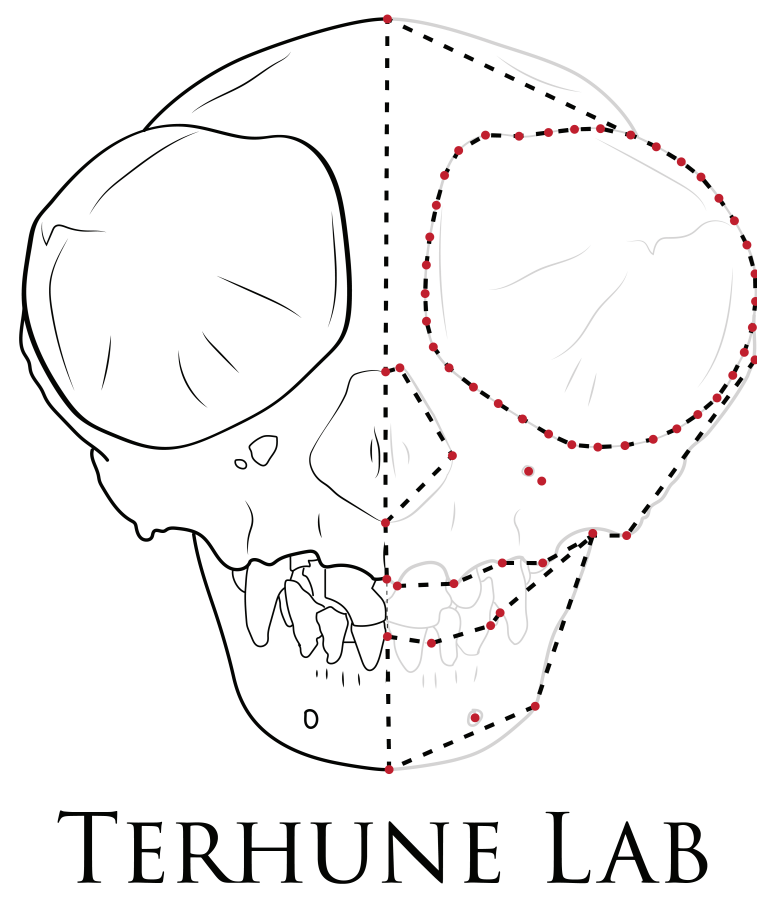


A survey of the inferior alveolar nerve and its corresponding bony canal and foramina in primates

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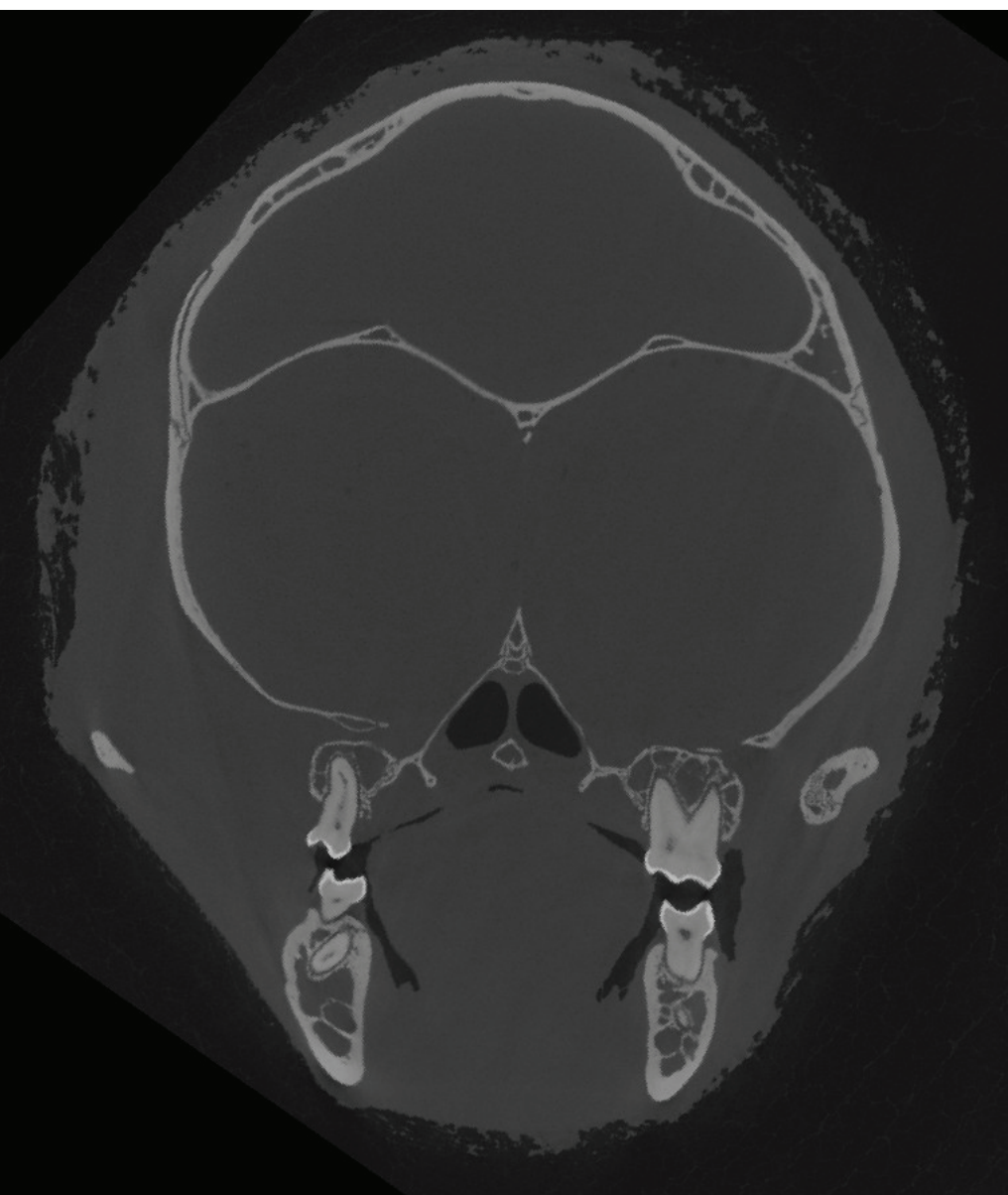
Introduction

Bony canals and foramina often form around soft-tissue structures that appear first in growth and development, thus allowing us to study the bony components rather than the nervous or vascular tissues themselves. However, recent research^{1,2,3} has shown that while canals/foramina may form initially around soft-tissue structures, they may not always represent the size and shape of those soft tissues throughout all points in an individual's life (e.g., the hypoglossal nerve/canal). While the mandibular canal has been studied extensively^{4,5,6}, there is little research regarding its relationship to the nerve it houses, the inferior alveolar nerve (IAN). Because it has been shown⁷ that the size of a nervous structure directly correlates to the speed and type of information (i.e., pain, temperature, etc.) a specific nervous structure can transmit, knowing the size of a nerve and its structure can help determine the information it can convey from the periphery to the central nervous system. The majority of work done on the IAN is found in the dentistry literature because this nerve can be damaged during procedures involving the mandibular tooth row. The work that has been done^{8,9} describes the canal/nerve relationship in humans as incredibly close and often shows the inferior alveolar artery (IAA) as traveling the length of the canal alongside the nerve. The IAN senses the vast majority of somatic sensation along the bottom tooth row and is thus integral to assessing the material properties of food while chewing. In turn, the ability to chew foods and not damage the teeth is critical for masitatory function. **This project explores the relationship between the IAN and the mandibular canal to establish if the canal can be used as a proxy for the nervous tissues.**

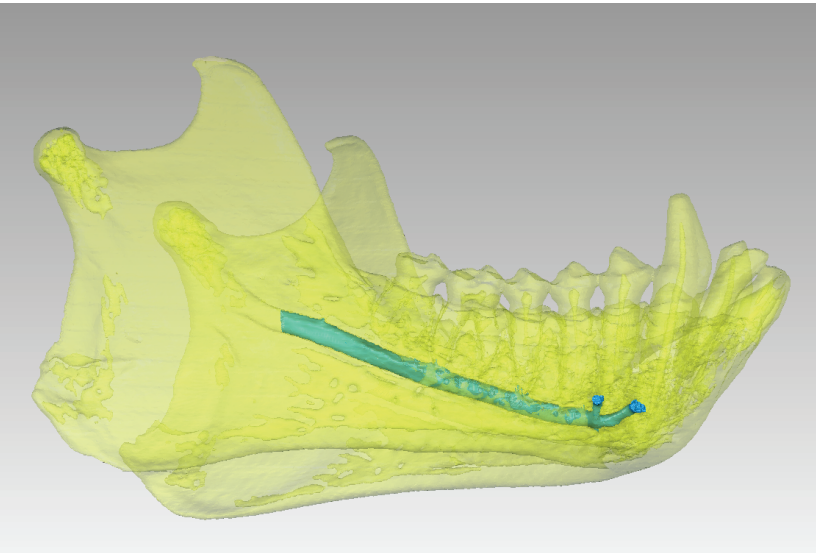
Materials and Methods

	Hard Tissue	diceCT stained
n	273	66
Females	131	23
Males	134	35
Unknown sex	8	8
Mammalian outgroups	3 (n = 10)	3 (n = 10)
# of primate species	68	33

CT scan of bony material

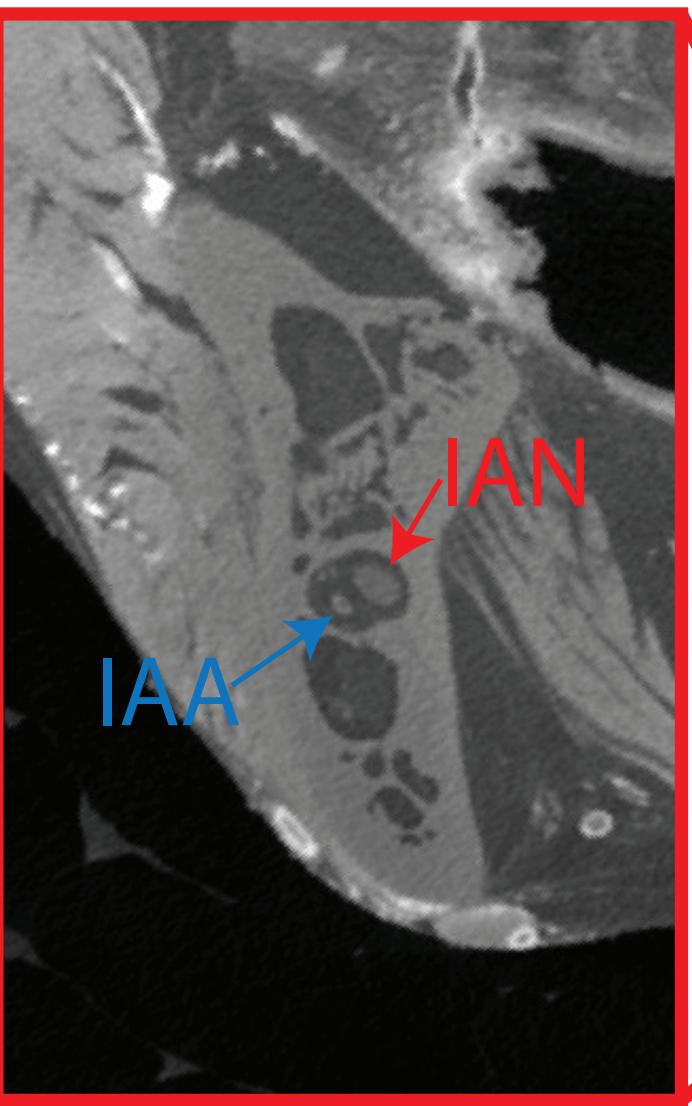
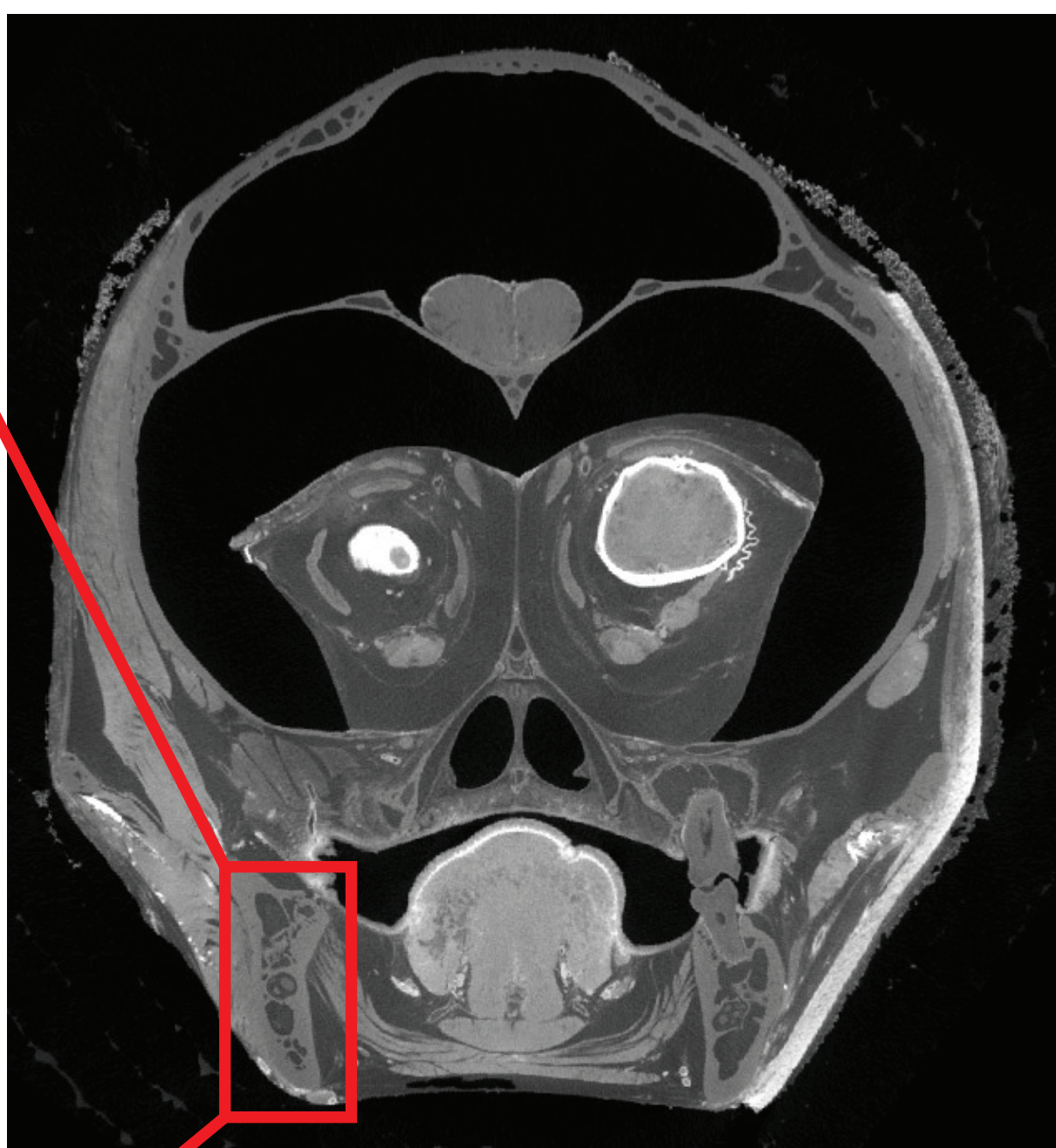


Saimiri sciureus



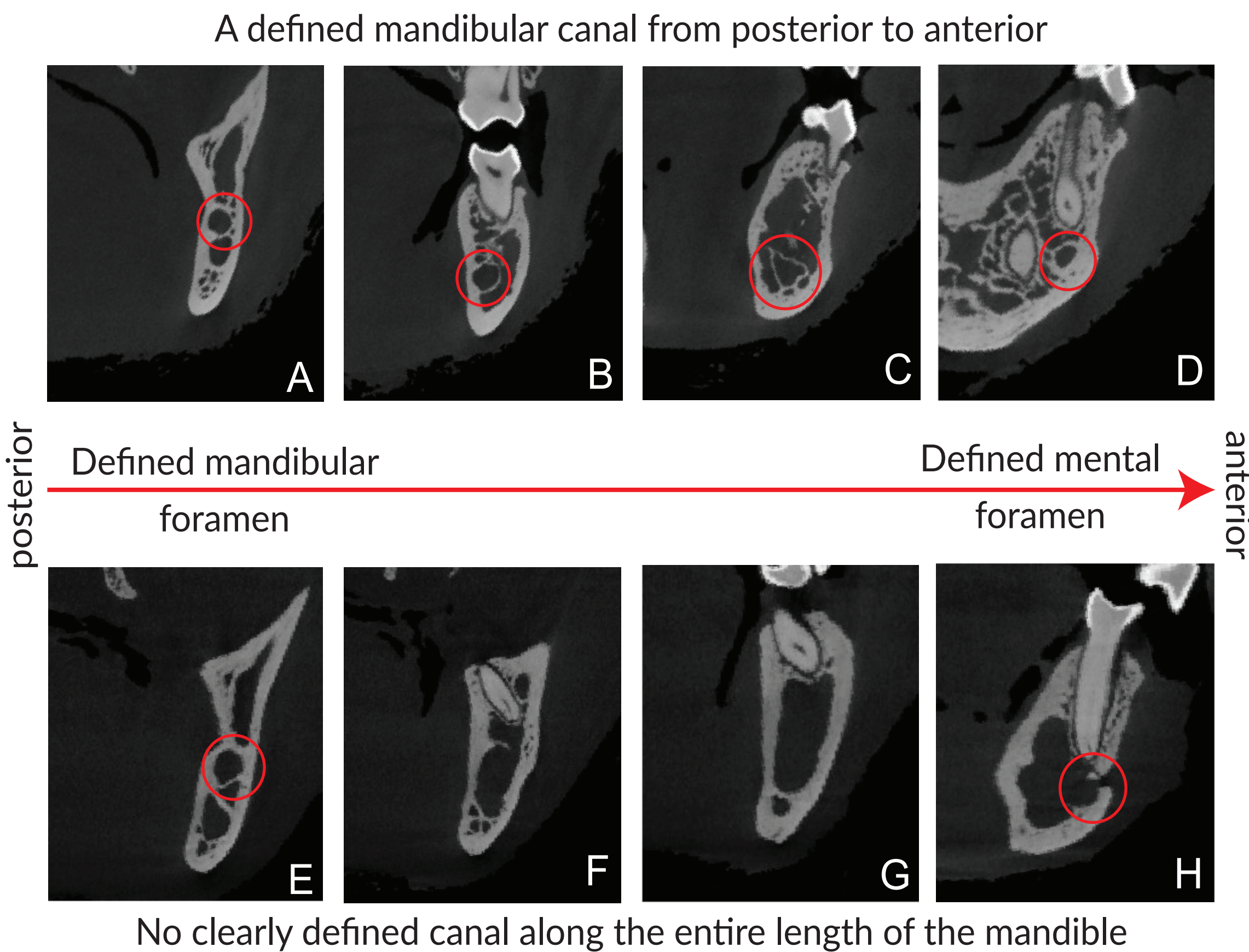
A segmented mandibular canal in Geomagic (segmentations done in Avizo)

CT scan after diceCT stain¹⁰

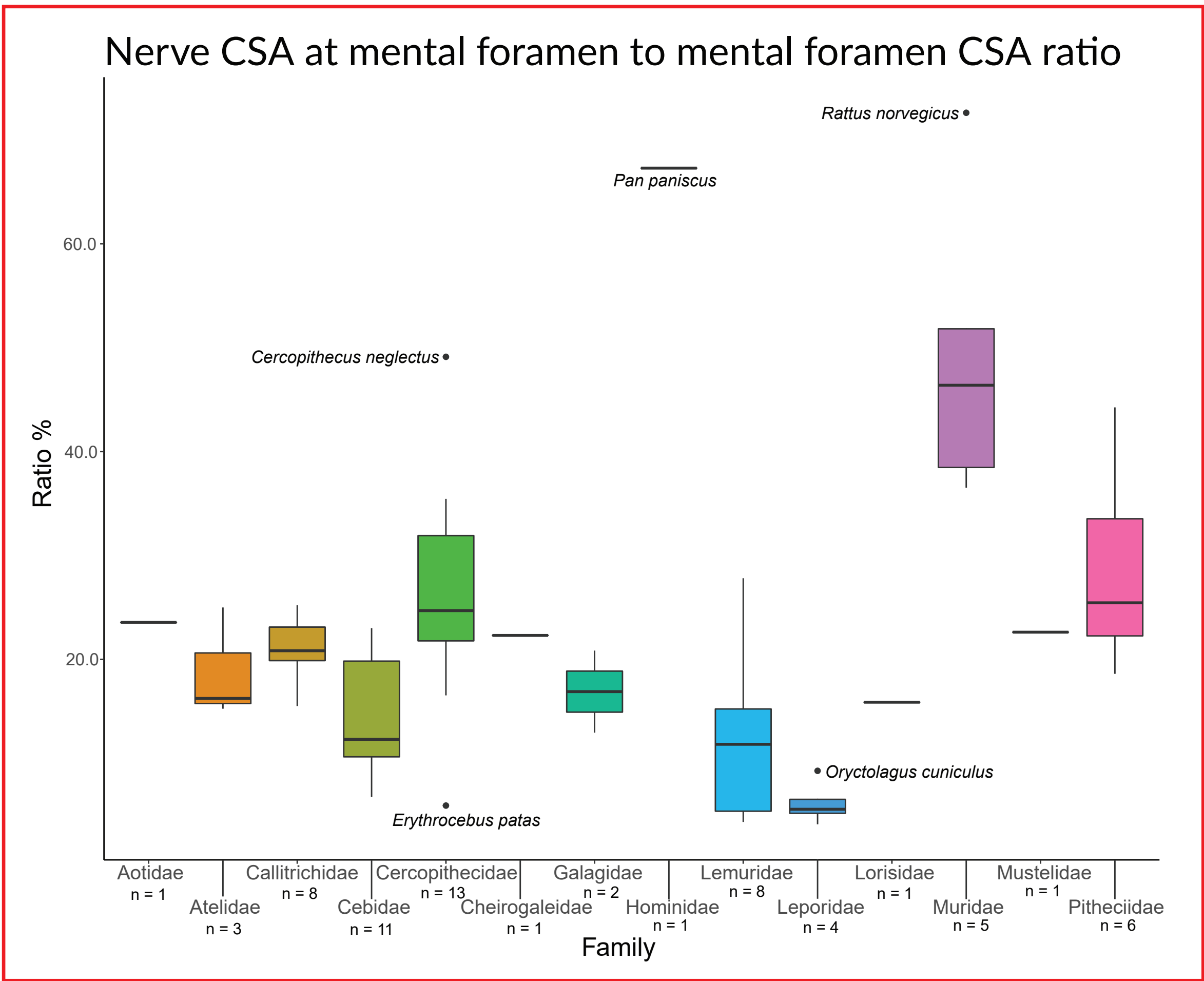


Results

- 25.1% of individuals had a defined canal along the entire length of the mandible/canal
- The IAN does not comprise a majority of the space within the mandibular canal
- The mandibular canal should NOT be used as a proxy for IAN size or nerve sensitivity



No clearly defined canal along the entire length of the mandible



Phylogenetic generalized least squares analysis results

Dependent variable	Independent variable	R ²	p-value
Mandibular foramen CSA	Nerve CSA at mandibular foramen	0.950	< 0.001
Mental foramen CSA	Nerve CSA at mental foramen	0.759	< 0.001
CSA of canal beneath M ₁	CSA of nerve beneath M ₁	0.865	< 0.001
CSA of canal beneath P ₄	CSA of nerve beneath P ₄	0.841	< 0.001
Mandibular canal volume	Mandibular nerve volume	0.954	< 0.001

Ratio averages and ranges across all variables

Denominator	Numerator	N	%Average	%Range	SD
Mandibular foramen CSA	Nerve CSA at mandibular foramen	66	23.84	11.71 - 36.65	0.059
Mental foramen CSA	Nerve CSA at mental foramen	66	22.35	4.13 - 72.61	0.139
CSA of canal beneath M ₁	CSA of nerve beneath M ₁	21	25.86	8.07 - 66.67	0.173
CSA of canal beneath P ₄	CSA of nerve beneath P ₄	13	19.72	10.51 - 35.09	0.072
Mandibular canal volume	Mandibular nerve volume	21	21.64	10.39 - 33.82	0.073

Ratio and average values represent % of canal IAN occupies

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MicroCT Imaging Consortium
for Research and Outreach



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Discussion

The IAN does not comprise most of the mandibular canal, the mental foramen, or the mandibular foramen across the species assessed here. Interestingly, while the IAN at the mandibular foramen and along the canal are similar in size across all species (when size is accounted for) there were two clear outliers at the mental foramen: *Pan paniscus* and *Rattus norvegicus*. This could indicate that these two groups have higher levels of somatosensation along the lower lip. Second, the mandibular canal is often not a canal at all except for the two foramina terminations and is much more accurately - but not always - described as an open space of trabecular bone within the body of the mandible. Finally, the PGLS analyses here show that although the size of the canal does not accurately represent the size of the IAN, the two structures are significantly related to one another. Overall, this work shows canals used to house peripheral nervous tissues should be used with caution as proxies for soft tissues and that these canals should not necessarily be used to infer somatosensory capabilities.