

Yoga as a Didactic Tool for Musculoskeletal Anatomy for First Year Medical Students

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<https://doi.org/10.55504/2578-9333.1131>

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Recommended Citation: Brueckner-Collins, Jennifer and Stuckey, Scott P. (2024) "Yoga as a Didactic Tool for Musculoskeletal Anatomy for First Year Medical Students," Journal of Wellness: Vol. 5 : Iss. 2, Article 10.

Received Date: Mar 09, 2022

Revised Date: Nov 22, 2023

Accepted Date: Feb 01, 2024

Publication Date: Aug 16, 2024



ABSTRACT

Introduction: Medical education requires students to adjust their study habits. Active learning has been shown to enhance understanding, especially regarding anatomy. Wellness has become increasingly emphasized for medical professionals; thus, it is important for medical students to develop wellness habits to mitigate burnout. Yoga is commonly practiced with a focus on wellness and flow of movements. Yoga as an educational and wellness tool integrated into medical gross anatomy is a worthwhile pursuit. This study describes a series of anatomy-based yoga videos designed to meld wellness activities with musculoskeletal anatomy review for preclinical medical students.

Approach: Six novel yoga lessons were developed as supplemental video resources for first year medical students enrolled in a course that incorporates musculoskeletal anatomy. Each of the yoga lessons guided student users through a series of basic yoga poses that incorporate bones, muscles, and joints that establish each posture. The intent of the video series was to provide an opportunity to practice meditation through movement in the form of yoga, while concurrently providing a review of relevant anatomical content.

Discussion: Incorporating yoga as a supplemental video resource into medical anatomy education offers opportunities not only to promote wellness but to provide a kinesthetic review of musculoskeletal anatomy. Formally incorporation of this content into the curriculum and with clinical application into the videos may promote increased student participation and interest.

INTRODUCTION

Active learning has been widely accepted for its efficacy in enhancing learning, backed by been many studies. A meta-analysis of 225 studies demonstrated an increase of 6% in student grades with active learning, while students who did not participate in active learning were 1.5 times more likely to fail [1]. Several studies have found that medical students, clinical professors, and residency directors are dissatisfied with the level of anatomical knowledge that students and residents have, either initially or several years after taking an anatomy course [2-4].

The practice of yoga has been linked to many health and wellness benefits. Yoga provides benefits as a form of aerobic exercise [5, 6]. Studies also have shown increases in strength, flexibility, balance, and mobility among yoga practitioners [7-11]. In addition to physical benefits, yoga has been shown to enhance the health of participants in other ways including reduction in stress, anxiety, and improved cognitive function comparable to memory enhancement training [12, 13, 14].

There has been a considerable push for wellness in the medical profession. Burnout rates among both medical students and physicians are alarming, with roughly 50% demonstrating some

degree of burnout [15-18]. A contributing factor to these high rates of burnout, particularly in medical students, may be the sense that there is not enough time for students to practice wellness activities and study adequately. Therefore, mitigating these and similar factors contributing to burnout, especially early in medical professionals' careers, is paramount. Yoga represents a feasible, evidence-based intervention to support health and wellbeing in health science trainees [19].

The combination of the widespread benefits of yoga, advantages of active learning, and apparent need for enhanced anatomical knowledge in physicians led to the hypothesis that an anatomy-based yoga class may be efficacious in promoting learning in anatomy and wellness of medical students.

APPROACH

To pilot the incorporation of yoga as an active learning modality for anatomy in a first-year medical school course, a series of six novel yoga lessons were created as supplemental video resources (for the Class of 2025 at the University of Louisville (n=163)). The student audience was enrolled in the first

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integrated course in the medical curriculum (Clinical Anatomy, Development and Examination), which included an intense 6-week curriculum focused on musculoskeletal anatomy. The videos were designed by a medical student in the University of Louisville School of Medicine Class of 2023 (Scott Stuckey), who blended his own longstanding personal experience in practicing yoga with a thorough review of the musculoskeletal anatomy curriculum in the Clinical Anatomy, Development and Examination course.

The six anatomy-focused yoga videos were sent to students concurrent with relevant course content. Accompanying each video were 4 multiple choice questions presented in Google

Forms, intended to evaluate the academic impact of this innovation. IRB approval was obtained (IRB number 21.0647).

Each of the yoga lessons guided student users through a consistent series of basic yoga poses and while doing so, incorporated the bones, muscles and joints that establish each posture. Each video featured the same flow of poses so participants could become acquainted with the yoga flow and turn their attention to the anatomy. The intent of this structure was to provide an opportunity for meditation through movement while reviewing relevant anatomical content. Each video was 20-25 minutes long, with a voice-over narration explaining the high-yield anatomy of each pose (**Table 1**).

Table 1: Anatomy of Yoga Poses

<i>Video Description</i>	<i>Narration excerpt</i>	<i>Image</i>
<i>1: Yoga Primer</i>	“Slowly rise to tabletop. Bring your palms under your shoulders and find a nice flat vertebral column. Then stretch your right leg back, planting your toes and finding a stretch in your posterior leg.”	
<i>2: Yoga-related Anatomy of the Back</i>	“Bring your hands back behind you and arch your hips toward the sky to find baby camel. Extend your back with the erector spinae muscles, from lateral to medial, iliocostalis, longissimus, spinalis.”	
<i>3: Yoga-related Anatomy of the Scapular and Pectoral Regions</i>	“Drop your left knee and swing your right hand high toward the sky, gazing at it. As you reach to the sky, stretch pectoralis major and minor as you pull the arm and the coracoid process away from the sternum.”	
<i>4: Yoga-related Anatomy of the Arm and Forearm</i>	“Flex your arms at the elbows with biceps brachii, brachialis and brachioradialis. Pronate your forearms with pronator teres, pronator quadratus and biceps brachii.”	
<i>5: Yoga-related Anatomy of the Anterior and Medial Thigh</i>	“Plant your hands under your shoulders and raise your chest up, finding big cobra here. As you do so, feel a deep stretch across the flexors of your hip which are rectus femoris, sartorius, pectineus and iliopsoas.”	
<i>6: Yoga-related Anatomy of the Posterior Thigh and Gluteal Region</i>	“Begin in child’s pose. As you find deep flexion in your hips, think about stretching gluteus maximus, semitendinosus, semimembranosus, and long head of biceps femoris. All these muscles extend the hip, so as you are flexed here, feel the deep stretch.”	

The first video was designed as a primer, demonstrating a sequence of foundational yoga poses that would be used throughout the series. This module introduced students to Child's Pose, Baby Camel pose, Tabletop pose, and Downward Facing Dog pose. An excerpt from this primer video follows:

“Begin in child’s pose. Bring your knees wide on the mat and touch your big toes together. Stretch your palms out to the top of the mat. And take a breath.

Slowly rise up and find baby camel. Plant your arms behind you. And arch your hips toward the sky, letting your head fall back. Take a breath.

Return to child’s pose. Stretch your hand out long and feel a good stretch along your spine. Take another breath.

Slowly rise up to tabletop. Bring your palms under your shoulders and find a nice flat spine. Then stretch your right leg back, planting your toes and finding a stretch in your calf.

Return back to tabletop. Stretch your left leg out and finding a stretch in this calf.

Once again return to tabletop.

Bring your knees together, tuck your toes and sit up, finding a nice stretch in the soles of your feet. Sit tall and take a breath.

Return to tabletop. Plant your hands under your shoulders, tuck your toes and drive your hips up toward the sky finding downward facing dog. Take a few breaths here. Feel the stretch across your back and legs.

Slowly walk toward the top of the mat until your feet meet your hands. Then grab the backs of your elbows, letting your torso hang down and find rag doll. Take a couple of breaths here...”

The remaining 5 videos followed the same sequence of poses, but with reference to the anatomy of different body regions: the back in video 2, the scapular and pectoral regions in video 3, the arm and forearm in video 4, the anterior and medial thigh in video 5 and the gluteal region with posterior thigh in video 6. Narrative excerpts from each of these videos are provided below.

An excerpt from Video 2, focusing on the Back, follows:

“Begin in child’s pose. As you stretch your arms toward the top of the mat, think about your scapula rotating with the traps and elevating with the traps and levator scapulae. Continue to stretch forward.

Bring your hands back behind you and arch your hips toward the sky to find baby camel. Extend your back with the erector spinae muscles, from lateral to medial, iliocostalis, longissimus, spinalis.

Return back to child’s pose, stretching your arms once more. As you pull your proximal humerus away from your torso, think about the stretch in your latissimus dorsi. Recall the actions of the traps we discussed earlier.”

An excerpt from Video 3, focusing on Scapular and Pectoral regions, follows:

“Begin in child’s pose. Extend your arms out long using the deltoid and find some medial rotation with pectoralis major. Take a breath.

Begin to walk your hands back until they are behind you, extending your arm with posterior deltoid. Drive your hips to the sky and find baby camel. As you laterally rotate your arms, think about using infraspinatus and teres minor to do so.

Release the pose and extend your arms to the top of the mat, returning to child’s pose. As you extend them, recall how you use the anterior deltoid to do so earlier. And how you medially rotated with pectoralis major.

Lift up to tabletop, finding a neutral spine. Reach your right leg back and find a stretch in your calf. As you hold your arms in medial rotation here, think about using pectoralis major, teres major and subscapularis to do so.”

An excerpt from Video 4, focusing on Arm and Forearm, follows:

“Begin in child’s pose. As you stretch your hands long on the mat, extend your fingers using extensor digitorum and extensor digiti minimi. You are also extending your wrist with extensor carpi ulnaris and extensor carpi radialis longus and brevis.

Sit up and stretch your hands out behind you. Drive your hips toward the sky and find baby camel. As you are here, think about the deep stretch of the flexors of your forearm. Flexor carpi radialis, palmaris longus, flexor carpi ulnaris, flexor digitorum superficialis and profundus.

Release the pose and return to child’s pose. Think about the same muscles that are extending your wrists and fingers as you did before. Recall their innervation is the radial nerve.”

An excerpt from Video 5, focusing on Anterior and Medial Thigh, follows:

“Begin in child’s pose. Stretch your arms out long and sit back on your heels. As you do so, feel the stretch across your knee as you drive it into flexion, stretching rectus femoris, vastus medialis, lateralis and intermedius.

Sit up and plant your hands behind you, driving your hips up to the sky for baby camel. As you do so, feel the stretch of rectus femoris and sartorius across the hip, both of which act to flex the hip and attach to the pelvis.”

An excerpt from Video 6, focusing on Posterior Thigh and Gluteal Region, follows:

“Begin in child’s pose. Find deep flexion in your hips. Think about stretching gluteus maximus, semitendinosus, semimembranosus, and the long head of biceps femoris. All of these muscles act to extend the hip so while you are flexed here, feel the deep stretch.

Sit up, plant your hands behind you, drive your hips up toward the sky for baby camel. As you do so, feel the deep contraction in gluteus maximus as you work to drive your hips into extension. Also feel contraction of the hamstring muscles at work here: semitendinosus, semimembranosus and the long head of biceps femoris.”

Upon completion of each yoga video, student participants had the opportunity to answer 4 multiple choice questions in Google Forms. These questions were also made available to students who did not utilize videos as a learning tool (non-participants) to compare sets of learners. Compiled outcomes were compared between yoga participants and nonparticipants using an unpaired student's t-test assuming unequal variance with $\alpha = 0.05$. Participants ($n = 28$) scored 2.29 ± 0.22 out of 4 while non-participants ($n = 46$) scored 2.54 ± 0.14 out of 4 ($p = 0.33$) across question sets, yielding no significant between group difference.

DISCUSSION

Traditionally, musculoskeletal anatomy has been considered a challenging and labor-intensive subject for medical students, largely due to teaching and learning strategies that promote rote memorization [22]. Given the high frequency of musculoskeletal complaints in the primary care setting, it is imperative that medical students fully master this important clinical domain [23]. This educational innovation was designed as a pilot exploration of yoga as a kinesthetic anatomy teaching tool that promoted active learning, while concurrently supporting health and wellbeing.

Prior work supports the use of other active learning strategies in teaching musculoskeletal anatomy [24], including strategies such as team-based learning, peer teaching, videos and virtual 3D models. While the concept of syncing a yoga class with anatomy lectures is not novel [12], our design, wherein a consistent flow of foundational yoga poses is introduced in a primer video and then revisited with 5 distinct musculoskeletal body regions that include a review of the pertinent anatomy, has not been described in the literature.

This video series was piloted at the University of Louisville School of Medicine in 2021 as an optional supplement to augment anatomical instruction of the musculoskeletal system. Twenty-eight students out of a total of 163 viewed the videos. The low participation was attributed to the fact that the video series was not a core component of the curriculum and was instead viewed as a nonmandatory, additional task to complete in an already busy schedule. This level of student participation was consistent with what is reported in the literature at other institutions (12, 20) and demonstrates the low proportion of medical students who demonstrate interest in participating in formalized medical school wellness curricula. The most common mode by which medical students participate in yoga at their universities is recreationally, often offered through university fitness facilities [21]. Other, less common modes for yoga participation include opportunities offered via research projects or educational activities, such as in the present study.

Medical students are motivated by supplemental educational activities that have a direct impact on their exam performance [21]. While our yoga anatomy curriculum offered the opportunity to actively reinforce anatomical knowledge, the academic benefits of this approach were not sufficiently anchored to the mode of testing used in our course, as evidenced by the lack of a difference in question performance between yoga participants and control students who did not view the videos.

Future plans to encourage use of the video series include incorporating relevant video clips into lecture and review sessions to reinforce the actions of key muscle groups in health and disease. Formalizing the role of the video series in the curriculum and incorporating clinical correlates into the script may increase awareness and appreciation for the active learning opportunity that it offers.

CONCLUSION

Incorporating yoga as both active learning tool for musculoskeletal anatomy and wellbeing promoter has promise in the medical education setting. To optimize this innovative approach, educators should be deliberate in the manner in which they introduce this content into their curriculum. Using yoga as one of several instructional platforms by which anatomical form, function and wellbeing are interwoven may enhance its utility in the curriculum. Incorporating yoga-specific instructional and wellness objectives in the curriculum may help students understand the benefits of this active learning strategy in the anatomical sciences.

Funding Source: The author(s) received no specific funding for this work.

Conflicts of Interest: The author(s) have no conflict of interest to declare for this work.

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