

BACKGROUND

Children born with cleft palate typically undergo primary palatoplasty within the first 2 years of life with the goal of anatomic restoration of the palate. This surgery also allows for the development of normal speech and swallowing patterns. To the best of our knowledge, *no large-scale quantitative data exists regarding typical velopharyngeal (VP) structures for infants and toddlers within the first 2 years of life.* This is particularly relevant to children born with cleft palate, as the primary goal of surgery is to establish “normalcy” within this region.

This retrospective study aimed to:

- (1) quantify the impact of age, sex, and race on the size and orientation of VP structures during the first 2 years of life
- (2) provide normative data for future comparison to infants born with cleft palate

METHODS

- An *a priori* power analysis was completed. A retrospective chart review was completed for all patients <24 months of age that underwent MRI of the head for medical necessity using a 3D FLAIR sequence at a large pediatric hospital within past 18 months.
 - Exclusion criteria: Poor scan quality, medical diagnoses/structural conditions affecting VP region
- VP measurements were obtained for 184 patients using ThermoFisher™ Amira™ software.
- Participants were divided into 5 groups based on corrected age.
- A MANCOVA was used to assess differences in VP variables by corrected age group while controlling for sex and race.
- Inter- and intra-rater reliability were completed using a PPMC ($r = 0.90+$).

RESULTS

Table 1. Association between measures and corrected age controlling for sex and race * $\alpha < .05$

Measure	Corrected Age ANCOVA p-value	Race ANCOVA p-value	Sex ANCOVA p-value	MANCOVA p-value
Adenoid Depth	0.0001*	0.4556	0.0794	<0.0001*
Angle of Origin	0.0602	0.4973	0.1266	
Effective VP Ratio	0.9241	0.8756	0.1126	
Effective Velar Length	0.0079*	0.9689	0.0225*	
Levator Length	<0.0001*	0.0519	<0.0001*	
Origin to Origin Distance	<0.0001*	0.6715	0.0019*	
PNS-PPW	0.0021*	0.8857	0.8774	
Sagittal Angle	0.0016*	0.2600	0.8240	
VP Ratio	0.0637	0.7041	0.3363	
Velar Insertion Distance	<0.0001*	0.7136	0.0283*	
Velar Length	<0.0001*	0.4788	0.0166*	
Velar Thickness	<0.0001*	0.2872	0.3709	

Table 2. Group means and standard deviations (in parentheses) for all variables and means for male and female participants below (male | female)

Variable	Group .5 (<0 yr) -0.05 (<.0)	Group 1 (0-.5 yr) 0.19 (0.2)	Group 2 (.5-1 yr) 0.72 (0.1)	Group 3 (1-1.5 yr) 1.24 (0.2)	Group 4 (>1.5 yr) 1.79 (0.1)
Adenoid Depth	1.66 (1.4) 1.80 1.57	4.42 (2.9) 4.43 4.41	8.03 (3.5) 8.95 6.20	9.09 (3.8) 9.16 9.03	7.52 (4.2) 8.39 6.80
Angle of Origin	53.47 (6.0) 55.30 52.37	50.63 (3.6) 51.38 49.59	51.98 (3.7) 52.53 50.89	53.02 (2.6) 53.09 52.96	52.23 (3.4) 53.71 51.03
Effective VP Ratio	0.47 (0.1) 0.47 0.47	0.51 (0.1) 0.53 0.48	0.55 (0.2) 0.59 0.47	0.49 (0.1) 0.48 0.51	0.50 (0.2) 0.55 0.46
Effective Velar Length	6.65 (1.4) 7.45 6.16	7.85 (1.8) 8.03 7.60	8.26 (1.7) 8.38 8.01	8.02 (1.7) 8.08 7.96	9.00 (1.9) 9.69 8.38
Levator Length	18.33 (2.6) 17.21 19.00	24.12 (2.9) 24.09 24.16	27.79 (2.2) 28.06 27.25	29.23 (2.1) 29.87 28.64	30.59 (2.0) 31.47 29.88
Origin to Origin Distance	26.63 (4.4) 24.67 27.81	34.98 (4.3) 34.68 35.40	39.66 (3.4) 39.95 39.08	41.11 (2.9) 41.84 40.44	43.03 (3.3) 43.62 42.55
PNS-PPW	14.03 (1.6) 15.62 13.08	15.79 (2.6) 15.66 15.96	15.68 (3.7) 14.70 17.64	16.83 (3.3) 17.27 16.43	18.77 (3.5) 18.55 18.95
Sagittal Angle	94.80 (7.7) 93.90 95.34	87.21 (8.8) 86.12 88.71	82.30 (8.8) 81.05 84.80	81.57 (11.9) 80.24 82.78	77.81 (6.9) 81.37 74.90
VP Ratio	1.21 (0.2) 1.12 1.26	1.34 (0.3) 1.33 1.34	1.57 (0.4) 1.69 1.35	1.56 (0.4) 1.56 1.57	1.45 (0.4) 1.48 1.43
Velar Insertion Distance	11.14 (2.1) 10.59 11.47	12.21 (1.7) 12.43 11.90	13.73 (2.0) 13.94 13.33	14.46 (1.7) 14.53 14.40	15.48 (2.1) 16.38 14.74
Velar Length	16.82 (2.0) 17.48 16.42	20.71 (3.4) 20.51 20.99	23.44 (2.4) 23.72 22.88	25.29 (2.4) 26.10 24.54	26.19 (2.6) 26.39 26.04
Velar Thickness	4.47 (0.8) 5.01 4.15	5.64 (1.1) 5.62 5.66	6.06 (1.2) 6.26 5.67	6.78 (1.4) 7.04 6.54	7.07 (1.2) 6.89 7.23

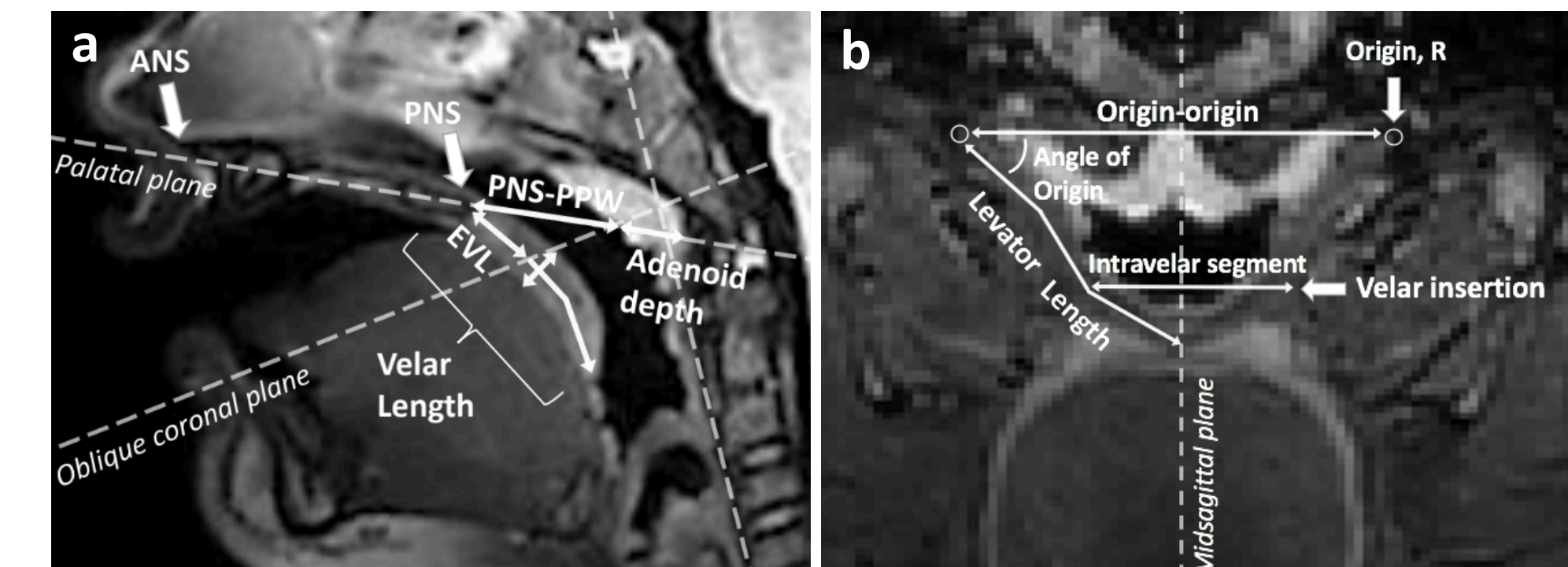


Figure 1a and 1b. Demonstration of measures obtained across VP variables in the a) sagittal plane and b) oblique coronal plane

DISCUSSION

Results demonstrate a significant impact of age on VP dimensions, which appears to be unrelated to the observed sex and race trends. VP variables also displayed sexual dimorphism with males exhibiting significantly larger measurements for 5 of the 12 variables.

Previous investigations into the VP mechanism among infants have primarily focused on infants with cleft palate. Results from this study provide an age- and sex- specific normative database for VP variables. This might have implications for evaluation of infants born with cleft palate and may be used to guide treatment and optimize speech/surgical outcomes within this population.

Limitations: This is a retrospective study. In such, there may be unforeseen confounding variables, such as syndromes/diagnoses that were not documented at the time of the MRI, which may have impacted the results.



SCAN ME

CONCLUSIONS

Significant variations in VP dimensions based on age and sex were observed in children under 2 years old. Data from the present study provide a normative database for future comparison to children born with cleft palate.