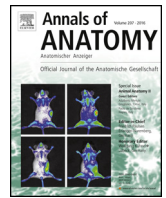




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## Integration of the musculature in the course “functional anatomy of the locomotor system”—Preparing medical students for the dissection course

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### ABSTRACT

**Purpose:** To enhance the efficacy of the preclinical first-year course for medical and dental students ‘functional anatomy of the locomotor system’ (demo course) which serves as a preparation for the dissection course at the Friedrich-Alexander University of Erlangen-Nürnberg, Germany.

**Methods:** The muscular system was integrated into the curriculum of the demo course. Moreover, the number of tutors was increased from around 5 to 15 for approximately 120 students. A detailed course agenda, which had been lacking hitherto, was developed for each course day. Extensive preparation and briefing of course tutors was introduced. Self-prepared questionnaires were applied to compare student attitudes towards the demo course before and after the restructuring process. Surveys were conducted at the end of the unchanged demo course, at the end of the dissection course in the following term (same students) and at the end of the restructured demo course.

**Results:** The mark given for overall course quality improved from 3 (“satisfactory”) to 2 (“good”). The students felt significantly better prepared for the dissection course after the restructuring process, although they perceived the work load as more challenging in relation to the limited time available. They assessed the new course as better structured and stated that the muscular system had been important for the functional comprehension of the locomotor system.

**Conclusions:** According to student opinion, the attempt to improve the demo course quality by providing a detailed course agenda and enhanced tutelage had been successful. As expected, the musculature is critical to functional understanding of the locomotor system.

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### 1. Introduction

In Germany, the anatomical dissection course is still an obligatory and central part of the preclinical curriculum for medical and dental students. Although there are curricular differences between universities as to the detailed organization of the course, it usually covers almost the entire field of gross anatomy—in some departments in only one semester. For many students it is a challenging task to master the material of the course as it commonly comprises the functional and topographical anatomy of the locomotor, visceral, circulatory and peripheral nervous systems. Some departments, like the Erlangen Department of Anatomy

(Friedrich-Alexander University Erlangen-Nürnberg, Germany), also include selected aspects of the central nervous system. While most German students pass the dissection course successfully, clinicians report the need to review basic anatomical knowledge at the beginning of their clinical curricula or residency programs (Cottam, 1999; Pabst and Rothkötter, 1997; Waterston and Stewart, 2005). This may be indicative of essential aspects of the dissection courses not being transferred to long-term memory by many students, and therefore having to be reiterated later-on. Nevertheless, the importance of cadaver dissection as it is perceived by medical students and professionals has been repeatedly demonstrated (Böckers et al., 2010; Kerby et al., 2011; Marom and Tarrasch, 2015; Ochs et al., 2012; Rizzolo and Stewart, 2006). To enhance the benefit of the dissection course, medical and dental students in the Erlangen Department of Anatomy participate in a preliminary course on the functional anatomy of the locomotor system in the preceding term. This mandatory course is also called “demonstration course” or “demo course”, highlighting the fact that no dissection is

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performed. It is aimed at endowing the students with valuable fore-knowledge they can build on and revisit in the dissection course. Spiral learning approaches like this one have been shown to be very effective for the acquisition of solid long-term knowledge (Bergman et al., 2008; Blunt and Blizard, 1975). Despite these fortunate local circumstances, there had been criticism by students and teaching staff regarding the subject matter of the demo course being comprised of the passive locomotor system only (bones, ligaments and joints) while almost entirely ignoring the active components (musculature). The students had been advised to learn the muscular system on their own prior to the beginning of the dissection course. Another point of criticism had been concerned with course supervision and structure. Although the demo course had also included seminars moderated by professional anatomy teachers, the students had been expected to spend most of the course time with self-study using their atlases and the bones, skeletons and anatomical joint models provided to them. During self-study, supervision and support for more than 100 students per course had usually been realized by one faculty member and four to seven higher-semester medical or dental students (“tutors”).

In an attempt to enhance the beneficial effect in preparation for the dissection course we fundamentally restructured the demo course as an answer to the abovementioned points of criticism (details given in Section 2). In this descriptive study, self-prepared questionnaires were utilized to detect and quantify changes in the student perception of demo course quality before and after the restructuring process.

## 2. Material and methods

### 2.1. Changes to the demo course

In the summer semester of 2015, the demonstration course was still unchanged. This cohort of students served as a control group. Student questionnaires were distributed and retrieved at the end of that course (for questionnaire content see Section 2.2). By that time, the muscular system had not yet been integrated into the course curriculum. The number of supporting tutors had still been rather low (between four and seven tutors for approximately 120 students per course) while tutor instruction had been sparse. Neither the students nor the tutors had been provided with a detailed agenda for each day of the course. Prosected anatomical specimens of joints and ligaments had been demonstrated by an anatomy teacher on some occasions. The students had been expected to spend most of the course time with self-study using atlases and textbooks as well as bones, skeletons and anatomic joint models which had been provided.

The same student cohort was surveyed again at the end of winter semester 2015/16. Having almost completed the dissection course, these students may have acquired a different view on the demo course, which had been supposed to prepare them adequately for the dissection course.

The demonstration course of 2015/16 was completely restructured (see also Table 1). First of all, the number of supporting tutors was markedly increased to 15. This allowed for a subdivision of the students into small groups of between seven and nine individuals which were then supervised by one tutor each. To enhance tutor competency, an in-depth preliminary briefing was conducted before the beginning of the semester. Immediately prior to each course, the tutors met with the course instructor (faculty member) for another quick briefing to answer open questions and to revise the course program. For each day in the course, a detailed agenda had been prepared by the course instructor and made available to tutors and students at least one week in advance. The agenda contained a set of explicit tasks and questions that the students

**Table 1**  
Summarized changes to the demo course.

Criterion	Demo course 2015	Demo course 2015/16
Musculature	Not integrated	Integrated
Number of tutors (for >100 students)	4–7	15
Instruction of tutors	Deficient	Detailed (one week in advance and immediately before course)
Agenda for every course	No	Yes (one week in advance)
Demonstration of prosected specimens	Occasionally	On every course day
Time for self-study	Very much	Very little

had to deal with during the class period under the supervision and with support of their assigned tutors. This resulted in a significant portion of the course time being spent with scientific discussions. Hence, the time for self-study was dramatically reduced, while active participation in the course and verbalization of important aspects by the students were enhanced. Another profound alteration to the course was the integration of the muscular system. Anatomical preparations of joints and musculature were demonstrated to small groups of students (around 15) by the course instructor. Special emphasis was placed on the functional aspects of the musculature necessary to understand the locomotor system in general. As the demonstrations did not exceed ten minutes, it was possible to have every student join in a demonstration during the course.

The course had always been supplemented with an accompanying series of lectures on the passive locomotor system. These lectures were also completed with an additional module covering the active locomotor system. Neither course nor lectures were aimed at dealing with the entire muscular system. Instead, a selection of muscles and muscle groups important to fully understand the various joint functions was covered. This selection was used to exemplify the importance of knowing a muscle's origin, insertion and course relative to a specific joint to deduce its functions. Thus, the students were presented with a strategy of how to learn the muscles not covered by the course curriculum to prepare for the dissection course and clinical practice. Furthermore, they were confronted with the task of adequately describing muscular/joint function by using appropriate anatomical vocabulary (e.g., axes, planes, terms of directions and positions, etc.).

The same questionnaires used for the demo course 2015 and the dissection course 2015/16 were administered at the end of the demo course 2015/16. In this manner, a direct comparative evaluation of the before and after the reorganization process was possible.

### 2.2. Student questionnaire

The student questionnaire was comprised of eight questions/items. Four of these had to be answered by marking with a cross on a seven-point Likert scale. This allowed the students to assume a neutral position, if desired (for details see Table 2). In one item the students were asked to evaluate “their” demo course with a German school mark (one decimal allowed). In the German grading system marks range from 1 to 6, with grade 1 representing the best mark and grade 6 representing the worst (1 = very good; 2 = good; 3 = satisfactory; 4 = adequate; 5 = inadequate; 6 = insufficient). Generally, 5 and 6 correspond to “failed”. Two further items asked whether important subject matter had been lacking or dealt with in too much detail. These ques-

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