Aesculapius: Adding a Dimension of Instruction Through Integrating Spatial Knowledge

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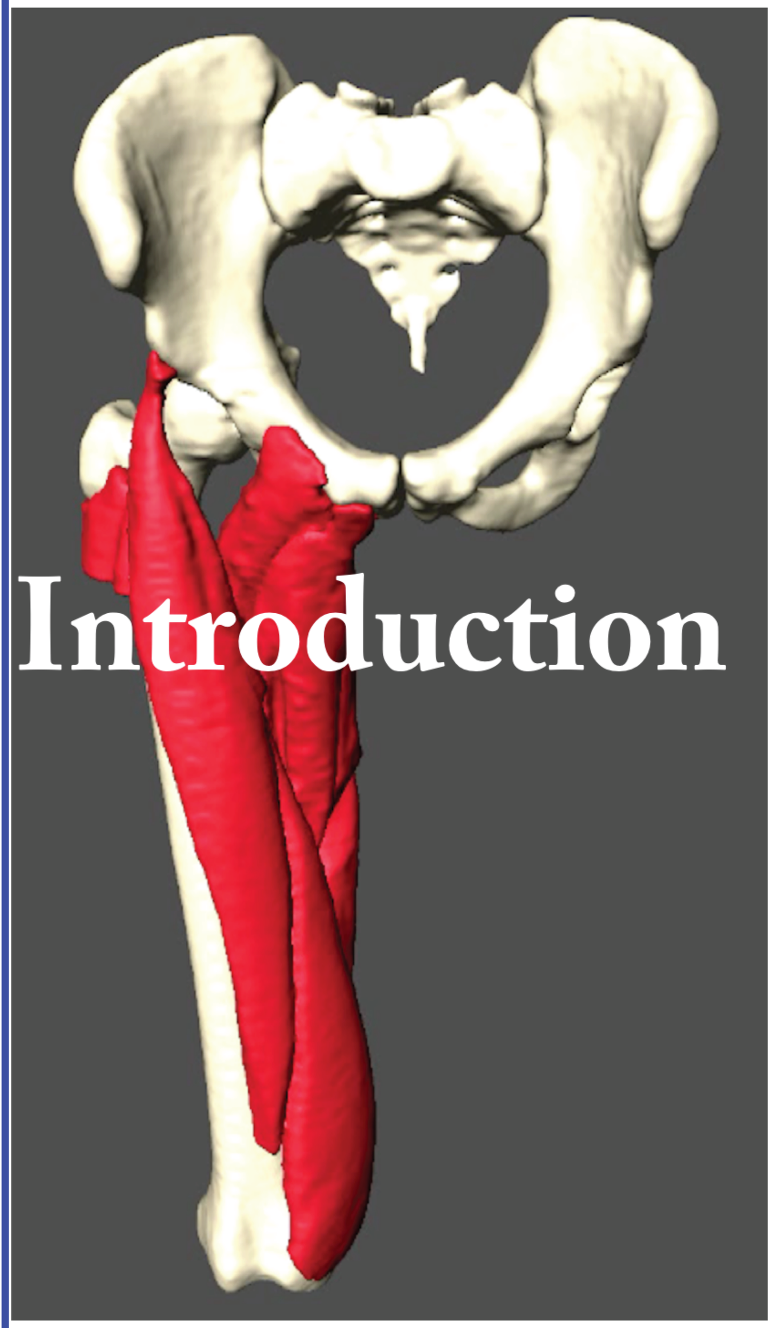
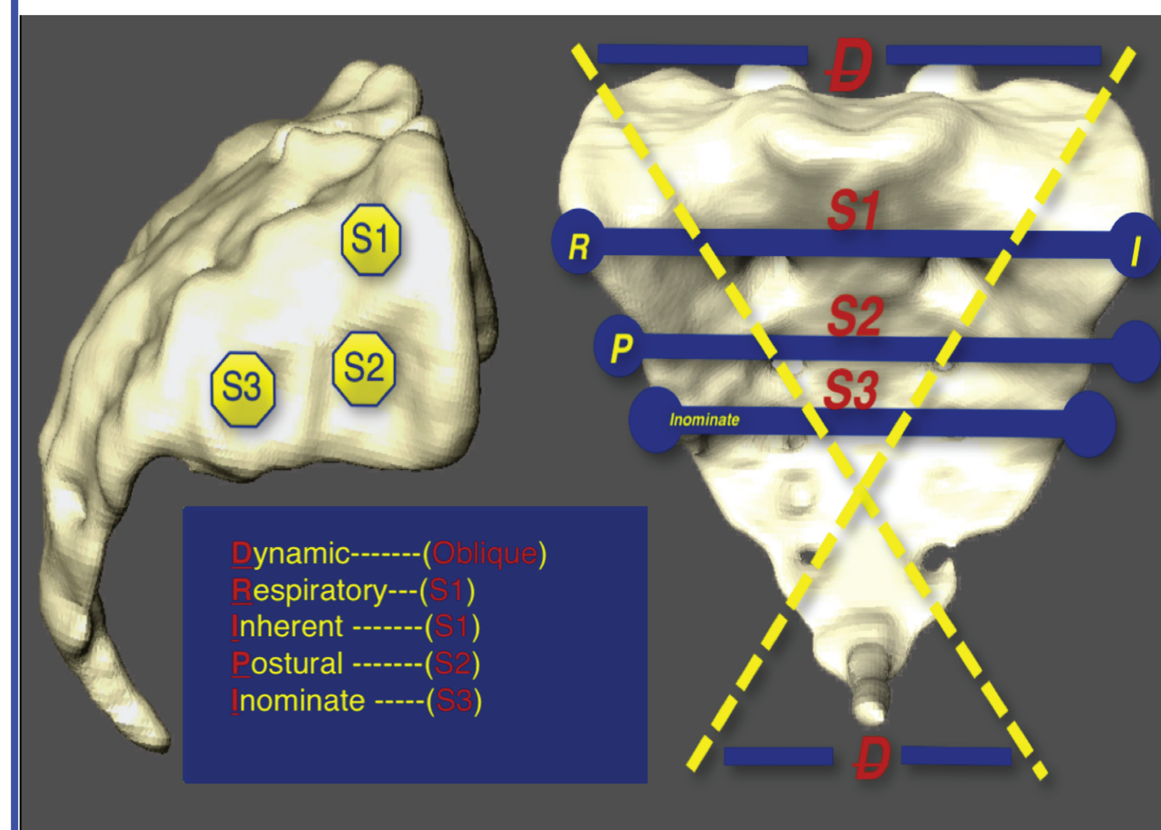
Introduction

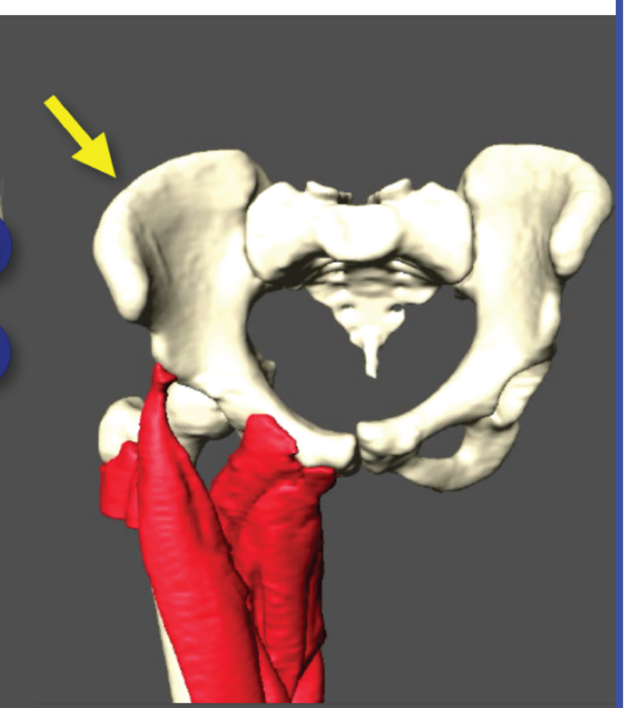


Instruction of osteopathic technique aims to add to the clinical therapeutic range of the osteopathic physician, and does so by supplementing clinical acumen with techniques that can be used either as an adjuvant or solely based on the nature, grade and/or stage of the disease that afflicts the patient. Such a goal however is fueled by a solid understanding of the basic anatomical concepts, which serve as the necessary platform upon which physical manipulation is built. This base knowledge can be better defined as the ability to conceptualize the working human anatomy/physiology, as well as the pathophysiological states that undermine and overwhelm the body's homeostatic controls. Attainment of this gestational understanding builds a solid and steady base. This paves the way to conceptualizing how osteopathic manipulations serve to remove the barriers restricting the body's return to homeostasis. Attainment of this knowledge lies squarely in the academic realm, where most students first learn these concepts in the classroom in order to understand the techniques to come. Therefore the more expediently that a functional knowledge of the basic underpinnings can be facilitated: the more opportunity and time the student might have to learn the osteopathic techniques that will be clinically useful. The technological advancements in computer science, engineering, and 3D modeling of the previous two decades have made a shift in the process of educating osteopathic physicians a probability. Portraying anatomy, physiology, and dysfunction as kinetic processes in 3-Dimensions may serve to expedite the process of internalization of information; as well as facilitate a deeper understanding of the relevant concepts in a more intuitive manner then previously possible.

Figure 1: (Shown Left) A screenshot of a narrated simulation of a "Posterior Innominate Rotation"

Results





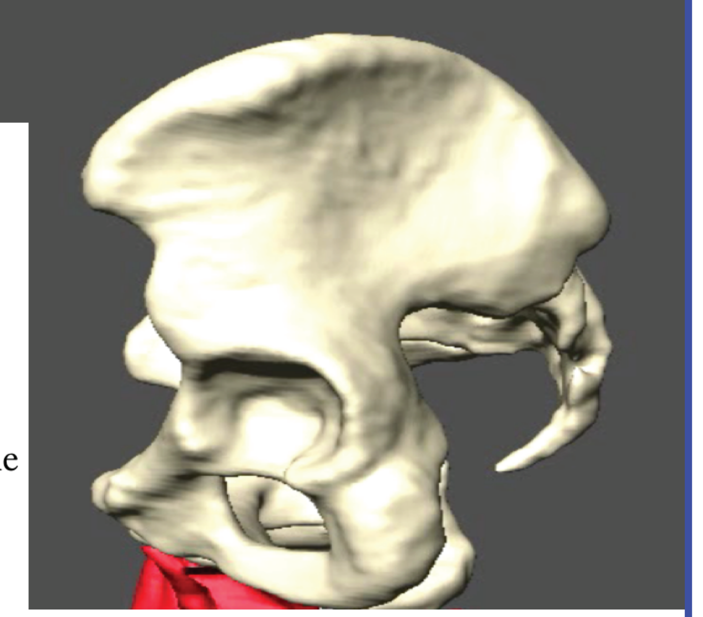
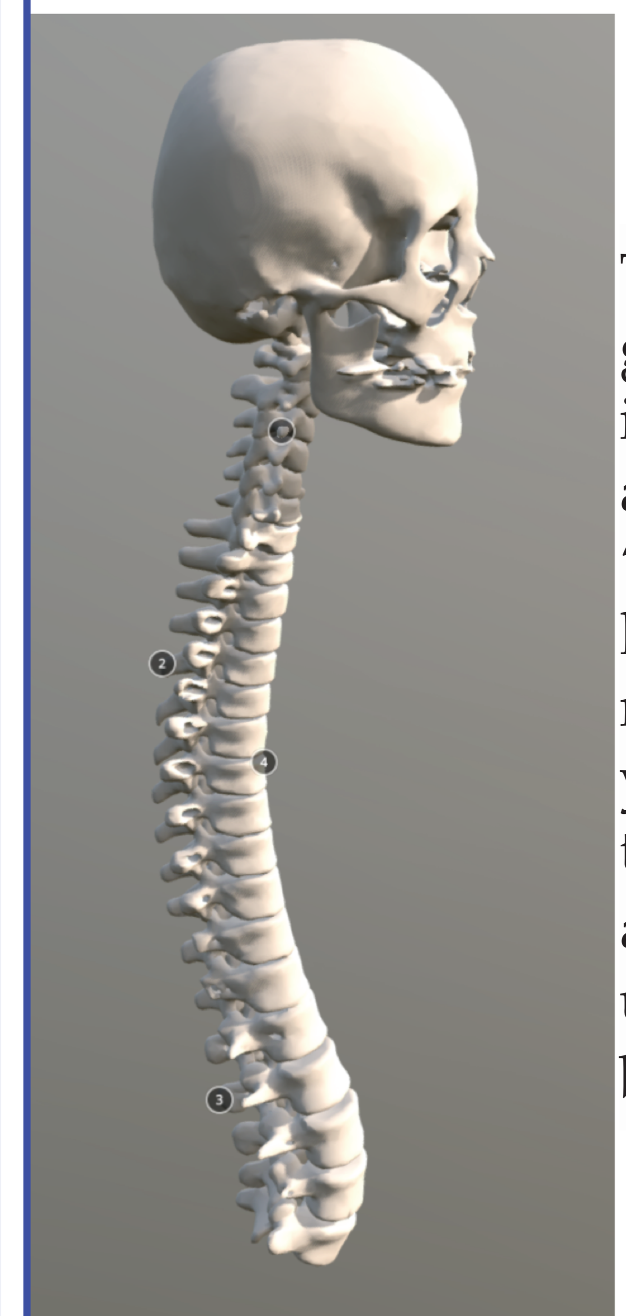


Figure 3 (Top): An explanation of the sacral axis upon which the innominate rotation occurs.
Figure 4(Top Right): The reference innominate upon which the hypertonic musculature is displayed posteriorly (not shown).
Figure 5(Bottom Right): A posteriorly rotated innominate from the lateral view.
Figures: The figures shown are screenshots of a narrated simulation utilizing the Camtasia software.

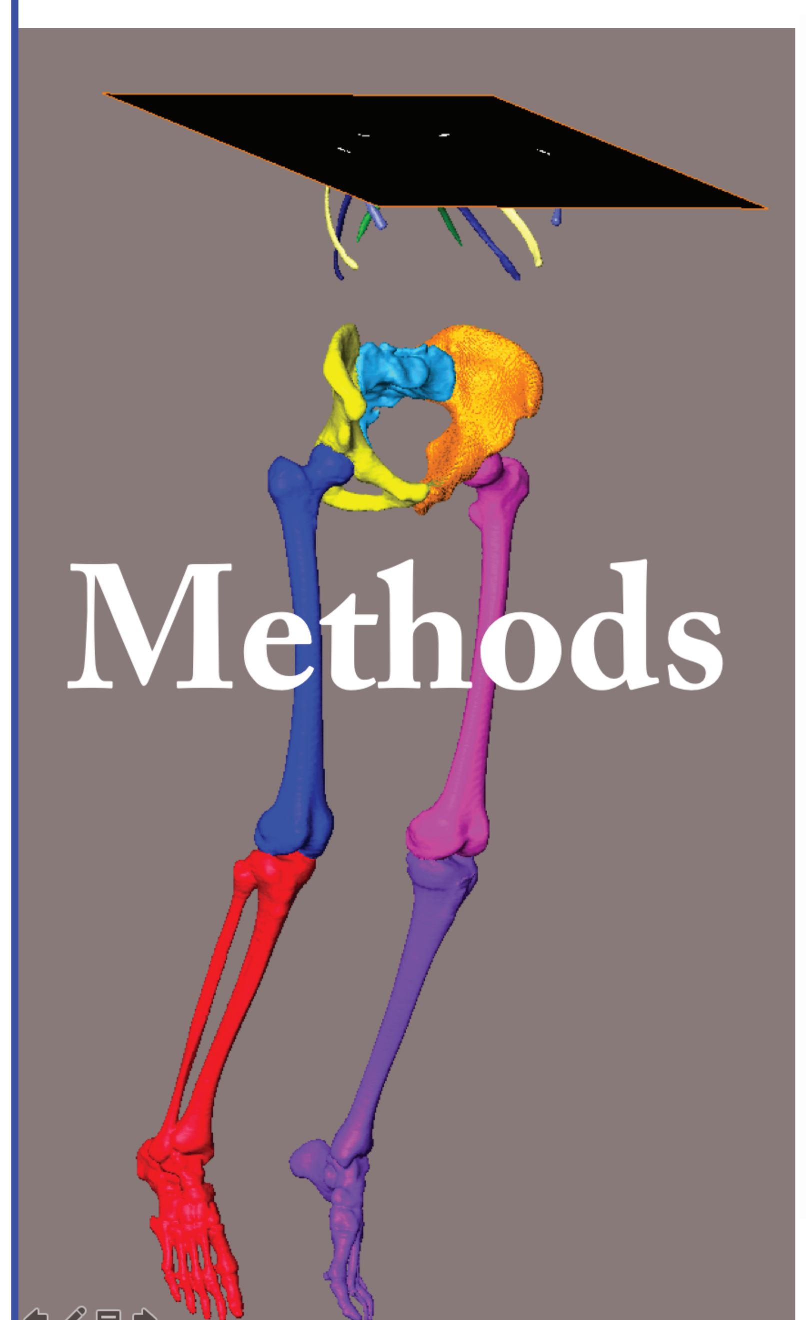
Conclusion



The ultimate goal is to utilize current technology as a tool to improve the level of adjunctive instruction available; specifically the learning and instruction of the foundational concepts of "Osteopathic Manipulative Medicine". The level of aid that this undeveloped software may bring to osteopathic medical students has yet to be examined. Future studies will aim to test the potential benefits of this form of visual aid, and its impact on both the retention and understanding of the subject matter presented by osteopathic curriculums.

Figure 8 (Left): A screenshot from the Sketchfab model of the Axial spine from the lateral view, showcasing the dropbox links and informational features

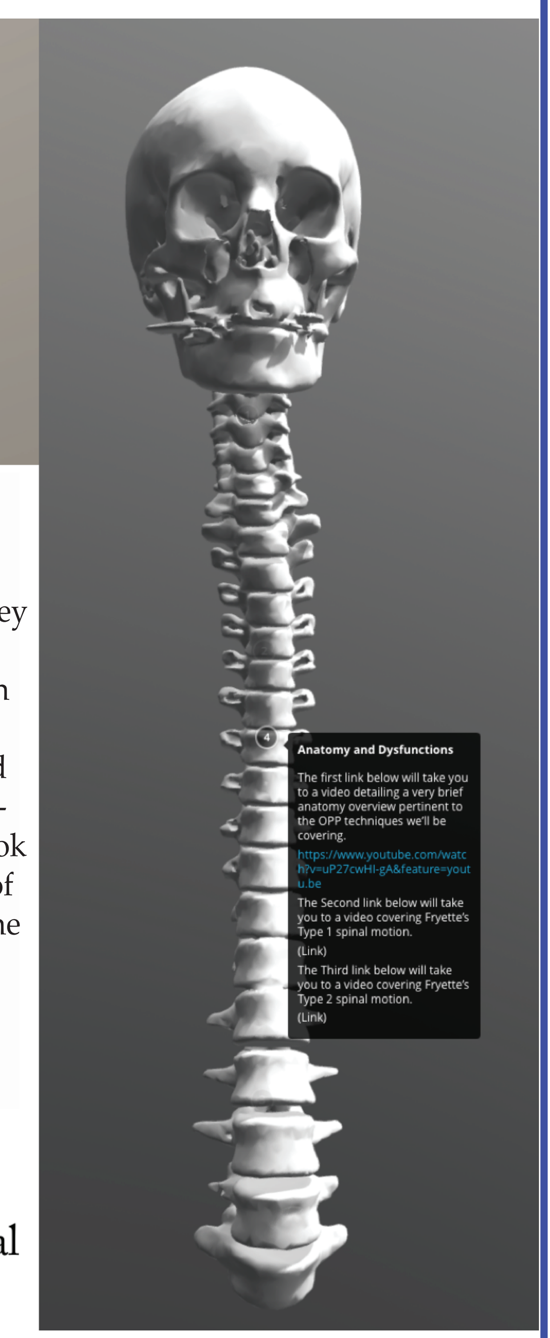
Methods



Data from a two dimensional Computerized Tomography (CT) image stack, uploaded to the Amira software, was analyzed and interpolated (slice-by-slice) to render individual three-dimensional bones and muscles. These data were used to construct educational simulations of kinetic three-dimensional movements—movements that are most often taught to be manifestations of musculoskeletal pathology in osteopathic medical schools in the United States and abroad. The movements modeled were: forward and backward rotation of the left innominate, as well as Fryette motion (Type One and Type Two) in the first and second lumbar vertebrae. The rotation of the left innominate was also simultaneously paired with a contralateral demonstration of a static right femur and innominate, with muscular attachments, as well as a static sacrum; these attachments are used as a reference to better demonstrate the etiology of bony dysfunctions caused by muscular hypertonicity in the lower limbs. These narrated simulations were uploaded unto the Sketchfab website, as hyperlinks, on a static human skeletal model. This model is meant to hold links to other models, on the same website, which show dysfunctions displayed statically and in three dimensions. Small pockets of information are plotted onto the landmarks of the model, that are relevant to the anatomical dysfunction; each is selectable as a dropbox that gives a short explanation as to the new position of the bony landmark, with respect to the dysfunction. These pockets of information are labeled systematically in an order that is intended to be read, chronologically, either from anterior to posterior or from most important to least important. At the final landmark on the static model a link to the narrated kinetic simulation is given, as well as a link to the techniques used to treat the dysfunction. The techniques used are modeled and explained by medical students at Marian University College of Osteopathic Medicine (MUCOM).

Figure 2: "Orthoslice" of the lower body data used to create various simulations

Discussion



Current technology can aid with the instruction of the concepts that serve to be the base for these techniques. The more accurately that the mechanisms of the true structural human anatomy, its functional physiology, and the dysfunction of the pathology are modeled the more intuitive the learning will become. The issue with the current modalities is not that they are inaccurate; rather it is that in order for the models to exist as they do, in the format of static text, they must first be divorced from the 3-dimensional planes in which they function in reality. They must then be distilled from the dynamic processes of function and dysfunction that they are, to a static image of the anatomy with the physiology relegated to text and arrows. These models, now stripped of a dimension and immobile, can be difficult to reconstruct. It becomes the task of the student to accurately imagine what such processes may look like. The student is asked to slowly piece together what was lost in translation, this task is of course achievable the question of its necessity however is debatable. The process can become significantly more intuitive by adopting the technology that is similarly used in the parallel field of anatomy, and retooling it to fit the needs of osteopathic education.

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Figure 6 (Top): A screenshot from the Sketchfab model linking to Lumbar Fryette Motion Simulations.
Figure 7 (Right): A screenshot from the Sketchfab model of the axial spine from the frontal view, with dropbox links and information.

Acknowledgements

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