

Another limitation was the nature of the participants. These students were not naïve to piriformis syndrome and the content presented in this seminar. However, this information was presented in an entirely new format. Because these students volunteered for the pre-doctoral fellowship and for this study, it may also be assumed they had a higher interest in musculoskeletal medicine and OMM than the average medical student. The students' interest is also a strength of this seminar because these students were motivated and actively involved.

Graduate course: clinical anatomy of the upper and lower extremity

The graduate course was offered as an elective in the Master of Medical Sciences program in the UNTHSC Graduate School of Biomedical Sciences. While this course was part of the graduate school schedule of classes, the course director, Harold Sheedlo, PhD, collaborated with Dr. Willard and John Colston to organize the course in a manner that allowed for further evaluation of this novel curricular model. This course served to test the effectiveness of the curriculum model with students who were naïve to the subject material and without clinical experience, key to assessing the model's effectiveness due to it being directed at first and second year medical students. The topics of upper and lower extremity were chosen by the course director, with focus on the shoulder and the piriformis muscle.

Graduate course participants

Students participating in this course had completed all required courses for their master's degree during the previous two semesters. The course was offered as one of several potential elective courses available during the summer semester. These students had performed minimal dissection and studied the musculoskeletal system as part of the required curriculum for their degree. However, the majority of the material presented in this course was new to them. This study was not meant to compare this curricular model versus the existing first year medical student curriculum but instead served to evaluate the process of executing the curricular model and assess the model's effectiveness in conveying the material.

Faculty who participated in the course included Harold Sheedlo, PhD, Frank Willard, PhD, Kendi Hensel DO, PhD, and Clayton Holmes, PT, EdD, MS, ATC.

Graduate course content and materials

As with the piriformis syndrome seminar, the syllabus and sequence of classes were created to ensure integration and contextual learning were emphasized to the fullest extent possible. There were two primary segments for this course. The first segment covered the upper extremity and was an in depth evaluation of the shoulder with minimal attention to the rest of the arm. The lower extremity segment was broader in scope to cover the entire leg but kept some aspects of the previous piriformis seminar that were applicable for this class.

A web-based interactive dissection guide was created for the shoulder component. The additional musculoskeletal content, OMM information, and clinical components were provided to the students through interactive lectures, power point presentations, and handouts. The clinical instruction occurred both inside and outside the gross lab allowing for direct viewing of structures on the cadavers while students practiced physical exam techniques on each other.

Graduate course assessments

Students completed a single pre-course knowledge assessment containing seven questions on the shoulder and three questions on the piriformis muscle. Due to the change in scope of content covered in this course, not all of the questions from the previous piriformis seminar could be used. The content and results of this initial assessment were directly discussed during the class. The students also completed a pre-course opinions survey. Both the knowledge assessment and opinions survey were also completed post-course. For the post-course assessment, the same knowledge questions were used however they were tested at the end of each segment on course exams. Additional questions from the course director were included on each segment's exam but they were not used in this study. The post-course opinions survey was identical to the one they took before the class with the exception of two additional questions related to their opinion about the course. All of the course assessments are provided in the appendix along with the syllabus, schedule, and other course materials.

Graduate course results

Ten students completed pre and post-class assessments and opinion surveys with the following results. All knowledge questions showed improvement in students' ability to identify the correct answer after completing the course, with five shoulder questions reaching statistical significance using McNemar's test at the 0.05 level (Table 1). The remaining questions demonstrated improvement but had a high number of students answering correctly pre-course, thus leaving little room for statistically significant improvement.

Wilcoxon signed rank test analyses of the opinions survey revealed a statistically significant increase in students' confidence that they could diagnose, exam, and treat the shoulder and exam the lower extremity. The remaining three opinion questions did not increase or decrease at a level of statistical significance, however it should be noted these opinions were already positive on the pre-class survey. The two questions included only in the post-course survey of opinions indicate this course changed their opinion of the usefulness of anatomical knowledge and that the structure of the class played an important role in changing that opinion.

Table 1. Outcome measures for knowledge assessment (n=10)

Question	**Number of Students Answering Correctly**		**McNemar p-value**
	Pre-course	**Post-course**	
Shoulder 1	5	10	.063
Shoulder 2	2	9	.016
Shoulder 3	0	9	.004
Shoulder 4	3	10	.016
Shoulder 5	1	10	.004
Shoulder 6	5	10	.063
Shoulder 7	2	10	.008
Piriformis 1	4	9	.063
Piriformis 2	2	7	.063
Piriformis 3	4	9	.063

Table 2. Outcome measures for opinions (n=10)

Opinion	Pre vs. Post-course Agreement (n)			Wilcoxon p-value
	Negative*	**Positive‡**	**Unchangedɸ**	
Confidence in shoulder differential diagnosis	0	8	2	.011
Confidence in physical exam (PE) of shoulder	1	8	1	.009
Confidence in PE of lower extremity	1	8	1	.016
Teach anatomy differently	1	4	5	.157
Integrating clinical skills and anatomy	2	1	7	.564
Understanding of OMM to treat shoulder	1	8	1	.014
Importance of anatomy in PE skills	1	2	7	.414

* A negative pre vs. post-course opinion indicates a student reported less agreement following the course.

‡ A positive pre vs. post-course opinion indicates a student reported more agreement following the course.

ɸ An unchanged pre vs. post-course opinion indicates a student reported the same level of agreement pre and post-course.

Graduate course strengths and limitations

This research was conducted at one health sciences university and thus has limited generalizability, and the results can be applied only to these students. The sample size was small, but repeated pretest and posttest measures were used. This course, like the seminar, demonstrated only a portion of the full curriculum. Due to the structure of the course and the students' minimal understanding of osteopathic medicine, the OMM component was limited and could not be tested. It should also be noted that pre and post-course assessment measures were created with guidance from subject matter experts but have not been validated.

Conclusions

This project was successful in implementing the novel curriculum, producing desired learning outcomes, and demonstrating the value of integrating clinical context with basic sciences. In both learning events students were provided opportunities to integrate clinical conditions into basic anatomy studies. Both the seminar and graduate course were pilot educational activities, thus it is too early to draw conclusions as to the overall effectiveness of this novel curricular model, however it has shown promise. This curriculum will encourage students to learn material in a way that is more similar to how it is used in the clinical years and beyond.

Further research is warranted to more fully evaluate the feasibility and efficiency of the curriculum before curricular reform can occur. Integration and context will continue to be the focus of curricular reform in medical education for the twenty-first century just as it was in the twentieth century, but curriculum reform should be supported by adequate research. It is our hope that the theories and lessons learned in this curricular model will continue to be developed and tested, and ultimately improve medical education for the future.

APPENDIX A

PIRIFORMIS SEMINAR MATERIALS

UNIVERSITY of NORTH TEXAS
HEALTH SCIENCE CENTER at Fort Worth

Education, Research,
Patient Care and Service

DATE: 30 March 2011

TO: des Anges Cruser, PhD
Mental Sciences Institute

(with John Colston, Jessica Ingram)

Office for the Protection of Human Subjects
3500 Camp Bowie Boulevard
Fort Worth, Texas 76107-2699

FROM: Brian A. Gladue, PhD
Director, OPHS / Chair, UNTHSC IRB

PROTOCOL: IRB 2011-063

Seminar on Piriformis Syndrome

IRB BOARD ACTION AND NOTICE OF APPROVAL

The Office for the Protection of Human Subjects (OPHS) on behalf of the Institutional Review Board (IRB) of the University of North Texas Health Science Center (UNTHSC) has reviewed your protocol and has granted approval for **EXEMPT** status (as specified in Federal Regulations 45 CFR 46 101(b), categories 1 and 2;

(1) Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods,
(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement) and survey procedures.

Note that you are responsible for complying with all UNTHSC IRB and OPHS policies, decisions, conditions and requirements regarding projects involving human subjects. You are responsible for insuring that the research is implemented as specified in the approved protocol. Unless otherwise authorized by the UNTHSC-IRB, you are responsible for notifying subjects that their participation and information will be used for research purposes. In addition, you are required to use ONLY the IRB approved documents, materials and/or process designated for this protocol.

You must report to the Chair of the IRB any changes affecting the protocol upon which this certification is based. **No changes may be made without prior approval by the IRB** except those necessary to eliminate immediate hazards.

If you have any questions, please contact Dr. Brian Gladue, IRB Chair and OPHS Director, at phone (817) 735-5083 in the Office for the Protection of Human Subjects, or send email to bgladue@hsc.unt.edu.

Texas College of Osteopathic Medicine • Graduate School of Biomedical Sciences • School of Public Health • School of Health Professions
Institutes for Discovery • University of North Texas Physicians Group
817-735-0409 • Fax: 735-0375

"Advanced Gross Anatomy: Application of Research, OMM, and Clinical Practice with an emphasis on Structure and Function"

This seminar is part of the NIH-NCCAM funded R25 grant led by des Anges Cruser, PhD which emphasizes research education. Students will participate in research literature review, gross dissection, peer teaching with further discussion of the dissection, and a grand rounds presentation. To evaluate the benefits of this seminar there will be a pre- and post-assessment of the students upon completion of the course.

Director: Kendi Hensel, DO
Instructor: Frank Willard, PhD
Advisor: des Anges Cruser, PhD, MPA
Advisor: Harold Sheedlo, PhD
Advisor: Rusty Reeves, PhD
Coordinator: John Colston, OMS-III, predoctoral fellow

Seminar Goals

1. Students will gain a better understanding of structure and function related to Piriformis Syndrome.
2. Students will gain a better understanding of Osteopathic Manipulative Medicine as it relates to Piriformis Syndrome.
3. Students will build on their ability to critically review a research article and discern clinically relevant information.

Seminar Objectives

At the completion of this seminar the student will have achieved the following objectives.

1. Reviewed an article at the level of Tier I competency as defined in the research education project
2. Developed osteopathic research questions related to Piriformis Syndrome
3. Demonstrated increased confidence in their skills to diagnosis and treat Piriformis Syndrome using OMM
4. Described the anatomical structures that relate to Piriformis Syndrome
5. Developed a rational treatment plan for Piriformis Syndrome
6. Developed a grand rounds presentation to summarize their participation and completion of the learning objectives in the course
7. Increased appreciation for clinical research and design

Seminar Participants and Roles

This seminar is designed as a trial run for a proposed future course for the spring of 2010 as an honors elective for 2nd year medical students and OMM fellows. The spring course would foster collaboration and communication between second year medical students, anatomy graduate students, and OMM fellows while completing the course and stated learning objectives. All students involved are expected to read two research articles and critically evaluate one of them.

Grand rounds presentation – All students will discuss what they learned about piriformis syndrome and how this class furthered their understanding of piriformis syndrome as it relates to structure and function.

Schedule of Classes

Tuesday April 28 – 7am Quick briefing by Dr Hensel and students will be given the pre-assessment and survey. Articles distributed for critical evaluation before first class session.
Monday May 4 – 11-1 Introduction and group discussion of the articles and discussion of the upcoming dissection. Dissection guide will be distributed.
Monday May 4 – 1-4 Students will be split into two groups. One group will dissect from the anterior while the other group takes a posterior approach
Monday May 11 – 1-4 Students will complete the dissection on the other side of their cadaver
Tuesday May 12 – 1-5 GROSS LAB: Fellows present and peer teach the completed dissection. Dr. Willard will provide further dissection and discussion. Dr. Hensel and the OMM resident will lead the discussion relevant to OMM diagnosis and treatment. Students will complete a post-course assessment and evaluation.
Wednesday May 27 – 12 – 1pm Grand round presentations at TCOM, and proposed for WVSOM, OUCOM and UNECOM.

Examining the Piriformis Syndrome:

A Dissection of the Piriformis Muscle and Correlation to its Radiological Presentation

Frank H. Willard, Ph.D.,
Department of Anatomy
University of New England
College of Osteopathic Medicine
Biddeford, Maine

Harold J. Sheedlo, Ph.D.
Department of Cell Biology and Anatomy
University of North Texas Health Science Center
Texas College of Osteopathic Medicine
Fort Worth, Texas

In this exercise the piriformis muscle will be exposed from the posterior aspect. This will involve a dissection to remove the skin, subcutaneous fat and fascia and the gluteus maximus muscle. The fascial relationship surrounding the piriformis muscle will be detailed and the ralationship between this muscle and the sciatic nerve studied.

The Specimen:

The specimen can be or either sex although a male is preferable due to the increased size of the piriformis muscle. Also, try to avoid the very elderly specimens due to the atrophy of this muscle. Obviously, the less fat in the gluteal region the better for the dissectors!

Preparation:

The specimen should be prone on the table. Marking the area of skin removal should be done as follows (Figure 01). Make a horizontal line across back at approximately T9 or T10 (A). Also, make horizontal lines on the posterior aspect of the thigh about one third of the distance from the gluteal fold to the popliteal fossa (C).

Laterally, these two sets of lines can be connected by two vertical lines drawn down the lateral aspect of the specimen parallel to the iliotibial band (B). Medially, the two horizontal lines on the thigh can be connected by a line passing upward on the inside of each thigh and connecting through the midpoint of the anus (D).

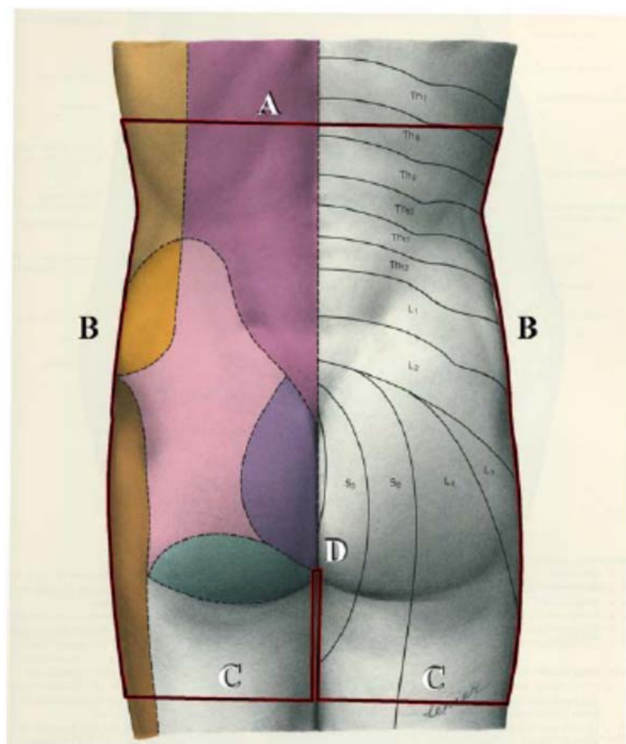


Figure 01: This is a posterior view of the gluteal region. The red and black lines indicate the borders of the skin removal. The letters A-D correspond to the intructions presented in the text.

Posterior Approach to the Piriformis Muscle

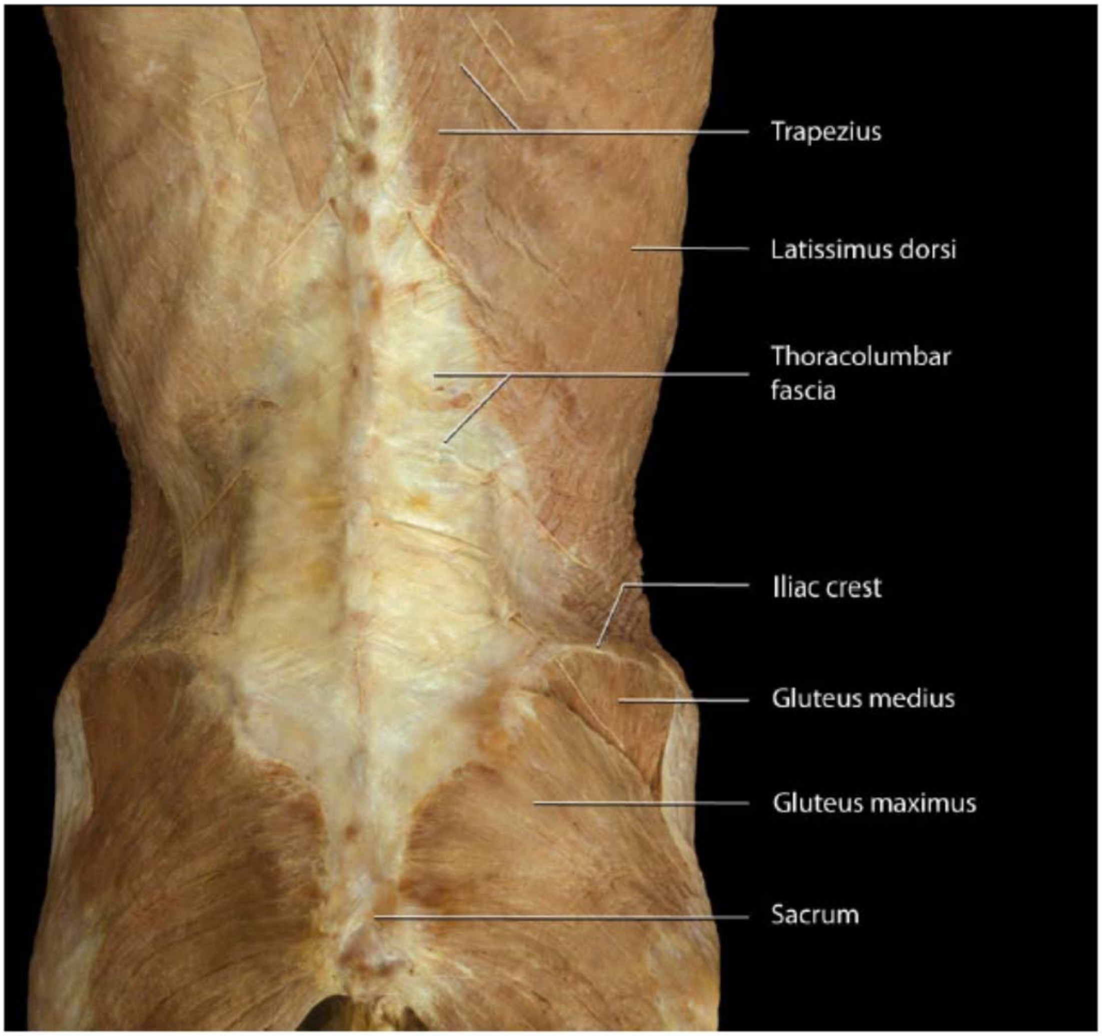


Figure 02: This is a posterior view of a 42-year-old female who died of metastatic breast disease. Her skin, subcutaneous fat and fascia and deep investing fascia has been removed to expose the thoracolumbar fascia and the gluteus maximus muscle.

Dissection:

Remove the skin and subcutaneous fat and fascia from the posterior aspect of the trunk to expose the gluteus maximus muscle.
(Figure 02)
Note carefully the multiple origins of the gluteus maximus musle. These include the iliac crest, the sacrum and the sacrotuberous ligament. The latter can only be appreciated by palpating under the inferior border of the muscle.

The gluteus medius muscle can be seen passing above the superior border of the gluteus maximus muscle to attach to the iliac crest.

In this view, examine the muscular attachments to the thoracolumbar fascia. These attachments include

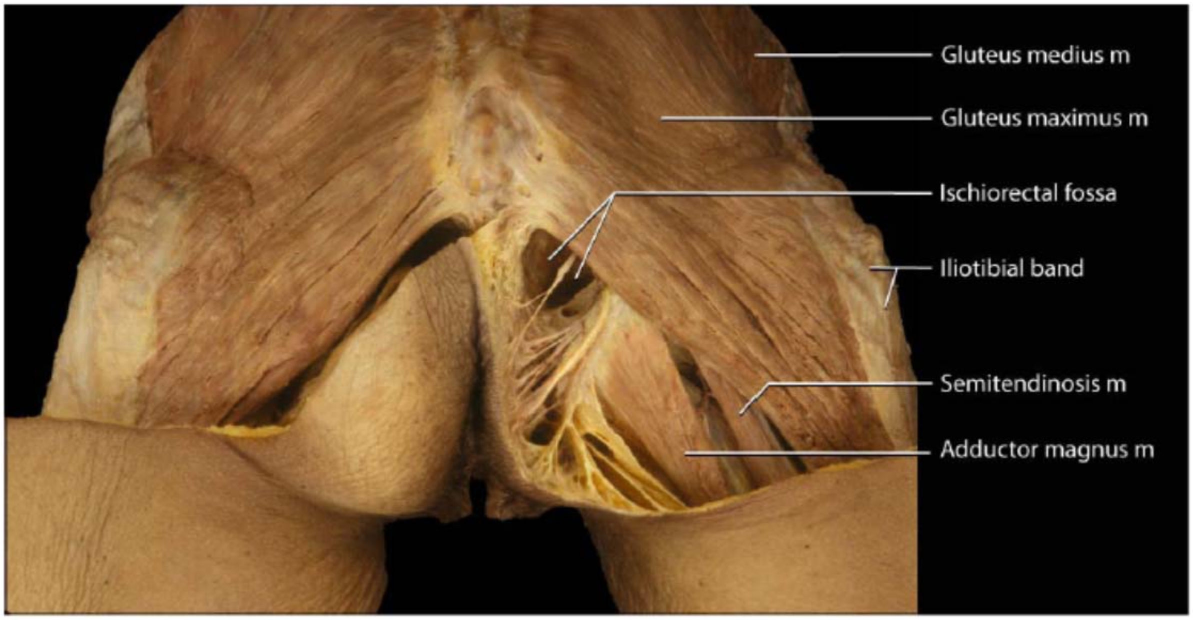


Figure 03: This is a posterior view of the gluteal region in the same specimen as the previous figure. The fat has been cleared from the ischiorectal fossa on the specimens right. Note the large connective tissue septae that support the fat in the fossa. The ischial tuberosity is located deep to the gluteus maximus muscle. The connective tissue on the midline forms the anococcygeal raphae.

the two gluteus maximus muscles inferiorly and the two latissimus dorsi muscles superiorly.

Dissection:

Gently elevate the inferior border of the gluteus maximus and begin removing fat and fascia from the ishiorectal fossa. As you proceed with fat removal, probe the fossa with your gloved finger. Attempt to palpate the levator ani medially and the obturator externis laterally in the fossa. Do not damage either of these muscles when removing the fat. When palpating the levator ani, follow this cone-shaped muscle superficially and identify the rings of the rectal sphincters. Note how the rectal sphincters are attached to the anococcygeal raphae posteriorly. Also be aware of the inferior rectal neurovascular bundle that pass from the region of the pudendal canal laterally to the sphincter of the rectum medially.

Attemp to remove as much fat as possible from the ishiorectal fossa. You should be able to extend a gloved finger to the level of the pubic symphysis when the fossa is empty.

With the fat and fascia removed from the fossa, palpate the ischial tuberosity and the sacrotuberous ligament. The deep and inferior fibers of the gluteus maximus arise from the sacrotuberous ligament. When removing the gluteus maximus be mindful of the ligament and avoid doing any damage.

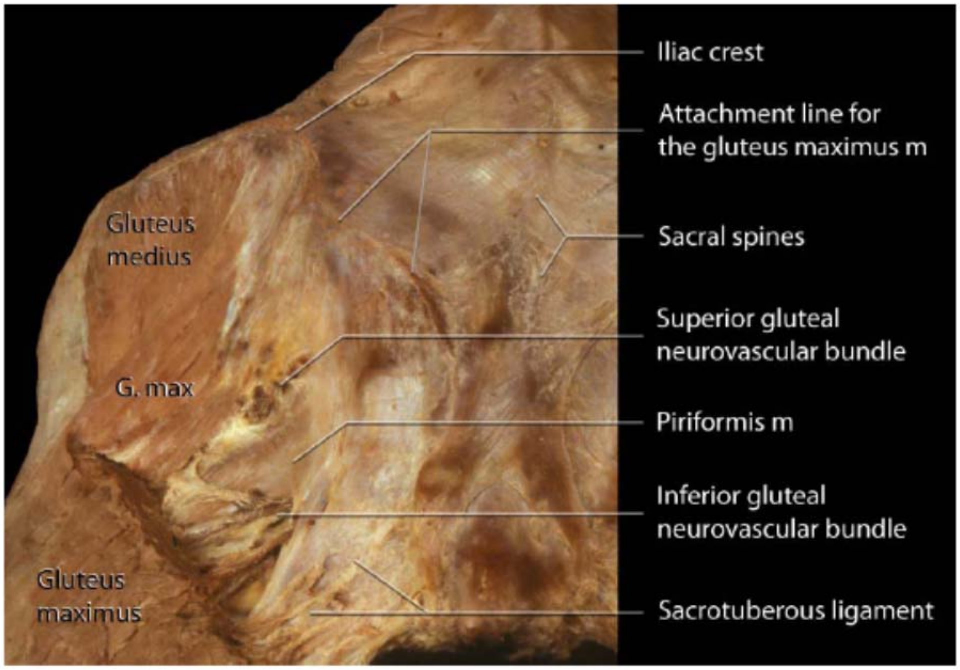


Figure 04: This is a posterior view of the left gluteal region in the same specimen as the previous figures. The sacral spines represent the midline. The medial and inferior portion of the gluteus maximus has been removed by detatching the fibers from the medial most attachment sites and peeling them laterally. These fibers were cut prior to reaching the iliotibial tract.

Dissection:
Before beginning to dissect, visualize the medial attachment of the gluteus maximus to the thoracolumbar fascia. Begin on this border to carefully remove the muscle fiber by fiber. Detach the muscle fibers from their medialmost border and peel them laterally. These fibers can be cut just prior to reaching the iliotibial tract (Figue 04). Do not disturb the fascia underlying the gluteus maximus muscle.

Comments:
In the above illustration, the fibers of G. max have been removed from the inferior and medial borders with the exception of a small portion of the muscle left along the superior border of the muscle.

The thoracolumbar fascia forms the protective sheet seen between the sacral spines and the attachment of the G. max. Note that with gluteus maximus removed, the thoracolumbar fascia can be seen to extend downward onto the piriformis muscle as well as to form the superficial fascia covering the sacrotuberous ligament. Much of the superficial surface of the sacrotuberous ligament serves as an attachment site for the inferior fibers of the G. max. The piriformis muscle can be seen entering the bed region of the gluteus maximus by passing out from under the lateral border of the sacrotuberous ligament. On either side of the piriformis muscle one can seen the superior and inferior gluteal neurovascular bundle.

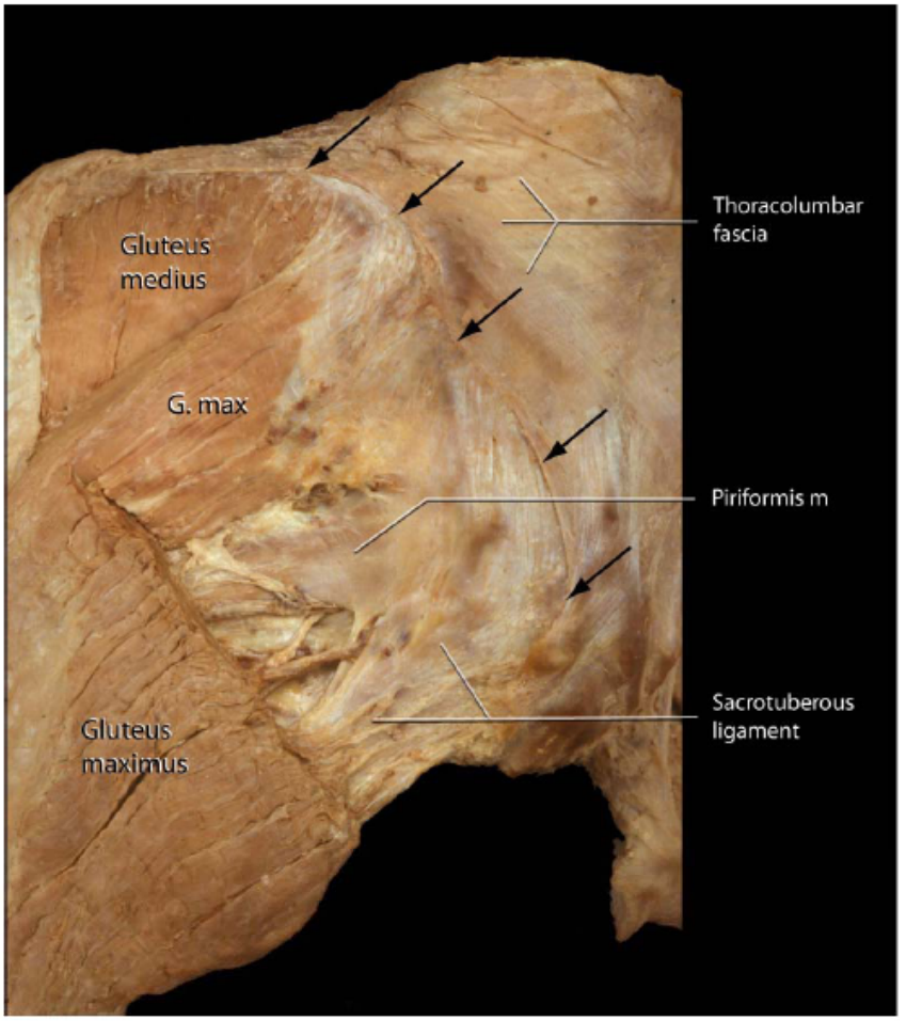


Figure 05: Posteroinferior view of the gluteal region illustrating the fascia of the piriformis muscle.

Dissection:
Visualize and palpate the piriformis muscle as it lies under the fascia in the bed of the gluteus maximus (Figure 05). Begin carefully removing the fascia from the superior and inferior aspects of the piriformis muscle. It is best to begin laterally and progress medially with fascia removal.

In the fascia superior to the piriformis locate and clean the superior gluteal vessels and in the facia inferior to the piriformis locate and clean the inferior gluteal vessels.

Comment:
Note how the fascia of the thoracolumbar ligament sweeps laterally under the attachment site for the gluteus maximus and down over the sacrotuberous ligament onto the piriformis muscle. As this fascia is removed from the piriformis, you should note the muscle sliding deep to the sacrotuberous ligament to reach its attachment site on the internal aspect of the sarum.

Note how the gluteus maximus attachment begins on the medial iliac crest, passes across the sacrum and ends on the sacrotuberous ligament.

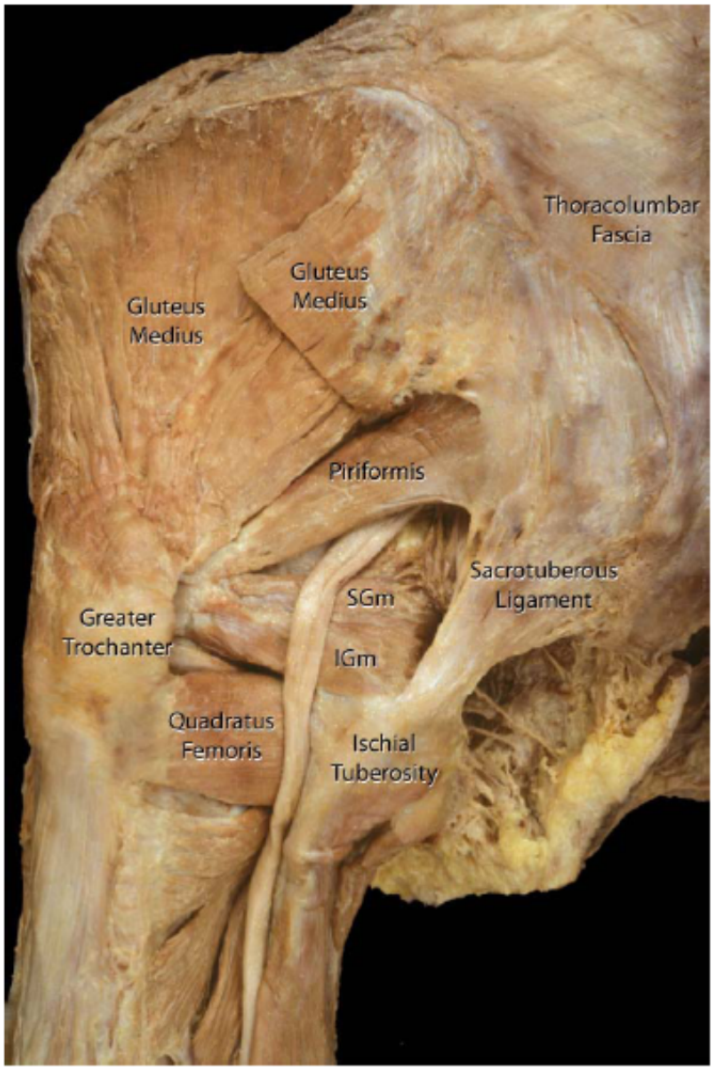


Figure 06: A poserior view of the gluteal region illustrating the piriformis muscle and its surrounding relationships.

Dissection:
Establish the lateral border of the sacrotuberous ligament by palpation. Complete the cleaning of the piriformis muscle to the lateral border of the sacro-tuberous ligament. Identify the sciatic nerve as it emerges from under the inferior border of the piriformis muscle. Carefully examine this relationship, occasionally the sciatic nerve will pass through the inferior margin of the piriformis muscle. Also, re-move the fascia from the gemelli muscles as well as the quadratus femoris and the ischeal tuberosity.

Comments:
Note that the piriformis exits the pelvic basin through the greater sciatic foramen while the two gemelli muscles and the tendon of the obturator internus exit through the lesser sciatic foramen.

Also, note the position of the sciatic nerve as it passes across the gemelli muscles, obturator internus tendon, and quadratus femoris muscle.

This completes the posterior approach to the piriformis muscle.

Medial Approach to the Piriformis Muscle

In this exercise the piriformis muscle will be approached from the medial aspect. To accomplish this, the pelvis will be bisected and the internal organs removed. The posterior and lateral walls will be cleaned to expose the medial attachments of the piriformis muscle and the lumbosacral plexus.

Dissection:
Transect the body in the axial plane just above the iliac crest (A-A'; see Figure 07)). Remove both lower extremities by transecting 2-3 inches below the gluteal folds (B-B'). Once these cuts are completed, bisect the torso on the midline (line between A and B). To make the bisection, the pubic synphysis should be cut first. Following which the torso should be positioned prone on a table, a line drawn along the

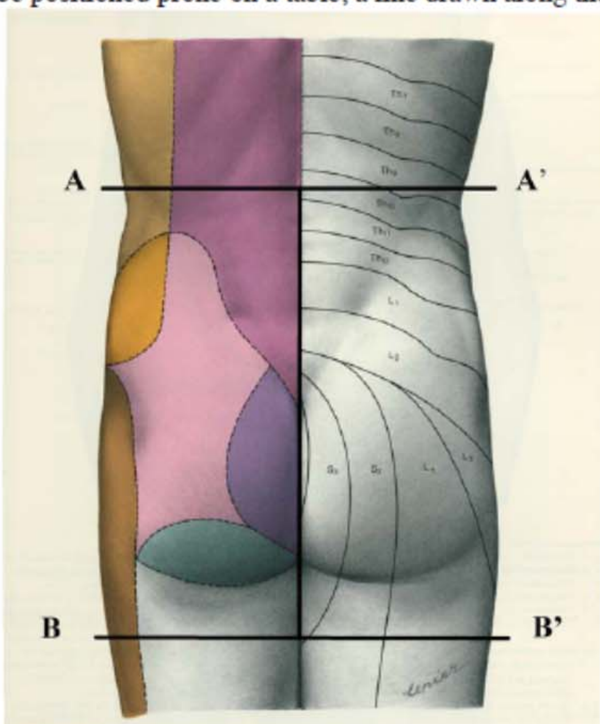


Figure 07: This is a diagram illustrating the planes of section necessary for bisecting the pelvis.

lumbar an sacral spinous processes and a cut made along this line. The bony elements should be cut with a large saw, the soft tissue with a large, sharpe knife.

Comment:
When completed, this procedure should produce a

Figure 08: this is a view of the bisected pelvis of a 55-year-old female who died of metastatic brest disease. The black line illustrates a plane for sectioning the pelvic organs.

specimen such is shown in Figure 08)

Dissection:
Remove the rectum, reproductive organs and urinary take organs by detaching them from the levator ani muscle. Use your gloved fingers to blunt dissect the organs from their lateral attachments to the fascia of the levator ani. To temporarily keep pelvic relationships intact, you can remove the pelvic organs by transecting them on a line between the pubic synthesis and the sacrum (see Figure 08).

Comment:
When completed this dissection should look like that depicted in Figure 09.

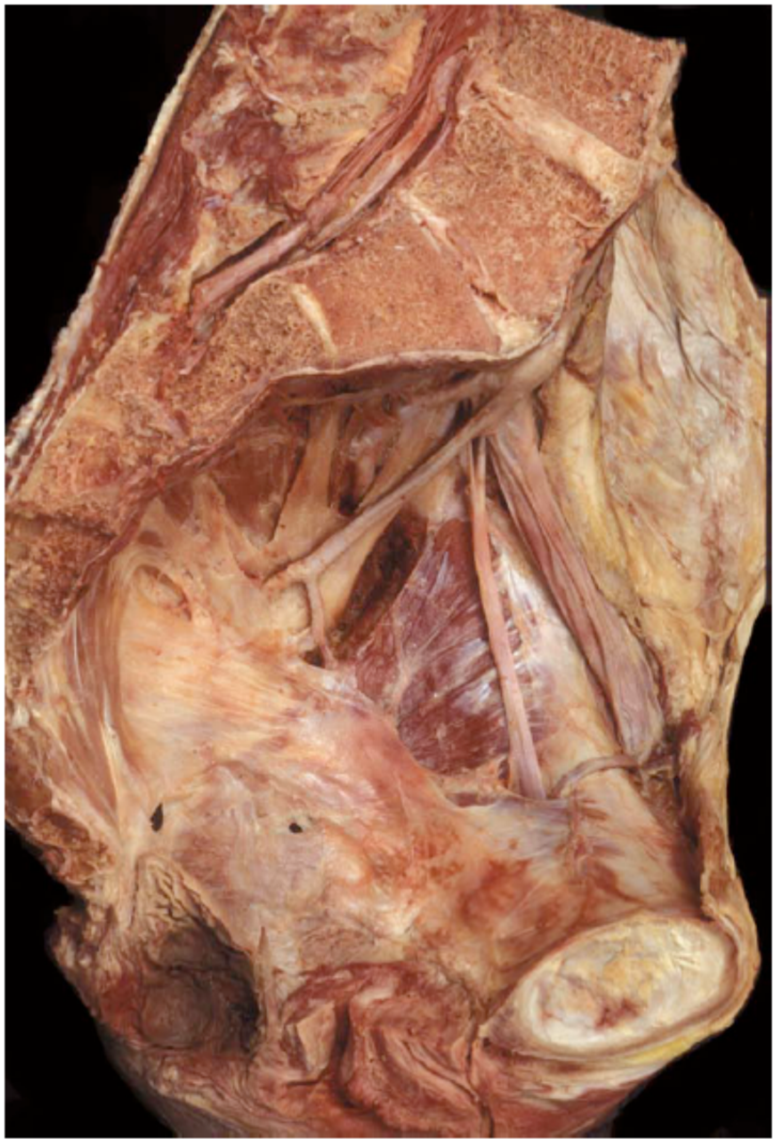


Figure 09: This is a view of the bisected pelvic basin of a 55-year-old female following removal of the pelvic organ systems. The broad whitish band across the pelvis is the fascia of the levator ani.

Dissection:
Remove the iliac vessels by sectioning them as they enter the pelvic basin. Cut these vessels distally as they enter the pelvic wall or pass behind the levator ani. (Note that not all of these vessels were removed in Figure 09.) Next remove the levator ani and the clean the fascia from the underlying ischiorectal fossa. This step should expose the lumbosacral plexus in the pelvic basin and the medial aspect of the piriformis muscle.

Comments:
Cleaning the fat and fascia of the ischial rectal fossa should expose a view of the lumbosacral plexus and the obturator internus muscle. In between the large nerves of the plexus one should be able to find the medial attachment of the piriformis muscle.

Dissection:
Next visualize the l4/L5, S1 - S3 spinal nerves in the lumbosacral plexus. Also visualize the sympathetic trunk (Figure 10) as it courses along the proximal ends of the spinal nerves. Carefully clean the fascia

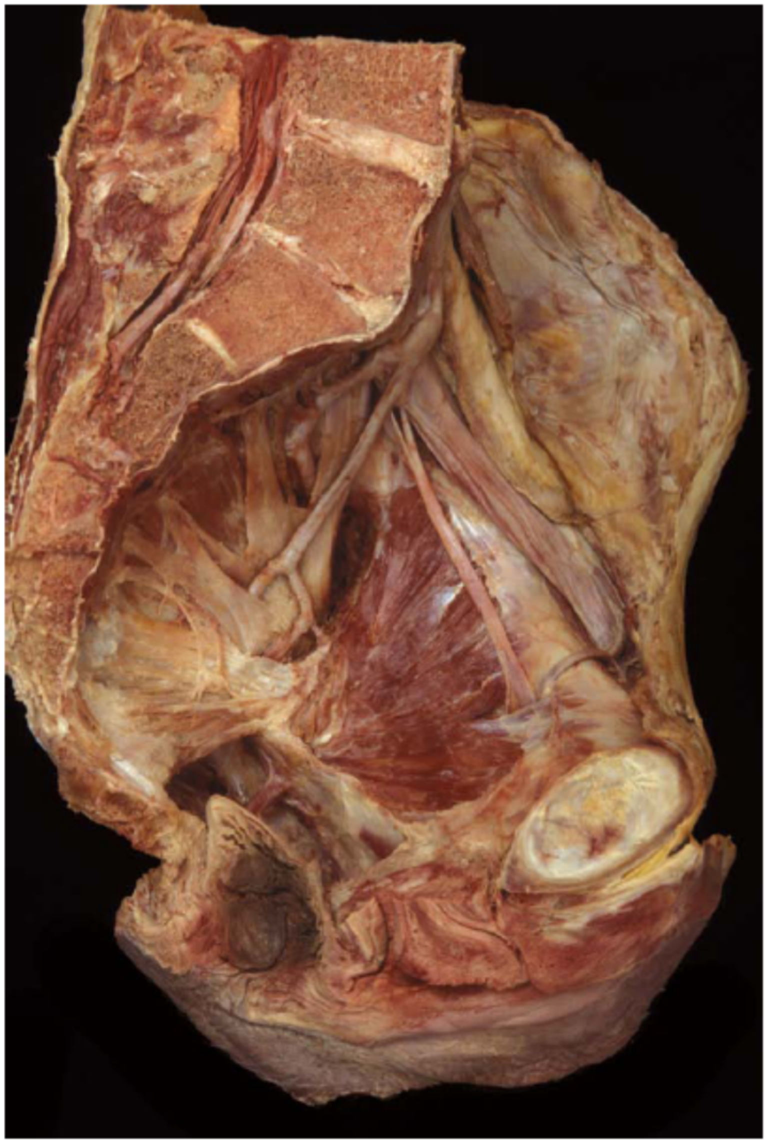


Figure 10: An illustration of the pelvic basin following removal of the levator ani and underlying fascia in the ischiorectal fossa. In the center of the picture one sees the obturator internus muscle. Note the large nerves of the lumbosacral plexus, between which can be seen the slips of the medial aspect of the piriformis muscle.

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from the lumbosacral plexus to expose the underlying piriformis muscle. Also clean the fascia from the sympathetic trunk. Careful cleaning of the trunk may expose small branches leaving the trunk to innervate the anterior longitudinal ligament (ALL in Figure 11).

Comment:

Use care when cleaning the plexus since the underlying muscle fibers may be very friable. Carefully note the relationship between the sympathetic trunk and the origin of the piriformis muscle. The Sympathetic trunk is known to supply sensory fibers to the anterior longitudinal ligament.

Dissection:

Remove all organs from the floor of the pelvic basin

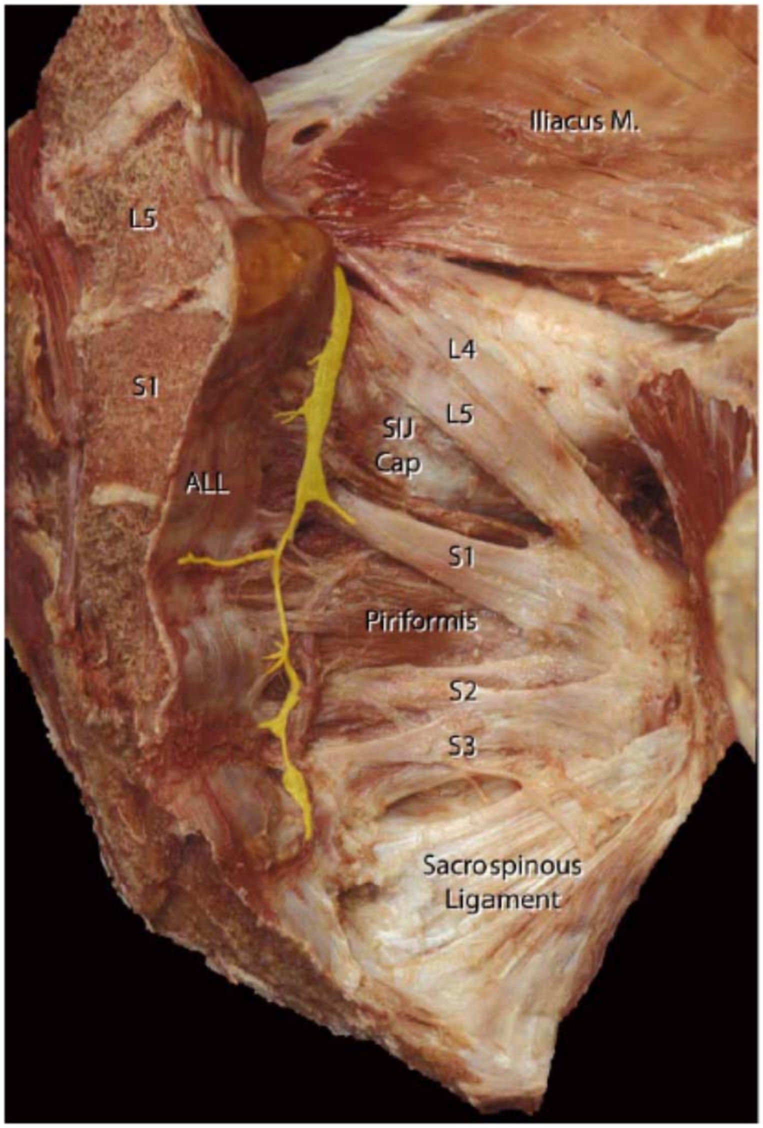

Figure 11: This is an illustration of the pelvic basin with the medial attachments of the piriformis muscle exposed. The sacral sympathetic trunk is illustrated in yellow. (Abb: ALL, anterior longitudinal ligament; SIJ cap, Sarcoiliac joint capsule)

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and clean the sacrospinous ligament as seen in Figure 10.

Dissection:
The final step is to remove the sacral plexus and visualize the piriformis muscle as it attaches to the lateral border of the internal side of the sacrum. Note that the plexus has not been removed in Figure 11.

Comment:
The piriformis muscle derives its attachment from the anterior longitudinal ligament.

Critical evaluation of a research article

1. What is the research question or hypothesis?

2. What is the sample population and does it represent the target population? (Is the study able to be generalized?)

3. What are the primary outcome variables? Are they clearly defined?

4. What are the major findings of the study?

5. Were the statistics employed appropriate for the types of variables analyzed and the research question?

6. Are the conclusions <u>valid</u>?

7. What are the strengths and limitations of this study?

8. How could this study affect your remaining education and future practice?

9. How could you improve on this study?

10. What is your overall impression of the article?

"Advanced Gross Anatomy Seminar: Application of Research, OMM, and Clinical Practice with an emphasis on Structure and Function"

Pre Seminar Assessment Questions

1. What is the origin and insertion of the piriformis muscle? Please be as specific as possible.

2. What is the innervation of the piriformis muscle? Circle all that apply.

L1	S1
L3	S2
L5	S3

3. What motion does contraction of the piriformis muscle cause at the hip joint? Circle all that apply.

Flexion	Extension
External Rotation	Internal Rotation
Abduction	Adduction

4. In approximately what percent of the population does the sciatic nerve or a branch of the sciatic nerve pass through the piriformis muscle?

5. What primary motion will be limited by a piriformis spasm?

6. How would you locate the piriformis muscle myofascial/counterstrain tenderpoint? Draw a diagram or give a brief description.

7. Given the diagnosis of psoas syndrome, where would you expect to find a secondary piriformis spasm?

8. How would you describe the position for counterstrain for the piriformis muscle? Circle all that apply.

prone	supine
flexion	extension
adduction	abduction
internal rotation	external rotation

"Advanced Gross Anatomy Seminar: Application of Research, OMM, and Clinical Practice with an emphasis on Structure and Function"

Survey of Opinions – Pre Seminar

Please circle the number in the right hand column that reflects your response to the questions.

Pre Seminar Questions	0 means "not at all" 4 means "completely or absolutely"
How confident are you that you can critically evaluate a research article or research information?	0 1 2 3 4
How confident are you that you could prepare and present a high quality grand rounds lecture on a topic with which you are familiar?	0 1 2 3 4
How confident are you that you could accurately diagnose piriformis spasm/syndrome?	0 1 2 3 4
How confident are you that you could independently and effectively treat piriformis spasm/syndrome?	0 1 2 3 4
How much do you agree that a thorough knowledge of anatomy is required to use osteopathic manipulative (manual) medicine techniques?	0 1 2 3 4
How much do you agree that manual medicine principles and practices are incorporated into the gross anatomy course taught at most osteopathic medical schools?	0 1 2 3 4
How much do you agree that there is a difference between gross anatomy taught in the first year of medical school and applied/functional anatomy for the clinical use of manual medicine techniques?	0 1 2 3 4
To what extent do you believe that anatomy should be taught differently at medical schools where students are required to learn manual medicine?	0 1 2 3 4
How much do you agree that anatomy could be taught with manual medicine principles integrated into the course material and approach to teaching?	0 1 2 3 4
To what extent do you believe that you already know enough anatomy to effectively learn and apply manual medicine techniques taught in the OMM courses?	0 1 2 3 4

APPENDIX B

HONORS COURSE MATERIALS

	Group A Traditional Format		Group B Novel Format	
Course session	Activity	Hours	Activity	Hours
I	Conduct pre-course questionnaires (knowledge and opinions) and distribute course materials	1	Conduct pre-course questionnaires (knowledge and opinions) and distribute course materials.	1
II	Instructor conducts clinical interview with standardized patient. Students develop preliminary differential diagnosis (DDx)	2	Instructor conducts clinical interview with standardized patient. Students develop preliminary DDx	2
III	Students will practice performing a complete shoulder physical exam of other students in Group A, and develop final DDx.	2	Students do not conduct any physical exam at this time, nor develop a final DDx. Students in Group B will develop a dissection strategy guided by the preliminary DDx with Frank Willard, Ph.D., neuroanatomist consultant to the project by tele-video conference, and Harold Sheedlo Ph.D. in the classroom.	2
IV	Students attend the regularly scheduled MSY2 Osteopathic Manipulative Medicine (OMM) lecture and hands-on laboratory.	3	Students perform dissection of the shoulder joint with Dr. Willard and Dr. Sheedlo in the gross anatomy lab.	3
V	Students use a group process facilitated by OMM faculty (TBN) and Student Dr. Colston, to develop a strategy for patient care including medical tests, assessments, and treatments that will utilize OMM skills (treatment plan).	2	Students attend the regularly scheduled MSY2 OMM lecture and hands-on laboratory.	3
VI	Four two-member student teams from Group A will present to the group a critical review of a selected research article.	2	Students complete the dissection of the shoulder joint.	3
VII	Students will attend a lecture by Dr. Sheedlo on the shoulder and be instructed in the dissection plan and methods.	2	Students will review with Dr. Willard in person or by televideo, the findings from the dissection strategy used by this group and discuss associated MRI images and overlays illustrating the area of focus, and refine the DDx.	3
VIII	Students perform dissection facilitated by Dr. Sheedlo.	3	Four two-member student teams in Group B will present to the group a critical review of a research article.	2
IX	Students complete the dissection.	3	Students will practice performing a complete shoulder physical exam of other students in Group B, and develop final DDx.	2
X	Students review the dissection results, and associated MRI images and overlays with Dr. Sheedlo.	3	Students develop a treatment plan.	2
XI	Post-course questionnaires (knowledge and opinions) and an Objective Structured Clinical Exam (OSCE).	2	Post-course questionnaires (knowledge and opinions) and OSCE.	2
	Total Hours	25	Total Hours	25

"Advanced Applied Anatomy: A novel curriculum integrating anatomy, clinical skills, and osteopathic manipulative medicine"

Syllabus   Spring 2010

Course Coordinator

John Colston, OMS IV, predoctoral fellow

Course Advisors and Instructors

des Anges Cruser, PhD, MPA
Kendi Hensel, DO, PhD
Harold Sheedlo, PhD
Frank Willard, PhD

Course Description

The Advanced Applied Anatomy course is part of the Texas College of Osteopathic Medicine second year's honors curriculum. This course is offered to the top 50% of the current second year class at the beginning of the spring semester. Only 16 students will participate and will be divided into two groups of eight for the entirety of the course. This course will incorporate clinical medicine skills, osteopathic manipulative medicine, and gross anatomy into a single curriculum. The students will participate in interactive classroom sessions, gross lab dissection, and hands on laboratories. This course will focus on the shoulder joint and common conditions associated with shoulder pain.

Course Goals

1. Students gain increased understanding of anatomy and its application to clinical and OMM skills.
2. Students gain increased confidence in examination, diagnosis, and treatment of shoulder pain.
3. Students develop a more thorough understanding of the usefulness of evidence based literature.
4. Students gain an appreciation for the usefulness of OMT in treatment of musculoskeletal complaints.
5. Students gain an appreciation for the necessity of a thorough knowledge of anatomy.
6. Students develop a higher level of thinking related to applying anatomic knowledge in the clinical setting.

Course Objectives

1. Perform a focused history and physical exam on the shoulder joint using the following methods:
    a. Clinical interview
    b. Obtain a thorough history of present illness using OLDCARTS as a guide (onset, location, duration, character, associated symptoms, alleviators, aggravators, radiation, timing, and severity)

c. Inspection and palpation of the shoulder including acromioclavicular joint, sternoclavicular joint, glenohumeral joint, scapulothoracic joint, and other significant landmarks
d. Testing range of motion in all relevant planes of motion
e. Testing strength of specific muscles and groups of muscles related to certain motions
f. Neuro-vascular exam of the upper extremity
g. Special tests such as arm drop, Apley scratch, Spurlings, Yergason's test, apprehension, Hawkins/Neer, Speed's test, cross arm, and painful arc

2. Develop a differential diagnosis related to shoulder pain
3. Critically evaluate the evidence base for assessing and treating shoulder pain
4. Demonstrate an understanding of the functional anatomy of the shoulder including muscles, bones, fascia, nerves (motor, sensory, and autonomic), blood supply, and lymphatics
5. Identify and differentiate among common shoulder diagnoses
6. Develop a coherent treatment plan for common shoulder diagnoses
7. Identify and treat somatic dysfunction of the shoulder joint with appropriate techniques

Grades/Assessment

The course will be graded only as pass/fail. Class participation and attendance will be the only components for determining the grade. Attendance will be required at every class session as this is an experiential rather than informational course. There will not be an opportunity to make up any missed classes; therefore, 100% attendance is expected. As part of the course, the students will be asked to complete a pre-course assessment, post-course assessment, and two month follow-up assessment. Students will also complete a pre and post-course survey. The knowledge assessment and survey will be completed electronically with all identifying information removed by the biostatistician before presentation to the principle investigator. At the completion of the course, the students will participate in an OSCE to be graded by a physician to assess the student's ability to translate their understanding of the information into the clinical setting. This information will not be used in determining the student's grade, but only for evaluation of the instructional strategies involved. The collection of information and the use of varied instructional strategies has been approved by the UNTHSC Institutional Review Board and granted EXEMPT status.

Course Components

Students in both groups will participate in the same activities but the order and execution of these activities may vary. These activities can be subdivided into four basic categories: gross anatomy, clinical medicine, osteopathic manipulative medicine, and literature review.

- Clinical medicine component will involve the students working their way through a typical clinical encounter with a patient presenting with shoulder pain. This will cover all aspects of typical encounter including interviewing, physical exam, developing an assessment and a treatment plan. This component will be more similar to a third or fourth year level experience than the students have been exposed to in the past.
- Gross anatomy component will involve the students performing gross dissection in the anatomy lab under expert direction. The students will be dissecting the

shoulder joint and then reviewing associated MRI images and original artistic overlays to enhance the learning experience.

- Osteopathic manipulative medicine component will involve primarily current second year curriculum as it is already a scheduled component of the spring semester. However, the students will have additional opportunities to apply their knowledge gained in these classes in a clinical setting.
- Literature review component will allow the students to apply their knowledge and understanding from the previous year's experience in evaluating the evidence base for treating common shoulder diagnoses.

Resources

Bates' *Guide to Physical Examination and History Taking*
Foundations of Osteopathic Medicine
Osteopathic Principles in Practice
Essential Clinical Anatomy
Netter *Atlas of Human Anatomy*
Principles of Manual Sports Medicine

A 52 year old woman presents to your family practice clinic with a chief complain of right shoulder pain.

CC: R shoulder pain

HPI: She reports that the pain started about a month ago, but has gradually progressed and is very painful now. The patient reports that she started playing tennis as a form of exercise about 3 months ago and wonders if that has anything to do with it. She states that the pain seems to be in the shoulder most of the time and difficult to localize. She describes the pain as sharp with some occasional achy pain. She has pain everyday but not all day long. She does note occasional night time awakenings with pain. She also describes some difficulty in reaching some of the upper shelves in the kitchen that were not a problem before. Since she started remodeling a room in her home with new paint and drapes, she has noticed that the pain occurs more often and is more severe. NSAIDS and heat have helped the pain some. Increased activity and reaching above her head make it worse. Sometimes the pain radiates up into her neck or down her arm. She also notes she has had some tingling in her fingers once or twice. The pain is worse at the end of the day. She states the severity is a 4/10 most of the time, but occasionally reaches an 8/10. She does not recall any sweating or palpitations, and she denies crepitus, dropping items, or an acute injury.

History: PMH:

- arthritis in her hands and knees – diagnosed three years ago
- breast cancer – diagnosed ten years ago
- diabetes – diagnosed 40 years ago
- HTN – diagnosed 5 years ago
- last PAP was one year ago and normal
- last mammogram was one year ago and normal

PSH:

- lumpectomy in right breast – 10 years ago
- C-section x 2 – 1980 and 1982
- tonsillectomy – 1965

FH:

- mother – died breast cancer at 54
- father – HTN, MI died at 59
- sister – breast cancer at 43
- brother – HTN
- brother – died at 12 months of age
- two children are healthy

SH:

- denies any alcohol or tobacco
- retired last year from teaching home economics to high school students
- married with two grown children
- plays tennis for exercise
- right handed

Medication:

- Aleve as directed on the bottle
- Lisinopril 10mg/day

- Centrum silver once daily
- Lantus and Lispro as directed by her endocrinologist

Allergy:

- seasonal only
- NKDA

Trauma:

- MVA – rear impact 10 years ago
- no other known trauma

ROS: HEENT – no abnormalities than occasional nasal drainage from allergies

Heart – with the exception of taking HTN medication she denies chest pain, palpitations, dyspnea, or history of heart disease

Lungs – denies SOB, or any other difficulties

GI – denies constipation, diarrhea, and any other difficulties

Neuro – some tingling in 1st and 2nd fingers, denies loss of balance, sensation, or any other difficulties

Musculoskeletal – Shoulder joint pain and stiffness, arthritis in hands and knees, and limitation of shoulder motion

Preliminary Differential Diagnosis

V: thoracic outlet syndrome, claudication

I: Septic arthritis, osteomyelitis

N: metastatic breast cancer, osteosarcoma, bone cyst, chondrosarcoma, median nerve impingment, Axillary nerve entrapment, brachial plexopathy, complex regional pain syndrome, thoracic outlet syndrome, cervical radiculopathy

D: tendonitis, synovitis, bursitis, arthritis (osteo/rheumatoid), adhesive capsulitis

I: iatrogenic

C: congenital

A: MI

T: rotator cuff tear, fracture, AC separation, glenohumeral subluxation/instability, labrum tear (SLAP)

E: DM

S: Somatic Dysfunction – shoulder, ribs, thoracic spine, and cervical spine; viscero-somatic pain from lumpectomy

Physical Exam:

- Observation/visual inspection – patient is examined from the anterior, posterior, and side with no visual anatomical differences. No swelling, redness, or warmth noted.
- Heart – RRR no gallops/rub/murmurs
- Lungs – CTAB
- Abdomen – BS x4, no bruit, non-tender to palpation
- Osteopathic Structural Exam
    - Cervical – non-contributory
    - Thoracic – T4-8 NSlRr, TART changes – tenderness, para-vertebral muscle spasm worse on the right, restriction as noted, some boggy tissue texture change appreciated
    - Lumbar – non-contributory
    - Upper extremity - palpation reveals tenderness at subacromial bursa and just below the tip of the acromion, and supraspinatus tender point; elbow, wrist, and clavicle were without significant somatic dysfunction.
- Neurovascular exam – reflexes were all normal, no deficits in sensorium, and the distal extremity appears pink with no evidence of vascular compromise
- Active ROM – Right arm - abduction is 140° and mildly painful; adduction, flexion, and extension are not reduced; internal rotation is 40° and mildly painful; external rotation is 40°; Left arm – no deficits noted
- Passive ROM – Right arm - abduction is 140-150° but not as painful. All other ROMs are the same as active. Left arm shows no deficit.
- Strength testing – all muscles were tested at 5/5 except supraspinatus was 3/5 on the right
- Spurling's test – negative bilaterally
- Apley scratch – right upper was significantly reduced compared to the left; lower were relatively equal
- Full can – positive
- Empty can – positive
- Neer – positive
- Hawkins – positive
- Painful arc – positive
- Apprehension – negative
- Yergason – negative
- Sulcus sign – negative
- Speeds – mildly positive
- Adson's test – negative
- Halstead – negative
- Wright – negative
- Cross arm – negative
- Lift off – negative
- Obrien's test – negative

Final Differential Diagnosis

1. rotator cuff tendonitis
2. supraspinatus tear
3. subacromial bursitis
4. biceps tendonitis
5. adhesive capsulitis

Assessment

1. Rotator cuff tendonitis
2. Somatic dysfunction of the upper extremity
3. Somatic dysfunction of the thoracic spine
4. Diabetes
5. HTN
6. Osteoarthritis

Plan

1. Perform OMT to the thoracic spine and upper extremity
2. Education on rest, ice, and home exercise program
3. NSAIDs for pain and anti-inflammatory
4. Recommend physical therapy
5. consider MRI, xray, bone scan of shoulder region
6. Consider referral to orthopedic surgeon if pain does not resolve with conservative treatment

<table>
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<tr><th colspan="11">Examining room</th></tr>
<tr><td></td><td colspan="2">Poor</td><td colspan="2">Fair</td><td colspan="2">Good</td><td colspan="2">Very Good</td><td colspan="2">Excellent</td></tr>
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<tr><td>Communication Skills</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr>
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<tr><td>Interview</td><td colspan="2"></td><td colspan="2">Not Performed</td><td colspan="2">Inadequate</td><td colspan="2">Adequate</td><td colspan="2">Superior</td></tr>
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<tr><td>History of Present Illness</td><td colspan="2">Onset</td><td colspan="2">0</td><td colspan="2">1</td><td colspan="2">2</td><td colspan="2">3</td></tr>
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<tr><td>History</td><td colspan="2">Past Medical</td><td colspan="2">0</td><td colspan="2">1</td><td colspan="2">2</td><td colspan="2">3</td></tr>
<tr><td></td><td colspan="2">Past Surgical</td><td colspan="2">0</td><td colspan="2">1</td><td colspan="2">2</td><td colspan="2">3</td></tr>
<tr><td></td><td colspan="2">Family</td><td colspan="2">0</td><td colspan="2">1</td><td colspan="2">2</td><td colspan="2">3</td></tr>
<tr><td></td><td colspan="2">Social</td><td colspan="2">0</td><td colspan="2">1</td><td colspan="2">2</td><td colspan="2">3</td></tr>
<tr><td></td><td colspan="2">Medication</td><td colspan="2">0</td><td colspan="2">1</td><td colspan="2">2</td><td colspan="2">3</td></tr>
<tr><td></td><td colspan="2">Allergy</td><td colspan="2">0</td><td colspan="2">1</td><td colspan="2">2</td><td colspan="2">3</td></tr>
<tr><td></td><td colspan="2">Trauma</td><td colspan="2">0</td><td colspan="2">1</td><td colspan="2">2</td><td colspan="2">3</td></tr>
<tr><td colspan="11"></td></tr>
<tr><td>Review of Systems</td><td colspan="2">HEENT</td><td colspan="2">0</td><td colspan="2">1</td><td colspan="2">2</td><td colspan="2">3</td></tr>
<tr><td></td><td colspan="2">Heart</td><td colspan="2">0</td><td colspan="2">1</td><td colspan="2">2</td><td colspan="2">3</td></tr>
<tr><td></td><td colspan="2">Lungs</td><td colspan="2">0</td><td colspan="2">1</td><td colspan="2">2</td><td colspan="2">3</td></tr>
<tr><td></td><td colspan="2">GI</td><td colspan="2">0</td><td colspan="2">1</td><td colspan="2">2</td><td colspan="2">3</td></tr>
<tr><td></td><td colspan="2">Neuro</td><td colspan="2">0</td><td colspan="2">1</td><td colspan="2">2</td><td colspan="2">3</td></tr>
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</table>

		Not Performed	Inadequate	Adequate	Superior
Physical Exam	Visual Inspection	0	1	2	3
	Heart	0	1	2	3
	Lungs	0	1	2	3
	Abdomen	0	1	2	3
	Osteopathic Structural Exam	0	1	2	3
	Neurovascular	0	1	2	3
	Active ROM	0	1	2	3
	Passive ROM	0	1	2	3
	Strength Testing	0	1	2	3
	Spurling	0	1	2	3
	Apley Scratch	0	1	2	3
	Arm Drop	0	1	2	3
	Neer/Hawkins	0	1	2	3
	Yergason	0	1	2	3
Osteopathic Manipulative Treatment	Patient Positioning	0	1	2	3
	Physician Posture	0	1	2	3
	Communication	0	1	2	3
	Appropriate Diagnosis	0	1	2	3
	Appropriate Technique	0	1	2	3
	Set Up	0	1	2	3
	Localization	0	1	2	3
	Activating Force	0	1	2	3
	Recheck	0	1	2	3

SOAP Note

	Poor		Fair		Good		Very Good		Excellent	
Subjective	1	2	3	4	5	6	7	8	9	10
Objective	1	2	3	4	5	6	7	8	9	10
Assessment	1	2	3	4	5	6	7	8	9	10
Plan	1	2	3	4	5	6	7	8	9	10

Employee Identification Number___________________

Applied Anatomy Course: Knowledge Assessment

An 18 year old male presents to your clinic Monday morning. He states that his right shoulder has been hurting since Friday night, he plays high school football. The shoulder is tender to palpation and has a prominent step-off at the acromion. What is the most likely ligament to be torn in this in injury?

Acromioclavicular *
Coracoacromial
Costoclavicular
Interclavicular
Sternoclavicular

<u>The following two questions are linked</u>

J. D. is a 39 year old patient who has been on crutches for three weeks due to a ankle injury. He reports that he has noticed some numbness and tingling in his left arm on the lateral side. Upon range of motion testing, the physician notes difficulty in abduction above 45 degrees on the left. What is the most likely nerve injured in this case?

Axillary *
Suprascapular
Radial
Subscapular
Ulnar

The involved nerve also supplies a muscle in the rotator cuff. Which of the following rotator cuff muscles has the same action/motion as the one weakened by this nerve injury?

Infraspinatus *
Subscapular
Supraspinatus
Teres minor
Teres major

Which of the following accurately describes the direction of lymph flow from the upper extremity?

Apical nodes -> Central nodes -> Thoracic duct
Lateral nodes -> Apical nodes -> Central nodes -> R/L thoracic duct
Lateral nodes -> Central nodes -> Apical nodes -> Subclavian nodes -> R/L thoracic duct *
Pectoral nodes -> Subclavian nodes-> Subscapular nodes -> Apical nodes -> Central nodes
There is no lymphatic drainage from the upper extremity.

<u>The following three questions are linked.</u>

A 65 year old woman presents to your family practice clinic for follow-up. She has not been back for about 6 months following a shoulder injury. She reports chronic pain and decreased ability to use her injured arm. She states that it has been getting progressively worse. On physical exam you note reduced ROM with moderate amount of pain. The exam is continued under conscious sedation and you note that the ROM is still the same as when she was awake. Which of the following describes a normal ROM for the shoulder joint?

Abduction of 130 degrees
Adduction of 50 – 65 degrees
Extension of 45 degrees *
Flexion of 180 degrees
Internal rotation of 90 degrees

The patient is diagnosed with adhesive capsulitis. Which of the following stages of adhesive capsulitis is she most likely in?

Stage 1
Stage 2 *
Stage 3
Stage 4
Stage 5

Noting the chronic nature of this injury, where would you also likely find somatic dysfunction?

OA
Ribs 3-5
T 1-5
T 2-8 *
T 5-9

The following two questions are linked

A 45 year old house painter comes to your OMM clinic for treatment of his painful right shoulder. He states that it has been getting worse in the past few months even though he has used ice and NSAIDS. He says that it is now very difficult to paint above his shoulders at all. What test would you perform if you suspected a rotator cuff tear or tendonitis?

Adson's test
Allen's test
Apley scratch test
Apprehension test
Arm drop test *

Which of the following would likely have led to this painter's rotator cuff tear/tendonitis?

Biceps tendon tear
Coracoacromial ligament tear
Degenerative changes to the subacromial bursa *
Injury to the long thoracic nerve
Spasm of the anterior and middle scalenes

Answer the following three questions by matching the correct spinal level with the appropriate neurological findings. Answer choices may be used once or not at all.

C5
C6
C7
C8
T1

Sensory – lateral forearm; motor – elbow flexion and wrist extension; reflex – brachioradialis *(C6)

Sensory – medial arm; motor – finger abduction and adduction; reflex – none *(T1)

Sensory – middle finger; motor – elbow extension and wrist flexion; reflex – triceps *(C7)

Answer the following four questions by matching the most likely answer choice (diagnosis) with each question (case presentation). Each answer choice may be used once, more than once, or not at all.

Adhesive capsulitis
Bicipital tendonitis
Rotator cuff tear
Rotator cuff tendonitis
Thoracic outlet syndrome

An 18 year old male pitcher presents with shoulder pain. He describes mild pain with overhead activities and no nighttime awakenings. Physical exam indicates no muscle atrophy or significant muscle weakness. Neer test is positive. *(Rotator cuff tendonitis)

A 75 year old female reports chronic right shoulder pain. She has had relief from NSAIDS in the past but now the pain is much more significant. She also reports nighttime awakening with pain. On physical exam, the neer test and arm drop (full can) test are positive. The physician also notes atrophy in supraspinatus fossa. *(Rotator cuff tear)

A patient presents with the chief complaint of shoulder pain. Pain is elicited upon palpation of the anterior proximal humerus. Speed's test is positive. *(Bicipital tendonitis)

A 50 year old male patient presents to your family practice clinic. He reports a long history of left shoulder problems but never went to the doctor because "he does not like doctors and shots." He notes a decreased ability to use his left arm. He also demonstrates reduced range of motion both actively and passively with the greatest restriction in internal rotation. *(Adhesive capsulitis)

Universal Syllabus

Description

This course will incorporate clinical medicine skills, osteopathic manipulative medicine, and gross anatomy into a single curriculum. The students will participate in interactive classroom sessions, gross lab dissection, and hands on laboratory sessions.

Goals

7. Students gain increased understanding of anatomy and its application to clinical and OMM skills.
8. Students gain increased confidence in examination, diagnosis, and treatment.
9. Students develop a more thorough understanding of the usefulness of evidence based literature.
10. Students gain an appreciation for the usefulness of OMT in treatment of musculoskeletal complaints.
11. Students gain an appreciation for the necessity of a thorough knowledge of anatomy.
12. Students develop higher order thinking related to applying anatomic knowledge in the clinical setting.

Objectives

8. Perform a focused history and physical exam on using the following methods:
    a. Clinical interview
    b. Obtain a thorough history of present illness using OLDCARTS as a guide (onset, location, duration, character, associated symptoms, alleviators, aggravators, radiation, timing, and severity)
    c. Inspection and palpation of significant landmarks
    d. Testing range of motion in all relevant planes of motion
    e. Testing strength of specific muscles and groups of muscles
    f. Neuro-vascular exam
9. Develop a preliminary differential diagnosis
10. Critically evaluate the research literature related to this differential diagnosis
11. Demonstrate an understanding of the functional anatomy including muscles, bones, fascia, nerves (motor, sensory, and autonomic), blood supply, and lymphatics
12. Develop a final differential diagnosis
13. Develop a coherent treatment plan for the most likely diagnosis
14. Identify and treat somatic dysfunction with appropriate techniques

Integrated Components

Each of the following components will be seamlessly integrated in the way they are presented, discussed and reviewed. They are described here as independent but actually are woven together throughout the course.

Clinical medicine component: students work through a typical clinical encounter with a patient. This will cover all aspects of typical encounter including interviewing, physical exam, developing an assessment and a treatment plan. This component will be more similar to a third or fourth year level experience than the students have been exposed to in the past.

Gross anatomy component: students complete gross dissection in the anatomy lab under expert direction. The gross dissection includes reviewing associated MRI images and original artistic overlays to enhance the learning experience.

Osteopathic manipulative medicine component: students will learn diagnosis and treatment techniques related to the area of focus.

Literature review component: develops skills in evaluating the evidence base for the area of focus.

Grades/Assessment

As part of the course, the students will be asked to complete a pre-course assessment, post-course assessment, and two month follow-up assessment. At the completion of the course, the students will participate in an OSCE to be graded by a physician to assess the student's ability to translate their understanding of the information into the clinical setting.

APPENDIX C

GRADUATE COURSE MATERIALS

UNIVERSITY of NORTH TEXAS
HEALTH SCIENCE CENTER at Fort Worth
★
Education, Research,
Patient Care and Service

DATE: 25 May 2010

TO: des Anges Cruser, PhD
Mental Sciences Institute
Kendi Hensel, DO, PhD
Department of Osteopathic Manipulative Medicine

Office for the Protection of Human Subjects
3500 Camp Bowie Boulevard
Fort Worth, Texas 76107-2699

FROM: Brian A. Gladue, PhD
Director, OPHS / Chair, UNTHSC IRB

PROTOCOL: # 2010-076

Advanced Applied Anatomy: A novel curriculum integrating anatomy, clinical skills, and osteopathic manipulative medicine

IRB BOARD ACTION AND NOTICE OF APPROVAL

The Office for the Protection of Human Subjects (OPHS) on behalf of the Institutional Review Board (IRB) of the University of North Texas Health Science Center (UNTHSC) has reviewed your protocol and has granted approval for **EXEMPT** status (as specified in Federal Regulations 45 CFR 46 101(b), categories 1 and 2;

(1) Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods,
(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement) and survey procedures.

Note that you are responsible for complying with all UNTHSC IRB and OPHS policies, decisions, conditions and requirements regarding projects involving human subjects. You are responsible for insuring that the research is implemented as specified in the approved protocol. Unless otherwise authorized by the UNTHSC-IRB, you are responsible for notifying subjects that their participation and information will be used for research purposes. In addition, you are required to use ONLY the IRB approved documents, materials and/or process designated for this protocol.

You must report to the Chair of the IRB any changes affecting the protocol upon which this certification is based. **No changes may be made without prior approval by the IRB** except those necessary to eliminate immediate hazards.

If you have any questions, please contact Dr. Brian Gladue, IRB Chair and OPHS Director, at phone (817) 735-5083 in the Office for the Protection of Human Subjects, or send email to bgladue@hsc.unt.edu.

Texas College of Osteopathic Medicine • Graduate School of Biomedical Sciences • School of Public Health • School of Health Professions
Institutes for Discovery • University of North Texas Physicians Group
817-735-0409 • Fax: 735-0375

Clinical Anatomy of the Upper and Lower Extremities

CBAN 5931.786

3 Credit Hours

Course Director: Harold J. Sheedlo, Ph.D.
Faculty: Rustin E. Reeves, Ph.D., Cara Fisher, M.S.

Department of Cell Biology and Anatomy
University of North Texas Health Science Center
Fort Worth, TX 76107

I. Course Description

This course will present a detailed description of selected upper and lower extremity emphasizing with an emphasis on clinical significance. This course will consist of some introductory lectures, clinical case presentations, and group discussions. Students will experience developing a differential diagnosis, reviewing pathophysiology, and then exploring the anatomy to gain a better understanding of the medical knowledge. Students will also be exposed to common treatment plans for selected clinical cases including instruction on PT and OMM treatment modalities. The lectures will be integrated with the dissection of each area. This approach gives the student an improved appreciation for why they need to know the anatomy of the upper and lower extremities. Students will be graded on their participation in the classroom discussion sessions as well as their participation in the gross lab. Students will be given a final written exam over the covered material.

II. Course Goals

1. Students gain increased understanding of anatomy and its clinical significance.
2. Students gain increased confidence in examination, diagnosis, and treatment of shoulder pain and selected lower extremity complaints.
3. Students develop a more thorough understanding of the usefulness of evidence based literature.
4. Students gain an appreciation for the usefulness of OMT and PT in treatment of musculoskeletal complaints.
5. Students develop a higher level of thinking related to applying anatomic knowledge in the clinical setting.

A. Upper Extremity

1. Bones
    - a. Scapula
    - b. Humerus
2. Muscles
    - a. Rotator cuff
    - b. Anterior and posterior muscles of arm
3. Arteries
    - a. Axillary artery and branches
    - b. Brachial artery and branches
4. Veins
    - a. Axillary vein and tributaries
    - b. Brachial vein and tributaries
5. Nerves
    - a. Brachial plexus
    - b. Nerves of arm

B. Lower Extremity

1. Bones
    - a. Hip bone
    - b. Femur
    - c. Tibia and fibula
    - d. Tarsal and metatarsal bones and phalanges
2. Muscles
    - a. Gluteal muscles
    - b. Hamstring muscles
    - c. Quadricep muscles
    - d. Muscles of anterior, posterior, and lateral leg
    - e. Muscles of foot

3. Arteries
    a. Femoral artery and branches
    b. Anterior and posterior tibial arteries
    c. Obturator artery
    d. Dorsalis pedis and plantar arteries
4. Veins
    a. Femoral veins and tributaries
    b. Greater and lesser saphenous
    c. Dorsal venous network
5. Nerves
    a. Femoral nerve and branches
    b. Sciatic nerve and branches
    c. Tibial and common fibular nerves and branches
    d. Plantar nerves

III. GRADING SYSTEM

This course will consist of a written examination for the upper and lower extremity which will consist of 50 multiple choice questions and will count for 50% of the student's grade. Students will also be graded on participation in classroom and lab sessions with 25% of the final grade for the classroom participation and 25% for the laboratory sessions. Participation is active involvement not just attendance.
Grades will be recorded as A for 89.5 - 100, B for 79.5 – 89.5, C for 69.5 – 79.5, and F for anything below 69.5.

GRADES OF I OR W

Grades of I (Incomplete) or W (Withdrawal) will be given in accordance with the policies of the University of North Texas Health Science Center at Fort Worth as stipulated in the current Catalog.

CHEATING

Instances of cheating will be dealt with according to the guidelines of the Student Handbook and the Student Honor Code.

SECURE TEST ITEM POLICY

Test questions and keys used written and laboratory examinations that contribute to a course grade will not be returned to students. The purpose of this policy is to facilitate the long-term development of a collection (bank) of questions whose increasing quality permit improved assessment of each student's knowledge and skills.

ACADEMIC ASSISTANCE

Academic assistance is available to all students in EAD-255 or by calling 735-2409. Students are urged to seek assistance at the earliest sign of difficulty.

ATTENDANCE POLICY AND MAKE-UP EXAMS

Policies of UNTHSC state that students are expected to attend all lectures and 100% attendance is required at all laboratories. The Department of Cell Biology and Anatomy expects 100% attendance at all lectures and dissection laboratories. It is recognized that there may be instances when an individual must be absent; however, the Student who misses a scheduled lecture or laboratory is in no way excused from the subject material presented during that scheduled activity. It is critical for all students to make every effort to attend each examination. In the event of absence from an examination, the student should contact the Gross Anatomy Laboratory Director prior to the examination. Written permission to take a make-up examination must be obtained from the Assistant Dean of the Graduate School of Biomedical Sciences. Because of the nature of the laboratory practical portion of examination, a make-up for this type of examination will be subject to the existence of appropriate anatomical material and may be given as an oral exam or as a computer-generated exam with digital images.

The provisions contained herein do not constitute a contract between the student and the College. These provisions may be changed at any time, for any reason, at the discretion of the Gross Anatomy Laboratory Director. When necessary, in the view of the College, appropriate notice of such changes will be given to the student.

Textbooks

Materials will also be provided by Dr. Willard and John Colston, OMS IV as necessary

Digital Dissector 3.5 (2009) H.J. Sheedlo, R.E. Reeves, R.S. Roque, J.E. Aschenbrenner, R.J. Wordinger, 3rd Edition, CAPI, Fort Worth, TX.

Essential Clinical Anatomy (2007) K.L. Moore and A.M.R. Agur, 3rd Edition, Lippincott Williams and Wilkins, Baltimore, MD.

Atlas of Human Anatomy (2006) F.H. Netter, 4th Edition, Saunders Elsevier, Philadelphia, PA.

DISSECTION LABORATORY

The principal learning experience for gross anatomy is the dissection laboratory. You will have the privilege of conducting a partial dissection of the human body, including the shoulder and hip and thigh. This experience will be invaluable to your progress and success as a medical student. Most of the cadavers were obtained as donations to our Willed Body Program. Proper laboratory behavior and respect for the cadaver material will allow everyone to have a positive learning experience.

Clinical Anatomy of the Upper and Lower Extremity
Description of classes

Tuesday June 1, 2010

1pm Room – RES 434
Presenters – Dr. Sheedlo and John Colston
Introduction to class
Pre class test and questionnaire

2pm Room - RES 434
Presenters – Dr. Sheedlo and John Colston
Anatomy overview – Dr. Sheedlo
Clinical surface anatomy – John Colston

3pm Room – Gross lab
Presenters – Dr. Sheedlo, Dr. Reeves, John Colston, etc
Inspect and palpate surface anatomy
Begin dissection of skin and superficial fascia

4pm Room – Gross lab
Complete removal of skin and superficial fascia

Wednesday June 2

1pm Room – RES 434
Presenter – John Colston
Case presentation and discussion of differential diagnosis

2pm Room – Gross lab
Presenters – Dr. Willard, Dr. Sheedlo, Dr. Reeves, John Colston, etc
Dissection of pectoralis and major
Manual muscle testing (MMT) of pec major

3pm Room – Gross lab
Presenters – Dr. Willard, Dr. Sheedlo, Dr. Reeves, John Colston, etc
Dissection/evaluation of the pec minor

4pm Room – Gross lab
Presenters – Dr. Willard, Dr. Sheedlo, Dr. Reeves, John Colston, etc
Dissection of trapezius
MMT of trapezius

Thursday June 3

1pm Room – RES 434
Presenter – John Colston
Refining DDX and look at pathophysiology
Brief discussion of evidence based medicine

2pm Room – Gross lab
Presenters – Dr. Willard, Dr. Sheedlo, Dr. Reeves, John Colston, etc
Dissection of Latissimus dorsi
Manual muscle testing of lat. dorsi

3pm Room – Gross lab
Presenters – Dr. Willard, Dr. Sheedlo, Dr. Reeves, John Colston, etc
Dissection/evaluation of the teres major

4pm Room – Gross lab
Presenters – Dr. Willard, Dr. Sheedlo, Dr. Reeves, John Colston, etc
Dissection/evaluation of Serratus anterior

Friday June 4

1pm Room – Gross lab
Presenters – Dr. Willard, Dr. Sheedlo, Dr. Reeves, John Colston, etc
Dissection/evaluation of the deltoid
MMT of the deltoid

2pm Room – Gross lab
Presenters – Dr. Willard, Dr. Sheedlo, Dr. Reeves, John Colston, etc
Dissection/evaluation of the rhomboid minor and major
MMT of rhomboids

3pm Room – Gross lab
Presenters – Dr. Willard, Dr. Sheedlo, Dr. Reeves, John Colston, etc
Dissection/evaluation of the levator scapula
MMT of levator scapula

Monday June 7

1pm Room – Gross lab
Presenters – Dr. Willard, Dr. Sheedlo, Dr. Reeves, John Colston, etc
Dissection of the brachial plexus
Discussion of clinical application of brachial plexus

2pm Room – Gross lab
Presenters – Dr. Willard, Dr. Sheedlo, Dr. Reeves, John Colston, etc
Dissection of the axilla and thoracic outlet
Discussion/evaluation of thoracic outlet syndrome

3pm Room – Gross lab
Presenters – Dr. Willard, Dr. Sheedlo, Dr. Reeves, John Colston, etc
Dissection/evaluation of the clavicle
Removal of arm from torso

Tuesday June 8

1pm Room – Gross lab
Presenters – Dr. Willard, Dr. Sheedlo, Dr. Reeves, John Colston, etc
Dissection of the rotator cuff muscles
Discussion/demonstration of MMT and special tests for rotator cuff

2pm Room – Gross lab
Presenters – Dr. Willard, Dr. Sheedlo, Dr. Reeves, John Colston, etc
Dissection of the glenohumeral joint
Discussion/demonstration of testing for glenohumeral joint

3pm Room – Gross lab
Presenters – Dr. Willard, Dr. Sheedlo, Dr. Reeves, John Colston, etc
Final review of dissection in gross lab

Wednesday June 9

1pm Room – RES 218
Presenters – Dr. Willard, Dr. Sheedlo, John Colston
Review of dissection and any additional imaging not previously discussed
Discussion of final assessment and treatment plan

2pm Room – RES 218
Presenter – Kendi Hensel, DO, PhD
Discussion of osteopathic manipulative treatment for shoulder pain

3pm Discussion of physical therapy approach to shoulder pain

Thursday June 10

1pm Room – RES 434
Midterm exam

Clinical exam of the shoulder joint and relevant treatments

CBAN 5931.786

Clinical surface anatomy

- Review important structures to note when performing a physical exam through observation and palpation

Observation

- Anteriorly
- Look for asymmetry:
  - shoulder heights
  - AC joints
  - muscle tone
  - alignment of midline structures

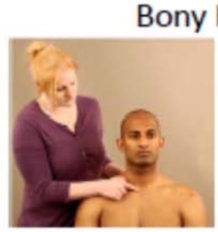
Observation

- Posteriorly
  - note atrophy or hypertrophy of shoulder girdle muscles
  - difference in shoulder heights

Observation

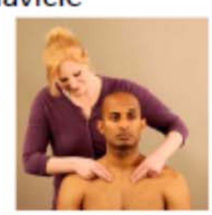
- Lateral view
  - Lordotic curve – cervical spine
  - Kyphotic curve – thoracic spine
  - Position of head in relation to shoulders (ear in line with acromion?)
  - Muscle symmetry

Bony Palpation – Clavicle



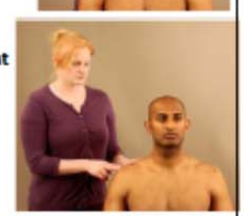
Sternal notch

SC joints

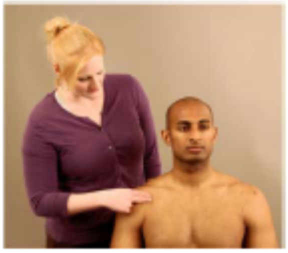


Medial clavicle

AC joint



Bony Palpation



Coracoid process

Greater tubercle

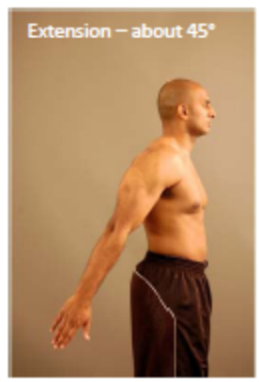
Bony Palpation

Inferior angle of the scapula

Spine of the scapula

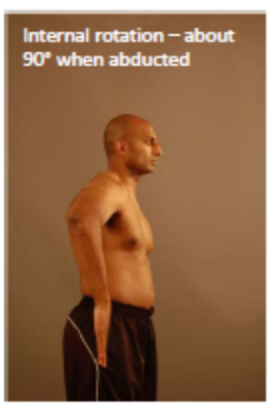
Range of Motion

Range of Motion

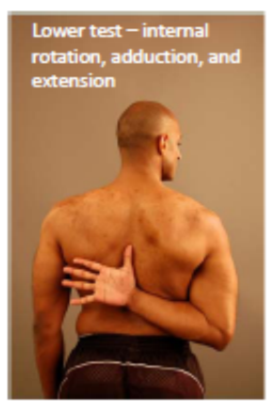


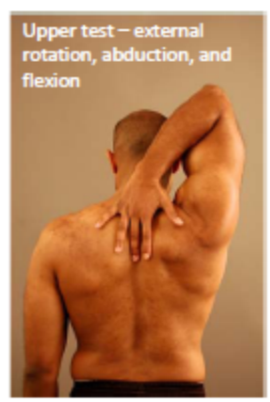
Flexion – about 90° with shoulder stabilized

Range of Motion



Range of Motion – Apley Scratch Test

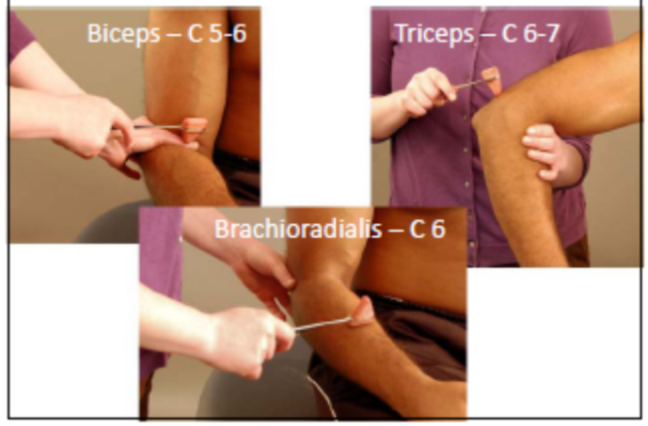




Neurovascular Exam

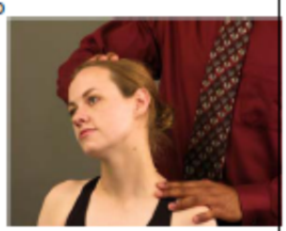
- Dermatomes
- Reflexes
- Skin color
- Capillary refill
- Pulses

Deep Tendon Reflexes (DTRs)



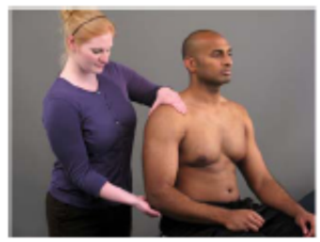
Spurling's Test

- The examiner extends the patient's neck and rotates it to one side with corresponding axial compression on the pt's head.
- Positive sign: pain elicited down the ipsilateral arm from the neck (reproducing pt's symptoms)
- Indicates: cervical disc disease (Note: nonradicular pain on ipsilateral side of neck could suggest facet pathology, on contralateral, strained muscles/traction nerve inj.)



Pectoralis major

- Primarily used in adduction
- Muscle most frequently absent congenitally

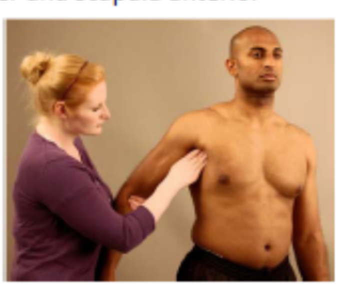


- Support shoulder and place finger pads anteriorly to palpate Pec major as it is tested
- Have patient adduct arm against resistance

Palpation of pec major

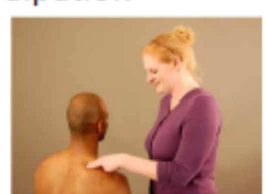
Pectoralis minor

- Assists in forced inhalation
- Also pulls shoulder and scapula anterior and inferior
- Palpate under pec major

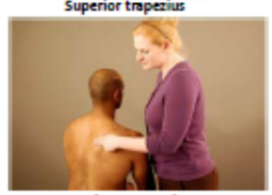


Trapezius - palpation

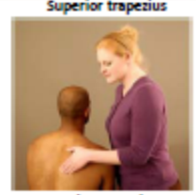
Superior trapezius



Superior trapezius



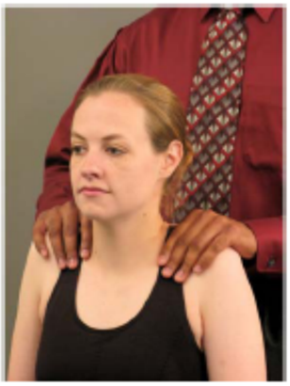
Middle trapezius



Inferior trapezius

Trapezius

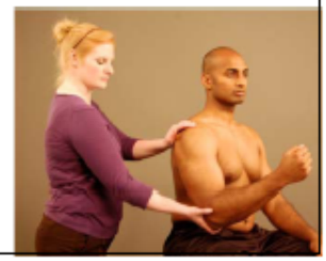
- Elevates shoulder (shrug)
- CN XI - part of your neuro exam



Latissimus dorsi

Palpated in the posterior axillary fold with the teres major muscle

- Aids in adduction, extension, and medial rotation
- Place the arm in slight flexion and abduction then extend the arm



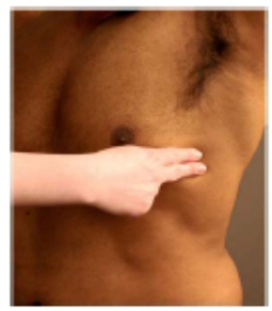
Teres major

- Palpated in the posterior axillary fold with the latissimus dorsi
- Aids in internal rotation and extension but not specifically tested in the clinical setting typically

Serratus anterior

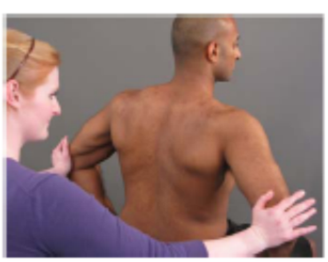
- Scapular protraction (anterior rotation of the scapula)
- Weakness results in winged scapula which can be evident with wall push up

- Palpated by starting in medial axilla down lateral chest wall
- The muscle may feel serrated as you move down the ribs



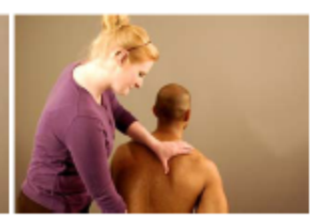
Serratus anterior

- Patient places hands on hips and then tries to push elbows posteriorly against resistance
- Evaluates serratus anterior muscle strength and can exhibit scapular winging with profound weakness



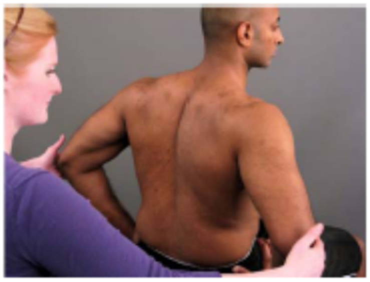
Rhomboid major and minor

- Causes scapular retraction "position of attention"
- Palpated by placing patients arm behind their back with the elbow bent and palm facing out, then the patient pushes hand posteriorly while monitoring between spinous processes and the medial border of the scapula



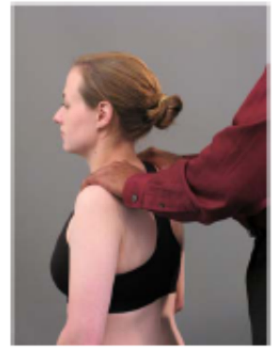
Rhomboid major and minor

- Muscle strength is tested by placing hands on hips and then patient pushes elbows anteriorly against physicians resistance



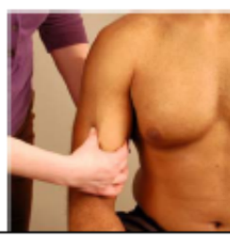
Levator scapula

- Palpated from the superior medial angle of the scapula up to the cervical spine
- Tested the same as for trapezius with resisted shoulder shrug
- This muscle is difficult to distinguish with muscle testing but is commonly tender to palpation and treated with manual techniques



Biceps brachii

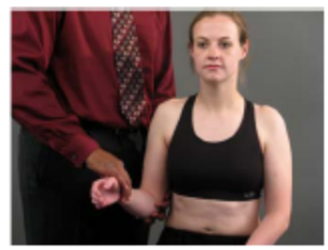
- Primarily functions to supinate the forearm and assist in flexion of the forearm (more prominent in supination)
- Palpate the tendon of the long head in the bicipital groove
- Palpate the belly of the muscle in the middle of the arm
- Muscle testing will be covered in the elbow section



Special tests for biceps

Yergason's test

- Patient is seated with physician holding the elbow with one hand and the other hand on the medial wrist
- Physician externally rotates against resistance and pushes downward on the elbow
- Positive test = tendon subluxation out of the bicipital groove



Special tests for biceps

Speed's test

- Patient seated with arm fully extended and at 90 degrees of forward flexion and supination
- Patient attempts to elevate arm further against physicians resistance
- Positive test = pain in the bicipital groove

Acromioclavicular joint

Cross arm test

- Patient is seated and arm is passively crossed to opposite shoulder by the examiner
- Positive test = pain at the end range of adduction

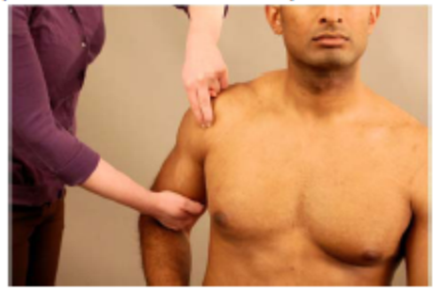
Acromioclavicular joint

Active compression test

- Patient is seated and forward flexes arm to 90 degrees and adducts 15 degrees with internal rotation
- Patient then resists downward pressure by the examiner
- The maneuver is repeated with the arm in full supination
- Positive test = pain in the AC joint that improves on the second maneuver

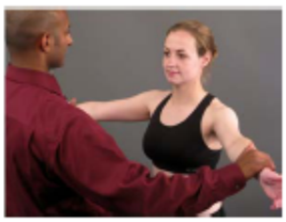
Subacromial bursa

- Palpation of the subacromial bursa may be accomplished by passively extending the arm
- Palpate anterior and laterally to the acromion

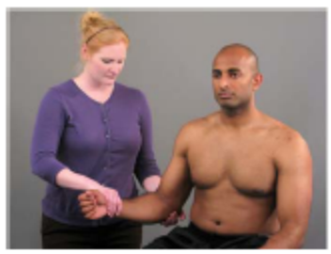


Supraspinatus

- Abducts the arm, mostly in the first 15 degrees
- The arms are abducted to 90 degrees and forward flexed about 30-45 degrees with palms facing forward
- Patient resists inferior pressure by the examiner

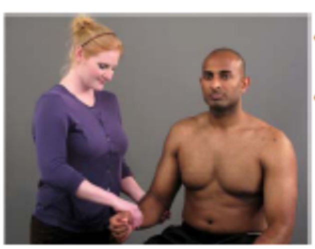


Teres minor & Infraspinatus



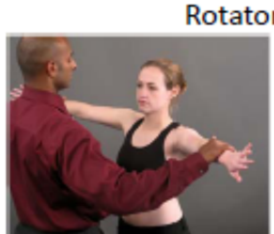
- External rotation of the shoulder
- Patient rests arms at the side with elbows flexed to 90 degrees then externally rotates against resistance

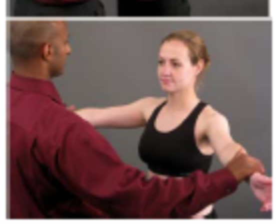
Subscapularis



- Internal rotation at the shoulder joint
- Patient rests arms at the side with elbows flexed to 90 degrees then internally rotates against resistance

Rotator Cuff Testing





- **Empty Can Test-** Pt. resists downward pressure by examiner with arms at 90 degrees abduction and forward approximately 30 degrees
- **Full Can Test-** Similar to above with patients thumbs turned down (full pronation)
- Pos. test: Weakness, pain, or dropping of the arm, indicating supraspinatus tendinitis or tear (the degree of weakness suggests the severity of the tear)

Hawkin's test

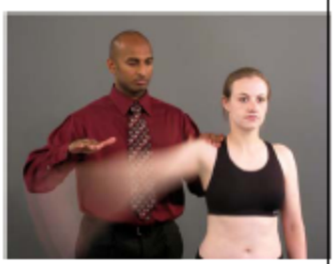
- Examiner passively rotates humerus into IR while forward flexing to 90 degrees in sagittal plane
- Positive test: Pain produced
- Indicates: Possibly rotator cuff pathology or other impingement injury

Neer impingement test

- Examiner stabilizes patient's scapula with one hand, and then passively forward flexes the arm above shoulder level to a fully flexed position.
- Positive test = Pain provoked
- Indicates rotator cuff or other impingement injury

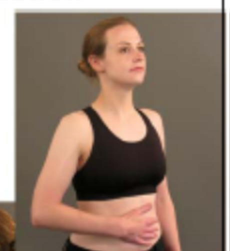
Drop arm test

- Patient brings arm to a fully abducted position then tries to lower slowly
- The arm can be gently tapped while at 90 degrees of abduction
- Positive test - the arm drops suddenly or patient has difficulty holding arm at 90 degrees after the tap (suggests complete rotator cuff tear)

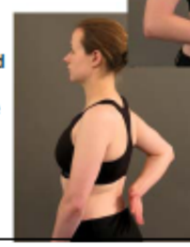


Subscapularis Evaluation

- **Napoleon Sign**-If unable to fully IR, place hand on abdomen & have patient push posteriorly. If elbow drops backward then subscapularis weakness or injury may be present

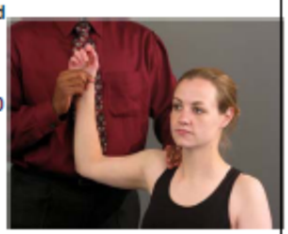


- **Liftoff Test**-Put hand behind back & attempt to lift the hand off the back. If unable to do so then subscapularis weakness or injury may be present

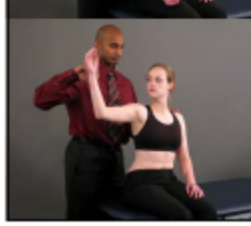


Glenohumeral Instability

- **Apprehension Sign** – patient is seated or in supine position, with the arm vertical, abducted to 90 degrees & elbow flexed to 90 degrees. The forearm is then forced into ER past 90 degrees.
- Positive Test: Pt becomes very apprehensive fearing a repeat dislocation. Indicates: GH instability, previous GH dislocation/subluxation.
- Note: this test could be performed with the doctor stabilizing the scapula and clavicle to isolate motion to the glenohumeral joint



Adson's Test

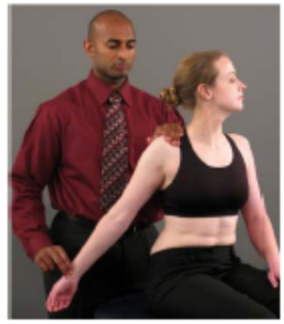


- The examiner palpates the radial pulse on the affected arm with the arm at pt's. side.
- As pulse is monitored, examiner moves pt's. arm into abduction and external rotation.
- Pt. takes a deep breath & turns head toward the raised arm.
- Positive test: marked diminution or loss of pulse.
- Indicates: Subclavian artery compression by cervical rib and/or scalene muscles (vascular, not neurologic etiology).

Wright's Test (Hyperabduction Test)

- Patient is seated and radial pulses are palpated then arms are hyper-abducted to 180 degrees
- Patient can also hold a deep breath or turn head away to increase the sensitivity
- Positive test – Reproduction of symptoms or loss of pulse
- Indicates pec minor compression of the subclavian artery

Halstead or Military Brace Test



- Assessment
  - Compression of neurovascular bundle between the clavicle and the first rib
- Military Brace
  - Patient is seated
  - Extension and external rotation of arm
  - Inferior traction
- Halstead Maneuver
  - Add head rot. Away from testing arm
- Positive Test
  - Loss of radial pulse or reproduction of SX

Sources

- *Physical Examination of the Spine and Extremities*, Hoppenfeld
- *Principles of Manual Sports Medicine*, Karageanes
- *Orthopedic Sports Medicine*, DeLee and Drez
- *Foundations of Osteopathic Medicine*, Ward
- *Guide to Physical Examination and History Taking*, Bates

A 72 year old man presents to your family practice clinic with a chief complain of right shoulder pain.

CC: R shoulder pain

HPI: He reports that the pain started about a month ago, but has gradually progressed and is very painful now. The patient reports that the pain started when he was pulling on the cord to start the lawnmower. He felt a crawling sensation in his shoulder and has had difficulty lifting his arm above his head since that time. He did not seek medical care sooner because he thought it was a pulled muscle and would get better on its own. He states that the pain is a constant ache that seems to be in the anterolateral shoulder most of the time and with occasional radiation down the anterior and lateral arm. He does note occasional night time awakenings with pain. He also describes some difficulty in reaching some of the upper shelves in the kitchen that were not a problem before. NSAIDS and heat have helped the pain some. Increased activity and reaching above his head make it worse. He also notes she has had some tingling in his fingers once or twice. The pain is worse at the end of the day. He states the severity is a 4/10 most of the time, but occasionally reaches an 8/10. He does not recall any sweating or palpitations, and he denies crepitus or dropping items.

History:

PMH:
- arthritis in his hands and knees – diagnosed three years ago
- diabetes – diagnosed 30 years ago
- HTN – diagnosed 35 years ago

PSH:
- tonsillectomy – 1946

FH:
- mother – died breast cancer at 54
- father – HTN, MI died at 59
- sister – breast cancer at 43
- brother – HTN
- two children are healthy

SH:
- denies any alcohol or tobacco
- retired from postal service
- married with two grown children
- minimal exercise
- right handed

Medication:
- Aleve as directed on the bottle
- Lisinopril 10mg/day
- Centrum silver once daily
- Lantus and Lispro as directed by his endocrinologist

Allergy:
- seasonal only
- NKDA

Trauma:
- MVA – rear impact 20 years ago
- no other known trauma

ROS: HEENT – no abnormalities than occasional nasal drainage from allergies

Heart – with the exception of taking HTN medication he denies chest pain, palpitations, dyspnea, or history of heart disease

Lungs – denies SOB, or any other difficulties

GI – denies constipation, diarrhea, and any other difficulties

Neuro – some tingling in 1st and 2nd fingers, denies loss of balance, sensation, or any other difficulties

Musculoskeletal – Shoulder joint pain and stiffness, arthritis in hands and knees, and limitation of shoulder motion

Preliminary Differential Diagnosis

V: thoracic outlet syndrome, claudication

I: Septic arthritis, osteomyelitis

N: osteosarcoma, bone cyst, chondrosarcoma, median nerve impingment, axillary nerve entrapment, brachial plexopathy, complex regional pain syndrome, thoracic outlet syndrome, cervical radiculopathy

D: tendonitis, synovitis, bursitis, arthritis (osteo/rheumatoid), adhesive capsulitis

I: iatrogenic

C: congenital

A: MI

T: rotator cuff tear, fracture, AC separation, glenohumeral subluxation/instability, labrum tear (SLAP)

E: DM

S: Somatic Dysfunction – shoulder, ribs, thoracic spine, and cervical spine

Physical Exam:

- Observation/visual inspection – patient is examined from the anterior, posterior, and side with no visual anatomical differences. No swelling, redness, or warmth noted.
- Heart – RRR no gallops/rub/murmurs
- Lungs – CTAB
- Abdomen – BS x4, no bruit, non-tender to palpation
- Osteopathic Structural Exam
  - Cervical – non-contributory
  - Thoracic – T4-8 NSlRr, TART changes – tenderness, para-vertebral muscle spasm worse on the right, restriction as noted, some boggy tissue texture change appreciated
  - Lumbar – non-contributory
  - Upper extremity - palpation reveals tenderness at subacromial bursa and just below the tip of the acromion, and supraspinatus tender point; elbow, wrist, and clavicle were without significant somatic dysfunction.
- Neurovascular exam – reflexes were all normal, no deficits in sensorium, and the distal extremity appears pink with no evidence of vascular compromise
- Active ROM – Right arm - abduction is 90° and mildly painful; adduction, flexion, and extension are not reduced; internal rotation is 40° and mildly painful; external rotation is 40°; Left arm – no deficits noted
- Passive ROM – Right arm - abduction is 140-150° but not as painful. All other ROMs are the same as active. Left arm shows no deficit.
- Strength testing – all muscles were tested at 5/5 except supraspinatus was 3/5 on the right
- Spurling's test – negative bilaterally
- Apley scratch – right upper was significantly reduced compared to the left; lower were relatively equal
- Full can – positive
- Empty can – positive
- Drop arm – positive
- Neer – positive
- Hawkins – positive
- Painful arc – positive
- Apprehension – negative
- Yergason – negative
- Sulcus sign – negative
- Speeds – mildly positive
- Adson's test – negative
- Halstead – negative
- Wright – negative
- Cross arm – negative
- Lift off – negative
- Obrien's test – negative

Final Differential Diagnosis

1. supraspinatus tear
2. rotator cuff tendonitis
3. subacromial bursitis
4. biceps tendonitis
5. adhesive capsulitis

Assessment

1. Rotator cuff tear
2. Somatic dysfunction of the upper extremity
3. Somatic dysfunction of the thoracic spine
4. Diabetes
5. HTN
6. Osteoarthritis

Plan

1. Perform OMT to the thoracic spine and upper extremity
2. Education on rest, ice, and home exercise program
3. NSAIDs for pain and anti-inflammatory
4. Recommend physical therapy
5. consider MRI, xray, bone scan of shoulder region
6. Consider referral to orthopedic surgeon if pain does not resolve with conservative treatment

Clinical Anatomy of the Upper and Lower Extremity

Knowledge Assessment

1. An 18 year old male presents to your clinic Monday morning. He states that his right shoulder has been hurting since Friday night. He plays high school football. The shoulder is tender to palpation and has a prominent step-off at the acromion. What is the most likely ligament to be torn in this injury?

   a) Acromioclavicular
   b) Coracoacromial
   c) Costoclavicular
   d) Interclavicular
   e) Sternoclavicular

2. J. D. is a 39 year old patient who has been on crutches for three weeks due to an ankle injury. He reports that he has noticed some numbness and tingling in his left arm on the lateral side. Upon range of motion testing, the physician notes difficulty in abduction above 45 degrees on the left. What is the most likely nerve injured in this case?

   a) Axillary
   b) Suprascapular
   c) Radial
   d) Subscapular
   e) Ulnar

3. A 65 year old woman presents to your family practice clinic for follow-up. She has not been back for about 6 months following a shoulder injury. She reports chronic pain and decreased ability to use her injured arm. She states that it has been getting progressively worse. On physical exam you note reduced ROM with moderate amount of pain. The exam is continued under conscious sedation and you note that the ROM is still the same as when she was awake. Which of the following describes a normal ROM for the shoulder joint?

   a) Abduction of 130 degrees
   b) Adduction of 60 – 75 degrees
   c) Extension of 45 degrees
   d) Flexion of 180 degrees
   e) Internal rotation of 20 degrees

4. A 45 year old house painter comes to your OMM clinic for treatment of his painful right shoulder. He states that it has been getting worse in the past few months even though he has used ice and NSAIDS. He says that it is now very difficult to paint above his shoulders at all. What test would you perform if you suspected a rotator cuff tear or tendonitis?

   a) Adson's test
   b) Allen's test
   c) Apley scratch test
   d) Apprehension test
   e) Full/empty can test

5. Sensory – lateral forearm; motor – elbow flexion and wrist extension; reflex – brachioradialis

   a) C4
   b) C6
   c) C7
   d) C8
   e) T1

6. A 75 year old female reports chronic right shoulder pain. She has had relief from NSAIDS in the past but now the pain is much more significant. She also reports nighttime awakening with pain. On physical exam, the neer test and arm drop (full can) test are positive. The physician also notes atrophy in supraspinous fossa. What is the most likely diagnosis?

   a) Adhesive capsulitis
   b) Bicipital tendonitis
   c) Rotator cuff tear
   d) Rotator cuff tendonitis
   e) Thoracic outlet syndrome

7. A patient presents with the chief complaint of shoulder pain. Pain is elicited upon palpation of the anterior proximal humerus. Speed's test is positive. What is the most likely diagnosis?

   a) Adhesive capsulitis
   b) Bicipital tendonitis
   c) Rotator cuff tear
   d) Rotator cuff tendonitis
   e) Thoracic outlet syndrome

8. Which of the following correctly identifies the origin and insertion of the piriformis muscle?

   a) Origin – anterior inferior sacrum Insertion – greater trochanter
   b) Origin – anterior inferior sacrum Insertion – greater tuberosity
   c) Origin – posterior lateral sacrum Insertion – greater trochanter
   d) Origin – posterior lateral sacrum Insertion – lesser trochanter
   e) Origin – L2-L4 Insertion – ischial tuberosity

9. Patient presents with sciatic type symptoms on the right side. Knowing that piriformis syndrome can cause sciatic type symptoms, what motion of the right leg/hip would you expect to be restricted?

   a) External rotation
   b) Internal rotation
   c) Extension
   d) Flexion
   e) Abduction

10. Which of the following is part of the nerve supply to the piriformis muscle?

   a) L1
   b) L2
   c) L4
   d) L5
   e) S2

Clinical Anatomy of the Upper and Lower Extremity

Survey of Opinions – Pre Course

Please circle the number in the right hand column that reflects your response to the questions.

Pre Course Questions	0 means "not at all" 4 means "completely or absolutely"				
How confident are you that you could develop a differential diagnosis for shoulder pain?	0	1	2	3	4
How confident are you that you could perform a thorough physical exam of the shoulder?	0	1	2	3	4
How confident are you that you could perform a thorough physical exam of the lower extremity?	0	1	2	3	4
How much do you agree that gross anatomy should be taught differently at osteopathic medical schools compared to allopathic schools?	0	1	2	3	4
How much do you agree that incorporating clinical skills into the anatomy curriculum would increase your understanding of both anatomy and clinical medicine?	0	1	2	3	4
How well do you understand the role of osteopathic manipulative medicine in the treatment of shoulder pain?	0	1	2	3	4
How much do you agree that a thorough knowledge of anatomy is required to effectively apply physical exam skills?	0	1	2	3	4

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MAY 25 2010

University of North Texas
Health Science Center

Clinical Anatomy of the Upper and Lower Extremity

Survey of Opinions – Post Course

Please circle the number in the right hand column that reflects your response to the questions.

Post Course Questions	0 means "not at all" 4 means "completely or absolutely"				
How confident are you that you could develop a differential diagnosis for shoulder pain?	0	1	2	3	4
How confident are you that you could perform a thorough physical exam of the shoulder?	0	1	2	3	4
How confident are you that you could perform a thorough physical exam of the lower extremity?	0	1	2	3	4
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How much do you agree that incorporating clinical skills into the anatomy curriculum would increase your understanding of both anatomy and clinical medicine?	0	1	2	3	4
How well do you understand the role of osteopathic manipulative medicine in the treatment of shoulder pain?	0	1	2	3	4
How much do you agree that a thorough knowledge of anatomy is required to effectively apply physical exam skills?	0	1	2	3	4
This course has changed my opinion of the usefulness of anatomical knowledge?	0	1	2	3	4
The structure of this course was important in understanding the usefulness of anatomic knowledge?	0	1	2	3	4

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