quantification of actual ontogenetic trajectories in the sample. We evaluated this by plotting principal components (shape data) against centroid size. As expected, when comparing between shape variables, centroid size was the most correlated to shape variability within the sample. This result, in turn, was consistent with a larger dataset, which also validated the importance of shape analysis on shape data when using 2D or 3D GM on fossils that have undergone taphonomic distortion.

Technical Session III (Wednesday, November 5, 2014, 3:00 PM)

A BIOMECHANICAL EXPLANATION FOR THE AMPULAE OF TYRANNOSAURID TEETH BASED UPON FRACTURE MECHANICS

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The teeth of tyrannosaurid dinosaurs possess ampullae, rounded or circular structures found at the demin of serration interdintes. The functions of these structures has been a mystery. Hypotheses include: 1) devices to stymie the propagation of carious infections and 2) serving to maintain the structural integrity of the tooth during feeding. In the latter, the ampullae are depicted as open semi-spherical voids at the end of serration channels. Presumably, they function to decrease the stress concentrations that cause cracking, thereby inhibiting fracture. We conducted a combined histological and FEM mechanical analysis of ampullae in North American tyrannosaurid teeth. The teeth were prepared in a variety of planes using standard petrographic techniques for osseous tissues. Finite element meshes were made for the regions of interest. These incorporated our findings on tissue distribution and inferred material properties. Meshes with and without ampullae were analyzed using uniaxial tension and the comparative stress results analyzed using modern fracture mechanics theory. Our histological results show that fractures do in fact originate between serrations, propagating through the enamel and terminating within individual ampullae. However, we find that the ampullae are solid structures and not voids, and are composed of mantle dentine. These observations necessitated a new explanation for how crack attenuation occurs in the teeth. The FEM analysis revealed that the interdenticle sulcus acted to help the tooth to crack formation at these locations. After propagating through the enamel, fractures terminate within the dentin of the ampullae. We find that stress is "absorbed" by the ampullae, due to their low elastic modulus, inhibiting further crack growth and protecting the tooth from catastrophic failure. However, this is only one potential toughening mechanism and we propose material property testing will be needed to further evaluate the likelihood of any of these mechanisms.

Poster Session IV (Saturday, November 8, 2014, 4:15 - 6:15 PM)

THE DISTRIBUTION OF DENTAL FEATURES IN NON-AVIAN THEROPODS AND A PROPOSED TERMINOLOGY OF THEROPOD TETHES

HENDRICKX, Christophe, Universidade Nova de Lisboa, Caparica, Portugal; MATEUS, Octavio, Universidade Nova de Lisboa, Caparica, Portugal; ARAÚJO, Ricardo, ISTUL, MN, SMU, ML, Lisbon, Berlink, Portugal

Although theropod teeth are abundant vertebrate fossils remains often reported in the literature, they are not comprehensively described since containing extensive anatomical and taxonomic information. Often, the paucity of original descriptions makes identification of isolated teeth difficult, and thus taxonomic assignments uncertain. We propose a standardization of the anatomical and morphometric terms for each tooth anatomical sub-unit, as well as a modus operandi to describe isolated teeth. Crown, carina, cervix, denticle, interdenticular sulcus, interdenticular diaphysis, flute, longitudinal undulation, outline, prepontine ridge, basal undulation, enamel texture are anatomical terms among others proposed to describe theropod teeth. We also investigated the distribution of 50 dental characters related to tooth size, crown shape, diaphysial nature and number of serrations, flute, interdenticular sulcus, prepontine ridge, basal undulation, crown extension, tooth length, and carina texture among 113 theropod taxa. Our research shows that isolated theropod teeth are more informative than previously thought. Most isolated teeth are broken at the identified fracture level and often broken.

Functional clues for each dental feature were assessed to provide context on the degree of homoplasy relating to function. For instance, numerous transversal undulations and marginal undulations are present in non-coelurosaur avestronaws and tyrannosaurs. Hypothetically, enamel undulations may have served to minimize suction when the tooth was pulled out of the flesh, to help strengthen the crown during feeding, or may be a byproduct of growth. Fluted crowns exist in mesial and lateral teeth of Coelophysis, Spinosaurus and some dromaeosauroids, being also common in pircovorous reptiles. Flutes most likely have some piercing and gripping function, allowing the sharp ridges to pierce the skin, and keeping slippery prey in the mouth. Interdenticular sulci are present in the dextin of serration interdintes. The function of these structures has been a mystery. Hypotheses include: 1) devices to stymie the propagation of carious infections and 2) serving to maintain the structural integrity of the tooth during feeding. In the latter, the ampullae are depicted as open semi-spherical voids at the end of serration channels. Presumably, they function to decrease the stress concentrations that cause cracking, thereby inhibiting fracture. We conducted a combined histological and FEM mechanical analysis of ampullae in North American tyrannosaurid teeth. The teeth were prepared in a variety of planes using standard petrographic techniques for osseous tissues. Finite element meshes were made for the regions of interest. These incorporated our findings on tissue distribution and inferred material properties. Meshes with and without ampullae were analyzed using uniaxial tension and the comparative stress results analyzed using modern fracture mechanics theory. Our histological results show that fractures do in fact originate between serrations, propagating through the enamel and terminating within individual ampullae. However, we find that the ampullae are solid structures and not voids, and are composed of mantle dentine. These observations necessitated a new explanation for how crack attenuation occurs in the teeth. The FEM analysis revealed that the interdenticle sulcus acted to help the tooth to crack formation at these locations. After propagating through the enamel, fractures terminate within the dentin of the ampullae. We find that stress is "absorbed" by the ampullae, due to their low elastic modulus, inhibiting further crack growth and protecting the tooth from catastrophic failure. However, this is only one potential toughening mechanism and we propose material property testing will be needed to further evaluate the likelihood of any of these mechanisms.

Poster Session IV (Saturday, November 8, 2014, 4:15 - 6:15 PM)

FAUNAL EVIDENCE FOR HOMININ PALEOVENIRONMENT AND BEHAVIOR IN EARLY PLEISTOCENE CHINA

HENSLEY-MARSCHAND, Blaire, Indiana University, Bloomington, IN, United States of America; KOROTAYEV, Alexei, Institute of Ethnology and Anthropology, Russian Academy of Sciences, Moscow, Russian Federation; TUNMANN, Dominika, Indiana University, Bloomington, IN, United States of America; YANG, Jianchun, Beijing Normal University, Beijing, China.

The expansion of hominins into northeastern Asia has important implications regarding their abilities to adapt to and to survive in new geographic and environmental settings. Here we present evidence of one of the earliest hominins in Asia found at the Paleolithic archaeological site of Feilian in the Nihewan Basin of China. This is an ancient, down-faulted lake basin located approximately 120 km west of Beijing in northwestern Hebei Province. Feilian is situated on the eastern margin of the Nihewan Basin in the Nihewan Formation and is dated to approximately 1.2 million years ago. At this time, no hominin fossils have been found at this locality, but their presence is known based on the discovery of stone tools in association with faunal remains. Homo erectus is suggested to be the first hominin to enter this region of northeastern Asia, where hominins are known from Asia during this time period. An analysis of the faunal collection from Feilian includes 361 mammalian specimens, of which 138 are identifiable to element and 36 are identified to family. The most common hominins in Asia at this time are Homo erectus and Homo luzonensis, although Homo erectus is more abundant. Feilian contains evidence of these hominins, including teeth and other skeletal material. We find that the hominins in Feilian are similar to those in other regions of Asia, such as the Nihewan region and Olduvai Gorge. In Feilian, however, the hominins are more abundant than their counterparts in other regions.

HISTOLOGICAL ANALYSIS OF AN ENIGMATIC MICROSTRUCTURAL PALEOPATHOLOGY ON LIMB BONES OF THE THEROPOD DINOSAUR \textit{FALCARUS UTENSIHS}

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Over the past decade, thousands of bones of the theropod dinosaurus \textit{Falcarius utenshenis} have been recovered from the Crystal Geyser Quarry (CGQ), a mass death assemblage in the Yellow Cat Member of the Cedar Mountain Formation in east central Utah. Several appendicular elements recovered from the CGQ, including a tibia, humerus, and metatarsal, display a prominent pathologic. The CGQ, external in the form of a smooth-surfaced raised bone callus. The bony calluses range in size from approximately 50 to 90 mm and remain undistorted despite widespread crushing of the mass death assemblage. Many specimens have a cavity in several. Here we comparatively examine the paleopathology of an \textit{F. utenshenis} bony callus and a non-pathological bony callus of approximately the same dimensions. The non-pathological bony callus is characterized by uniform fibrous calcification of the cortical bone tissue. The pathological bony callus is characterized by a distinct microstructure, reactive bone surface at the site of the morphology. This includes a cryptogenic material that is embedded between primary and secondary bone matrix and collagen bands of secondarily deposited lamellar bone. Capping this central region and extending to the periosteal surface is a damped mass of reactive, rapidly deposited, secondary bone extending to the radial vascular canals. The opposed endosteal surface exhibits a highly localized region of reactive bone.

LITERATURE ON DIAGNOSTIC PATHOLOGIES VIA HISTOLOGICAL ANALYSIS IS SPARSE. HOWEVER, THIS TECHNIQUE PROVIDES AN INDEPENDENT METHOD FOR EXAMINING BONE MINERALIZATION PATTERNS THAT CAN BE COMPLEMENTARY TO OTHER HISTOLOGICAL METHODS. ADDITIONALLY, PALEOPATHOLOGICAL ANALYSIS OF PATHOLOGIES REVEALS THE STEPSWIESE SEQUENCE OF BONE REMODELING THAT MAY PROVIDE NEW INSIGHT INTO DISEASE PROGRESSION.