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## COMPARATIVE STUDY ON RHINOCEROS HEAD ANATOMY USING ENDOSCOPY, COMPUTED TOMOGRAPHY (CT) AND GROSS MORPHOLOGY

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### Abstract

Studies of rhinoceros head anatomy are rare in the literature.<sup>1,2,4-6</sup> In order to elucidate the normal anatomy and morphology of the rhino head, five adult zoo animals were examined by different methods. The study was carried out for three reasons: First, considering the paucity of information about rhino head anatomy further investigation was indicated. Second, the characterization of the dental apparatus was a primary interest in order to improve the evaluation and current therapies for recurring dental problems in captive animals. Finally, the characterization of the upper respiratory tract was performed in order to describe intubation techniques for improved inhalation anesthesia. Inhalation anesthesia may be necessary if long medical interventions are performed.<sup>3</sup>

The heads of five captive animals of two species (Asian rhinoceros, *Rhinoceros unicornis* and white rhinoceros, *Ceratitherium simum*) that died or were euthanatized for various medical reasons were examined by three methods: endoscopy (live animal), computed tomography and classic preparation techniques (post mortem preparation, band-saw preparation with the frozen head, maceration) (Table 1).

Endoscopic examination gave a detailed insight into the *cavum oris proprium* of the living animal with severe dental problems.<sup>5</sup> The classic preparation techniques provide a detailed analysis of the entire anatomic structures of the head. However, these classic mechanical preparation techniques are destructive as important details are lost during the examination. Therefore computed tomography proved an excellent tool by imaging the anatomic structures *in situ* in a non-destructive way. For example, the osseous structures in a three-dimensional model could be imaged followed by addition of the soft tissue in a definite, preplanned way using the option of “windowing”. In this technical process, selected parts of the dataset can be imaged, while other parts can be faded out, depending on the radiographic density (measured in Hounsfield units, HU). The subject head can be planarly or curvilinearly dissected in a virtual manner. Multiple measurements were easily obtained including the diameters and distances of the oral cavity, the epiglottis and the trachea. A virtual endoscopy within the upper respiratory tract was also performed to review intubation techniques. Specific problems with the computertomographic examination were the large size (the horn) and weight of the rhino heads

combined with the high radiographic density of the integument. Therefore in one specimen, the main part of the horn and associated skin were removed in order to obtain improved image quality of the other head structures. The resulting images showed a significant enhancement of image quality with a decrease in artifact compared to the scan of the intact head. All methods were considered to be of value for the study with the combination of techniques enabling a detailed investigation of rhino skull and head morphology.

#### LITERATURE CITED

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**Table 1. Specimen and method of examination.**

Species (#)	Sex	Endoscopy (live animal)	Computed Tomography	Post Mortem Preparation	Band-Saw Preparation	Maceration
<i>Cerat. simum</i> I	male			x		x
<i>Cerat. simum</i> II	female				x	
<i>Cerat. simum</i> III	female			x		x
<i>Cerat. simum</i> IV	female		X	x		
<i>Rhino. unicornis</i> I	female			x	x	
<i>Rhino. unicornis</i> II	female	x	X		x	