Designing enhanced treatment options for animals using 3-D printing

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This 3-D model of a dog's skull helped a university veterinarian determine how much growth on the dog's jaw would need to be removed.

A research project by an interior architecture & product design student at Kansas State University is one that could get some tails wagging.

For her Developing Scholars Program project in the 2014-2015 school year, Kelsey Castinado, now a fourth-year student in the College of Architecture, Planning & Design, turned CT scans of animal bone fractures and deformities into full-scale 3-D prints that veterinarians at the university's College of Veterinary Medicine are using for teaching, to plan surgeries and to find more cost-effective ways to treat four-legged patients.

The project, "3-D Printing Animal Bone Fractures Through Experimental Applications in Digital Fabrication," was suggested to Castinado by her second-year studio instructor Dustin Headley, an assistant professor of interior architecture & product design. Headley's research interest is in digital design, including 3-D printing.

"I knew that for my third year I wanted to change my research a little bit since I had been doing mostly architecture-based research," said Castinado, who is from Overland Park. "I thought product design-based research would be a little bit more interesting, so I asked Dustin if he needed any help with his research and if he would like to mentor me in the Developing Scholars Program."

The program pairs underrepresented students with faculty mentors on research projects.

Castinado joined Headley on a collaborative project with the College of Veterinary Medicine involving 3-D printing of bone fractures and deformities.

"A lot of my research focuses on alternative applications for the design discipline," Headley said. "Instead of studying the lines of architecture or looking at new products to market, I'm interested in looking at what are some of the skills interior architects have that we can engage with other disciplines and expand the scope of the design profession as a whole."

For her project, Castinado used digital files of CT scans provided by the college's Veterinary Health Center.

This 3-D model is of a dog with a rotated ulna and was used by a university veterinarian to determine the best treatment option for the animal.

"The digital CT scan files are just a lot of small, chopped up pieces of the bone image," Castinado said. "I use a 3-D modeling software to make all those pieces into a whole. I also have to take away all the extra fragments that are attached to the bone so that when it is 3-D printed, it will look like a bone."

The 3-D printing process retains—and can enhance—the important information found on the scan that a doctor or veterinarian needs in making a diagnosis.

Walter Renberg, an orthopedic surgeon and professor and head of small animal surgery at the Veterinary Health Center, said the 3-D models Castinado and Headley have produced are proving beneficial in a variety of ways.

"While Kansas State University is not the first to use 3-D printing in veterinary medicine, we've thought about doing so for awhile," Renberg said. "It helps us with a couple of things clinically, particularly with bone deformities, which can be difficult to reconstruct with a CT scan. For example, when planning a surgery to correct a deformity or even determining whether such a surgery is necessary, the model can help us determine the right surgical approach or come up with less expensive alternatives to certain procedures."

That's what happened earlier this summer with a 3-D print Headley made of a dog's malformed tibia, which is one of two bones in the lower hind leg.

"I thought we would have to do an expensive reconstruction that the client probably couldn't afford, but the 3-D modeling gave us a better understanding of the problem and we came up with a less invasive and less expensive route," Renberg said.

The models also are teaching tools.

"From a clinical standpoint, we can use the 3-D models with clients to explain procedures," Renberg said. "It can be easier to show them a model than a CT scan."

Renberg and Headley are continuing to collaborate on other ways 3-D printing could be used.

"We are looking into the ability to explore soft tissues in 3-D at scale, such as tumors and vascular systems," Headley said. Such models

would have potential to assist in teaching procedures, too."

While such 3-D models already exist, Renberg said they can be expensive. Having the capability to produce them in-house has cost benefits in a time of tight budgets for state universities.

"I'm very surprised at the capabilities 3-D printing has opened up," Renberg said.

Provided by Kansas State University