



Raising the Standard

FDM[®] technology plays a vital role in elevating the health care of large animals.

Animal health care is not vastly different from human health care. Beyond the obvious physiological differences, the objectives are the same: to provide optimal patient outcomes while minimizing the degree of intervention. But the level of technology applied to treating animals tends to lag that of human health care. And it's a condition that veterinary doctors at the University of Florida are working to change.

“

[With 3D printing], we are raising the standard of care and doing it quicker and more accurately than they did before.”

Dr. Adam Biedrzycki

**assistant professor,
University of Florida
College of Veterinary Medicine**



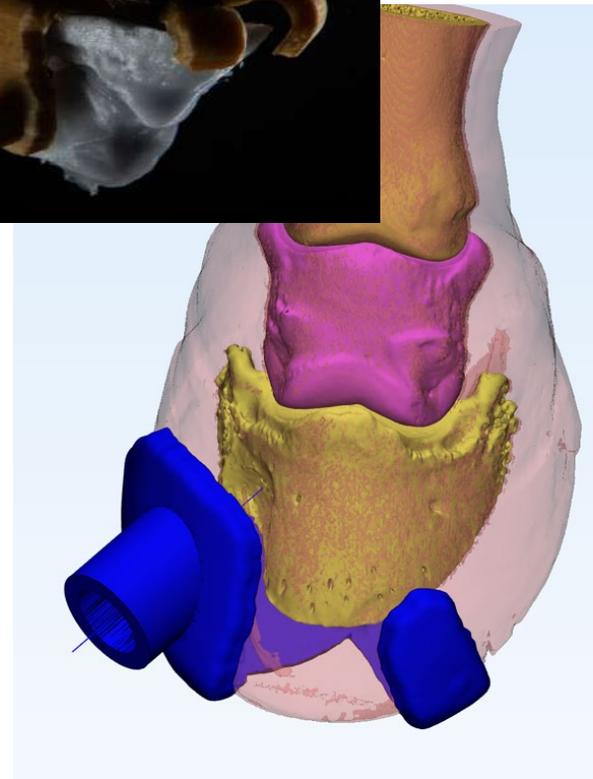
Improving Care and Education With 3D Printing

3D printing applications for human health care are well established and continue to drive new treatment innovations. That fact was not lost on Dr. Adam Biedrzycki, assistant professor at the University of Florida College of Veterinary Medicine, who specializes in large animal clinical sciences. Dr. Biedrzycki noted that while some 3D printing applications have trickled down to small animal care, the same cannot be said for large animals such as horses.

As an orthopedic surgeon, Dr. Biedrzycki saw the benefits 3D printing offers human health care and believed the same benefits could apply to large animals. They include reduced operative time, less invasive procedures, faster patient recuperation and ultimately, better patient outcomes.

“For equine treatment, there was nothing before I started using 3D printing. But it’s not like I reinvented the wheel. I took what other people have done and adapted it to animals,” says Dr. Biedrzycki. He and his team have applied the technology to multiple purposes including patient-specific surgical guides, prosthetics and implants.

Dr. Biedrzycki highlights the removal of a keratoma, or tumor, from a horse’s foot as just one example of 3D printing’s benefits. Starting with a CT scan of the hoof, Dr. Biedrzycki uses 3D printing to create a custom surgical guide to remove the tumor. This approach enables a more targeted procedure that shortens the duration and results in less anesthesia for the animal. “For me, it’s the ability to plan and access things that are hidden. I think it really helps to be more accurate,” says Dr. Biedrzycki. He notes that 3D printing has changed the typical duration of this procedure. Previously, it would often take a couple of hours; with 3D printing,



A CAD model of the horse’s foot shown with the placement of a 3D printed surgical guide in blue.

that’s been reduced to 20 or thirty minutes from start to finish.

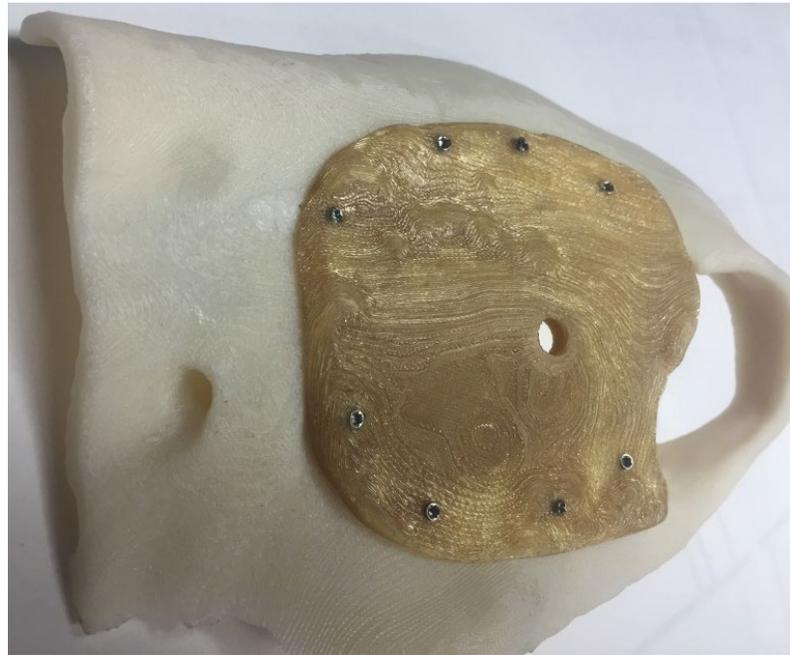
Dr. Biedrzycki also touts 3D printing’s capabilities for increasing physician expertise and the education of the animal’s owner. He notes that when explaining a procedure, clients typically nod in agreement without really understanding what’s being done to their animal. 3D printed models and tools provide a clearer picture by giving clients something to see and feel in three dimensions. “I think the clients get a lot more out of it when we can show them exactly what’s going on and what we are going to do,” Dr. Biedrzycki says.

Innovative Treatment and Lower Cost Via FDM Technology

Medical 3D printing takes many forms but for Dr. Biedrzycki, FDM technology is the right fit. The University leverages the capabilities of the Stratasys Fortus 450mc™ 3D printer to shoulder the brunt of its printing needs. “The Fortus 450mc has high capacity and it’s accurate. It can do a lot of things we want it to do,” says Dr. Biedrzycki.

The ability to print with carbon fiber and biocompatible materials also offers application versatility. FDM® Nylon 12CF (carbon fiber) provides sufficient strength to replace metal for certain applications. Dr. Biedrzycki cites the example of a unique, out-of-production surgical tool that was initially printed on one of the University’s metal 3D printers. However, it needed excessive post-processing, raising its cost. Dr. Biedrzycki adjusted the design slightly and printed it with FDM Nylon 12CF. “You can print 10 of them in one go and it costs a tenth of what the metal tool costs for the same level of rigidity,” he says.

3D printing reduces costs in other ways, too. As an alternative to buying expensive equipment from medical device suppliers, surgical tools can be easily designed, printed and modified as needed to accommodate the desired results. “It’s so easy to just make a different size spoon or something for some of the surgeries we do,” Dr. Biedrzycki says. The same principle applies for a lot of orthopedic plates used to train students and residents that companies sell for \$800. Rather than pay those prices, the team will simply print plates as needed out of thermoplastic, providing invaluable, cost-effective training for residents.



The gold-colored ULTEM™ 1010 resin implant shown attached to a model of the horse’s facial bone.

High-performance FDM materials enable other applications like implants. The design freedom inherent with FDM technology allows for patient-specific implants designed and printed to match the patient’s anatomy. For example, Dr. Biedrzycki’s team used biocompatible ULTEM™ 1010 resin for an implant to reconstruct a horse’s facial bones. The implant was created using a CAD model of the animal’s physiology taken from a CT (computed tomographic) scan. Biocompatible thermoplastic lowers the cost compared to metal reconstruction, making the procedure more accessible for the animal’s owner.

In another remarkable example of how 3D printing improves the lives of animals, Dr. Biedrzycki restored a goat's deformed hoof with a 3D printed prosthetic. It was made with FDM Nylon 12CF to provide suitable mechanical properties while keeping it sufficiently light. After the hoof was printed, it was bonded onto the deformed hoof

with medical-grade epoxy. "The carbon fiber lets you make it thinner for the same kind of strength. It's lightweight and strong, which are the two main attributes we were going after," says Dr. Biedrzycki.



The goat's deformed hoof before treatment.



After the application of the 3D printed hoof prosthetic.

Raising the Standard of Care

Before adopting 3D printing, there were conditions that tested the medical team's capabilities for successful treatment. Some things weren't possible or in other cases, treatment was difficult and imperfect. "You did the best you could," Dr. Biedrzycki notes. "It was like, this is the current standard for how we do these things and these are the outcomes we have," he continues.

But that has changed as 3D printing becomes more widely integrated into the University's veterinary practice. Dr. Biedrzycki says their Fortus 450mc prints every day, with little downtime. "I feel that with 3D printing, we are raising the bar on a lot of those techniques. We are raising the standard of care and doing it quicker and more accurately than before," he says. And this capability not only benefits the animals, but their owners as well.



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