Permanent and deciduous canine size in tufted vs. untufted capuchins

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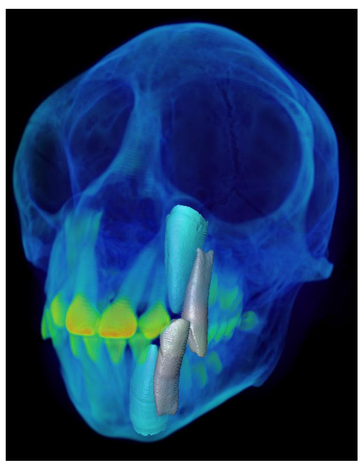
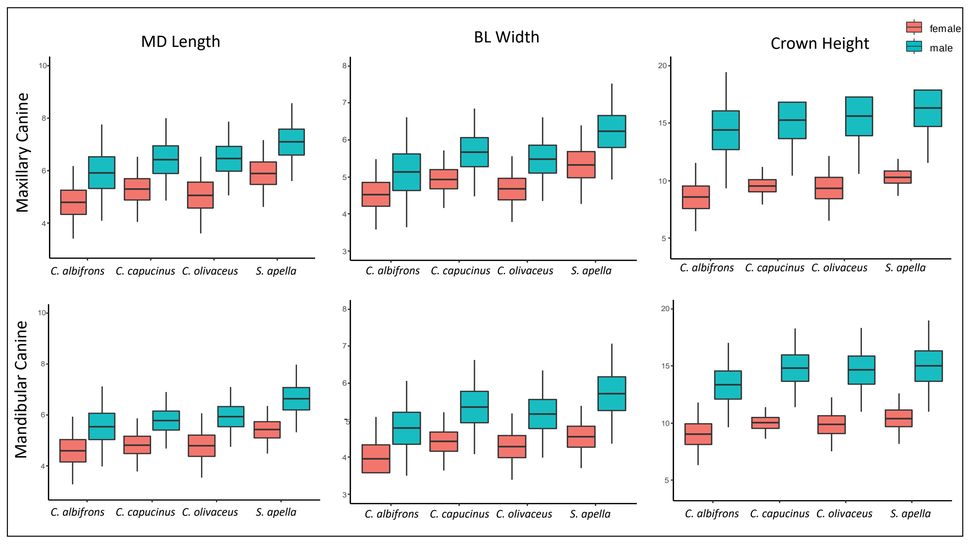
INTRODUCTION: Tufted capuchins (*Sapajus* spp.) feed on more resistant foods than untufted capuchins (*Cebus* spp.), which has resulted in selection for robust morphologies in *Sapajus*, including more advantageous jaw leverage (e.g., Wright, 2005). Prior analyses have also documented clear intraspecific differences in adult canine size dimorphism between sexes within capuchin species and interspecific differences in adult canine dimensions between species (Masterson, 2003), which are likely a result of a combination of sexual selection and feeding behavior. However, no analyses have examined how the deciduous canines mirror the patterns observed in adults. **Here we examine dimensions of both the permanent and deciduous canines in an ontogenetic sample of tufted and untufted capuchins with the goal of identifying whether there are inter- and intraspecific patterns in deciduous canine size.**

MATERIALS AND METHODS:

- MicroCT scans of 20 *Cebus* and 33 *Sapajus* soft-tissue specimens ranging in dental age from partially erupted deciduous dentition to fully adult
- Mandible, crania, and teeth segmented out in Avizo
- Maxillary and mandibular deciduous and permanent canines measured in Geomagic: mesiodisal (MD) length at EDJ, buccolingual (BL) width at EDJ, crown height
  - Partially formed crowns measured and ~% formation estimated
- Permanent canine size/shape used to assign individuals to sex
- Analyzed both raw measurements and data scaled by average adult mandible length per species
- Descriptive statistics, t-tests, and/or ANOVA to examine differences between species/sexes
- Measurements compared to published adult capuchin canine measurements from Masterson (2003)



Volume rendering of a juvenile Cebus *sp. individual showing segmented deciduous and permanent canines*

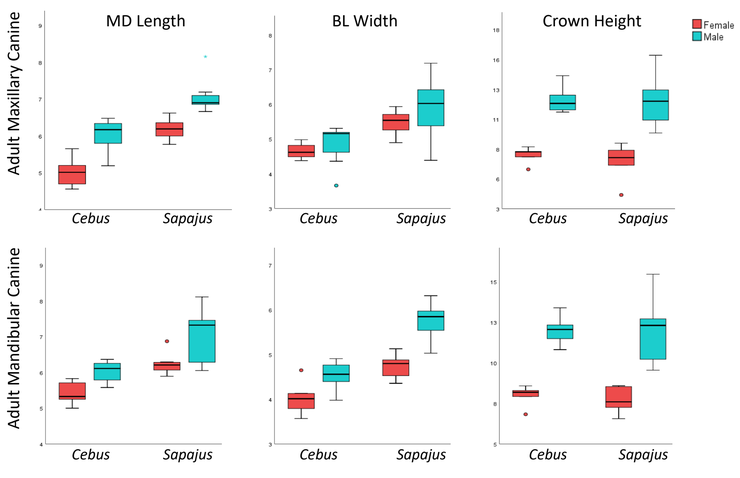


Adult canine data by sex for four species of capuchins (Cebus albifrons, Cebus capucinus, Cebus olivaceus, and Sapajus apella) from Masterson (2003)

RESULTS:

Permanent Canines

- Adult canine measurements are consistent with data from Masterson (2003)
  - *Sapajus* canines are absolutely larger than *Cebus* in most dimensions, but not necessarily larger when scaled by mandible length
  - Most measurements are both absolutely and relatively larger in males than in females within species, except BL width

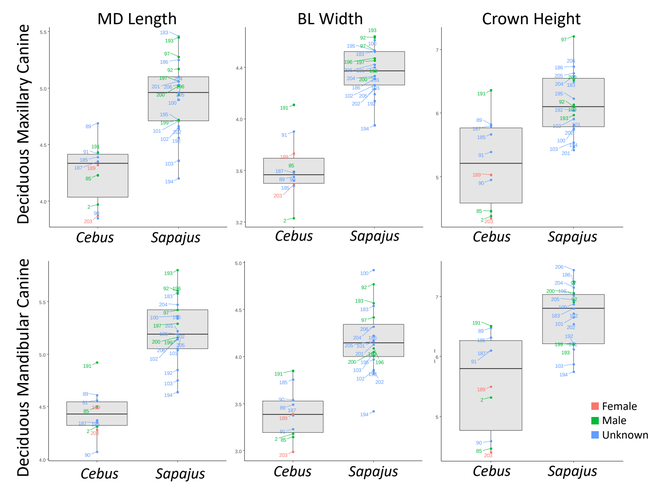


Box plots (left, raw data) and Tukey post-hoc p-values for differences (scaled) between Cebus *females (CF) and males (CM) and* Sapajus *females and males (SF and SM)*

		CF	CM	SF	SM
MaxC MD	CF	-	**0.001**	**0.021**	n/a
	CM	**0.002**	-	n/a	0.074
	SF	**<0.001**	n/a	-	**0.004**
	SM	n/a	**<0.001**	**0.003**	-
MaxC BL	CF	-	0.953	0.574	n/a
	CM	0.959	-	n/a	0.210
	SF	0.110	n/a	-	0.625
	SM	n/a	**0.019**	0.608	-
MaxC Ht	CF	-	**<0.001**	0.641	n/a
	CM	**<0.001**	-	n/a	0.692
	SF	0.940	n/a	-	**<0.001**
	SM	n/a	1.000	**<0.001**	-
ManC MD	CF		0.099	0.450	n/a
	CM	0.129	-	n/a	0.241
	SF	**0.024**	n/a	-	**0.038**
	SM	n/a	**0.005**	**0.034**	-
ManC BL	CF	-	0.054	0.250	n/a
	CM	0.067	-	n/a	**0.001**
	SF	**0.008**	n/a	-	**<0.001**
	SM	n/a	**<0.001**	**<0.001**	-
ManC Ht	CF	-	**<0.001**	0.648	n/a
	CM	**<0.001**	-	n/a	0.641
	SF	0.983	n/a	-	**<0.001**
	SM	n/a	0.999	**<0.001**	-

Deciduous Canines

- Deciduous canine measurements show consistent differences in absolute and relative dimensions between *Sapajus* and *Cebus*, except in scaled crown height
- There are no consistent differences in measurements between sexes (as indicated by permanent canines) within species



Box plots (left, raw data) and t-test results for differences between Cebus *and* Sapajus *deciduous canine measurements*

		t	df	p-value
raw data	MaxdC_MD	-5.48	29	**<0.001**
	MaxdC_BL	-9.83	29	**<0.001**
	MaxdC_Ht	-3.45	28	**0.002**
	MandC_MD	-7.46	29	**<0.001**
	MandC_BL	-6.21	28	**<0.001**
	MandC_Ht*	-3.78	12.4	**0.002**
scaled data	MaxdC_MD	-2.68	29	**0.012**
	MaxdC_BL	-5.93	29	**<0.001**
	MaxdC_Ht	-1.74	28	0.092
	MandC_MD	-4.08	29	**<0.001**
	MandC_BL	-4.04	28	**<0.001**
	MandC_Ht*	-2.13	11.9	0.054

*equal variances not assumed

DISCUSSION: Our data demonstrate consistent differences in both permanent and deciduous canine dimensions between *Sapajus* and *Cebus,* and between sexes within adults of both species. Results for the adult canines are consistent with previous work by Masterson (2003), though in contrast to this previous work our results suggest that buccolingual width is less reliable. We also note that canine crown height, while an excellent indicator of sex, does not differ significantly between *Cebus* and *Sapajus* either for the raw data or when scaled by mandible length. Our analyses of the deciduous canines reflect these differences in dimensions between genera, but we do not observe any sexual dimorphism in deciduous crown dimensions within species. Previous analyses of deciduous dental dimensions in cercopithecoids (Koppe and Swinder, 2004) have found similar results, though some analyses suggest that humans display slight canine dimorphism in the deciduous dentition (e.g., Black, 1978). This lack of sexual dimorphism in the juvenile teeth of capuchins is unfortunate, since identifying sex in very young individuals is challenging and often impossible on the basis of craniodental remains alone, which hinders ontogenetic analyses of feeding behavior. One possible path forward in this regard is to pair dental dimensions with other aspects of craniofacial shape to identify sex in particularly young individuals.

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