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Fossilized Mare Sheds Light on Reproductive Tract Evolution

This fossil, first unearthed in 2000 in southwest Germany, contains the oldest and most well-preserved fetus of a primitive horse ancestor. Photo: Sven Tränkner/Senckenberg Research Institute Frankfurt

The equine reproductive system can be considered "quite optimal," one researcher said, as recent study results show that the system has undergone surprisingly little evolution over the past 48 million years.

Detailed exploration of a fossil of an Eocene-era pregnant mare has revealed uterine and placental structures that are almost identical to modern-day horses—even though the rest of the horse's body has evolved significantly, said Christine Aurich, DVM, PhD, of the University of Vienna and the Graf Lehndorff Institute in Neustadt, Germany.

The fossil, first unearthed in 2000 in southwest Germany, contains the oldest and most well-preserved fetus of a primitive horse ancestor, *Aurich* said. The fact that the fetus was in a late stage of gestation and near term contributed to its preservation because its bones had become more solid. But it was also helpful that the mare had fallen into the prehistoric Lake Messel, an ancient lake that contained high levels of bacteria which had a preservation effect on soft tissues like muscles and membranes.

German researchers recently decided to examine the well-preserved fetus, mainly to better understand the evolution of equid reproduction, Aurich said. The latest technology—including scanning electron microscopy and high-resolution micro-X ray—allowed the scientists to get new glimpses of this fetus, which is partially hidden by the mare's pelvic bones, that couldn't have been achieved even 15 years ago.

They found that the structure of the uterus, the position of the fetus, the placental anatomy, and the membranes surrounding the fetus all appear to be very similar to what we see in modern horses, she said. That's in stark contrast to what we see in the rest of the animal's body: these ancestors (*Eurohippus messelensis*) were about the size and weight of a fox, had four toes in front and three in back, and had very different teeth, among other varying characteristics.

"We can now assume that the reproductive tract of horses developed very early in their history," Aurich said.

What's more, these early equids, despite their physical similarities to modern dogs, foxes, or even goats, didn't give birth to litters of young, she added. The seven *other* pregnant mares discovered at the same time in the same former lake (now a quarry) also had a single fetus each—meaning singleton pregnancies were the norm. The other seven fetuses were not as advanced in gestational age, so they were less well preserved.

"It seems we're dealing with a very ancient (reproductive) system that has not changed a lot over millions of years," Aurich said. "Obviously this reproductive system has to be considered quite optimal, as long as no pathological changes (in individual mares) occur."

And that's contrary to what scientists used to believe, Aurich said. Until recently, it was commonly assumed that equine placentas were "primitive" because they are "non-invasive," meaning they're not efficient in transferring nutrients to the fetus. So in certain situations, such as illness, the fetus is at greater risk of death with a non-invasive placenta. However, a non-invasive placenta also means far less chance of maternal hemorrhage after birth.

"The 'new reproductive strategy' is that this kind of placentation, due to its non-invasiveness, enabled flight animals to stand up and run away from a predator almost immediately after birth," Aurich explained of researchers' current theories on the equine placenta. "Human placentation is much more invasive, and bleeding may occur after birth and even result in a life-threatening situation. This problem will not occur in horses."

The young *Eurohippus messelensis* mare most likely didn't die from birthing complications, Aurich added, as the fossil's structures suggest the mare was close to foaling but had not yet begun the foaling process.

"The little mare probably came to the shore out of a lack of drinking water and died, either because she was attacked by an alligator (we know that they also lived in this sea) or because of poisoning by toxic gases (volcanic activity was around)," she said. "She then sank to the bottom of the lake where she was fossilized due to lack of oxygen and the activity of bacteria."

The study, "Description of a Well Preserved Fetus of the European Eocene Equoid *Eurohippus messelensis*," was published in *PLoS One*.