New look at embryonic teeth could prevent problems later in life

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A new 3D imaging technique could help prevent teeth and jaw problems through early intervention by identifying incoming wisdom teeth, crowded teeth, and malocclusion - all before they have time to start.

The findings lay the groundwork and could have future impact on oral health-related quality of life.

Working with scientists on the Biomedical Imaging and Therapy (BMIT) beamline at the Canadian Light Source synchrotron, a research group from the University of Saskatchewan observed, in microscopic detail, the 3D organization of young teeth within the jaw. The research was recently published in The *Anatomical Record*.

"When you look at developing teeth, these embryonic tooth organs, they are like a pocket of jelly," said Dr. Julia Boughner, assistant professor of anatomy and cell biology in the College of Medicine. "It's like trying to X-ray Jello – you can't do that with conventional dental X-rays, so you can't see the developing tooth organ or predict what's going to happen."

Boughner said that with the BMIT imaging technique, they are developing models that will help anticipate problems in the mouth. Using this technique, scientists can see such an early stage in development that the teeth tissues are un-mineralized.

"To understand how constrained and flexible teeth are in the mouth, you have to first understand what they are and how they form, and until recently the technology to see this was not available."

As an example of how this research would help people, Boughner said they might one day look into the mouth of a young child, observe the wisdom teeth and other molars in early development, and predict if the teeth are on the right "road" to forming and erupting normally.

"Is there enough space for the teeth as you grow up? This is what we are trying to predict," said Boughner. "Through early intervention, we might then reduce invasive procedures and pain later in life."

Using a synchrotron-based micro-computed tomography (micro-CT) imaging technique, silver-stained mouse embryo samples showed even the very earliest stages of tooth development. This type of 3D imaging technique for teeth is rare because of the technical specs required to "juice up" the scanner so that it can capture such tiny, translucent and jelly-like tissues.

"This project at the beginning looked almost impossible," said Tomasz Wysokinski, BMIT staff scientist. "When you are trying to look at very small embryonic structures near the limits of the resolution capability of the beamline, to visualise miniscule changes in density between the tissue is difficult. But in the end, the results were great!"

Wysokinski said the BMIT scientists enjoyed the challenge of Boughner's experiment.

"When we use cleverly-designed filters, it is amazing what the synchrotron beam can show us, especially when combined with enhanced contrast due to silver staining."

An anthropologic look

Boughner has also used this research to look at the evolutionary development of humans through the size and shape of the mouth. She points out that our early human ancestors had much bigger teeth and jaws than modern humans.

"Modern humans have smaller teeth and jaws, maybe in part because of an increase in culture that relaxed the pressure on growing big teeth and jaws," she said. "Rather than ripping apart food with our mouths, tools were used to cut and prepare

food. Softer foods became available.

"Teeth are a way for us to understand the interplay between human biology and human culture, as well as a way to get a look at the features that might make us unique relative to our ancestors and living primates."

More information: "Technique: imaging earliest tooth development in 3D using a silver-based tissue contrast agent." Raj MT, et al. *Anat Rec* (Hoboken). 2014 Feb;297(2):222-33. DOI: 10.1002/ar.22845. Epub 2013 Dec 19.

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