# Airway dimension change after open bite treatment – 3D CBCT study


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## Introduction

- Studies have shown that airway dimension can be correlated to skeletal/dental malocclusion, including anterior open bites.[1]
- Counter-clockwise rotation of mandible or extrusion of incisors can be used to correct anterior open bites; however, their subsequent effect on airway dimension has not been well studied.
- Studies have shown that both the inferior oropharyngeal airway volume and cross-sectional area increased as the mandibular position is advanced forward (decreased mandibular plane angle).[2]
- Previous 3D MRI studies have shown that total airway volume, retropalatal and retroglossal airway volume increased following open bite closure.[3]

## Objectives

- To investigate how skeletal and dental changes, including mandibular plane angle and incisor position changes, affect airway dimension in non-surgical orthodontic open bite treatment.

## Material and Methods

- Retrospective study of open bite adult patients treated at UOP from 2006 (n=196)
- All subjects had T1 (before orthodontic treatment) and T2 (end of orthodontic treatment) CBCT
- Exclusions: orthognathic surgery and craniofacial patients
- Fifty-three cases were collected.
- The sample was divided into growing (Female younger than 15 yrs, Male younger than 18 yrs) and non-growing (Female older than 15 yrs, Male older than 18 yrs) groups for further analysis.
- Used 3D tracings and airway measurements (using Invivo 6) to evaluate changes in airway dimensions in various skeletal patterns - tracings were done by 2 judges
- 19 skeletal and 12 dental landmarks were evaluated

- Areas measured:
  - Upper oropharynx
    - From palatal plane (ANS-PNS) to base of soft palate parallel to FH
  - Lower oropharynx
    - From base of soft palate to epiglottic vallecula parallel to FH
- Airway measurements include:
  - Minimum cross-sectional area (MCA, $mm^2$)
  - Volume (cc)



## Results

**Impact of skeletal and dental changes during open bite treatment on airway:**
(n=52, 1 outlier excluded from analysis)

| | U.VOL | | U.MCA | | L.VOL | | L.MCA | |
|---|---|---|---|---|---|---|---|---|
| | r | p | r | p | r | p | r | p |
| Mn length | 0.29* | 0.04 | 0.28* | 0.04 | 0.48* | <.001 | 0.36* | 0.01 |
| Mn ramus length | 0.24 | NS | 0.19 | NS | 0.40* | 0.003 | 0.28* | 0.04 |
| Mn body length | 0.11 | NS | 0.19 | NS | 0.23 | NS | 0.26 | NS |
| Mandibular plane angle | -0.09 | NS | -0.10 | NS | 0.25 | NS | -0.05 | NS |
| SNB | 0.16 | NS | 0.20 | NS | 0.03 | NS | 0.25 | NS |
| ANB | -0.33* | 0.02 | -0.35* | 0.01 | -0.26 | NS | -0.25 | NS |
| SNA | 0.04 | NS | 0.02 | NS | -0.10 | NS | 0.17 | NS |
| S perp A | 0.13 | NS | 0.04 | NS | 0.17 | NS | 0.12 | NS |
| S perp B | 0.22 | NS | 0.23 | NS | 0.11 | NS | 0.25 | NS |
| S perp Pog | 0.22 | NS | 0.22 | NS | 0.09 | NS | 0.23 | NS |
| S perp U1 | 0.21 | NS | 0.20 | NS | 0.03 | NS | 0.21 | NS |
| S perp L1 | 0.30* | 0.03 | 0.30* | 0.03 | 0.21 | NS | 0.25 | NS |

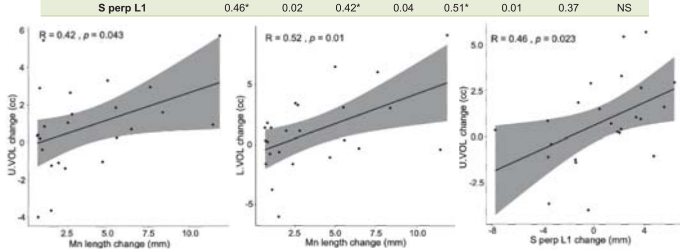
- Correlations between airway dimension and mandibular size, ANB, L1 position changes were statistically significant

Growing group (n=24, F<15, M<18)

| | T1 | | T2 | | T2-T1 | |
|---|---|---|---|---|---|---|
| | mean | sd | mean | sd | mean | sd |
| SNA | 80.88 | 4.32 | 80.57 | 4.42 | -0.31 | 1.10 |
| SNB | 76.27 | 5.21 | 76.29 | 5.42 | 0.02 | 1.53 |
| ANB | 4.66 | 2.35 | 4.48 | 2.53 | -0.18 | 1.24 |
| Mandibular Plane Angle (FH-MP) | 29.39 | 5.48 | 28.93 | 5.44 | -0.46 | 1.40 |

- The patients presented with hyperdivergent Class II skeletal pattern before treatment (T1).

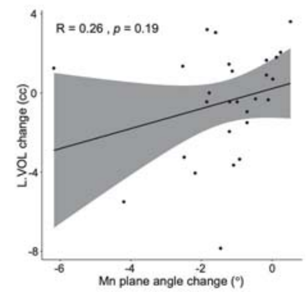
| | U.VOL | | U.MCA | | L.VOL | | L.MCA | |
|---|---|---|---|---|---|---|---|---|
| | r | p | r | p | r | p | r | p |
| Mn length | 0.42* | 0.04 | 0.33 | NS | 0.52 | 0.01 | 0.51* | 0.01 |
| Mn ramus length | 0.3 | NS | 0.25 | NS | 0.47 | 0.02 | 0.48* | 0.02 |
| Mn body length | 0.45* | 0.03 | 0.37 | NS | 0.36 | 0.09 | 0.37 | NS |
| Mandibular plane angle | -0.33 | NS | -0.33 | NS | -0.06 | NS | -0.24 | NS |
| SNB | 0.34 | NS | 0.27 | NS | 0.29 | NS | 0.35 | NS |
| ANB | -0.42* | 0.04 | -0.43* | 0.03 | -0.29 | NS | -0.34 | NS |
| SNA | 0.11 | NS | 0 | NS | 0.14 | NS | 0.26 | NS |
| S perp A | 0.25 | NS | 0.09 | NS | 0.32 | NS | 0.27 | NS |
| S perp B | 0.48* | 0.02 | 0.38 | NS | 0.38 | NS | 0.44* | 0.03 |
| S perp Pog | 0.45* | 0.03 | 0.36 | NS | 0.34 | NS | 0.42* | 0.04 |
| S perp U1 | 0.41 | 0.05 | 0.37 | NS | 0.29 | NS | 0.42* | 0.04 |
| S perp L1 | 0.46* | 0.02 | 0.42* | 0.04 | 0.51* | 0.01 | 0.37 | NS |




- Mandibular length change had positive correlations with upper airway volume (U.VOL), lower airway volume (L.VOL), and lower airway minimal cross-sectional area (L.MCA).
- Mandibular ramus length change showed positive correlations with L.VOL and L.MCA.
- ANB angle showed a negative correlation with upper airway size.
- B point and pogonion (Pog) position change in the anterior-posterior (AP) dimension showed positive correlation with airway size.
- Upper and lower incisor positions in the AP dimension showed positive correlations with airway size.

Adult (non-growing) group (n=28, F≥15,M≥18)

| | U.VOL | | U.MCA | | L.VOL | | L.MCA | |
|---|---|---|---|---|---|---|---|---|
| | r | p | r | p | r | p | r | p |
| Mn length | 0.03 | NS | 0.22 | NS | 0.42 | 0.03 | 0.12 | NS |
| Mn ramus length | 0.07 | NS | 0.04 | NS | 0.21 | NS | -0.05 | NS |
| Mn body length | -0.15 | NS | 0.03 | NS | 0.07 | NS | 0.17 | NS |
| Mandibular plane angle | 0.02 | NS | 0.06 | NS | 0.43 | 0.02 | 0.05 | NS |
| SNB | 0.01 | NS | 0.13 | NS | -0.24 | NS | 0.16 | NS |
| ANB | -0.24 | NS | -0.22 | NS | -0.22 | NS | -0.15 | NS |
| SNA | 0.04 | NS | 0.09 | NS | -0.32 | NS | 0.11 | NS |
| S perp A | -0.10 | NS | -0.08 | NS | -0.17 | NS | -0.19 | NS |
| S perp B | -0.08 | NS | 0.00 | NS | -0.27 | NS | -0.01 | NS |
| S perp Pog | -0.06 | NS | -0.01 | NS | -0.29 | NS | -0.06 | NS |
| S perp U1 | 0.03 | NS | -0.01 | NS | -0.25 | NS | -0.03 | NS |
| S perp L1 | 0.11 | NS | 0.13 | NS | -0.21 | NS | 0.08 | NS |




- When one outlier was excluded, mandibular plane angle had no significant correlation with airway size.
- Dental or skeletal changes during open bite treatment did not present any statistically significant correlation with airway change in adults.

## Conclusion

- Change in airway dimension showed statistically significant, moderate, positive correlations with amount of mandibular growth and anterior movement of B point and Pog in the growing group.
- Airway size change after open bite treatment did not show any significant correlation with skeletal/dental changes in the adult group.

## Clinical Implications

- Increase in airway size can be expected when treating growing patients.

## References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