

Bridging the Transfer Gap: Laboratory Combines Clinical Exposure and Anatomy Review

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- One goal of medical education is to bridge the gap between basic science and clinical practice.
- Students acquire basic science knowledge during preclinical years, yet the opportunity to apply this knowledge in the clinical setting is limited.
- Medical students may fail to recognize the relevance of basic science for their future practice.
- Often, the retention of basic science information by the time of clerkships and residency is poor (*Lazic E. et al. Croat Med J. 2006 and D'Eon MF. BMC Medical Education. 2006*).
- Early introduction of clinical problems provides a framework for basic science, and can ultimately facilitate integration between the basic science and clinical disciplines (*Patel VL. et al. Clinical reasoning in the health professions. 2002*).
- Transfer of knowledge from one realm to another may increase when subjects are given an indication that a concept is important for future problem solving (*Catrambone R, et al. Journal of Experimental Psychology-Learning Memory and Cognition. 1989*).

- In the present work, we evaluated a 3-hr clinical procedures laboratory presented to 2nd year medical students in which resident and attending physicians guided students through 5 procedures on cadavers with particular attention to the relevant anatomy of each procedure.
- The purpose of the present work was threefold:
 - First, we evaluated the use of a clinical procedures laboratory as a meaningful way to review anatomy.
 - Secondly, it was our intent to demonstrate that knowledge of procedural practices is gained more readily through demonstrations and hands-on practice than through attempts to learn from a written syllabus.
 - Lastly, we wanted to show that a procedural laboratory furthers a student's awareness of the important relationships between anatomy and clinical practice.

Methods

- In the Fall of 2007, the idea of conducting a procedural laboratory was presented to the course directors of medical gross anatomy at Rush by Dr. Christopher Ross, an attending ER physician at John H. Stroger Jr. Hospital of Cook County.
 - Dr. Ross already was conducting this laboratory yearly with his residents as a means for them to practice these clinical skills on cadavers at the beginning of their residency training.
- In April of 2008, a pilot study was performed at Rush University with 29 first-year students to investigate the utility and feasibility of conducting a procedural laboratory for undergraduate medical students.
- Survey and focus group data collected from this pilot project identified 2nd year students as a more appropriate group for this laboratory experience.

- In September of 2008, the clinical procedures laboratory was offered to the entire second-year medical class (n=117) during the first and second weeks of the fall quarter.
- In total, 76 second-year medical students volunteered to participate in the clinical laboratory experience. All participants had completed their required medical anatomy courses six months prior to the start of this study.
- Students were organized into one of **two groups: control or experimental**.
 - **Control group participants** (CG, n=17) volunteered to take part in a traditional review of anatomy and were offered a chance to participate in the procedural laboratory subsequent to the completion of all required posttest examinations.
 - **The experimental group** (EG) was made up of 48 students who participated in one of four clinical laboratory sessions.
- **Students who were involved in the pilot study** (PG =11) were allowed to participate in the clinical exercise for a second time during the course of the full-scale study. Data from these students was collected and treated separately.

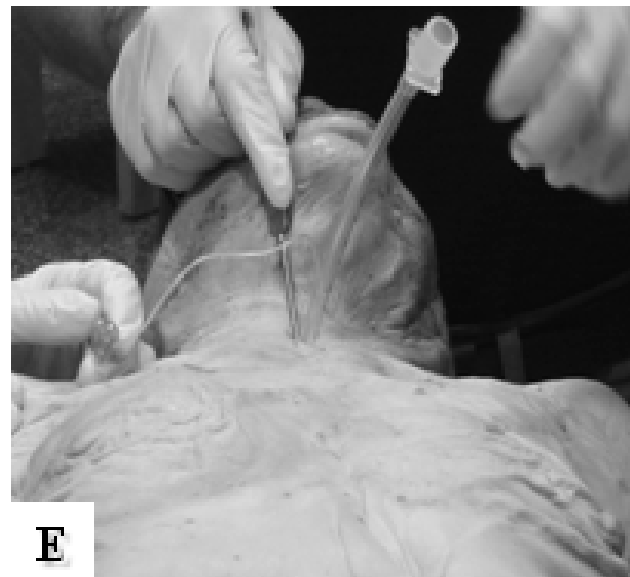
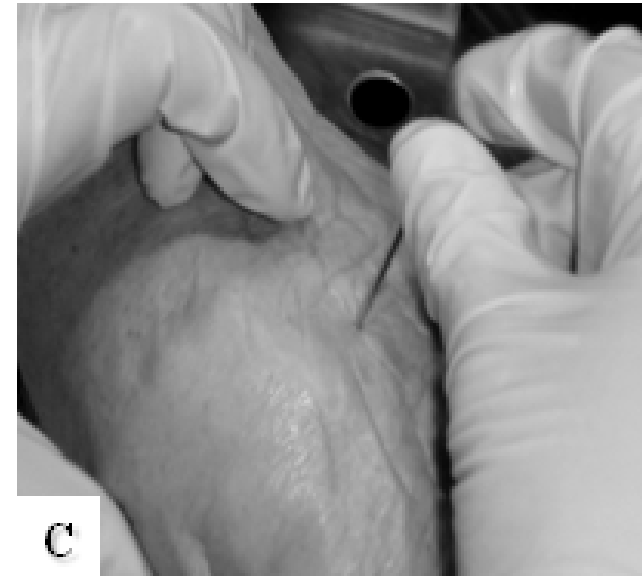
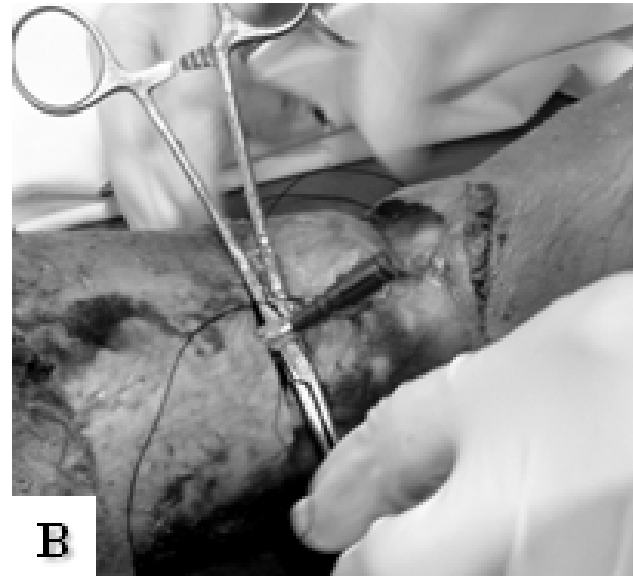
Pretesting and Syllabi

- Written **anatomy** and **clinical pretests** were administered in a common setting to all participants prior to the anatomy review and clinical laboratory sessions.
 - **Anatomy Pretest:** 15 multiple-choice questions tested students' knowledge of basic anatomy related to the clinical procedures (**required no knowledge of the procedures**)
 - **Clinical Pretest:** 15 multiple-choice questions which focused on instrumentation, clinical vocabulary, and procedural protocols (**did not include questions regarding anatomy of the procedures**)
- After the completion of both pretests, **every student received a clinical procedures syllabus** outlining the five invasive procedures and an **anatomy review syllabus** covering concepts and structures pertinent to each procedure.

- CG students participated in a **3 hour traditional review of anatomy under the supervision of two anatomists.**
- They reviewed important anatomical structures and concepts relevant to the five procedures introduced to EG without demonstrations of the procedures themselves or equipment utilized.
- Available for the students were:
 - ✓ Two prosected cadavers
 - ✓ One intact cadaver for surface anatomy
 - ✓ Skeletons, models, and prosected joints
 - ✓ a single intact specimen displaying the larynx, trachea, lungs, heart, and great vessels
 - ✓ anatomy atlases, and dissection manuals

The Procedural Laboratory

- Participants of EG were randomly assigned to **one of four clinical procedure laboratories** conducted over a period of four days and covering identical content.
- Each session last 3 hours and consisted of approximately 20 students **supervised by two attending physicians and four senior residents.**
- The head attending physician introduced a total of **five invasive procedures** including:
 - central venous access,
 - peripheral venous cutdowns,
 - arthrocentesis,
 - tube thoracostomy,
 - cricothyrotomy
- The task of the **students** was to **observe and practice** each of the five procedures on embalmed, undissected cadavers **under the direct supervision of the physicians.**
- The laboratory sessions were used to demonstrate and practice the five procedures, as well as to discuss the relevant anatomy related to each.

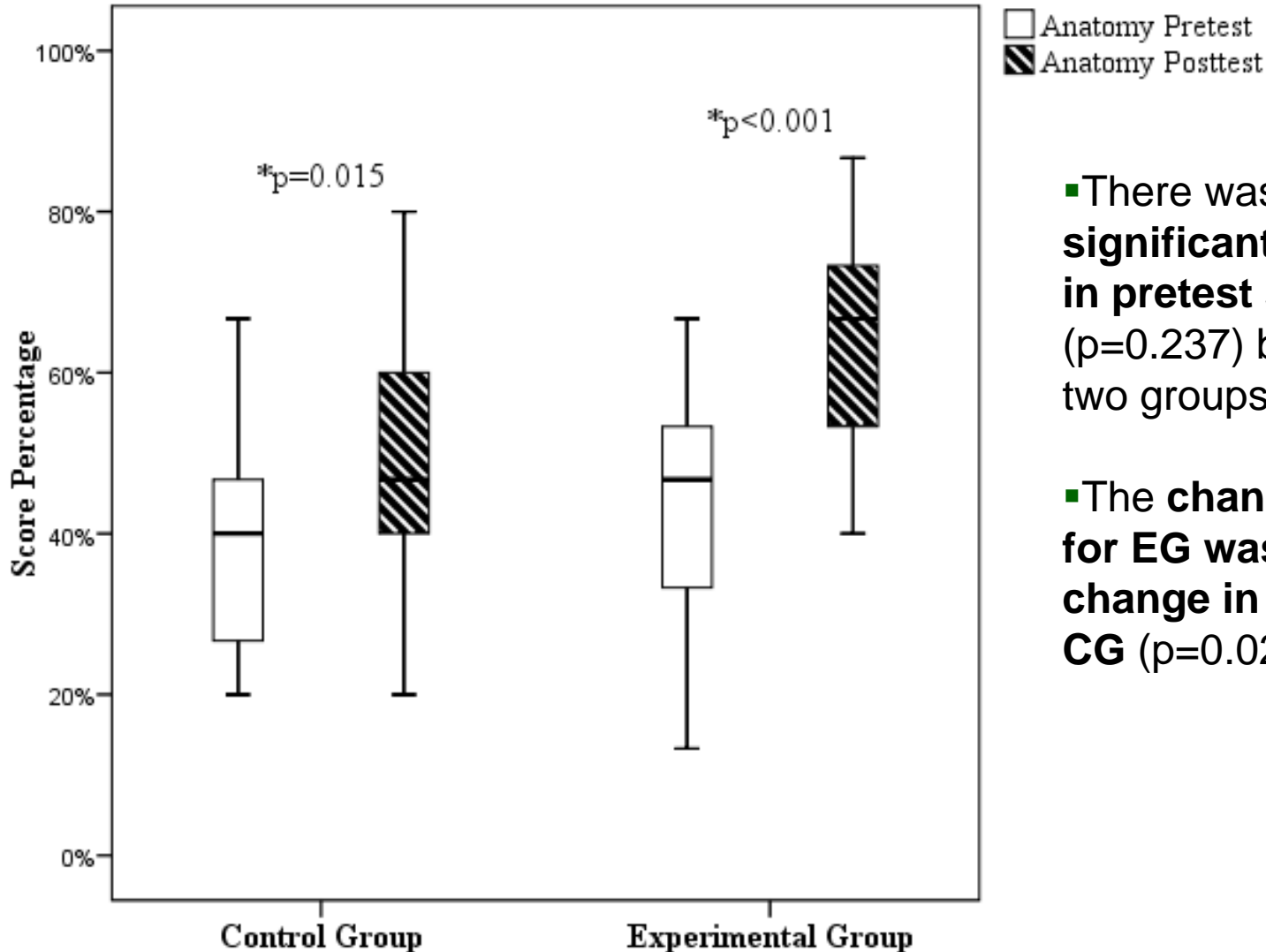


Post-testing and Survey

- Written **anatomy** and **clinical posttests** were administered in a common setting to all participants **after** the anatomy review and clinical laboratory sessions.
 - Posttest questions for both exams were **identical to pretest questions**, but were **presented in a different order**.
 - Additionally, **five new questions were added to each posttest** as distracter questions. These questions did not count toward the score.
- After the completion of the posttest exams, students **completed a 22 closed item, Likert-scale questionnaire regarding specific aspects of the entire clinical exercise**. CG participants had the choice of completing the questionnaire after taking part in the procedural lab.

- Mann-Whitney testing was performed at $\alpha=0.05$ to compare the test scores of the two groups.
 - Wilcoxon signed ranks test was utilized to identify statistical differences within groups.
 - Cohen's d (d=standardized difference of means) was used to demonstrate the relationships (effect-size) between the educational intervention and exam performance.
 - This measure compares the overlap of group means (i.e. $d=0.20$ is a small effect/large overlap of means, $d=0.80$ is a large effect/less overlap of mean scores, $d=2.00$ is the optimal effect showing that groups differ in scores by 2 standard deviations, little overlap exists between mean scores, and a p-value of 0.05 or less is unquestionably significant (*Colliver JA. Journal of Developmental and Behavioral Pediatrics. 2007 and Colliver JA. Teaching and Learning in Medicine. 2002*)

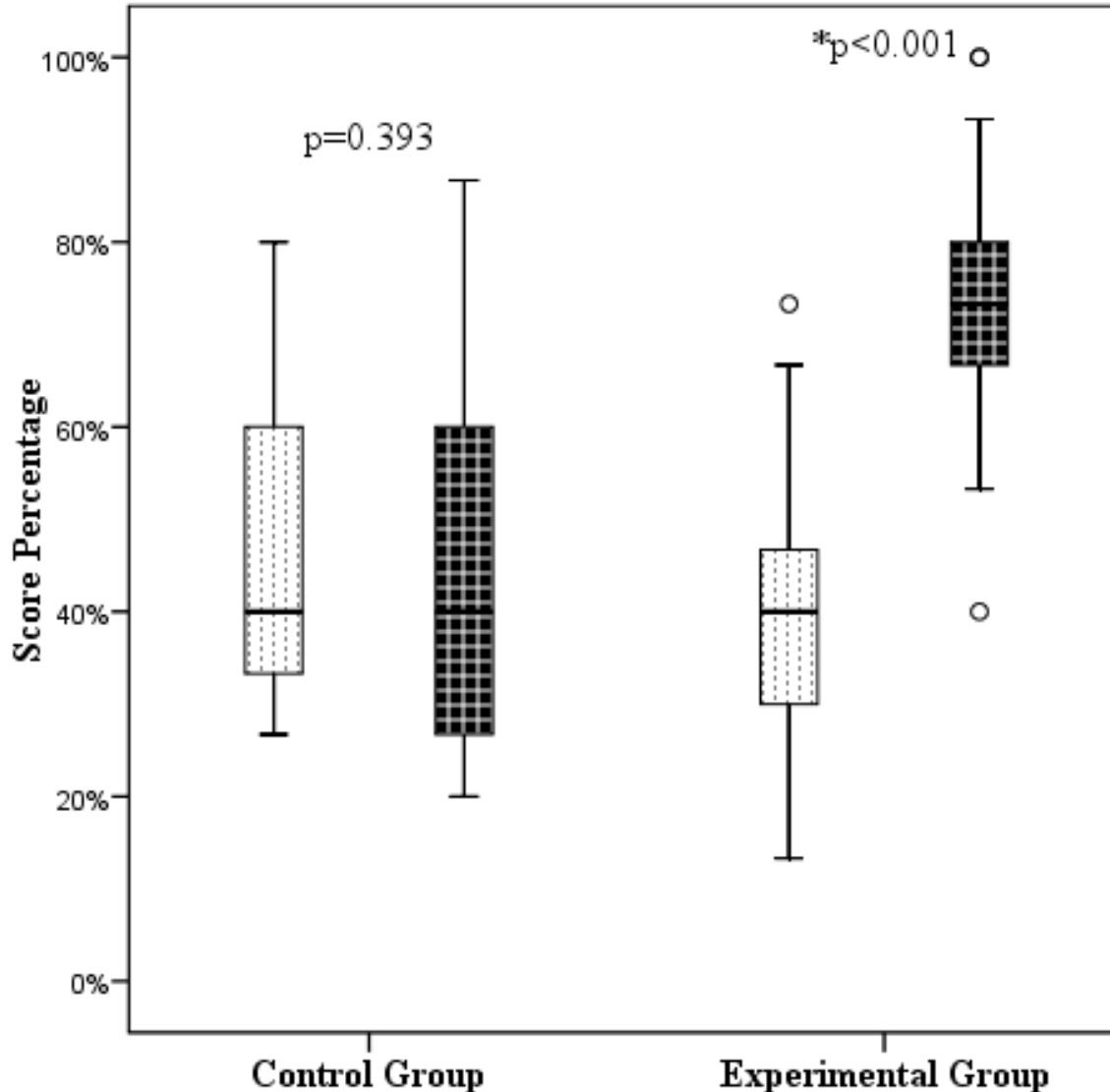
Summary of Anatomy Exams





- There was **no significant difference in pretest scores** ($p=0.237$) between the two groups.

- The **change in score for EG was twice the change in score of CG** ($p=0.023$, $d=1.15$)

Summary of Clinical Exams

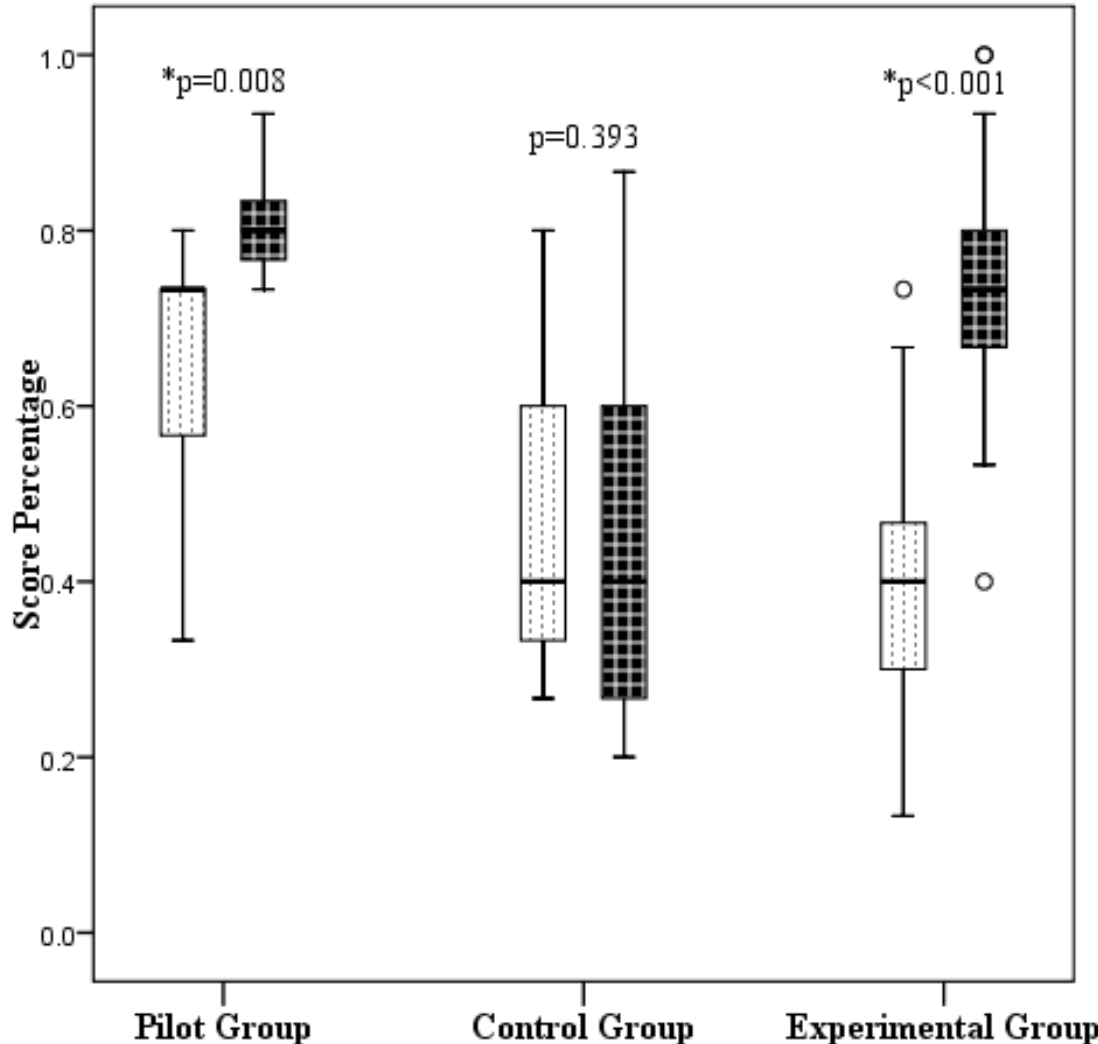




 Clinical Pretest
 Clinical Posttest

- There was **no significant difference in pretest scores** ($p=0.152$) between the two groups.

- Results of the clinical posttest demonstrated that EG performed substantially better ($p < 0.001$, $d=2.00$) than CG

Summary of Clinical Exams



 Clinical Pretest
 Clinical Posttest

- Interestingly while the PG did not perform better than the other groups on **pretest anatomy exams** ($p=0.283$).
- Results of the **clinical pretest** demonstrated that PG performed substantially better ($p<0.001$) both the CG and EG.

Results: Survey

- **71 (of 76) students** completed the survey following the procedural laboratory experience.
- Only **32%** said they had read the **syllabi** prior to attending the laboratory sessions and **75%** reported they learned more from the **hands-on practice** than the written syllabi.
- **100%** of respondents said this experience **enhanced their knowledge of basic clinical procedures** and only **15%** reported having previous experience with **invasive techniques**.
- **97%** agreed the lab **improved their knowledge of basic anatomy**.
- **94%** agreed that the lab **emphasized the importance of anatomical knowledge for clinical practice**.

Discussion

- Based on group exam performance, the procedural lab not only introduced students to basic information about clinical skills but it also provided a review of gross anatomy for 2nd year students that was superior to traditional methods.
- Both performance of the CG on clinical exams and student feedback suggest that a hand-on experience is superior to written information for learning about clinical procedures.
- While a formal assessment of transfer was beyond the scope of the present work, the third goal of this project was to demonstrate the importance of anatomy in clinical practice. Survey results students (67 of 71) agreed the laboratory had emphasized the importance of basic anatomy.
- One potential limitation of the study was volunteer bias.

Conclusion

- Overall, we believe this procedural laboratory was a useful instructional tool for reviewing anatomy and introducing clinical procedures.
- This experience was of interest to the student and was superior to a traditional anatomical review.
- Such an exercise would be a useful adjunct to current second-year curricula as it highlights the anatomical foundations for clinical practice and bridges the gap between preclinical and clinical training.

Acknowledgements

- This idea for this procedural laboratory was developed by Dr. Christopher Ross and without the work of Dr. Ross and his residents the execution of this laboratory would not be possible.
- This work was supported by a Rush University Medical Center-John H. Stroger Jr. Hospital of Cook County Collaborative Grant Award.
- The work presented here is currently in press “*Bridging the transfer gap: laboratory exercise combines clinical exposure and anatomy review*” Adam B Wilson, Christopher Ross, Michael Petty, James M Williams, Laura E Thorp *Medical Education*. 2009; 43: 790-798.