Piecing Together Prehistoric Life: Scanning and Articulating *Gorgosaurus*

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Introduction

The skull bones of a *Gorgosaurus Libratus* were found at Alberta's Dinosaur Provincial Park in 2010, 664 metres above sea level. They were very well preserved. However, some of the contact pieces of the bones where missing making it difficult to put it together. Due to this we scanned the bones of the *Gorgosaurus libratus* in order to create an accurate depiction of what the skull would look like fully articulated. A put together skull could teach us a lot about the dinosaur.

The *Gorgosaurus Libratus* was a bipedal predator. This dinosaur was approximately 8 meters tall weighing about 2.5 tons. The *Gorgosaurus* most likely hunted in packs. It was a Therapod lizard. [2]

Fossil Materials

- Found in Dinosaur Provincial Park; Quarry number 258; Oldman Formation
- Fossils from the Cretaceous-Cretaceous Late period (The fossils are anywhere between 66-145 million years old [1])
- The only preserved skull bones was the entire left side of the skull. The right-side was missing most of the outer bones (Right dentary, Surangular, Quadrate, Quadratojugal, Articular, and Prearticular)
- The skull itself was about 1 meter in length.

Figure 1: Left Dentary of Gorgosaurus libratus in medial view

Figure 2: Brain Case of Gorgosaurus libratus in medial view

Methods

We scanned the skull of *Gorgosaurus libratus*

3D Scanning

- Scanned the bones using HDI © laser scanner and FlexScan3D ©
- First the scanner was calibrated (adjusting focus, exposure, lighting etc.). After this, depending on the fossils size we would use a rotary board in order to capture the scans.
- Scanning took about 3 weeks total

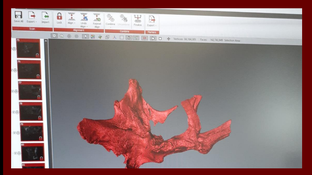

Figure 3: Flex Scan 3D working on the brain case. The brain case was the biggest scan manually done.

Figure 4: HDI scanner scanning the pterygoid on the rotary table.

3D Articulation

- Put the bones together using the software Maya © and Geomagic Design X ©
- We made two versions; one with mirroring and one without mirroring. This was done because some of the bones were missing.
- Took about a week and a half total

Figure 5: Maya articulated skull with mirroring

3D Printing

- Pieces were printed at Cameron Library and The Shack
- We had to cut and fill holes for all the models in order to print
- There were over 40 pieces that were put together
- The models were printed half of their original size to make them fit on the print bed

Results

This is the process and results for the Left Squamosal. All bones underwent the same process.

Figure 5: Left Squamosal bone

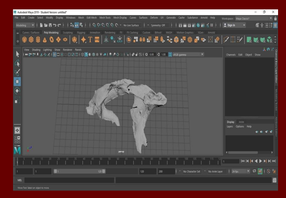

Figure 6: Left Squamosal in Maya; scaled and holes filled

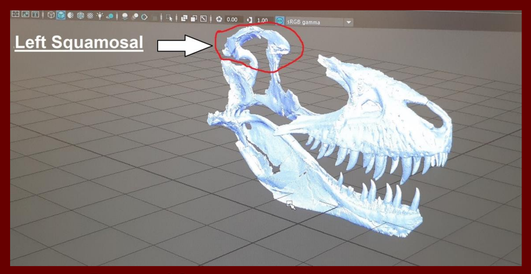

Figure 7: Left Squamosal being articulated into Maya

Figure 8: Left Sqamosal being Printed on 3D Printer

Figure 9: 3D Printed Left Squamosal

Other Modelling Methods

Prior to laser scanning another method of scanning was photogrammetry. This is where you would take pictures of the object and model it in a program known as Agisoft ©. Silicon molds of bones were also done. This process could have damaged the bone. Laser scanning has proved itself to be the most efficient and safest way to scan a bone.

Discussion

- Being able to accurately scan fossils has many implications. Paleontologists who do not have access to the bone can still study it. You can animate the way the dinosaur moved in Maya. You could analyze the bone without damaging it. Being able to Laser scan bones in detail is a very useful process.
- 3D modelling will continue to be used by people around the world to learn more about prehistoric life.

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2. Redpath Museum, 2017, Mcgill Univeristy, https://www.mcgill.ca/redpath/article/gorgosaurus