

Airway Dimension Change Assessment in Individuals After Open Bite Treatment

Mehtab Warya, Nick Vermette, Mona Awadi, Heeyeon Suh, Joorok Park, Heesoo Oh

Craniofacial Research Instrumentation Lab, Department of Orthodontics
University of the Pacific Arthur A. Dugoni School of Dentistry



Introduction

- Healthy airway function is an integral part of an individual's overall health and wellbeing. Airway obstruction can result in mouth breathing and low tongue position, leading to an open bite.¹ Thus, with the ability to alter the alignment of the dentition and dentofacial structures with orthodontic treatment, clinicians may be able to improve a patient's airway to a statistically significant degree.
- Several publications have demonstrated statistically significant changes in airway dimension upon treatment of open bite malocclusion.
- Gracco et al. found a strong correlation between nasopharyngeal development, inherent mouth breathing, and skeletal and dental malocclusions.²
- Chen et al. found that the retroglossal airway width and retroglossal area measured on cephalometric radiographs both increased significantly after open bite treatment.³

Objectives:

- To investigate whether orthodontic treatment to close anterior open bite leads to a change in airway dimension.
- To determine whether growing and non-growing patients undergoing treatment for open bite malocclusion display a significant change in airway dimension.

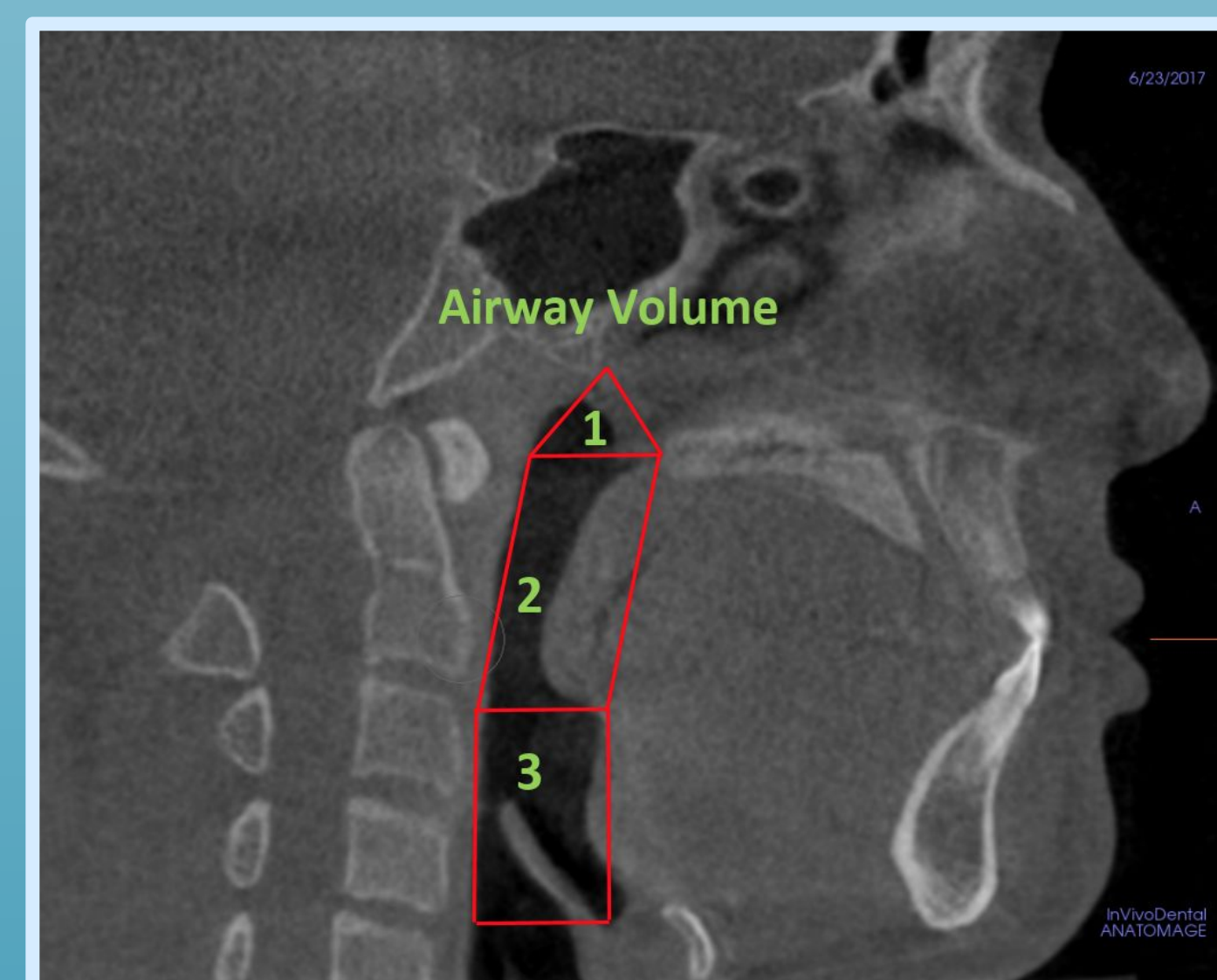


Figure 1A. Airway volume measured after dividing it into 3 areas: 1) Nasopharynx 2) Upper oropharynx 3) Lower oropharynx. Volume and cross sectional area recorded for the 3 areas.

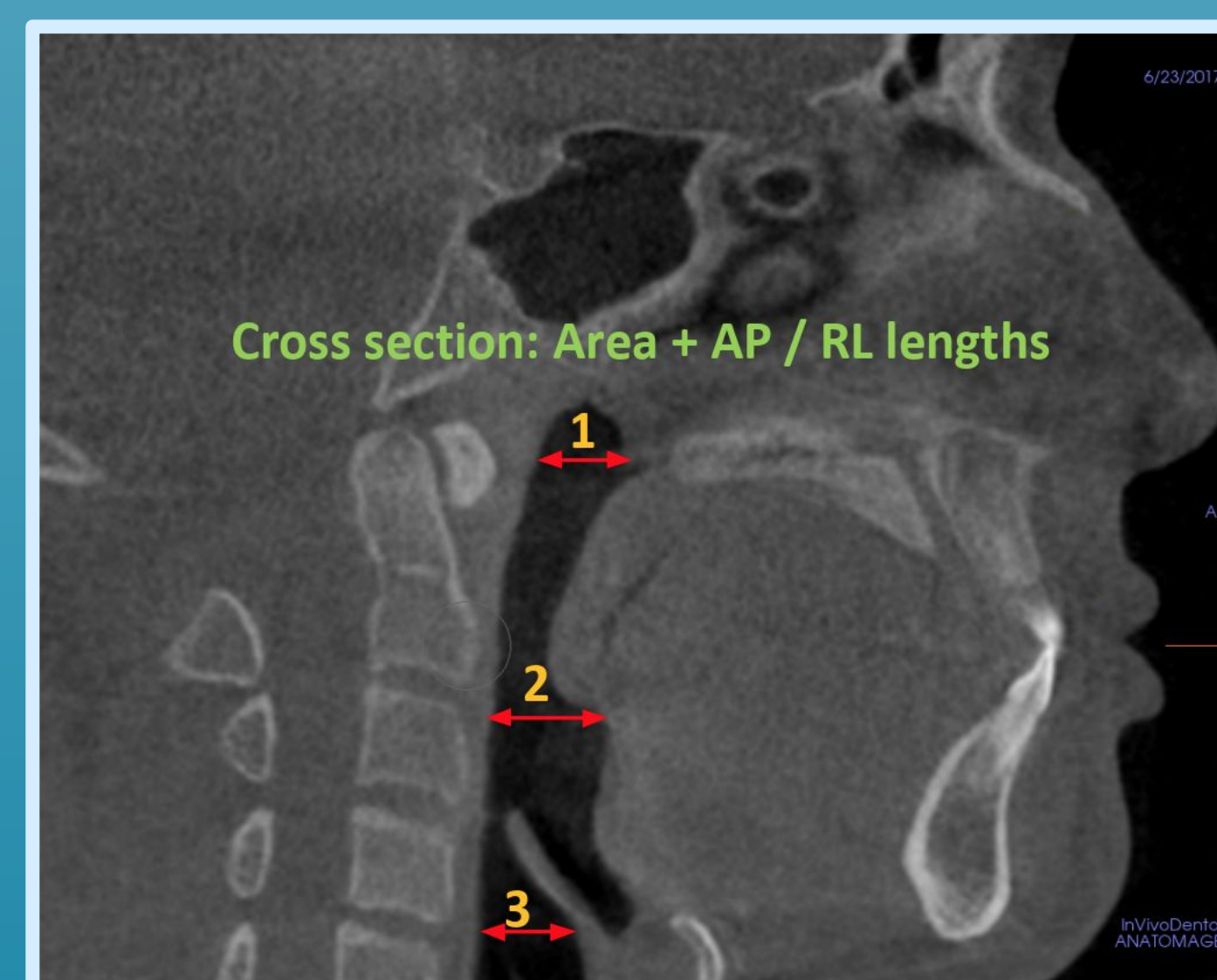


Figure 2B. Airway measurements include: anterior-posterior lengths (sagittal), right and left lengths (transverse), minimal cross-sectional area, AP, RL and cross section area recorded for nasopharynx, upper oropharynx and lower oropharynx.

	T1	T2	T2-T1	Paired t-test
M.AP	11.51 ± 3.41	11.54 ± 3.29	.04 ± 2.71	NS
M.LR	20.60 ± 7.52	21.22 ± 6.35	.62 ± 6.20	NS
M.X.SEC	239.30 ± 125.63	241.10 ± 108.78	1.77 ± 112.95	NS
L.AP	9.34 ± 3.51	9.47 ± 3.45	0.12 ± 3.99	NS
L.LR	24.65 ± 8.00	23.05 ± 7.94	-1.59 ± 8.14	NS
LX.SEC	232.60 ± 119.90	221.50 ± 103.70	-11.05 ± 118.77	NS
U.VOL	7.93 ± 3.67	8.21 ± 3.82	0.29 ± 2.73	NS
U.MCA	185.70 ± 92.01	183.48 ± 83.36	-2.19 ± 77.84	NS
L.VOL	6.89 ± 4.29	7.11 ± 3.48	0.23 ± 3.45	NS
L.MCA	170.18 ± 110.38	165.20 ± 86.48	-5.02 ± 93.71	NS

Table 1. Airway change measured in entire sample. Airway dimension at T1, T2, and airway dimension change during treatment (T2-T1) (n=53). $\alpha < 0.05$. NS = not significant.

Materials and Methods

- Design
 - Retrospective study
 - Patient records were collected from the University of the Pacific Graduate Orthodontic clinic.
- Sample
 - 53 subjects treated for open bite treatment since 2006, excluding orthognathic surgery and craniofacial patients.
 - Sample consisted of 29 females and 24 males between the ages of 10-43, with a mean age of 20.42.
 - All subjects presented with clinical photos and both T1 (before orthodontic treatment) and T2 (after orthodontic treatment) CBCT records.
 - Sample included 17 subjects with premolar extraction treatment and 36 subjects with no- extraction treatment; 44 subjects had fixed treatment and 9 subjects had Invisalign treatment.
- Method
 - 2 judges measured airway dimensions using Invivo 6 software.
 - 1. Airway change was measured in the entire sample
 - 2. Airway change was measured in growing vs non-growing groups
 - 3. Airway change was measured in non-extraction growing and non-growing groups
 - The airway was divided into three areas and measured in four ways (Figure 1). Upper oropharynx (U) and lower oropharynx (L) volume (VOL) and minimal cross-sectional area (MCA) were used for analysis.
- Statistics
 - ICC utilized to determine reliability of the landmark tracings performed by the 2 judges.
 - Airway size measurements demonstrated good interrater reliability, ranging from 0.74-0.97. ICC values greater than 0.92 for U.VOL, UMCA, L.VOL and L.MCA measurements.
 - Paired t-test performed to determine statistical significance between the T1 and T2 data points.
 - Independent t-test performed to determine statistical significance between growing and non-growing groups.

Results

- The paired t-test concludes no statistically significant change in airway dimensions after open bite treatment (Table 1).
- Since the paired t-test values were less than the alpha value of 0.05, 0.01 for U.VOL and 0.04 for U.MCA, the statistical analysis suggests that there is a significant increase in U.VOL and U.MCA in the growing group (Table 2).
- However, since the independent t-test values are greater than the alpha value, there is no significant difference between the growing (14 females and 6 males) and nongrowing group (14 females and 14 males) (Table 2).
- The paired t-test suggests that there is a significant increase in U.VOL (t = 0.01), U.MCA (t = 0.01), and L.VOL (t = 0.02) in the non-extraction growing group that consisted of 9 females and 3 males (Table 3).
- In addition, the independent t-test shows that there is a significant difference in U.VOL (t = 0.03), U.MCA (0.01), and L.VOL (0.01) landmarks (Table 3).
 - The significant increase in U.VOL, L.VOL, and U.MCA between growing and non-growing groups is visualized in figure 2.

	Growing				Non-growing					
	T1	T2	T2-T1	Paired t-test	T1	T2	T2-T1	Paired t-test	Independent t-test	
U.VOL	6.12 ± 2.88	7.43 ± 2.54	1.31 ± 2.18	0.01	U.VOL	8.78 ± 3.87	8.91 ± 4.56	0.13 ± 2.58	NS	0.09
U.MCA	158.69 ± 74.63	187.30 ± 65.63	28.63 ± 57.49	0.04	U.MCA	187.30 ± 96.03	185.56 ± 96.22	-1.75 ± 60.65	NS	0.08
L.VOL	5.57 ± 3.44	7.06 ± 3.09	1.49 ± 3.42	0.07	L.VOL	6.99 ± 4.45	6.82 ± 3.57	-0.17 ± 3.06	NS	0.09
L.MCA	135.80 ± 49.78	165.9 ± 75.23	30.15 ± 75.51	0.09	L.MCA	167.40 ± 119.75	161.50 ± 92.34	-5.85 ± 76.58	NS	0.11

Table 2. Airway change measured in growing vs non-growing groups. Growing individuals include females < 15 yrs, males < 18 yrs at T1 and females < 19 yrs, males < 19 yrs at T2 (n=20). Non-growing individuals include females ≥ 15 yrs, males ≥ 18 years (n=28). $\alpha < 0.05$.

	Growing				Non-growing					
	T1	T2	T2-T1	Paired t-test	T1	T2	T2-T1	Paired t-test	Independent t-test	
U.VOL	5.20 ± 2.28	7.20 ± 2.74	2.00 ± 2.04	0.01	U.VOL	8.88 ± 4.21	9.01 ± 4.83	0.13 ± 2.68	NS	0.03
U.MCA	132.21 ± 51.84	180.90 ± 68.66	48.65 ± 49.88	0.01	U.MCA	181.20 ± 100.70	176.76 ± 96.62	-4.48 ± 62.15	NS	0.01
L.VOL	4.57 ± 1.31	6.95 ± 3.34	2.38 ± 2.89	0.02	L.VOL	6.46 ± 4.35	6.17 ± 3.47	-0.28 ± 2.55	NS	0.01
L.MCA	125.07 ± 38.33	165.61 ± 89.17	40.54 ± 83.51	0.12	L.MCA	158.21 ± 123.56	155.21 ± 98.83	-3.00 ± 79.05	NS	0.15

Table 3. Airway change measured in non-extraction growing and nongrowing groups. Growing individuals consist of 9 females <15 yrs and 3 males <18 at T1 (n=12). Non-growing individuals consist of 12 females ≥ 15 yrs and 11 males ≥ 18 yrs (n=23).

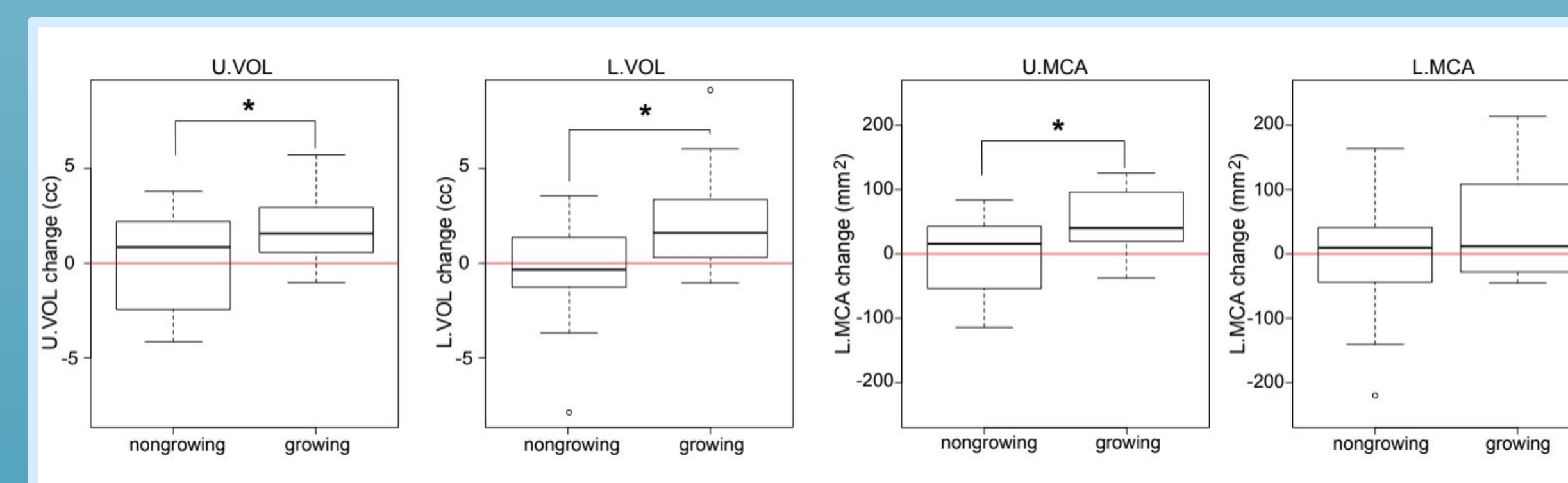


Figure 2. Airway volume and minimal cross section area change of non-extraction growing and adult groups. The growing groups in U.VOL, L.VOL, and U.MCA show a higher increase in growth as compared to the non-growing groups. L.MCA remains similar for both the non-growing and growing groups.

Conclusion

- Although airway dimension can be influenced by skeletal and dental characteristics, this study showed that open bite treatment did not change oropharyngeal airway dimension. However, after excluding the subjects who received extractions, an increase in airway dimension was observed for the non-extraction, growing group.
- Since patients included in this study underwent various treatments such as TADs and expanders, these confounding variables may have influenced the results.
- In growing patients, there was a significant increase in airway dimension, which would most likely be attributed to the increase in growth.
- The results of this study conclude that closing an open bite does not significantly increase or decrease airway dimension.

Clinical Implications

- As presented in this study and in prior studies that were referenced in the introduction, it is clear that there is conflicting evidence as to whether or not open bite treatment can improve airway dimension to a statistically significant degree.
- Thus, further research isolating specific treatment modalities may yield more consistent results.
- Similarly, airway restrictions may be improved by correcting skeletal-facial discrepancies rather than dental malocclusion.

References

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