Early Assessment of a New Integrated Preclinical Musculoskeletal Curriculum at a Medical School

Charles S. Day, MD, MBA, Christine S. Ahn, BA, Albert C. Yeh, BA, and Shervin Tabrizi

Abstract

Increased incidence of musculoskeletal conditions and medical students' deficiencies in musculoskeletal knowledge have been a cause for concern for educators in this field. Findings from a 2005 study conducted at our institution revealed that medical students, despite acknowledging the importance of musculoskeletal education, have inadequate knowledge and skill in this system.

In response to these findings, additions to the preclinical musculoskeletal curriculum were designed and instituted. Medical students were assessed at the end of the new curriculum, using the same evaluation tools that had been administered before the curricular changes, and responses from the second-year students who completed the entire new preclinical curriculum were compared with those of students who had completed the old curriculum.

Results showed that students reported significantly higher levels of clinical confidence in performing physical examinations of several anatomical regions of the musculoskeletal system. A notable proportion of students cited weaknesses in other fields, such as anatomy, as a prominent contributor to their lack of confidence in the musculoskeletal system.

Increased incidence of musculoskeletal orthopedic conditions and declaration of the Global Bone and Joint Decade in 2000,[1] have led to heightened awareness of the musculoskeletal system. An important remaining issue is deficiency in musculoskeletal education and skill in medical schools across the United States.[1-5]

In 2005, findings from a cross-sectional study conducted at our institution revealed that students understood the importance of musculoskeletal education for the future of medicine but lacked knowledge and skill in this field. When asked to list 8 fields of medicine in order of importance to their future medical careers, medical students ranked musculoskeletal medicine significantly higher than respiratory medicine, but also reported much higher levels of clinical confidence in the respiratory system than in the musculoskeletal system. Mean reported confidence level in conducting a physical examination and generating differential diagnoses for musculoskeletal conditions of different anatomical regions was below "adequate" on a 5-point Likert scale, whereas, it was between "adequate" and "good" in the respiratory and pulmonary systems. In addition, only 26% of the graduating class passed the established benchmark on a nationally validated cognitive mastery examination in musculoskeletal medicine.[3,4]

A study conducted at the University of Minnesota Medical School demonstrated the effectiveness of an integrated musculoskeletal disease course through an assessment of medical students' knowledge and skill in musculoskeletal medicine before and after a course in musculoskeletal medicine. Effectiveness was measured by medical students' knowledge, confidence, and retention of physical examination skills in the musculoskeletal system.[6] The study concluded that students were significantly more knowledgeable and confident in the musculoskeletal system after completing a course in musculoskeletal medicine than were students who did not take an integrated musculoskeletal course. However,

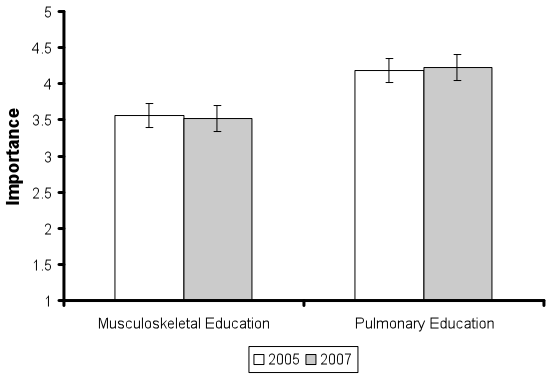

Figure 1. Students were asked to rate the importance of musculoskeletal and pulmonary education on a 5-point Likert scale ranging from 1 (not important at all) to 5 (very important). Academic years 2005–2006 and 2007–2008 were compared.

Dr. Day is Director of Orthopedic Curriculum and Associate Professor of Orthopedic Surgery, Harvard Medical Center, Boston, Massachusetts, and Chief of Hand and Upper Extremity Surgery, Beth Israel Deaconess Medical Center, Boston, Massachusetts.

Ms. Ahn is Research Student, Beth Israel Deaconess Medical Center, Boston, Massachusetts.

Mr. Yeh is Third-Year Medical Student, Harvard Medical School, Boston, Massachusetts.

Mr. Tabrizi is Student, Harvard College, Cambridge, Massachusetts.

Address correspondence to: Charles S. Day, MD, MBA, 330 Brookline Ave, Stoneman 10, Boston, MA 02215 (tel, 617-667-3940; fax, 617-667-2155; e-mail, cday1@bidmc.harvard.edu).

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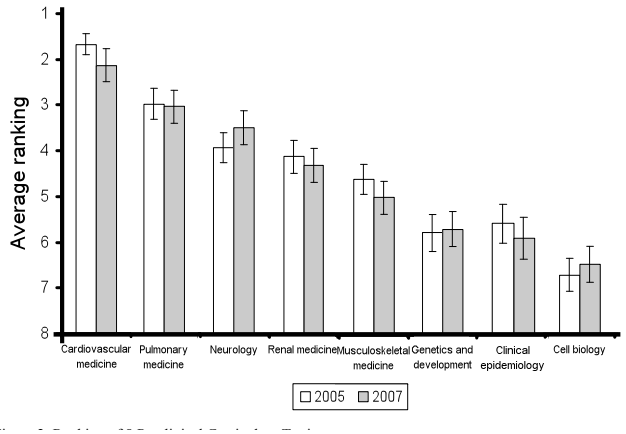

Figure 2. Students were asked to rank 8 preclinical curriculum topics from 1 (most important) to 8 (least important). Results from second-year students in the 2005 and 2007 academic years are shown.

no studies have been performed to assess the effectiveness of curricular reform, comparing a previous musculoskeletal curriculum with one designed after curricular reform.

In 2006, our institution developed and began implementing a new integrated musculoskeletal curriculum to address the musculoskeletal education deficiencies demonstrated by our medical students. The changes in the curriculum were based on learning objectives developed by a panel of musculoskeletal experts of the Association of American Medical Colleges. The panel highlighted the relevant attitudes, knowledge, and skills important to musculoskeletal education for medical students, in addition to educational strategies by which these objectives may be achieved.[7] The effectiveness of the new curriculum was assessed by comparing the knowledge and clinical confidence demonstrated by second-year medical students at the completion of the old musculoskeletal curriculum (during the 2005–2006 academic year) with those of second-year students who experienced the new curriculum (during the 2007–2008 academic year). This study prospectively assessed the effectiveness of the changes to the preclinical musculoskeletal curriculum, evaluating attitude, competency, and clinical confidence.

Materials and Methods

2005–2006 Assessment

All medical students at our institution were administered a subjective survey assessing attitude and clinical confidence and a nationally validated objective survey—the Freedman and Bernstein examination.[3,4] Results from second-year students were isolated for this study.

Curriculum Change in 2006

According to the survey of the preclinical curriculum, 3 courses had musculoskeletal objectives: Human Body, an 8-week anatomy course; Human Systems, a 1-year pathophysiology course; and Patient–Doctor II (PDII), a 1-year course developing physical examination and clinical skills.

The old Human Body course devoted 6 days to the musculoskeletal system. Approximately 21 hours of class were in the form of 6 tutorials, 3 gross anatomy laboratories, 3 lectures, and 1 radiology laboratory. For the 2007–2008 curriculum, 4 hours were added to the same 6-day frame. Most of the change came in a shift of both focus and time from the tutorials to the gross anatomy laboratories. The new curriculum devoted approximately 25 hours of class in the form of 4 tutorials, 5 gross anatomy laboratories, 3 lectures, and 1 radiology laboratory. Time devoted to gross anatomy laboratories increased from about 8.5 hours to 15 hours.[8]

The Human Systems course originally included a 6-day musculoskeletal block, with a primary focus on inflammatory joint disease and metabolic bone disorders, and only one 1-hour lecture on bone tumors and one 30-minute lecture on rehabilitation and fractures. In the new course, 17 hours were added to the musculoskeletal block to emphasize orthopedic pathophysiology. The new course also integrated another 4-day orthopedic block, consisting of tutorials, lectures, and small-group sessions.[8]

Changes were made to expand the musculoskeletal portion of the PDII course, which had previ-

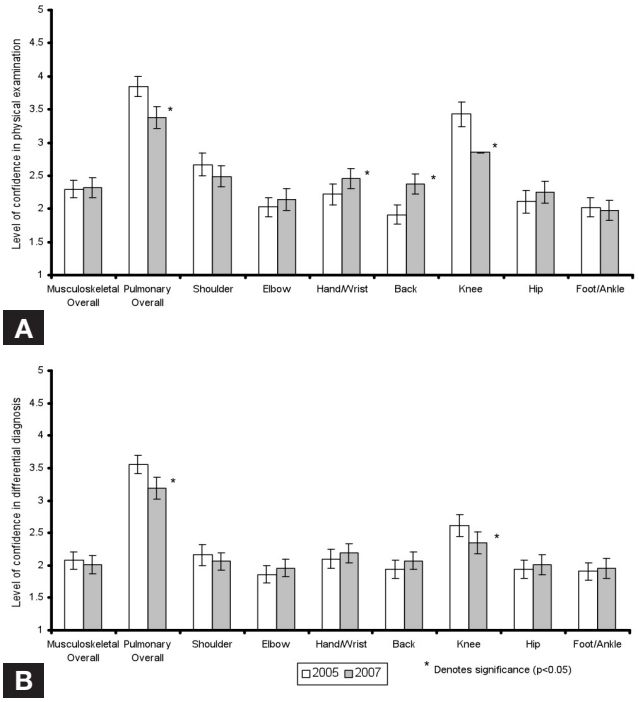

Figure 3. (A) Self-reported clinical confidence in physical examination of overall musculoskeletal and pulmonary systems and of several anatomical regions of the musculoskeletal system for academic years 2005–2006 and 2007–2008. Numeric scales were categorized from 1 (no confidence) to 5 (complete confidence). (B) Self-reported clinical confidence in differential pain diagnoses of overall musculoskeletal and pulmonary systems and of several anatomical regions of the musculoskeletal system. Numeric scales were categorized from 1 (no confidence) to 5 (complete confidence).

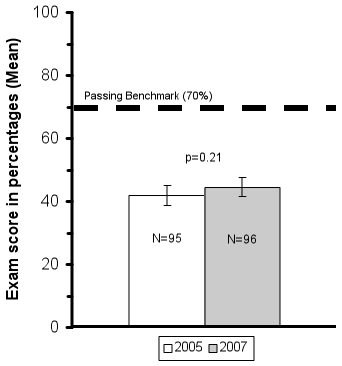

Figure 4. Second-year students' mean weighted percentage scores on Freedman and Bernstein examination.

ously devoted only one 2-hour combined session with a rheumatologic "mock" patient. The new course had 4 centralized 1.5-hour sessions on musculoskeletal physical examination of each major joint, with an 8:1 student:faculty ratio.[8]

Study Population

All 135 second-year medical students in the 2007–2008 academic year were eligible to participate in this study, excluding those who had seen the examination before. This class was the first to complete the new integrated musculoskeletal preclinical curriculum, which began in the 2006–2007 academic year. Students completed a survey assessing their attitude toward musculoskeletal medicine and asking them to report their clinical confidence levels in musculoskeletal medicine and pulmonary medicine. In addition, students completed the Freedman and Bernstein musculoskeletal examination (a nationally validated basic competency examination) and a course evaluation of the new musculoskeletal curriculum.

In the attitudes survey, students were asked to list 8 preclinical topics in order of perceived importance to their future medical careers and to rate the importance of musculoskeletal medicine to their future medical careers on a 5-point Likert scale. As a basis for comparison, students were asked to rate the importance of pulmonary medicine as well, because musculoskeletal and pulmonary conditions are the top 2 reasons for visits to physicians' offices in the United States.

In the assessment of clinical confidence levels, students rated their clinical confidence in physical examination of the musculoskeletal (overall and region-specific) and pulmonary/respiratory systems on a 5-point Likert scale from 1 (no confidence) to 5 (complete confidence). Students were asked to rate their level of confidence in making a differential diagnosis for pain on this same scale.[3]

The Freedman and Bernstein examination, a 25-question short-answer basic competency examination, tested for cognitive mastery of a wide range of musculoskeletal topics, including general musculoskeletal questions, anatomical region-specific questions, and systemic diseases.

Finally, the course evaluation asked students to rate the new musculoskeletal pathophysiology block, the 2 new clinical skills sessions (1 on the knee and lower back, 1 on the shoulder and hand), time spent on musculoskeletal pathophysiology and medicine in the musculoskeletal curriculum, and recommended changes (if any) in musculoskeletal education.

Statistical Analysis

We conducted all analyses using SPSS version 15.0 (SPSS Inc., Chicago, Illinois). We used independent-samples *t* tests to compare the data between the 2 classes and *t* tests to compare self-reported clinical confidence between the musculoskeletal and pulmonary systems. Statistical significance was assessed at $P<.05$.

Results

Response Rate

Out of a class of 135 students, 98 second-year students were present during the administration of the surveys and examination. We excluded the examination scores of students who had previously seen the Freedman and Bernstein examination or who did not complete the examination; incomplete subjective surveys also were excluded. The resulting response rate for the Freedman and Bernstein examination was 71% (96/135), and the response rate for the subjective survey was 69% (93/135).

Attitude Toward Musculoskeletal Medicine

In the 2007 survey, second-year students estimated that musculoskeletal conditions account for 49.9% of all pri-

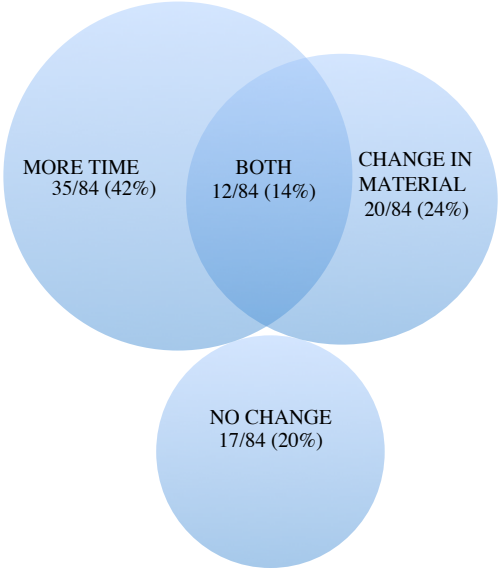

Figure 5. Students were asked to identify specific weaknesses in the curriculum. The majority of students suggested that more time, a change in material, or both would be helpful to their musculoskeletal education.

mary care visits—a significant increase (P = .003) from second-year students' estimates of 41.4% in 2005. On the 5-point Likert scale, students rated the importance of musculoskeletal medicine as 3.56 (between average and major importance)—not a significant change from 3.51 in 2005. Their rating of importance of pulmonary/respiratory medicine, 4.22 (between major and critical importance) (Figure 1), was significantly higher than that for musculoskeletal medicine. When asked to rank the importance of musculoskeletal medicine and 7 other preclinical curriculum topics on a scale from 1 (most important) to 8 (least important), students ranked musculoskeletal medicine at a mean of fifth place, or 5.08/8, which represented no significant change from 4.58/8 in 2005 (Figure 2).

Clinical Confidence

When asked to rate their level of confidence in performing a physical examination of the musculoskeletal system, students reported an overall level of 2.32/5 (between low and adequate confidence). Overall level of confidence in examining the musculoskeletal system remained significantly lower (P<.001) than for the pulmonary/respiratory system (3.38/5). When clinical confidence was divided according to anatomical region, there was a significant increase in clinical confidence in examining the regions of the hand and wrist (P = .03) and the back (P<.001). There was an observed decrease (P<.001) in confidence in examining the knee (Figure 3A).

Students' clinical confidence in providing differential pain diagnoses in the overall musculoskeletal system was 2.08/5 (low confidence) and remained lower (P<.001) than their confidence in the pulmonary/respiratory system (3.56/5). There were no significant changes observed in students' confidence in providing differential pain diagnoses in the overall musculoskeletal system or in any of the specific anatomical regions, except for a decrease (P = .03) in confidence in the knee (Figure 3B).

Cognitive Mastery Examination Scores

Mean weighted percentage score on the Freedman and Bernstein standardized examination was 44.6%, slightly higher than the mean of 41.9% in 2005, though the difference was not significant (P = .21) (Figure 4). Mean score was below the passing 70% benchmark set by the internal medicine program directors surveyed in the study by Freedman and Bernstein.[6] Out of the 96 second-year student scores, however, 6 scored above the 70% benchmark in 2007. Out of the 95 second-year student scores collected in 2005, only 2 were above the 70% benchmark.

Student Course Evaluations

On average, students rated the components of the musculoskeletal curriculum (Human Systems orthopedics block, PDII knee/back, PDII shoulder/hand) between adequate and good. Student satisfaction with time spent on the musculoskeletal system increased significantly (P<.001) from 2.24/5 in 2005 to 2.67/5 in 2007.

Students were asked whether musculoskeletal education at our institution needed any changes ("no change," "more time," "change in material"). Of the 84 students who responded to this question, 17 felt no change was needed, 35 recommended more time, 20 recommended a change in material, and 12 recommended both more time and a change in material (Figure 5). Sixty-one (73%) of the 84 students commenting on the content of the musculoskeletal block pointed to weakness in anatomical knowledge as an obstacle to course effectiveness. Several students expressed the need for better integration of the first-year anatomy courses with the second-year musculoskeletal curriculum.

Discussion

A broad spectrum of medical fields, including emergency medicine and primary care, requires basic knowledge of musculoskeletal medicine. Nevertheless, musculoskeletal education at our institution has been insufficient—a trend found at medical schools across the United States. This insufficiency supports the need for appropriate musculoskeletal curriculum assessment and reform.

Our results suggest that second-year medical students are aware of the prevalence of musculoskeletal conditions: Students estimated that musculoskeletal problems account for approximately 50% of primary care visits. Students also considered musculoskeletal medicine to be of major importance yet ranked its importance below that of pulmonary/respiratory education. Therefore, students perceived musculoskeletal medicine as less important than pulmonary medicine, even though musculoskeletal conditions have superseded pulmonary conditions as the primary reason that patients seek medical attention.

There were some significant increases in levels of clinical confidence in physical examination of the hand and back—likely the result of the creation of new clinical skills sessions for each of the major joints of the body. Originally, the knee had been used as "representative" of all other orthopedic joints of the body. This may explain why clinical confidence levels in 2005 were significantly higher for the knee than for any other anatomical region of the musculoskeletal system. In the new curriculum, however, there were centralized sessions on each major joint of the body, which may have resulted in a net decrease in the amount of curricular time spent specifically on the knee now compared with before. In 2007, there was less of a discrepancy between clinical confidence levels for the knee and all the other joints, which may result from a more equal distribution of time spent on the different anatomical regions of the musculoskeletal system. These results suggest that the specific areas of curricular additions may have been immediately effective (eg, significant increase in clinical confidence levels of the hand/wrist and back resulting from the addition of clinical sessions).

Limitations

Students' performance on the Freedman and Bernstein cognitive mastery examination did not improve significantly after implementation of the new musculoskeletal curriculum. It is possible that the difference in the timing of the examination may have influenced examination scores. In the 2005 cross-sectional survey, the examination was given to students immediately after they finished the musculoskeletal pathophysiology block in the spring. In 2007, students were surveyed 2 months after completing the rheumatology/orthopedic block; they had not been recently exposed to musculoskeletal medicine topics and had not been given the chance to review relevant concepts.

The heterogeneity of the 2 cohort groups presents another limitation, particularly in the ability to establish a statistically significant relationship between 2 different classes of second-year medical students. However, it is not feasible in the design of a comparative study in an academic setting to expose separate cohorts of students to different musculoskeletal curricula.

In addition, use of subjective measures of clinical confidence may be a limiting factor in this study. Self-reported levels of confidence provide valuable but limited information about students' actual skill in performing physical examinations and providing differential pain diagnoses.

Future Direction

Literature has been dedicated to identifying deficiencies in musculoskeletal education. Results from the present study highlight both the successes and challenges of musculoskeletal education reform. Although there was significant improvement in student satisfaction with time spent in the new musculoskeletal curriculum, there was still a need to refine the curriculum, as students' cognitive mastery showed only limited improvement. Given that time devoted to musculoskeletal medicine in the preclinical curriculum was already increased, it will be necessary to strive for more effective integration of existing courses. Students identified lack of knowledge of basic physiology and anatomy as a major obstacle to their confidence in and knowledge of musculoskeletal medicine—demonstrating a need to emphasize the overlap of these curriculum topics throughout the preclinical years. For further refinement of new curricula, it will be important to actively involve students in the reform process and to elicit anonymous survey responses.

The future of musculoskeletal education reform efforts will involve addressing the limitations of this early assessment. The issues that stem from comparing 2 separate cohorts cannot be completely addressed in this study, but their effect can be reduced by administering more objective measures of clinical confidence.

Incorporation of more objective measures of clinical confidence, through standardized tests of physical examination and differential diagnosis skills, also will address the limitations of self-reported clinical confidence as a skill indicator.[9] De-emphasis on subjective surveys and emphasis on objective measures of both cognitive mastery and clinical confidence will allow for a more sensitive evaluation of knowledge and skill.

In addition, as these results represent only an early assessment of the curriculum, it will be important to evaluate the curriculum over the long term, through students' retention of knowledge and skills.

Authors' Disclosure Statement

The authors report no actual or potential conflict of interest in relation to this article.

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