Hybriding photogrammetry techniques and AI to produce a 3D printing realistic replica of the horse colon.

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The three-dimensional (3D) visualization of anatomical structures and the study of their topographical relationships represent a significant challenge in veterinary medical education, particularly for complex regions such as the equine caecum and colon. To date, no existing technology provides a 3D-printable model of this anatomically and pedagogically essential region. This project seeks to address this gap by implementing a hybrid methodology that combines photogrammetry with artificial intelligence (AI) to develop a highly realistic and accurate replica of the equine colon.
This initiative adheres to the principles of the 3Rs (Replacement, Reduction, Refinement) and upholds biosafety standards. By delivering an accessible, realistic, and 3D-printable anatomical model, this approach reduces the reliance on animal dissections for educational purposes, thereby limiting the use of animal specimens. Research in educational pedagogy has demonstrated that the integration of physical 3D models significantly enhances the acquisition of anatomical knowledge. The manipulation of three-dimensional representations fosters a deeper understanding of the complex spatial relationships among anatomical structures and promotes cognitive engagement in learners [1].
The methodology begins with the creation of a plasticine model, sculpted to replicate the anatomical features of the caecum and colon with high precision.

Figure 1. Photography of 3D printing first version (without taeniae)

Photographs of this model were captured from five distinct angles and processed using software embedded with AI algorithms (Hyper3D Rodin 1.4) to generate an accurate 3D digital representation optimized for 3D printing. Key anatomical landmarks, including taeniae and haustra, were highlighted using (Mesh Inspector 2.4.8). A PRUSA XL printer produced a hollow prototype measuring 15 × 8 × 8 cm, with a weight of 300 g, at a cost of €5. A full-scale model, weighing approximately 5 kg, is estimated to cost less than €100. Additionally, the model includes strategically designed windows to provide internal visualization of critical structures such as the ileocaecal papilla and the caecocolic orifice.

This work proposes the development of a life-size 3D-printed model of the caecum and ascending colon to be integrated within an equine skeletal framework, enabling veterinary students to gain a precise understanding of topographical anatomy. Furthermore, a reduced-scale version of the model, designed as an open-access resource and easily manipulable, is intended to support self-directed learning outside of the classroom setting.

[1] A. Yousef, D. Manisha, S. Stéphane, and S. Goran, “The application of 3D printing in anatomy education,” *Med Educ Online*, vol. 20 (1), 2015, [Online]. Available: https://doi.org/10.3402/meo.v20.29847

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