Video Dissections to Determine the Usefulness of Synthetic Cadavers vs. Real Cadavers

Terence Mitchell, PhD, Bruce W. Newton, PhD, Robert R. Terreberry, PhD, Mark X. VanCura, PhD

Campbell University, School of Osteopathic Medicine, P.O. Box 567, Buies Creek, NC 27506

Abstract

Cadaver dissection is a staple of medical education and remains one of the most powerful tools for teaching anatomy, realistically pairing visual and haptic (kinesthetic communication) feedback. Cadaver dissection is used in many settings including undergraduate anatomy programs and specialized programs that train allied health professions. However, logistical difficulties encountered with the use of real cadavers, including the cost of cadavers, specialized facilities to house and store the cadavers, and access to instructors experienced in dissection, can be prohibitive and negatively impact student learning. Full-scale synthetic cadavers (SynDaver™Labs http://syndaver.com/) with realistic tissue properties, offer an exciting possibility for expanding the scope of teaching gross anatomy. Synthetic cadavers are easy to store, do not require specialized facilities, and are accessible with minimal dissecting experience. We evaluated the use of synthetic cadavers and video dissections of synthetic vs. real cadavers using feedback from first year medical students at Campbell University Jerry M. Wallace School of Osteopathic Medicine.

Key words: cadaver, synthetic cadaver, SynDaver™, dissection, prosection

Introduction

Dissection of cadavers is a staple of medical education, and remains one of the most powerful tools for teaching anatomy as it realistically pairs visual and haptic feedback. While the utility of this technique transfers well to other settings, including programs that train undergraduates for the allied health professions, logistical difficulties including cost of cadavers, facilities, and access to instructors experienced in dissection can be prohibitive. Synthetic full-scale cadavers with realistic tissue properties offer an exciting possibility for expanding the scope of teaching gross anatomy. Here we evaluate the use of synthetic cadavers and video dissections of synthetic cadavers using feedback from first year medical students.

The study of anatomy has been traditionally looked upon as a rigorous learning experience as well as a rite of passage that every medical student experiences. Dissection of the human body is the principal method to directly observe and measure the tissues, muscles, organs and bones of the body. This fundamental aspect of medical training is based on the premise that physicians cannot treat disease without a thorough understanding of anatomy. This tradition dates back to the Greek Physician Herophilus, and to the dissections of Galen in 162 AD, which identified cranial nerves, described heart valves, and demonstrated arteries contain blood and not air. In 1315, Mondino de Liuzzi performed the first officially sanctioned public dissection in Bologna in the presence of medical students and other spectators, and this led to his publication of the first modern dissection manual, *Anathomia Corporis Humani* in 1316. Around 1490, Leonardo Da Vinci dissected specimens in the hospital of Santa Maria Nuova and broadened his anatomical work into a comprehensive study of the structure and function of the human body. Around the same time, Andreas Vesalius, a Belgian physician, published *De Humani Corporis Fabrica*. In 1761, Italian anatomist Giovanni Battisti Morgagni published *The Seats and Causes of Diseases Investigated by Anatomy* (*De Sedibus et Causis Morborum per Anatomen Indagatis*). The work contained records of 640 dissections (Ghosh 2015).

The Murder Act of 1752 in Great Britain allowed bodies of executed murderers to be dissected for anatomical research and education. In the mid-18th century, the Royal College of Physicians and the Company of Barber Surgeons were the only organizations permitted to carry out dissections in England. In 1832, the Anatomy Act in the United Kingdom allowed physicians and surgeons to have legal access to unclaimed corpses, particularly those of people who had died in prison. In 1858, Henry Gray and Henry Vandyke Carter published *Anatomy: Descriptive and Surgical*, a work covering 750 pages and containing 363 figures. The success of this book was largely due to its excellent illustrations and it subsequently became known simply as "*Gray's Anatomy*". The 41st edition of *Gray's Anatomy* was published in 2016 (Ghosh 2015).

It was not until 1910 that dissection became an established requirement in medical school curricula. With the passage of time, laws were incorporated in the Uniform Anatomical Gift Act and this was followed by improved preservation techniques, such as plastination and latex injection (Anatomical Gift Association of Illinois).

continued on next page

MATERIALS AND METHODS

Dissections of the gluteal region in an embalmed (Figs. 1-6) and synthetic cadaver (SynDaver™ Labs) (Figs. 7-12) were prepared by faculty. Video presentations of the dissections were created to demonstrate the anatomy of the gluteal region. Students were allowed to interact with the synthetic cadaver in lab and view the narrated presentations. An optional questionnaire assessing the usefulness of the synthetic cadaver in lab and the video dissection was approved by Campbell University IRB (CUIRB-190) and delivered electronically to 162 medical students. A total of 54 students completed the questionnaire.

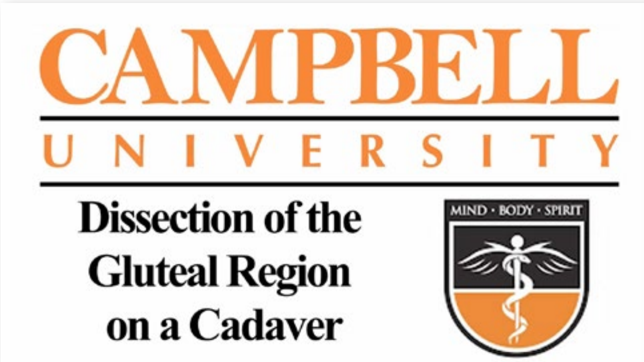

Figure 1. Title page of the video showing the dissection of the gluteal region on a cadaver.

Figure 2. Gluteal region and posterior thigh with skin and fascia removed.

Figure 3. The demonstrator is beginning to point to the gluteus maximus muscle.

Figure 4. The demonstrator is holding onto the semimembranosus (deep to fingers) and semitendinosus (deep to thumb) muscles. The tip of thumb is on the long head of the biceps femoris muscle.

Figure 5. The gluteus maximus is reflected and the demonstrator is pointing to the gluteus medius muscle. The sciatic nerve is seen emerging from beneath the gluteus medius and coursing down the posterior thigh between the semitendinosus and the long head of the biceps femoris muscles.

Figure 6. Both the gluteus maximus and medius muscle are reflected. The gluteus minimus muscle is seen just above the hand of the demonstrator. The demonstrator is holding onto the sacrotuberous ligament with forceps.

continued on next page

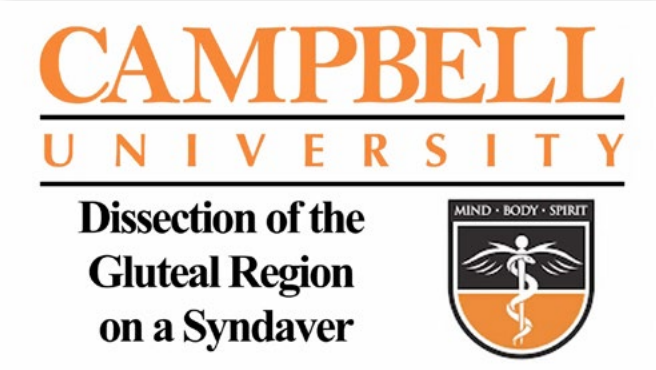

Figure 7. Title page of the video showing the dissection of the gluteal region on a synthetic cadaver.

Figure 8. Gluteal region and posterior thigh with skin and fascia removed. The tip of the probe is on the superior aspect of the gluteus maximus muscle at its origin from the iliac crest.

Figure 9. Parts of the "hamstring" muscles are revealed – the semitendinosus and long head of the biceps femoris muscles are in view.

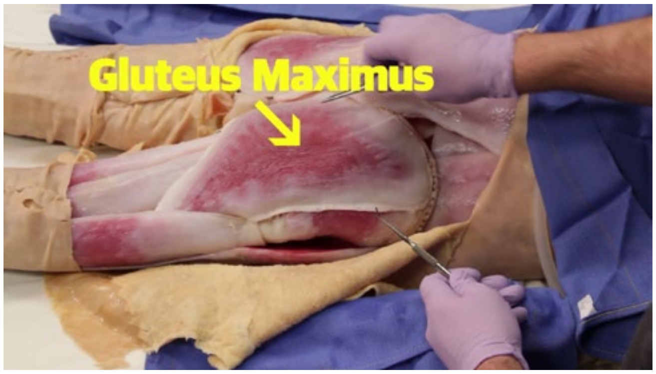

Figure 10. The gluteus maximus muscle is labeled.

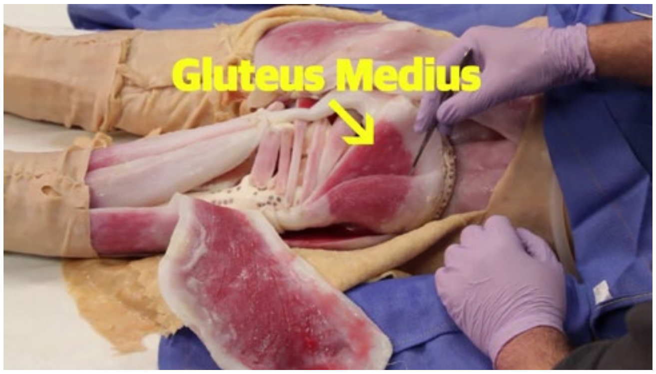

Figure 11. The gluteus maximus muscle has been reflected to reveal the labeled gluteus medius muscle. Inferior to the gluteus medius muscle are the deep muscles of the gluteal region; from superior to inferior, the piriformis, superior gemellus, tendon of internal oblique, inferior gemellus and quadratus femoris muscles are seen. The gluteus minimus is deep to the gluteus medius and cannot be seen.

continued on next page

RESULTS

Table 1 indicates students thought the synthetic cadaver in lab and review videos were helpful in understanding musculoskeletal relationships (Average Likert score of 3.98 and 3.91 respectively). However, neither the synthetic cadaver in lab nor review videos were helpful for understanding the gluteal neurovasculature (Average Likert score of 2.87 and 3.04 respectively). Overall students felt the synthetic cadaver was a useful adjunct (Average Likert score of 3.50), but would not serve as a replacement for cadaver-based anatomy in a medical school curriculum (Average Likert score of 1.50).

Table 1: The Average Likert Response for the Cadaver vs. Syndaver Dissection Video Questionnaire (1=Strongly Disagree, 2=Disagree, 3=Neither, 4=Agree, 5 = Strongly Agree)	Average Likert score	N
The synthetic cadaver was helpful in understanding musculoskeletal relationships.	3.98	54
The synthetic cadaver was helpful in understanding neurovascular relationships.	2.87	54
The video prosection of the synthetic cadaver was helpful in understanding musculoskeletal relationships.	3.91	54
The video prosection of the synthetic cadaver was helpful in understanding neurovascular relationships.	3.04	54
Dissection of the synthetic cadaver would be a useful tool in addition to human cadaver dissection.	3.50	54
Dissection of the synthetic cadaver should replace human cadaver dissection.	1.50	54

Discussion

Synthetic cadavers are a useful adjunct to teaching gross anatomy in a medical curriculum and could be used in a variety of educational settings. They are easy to store, do not require specialized facilities, and are accessible with minimal dissecting experience. Instructors need to verify the level of anatomical detail that is appropriate for the course being taught since some structures may be absent in synthetic cadaver preparations. For example, the gluteal dissection of the synthetic cadaver we used for this study lacked neurovascular structures including the superior and inferior gluteal nerve, the accompanying artery and vein, and the pudendal structures. However, models can be augmented with additional structures and pathologies increasing the educational utility.

Literature cited

Anatomical Gift Association of Illinois (2013) History of Dissection. Retrieved from http://agaillinois.org/dispo.htm 7/12/16.

Ghosh SK (2015) Human cadaveric dissection: a historical account from ancient Greece to the modern era. Anat. Cell Biol. 48, 153-169. http://dx.doi.org/10.5115/acb.2015.48.3.153

SynDaver™ Labs http://syndaver.com/ Accessed July 2016

Acknowledgements

The authors express their sincere thanks to those individuals who donate their bodies for educational purposes.

Terence Mitchell, PhD

Bruce Newton, PhD

Robert Terreberry, PhD

Mark VanCura, JD, PhD

The authors are all in the Department of Anatomy at the Campbell University Jerry M. Wallace School of Osteopathic Medicine in Lillington, NC, which opened in 2013. Terence Mitchell, PhD, is an Assistant Professor of Anatomy and the director of the gross anatomy lab. Bruce Newton, PhD, is a Professor and Chair of Anatomy. Robert Terreberry, PhD, is a Professor of Anatomy. Mark VanCura, JD, PhD is an Adjunct Professor of Anatomy.