

NOVEL THREE-DIMENSIONAL METHODS TO ANALYZE THE MORPHOLOGY OF THE NASAL CAVITY AND UPPER AIRWAY

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Aims: The objective of this technical report was to assess the validity, intra- and inter-examiner reliability of the novel semi-manual methods to segment the nasal cavity (NC) and upper airway (UA) volume, as well as to determine the minimal cross-sectional area (MCS) and minimal hydraulic diameter (HD) of UA.

Methods: Cone-beam computed tomography (CBCT) scans of 10 subjects were randomly selected from a database that included 345 patients for orthodontic treatment from 2011 to 2018. Semi-manual segmentation methods were used to segment and visualize the NC and UA respectively using Mimics (Materialise, Belgium). The UA centerline was determined for each CBCT dataset individually, and was used to assess the MCS and HD. Two examiners measured the NC and UA volume, MCS and HD independently, while one examiner performed the measurements twice. The intraclass correlation coefficient (ICC) was used to assess intra- and inter-examiner reliabilities and measurement errors were assessed by Dahlberg's formula and paired *t*-test. The agreement was further assessed using the Bland-Altman method.

Results: All the ICC values were above 0.9, which indicated excellent reliability for both intra- and inter-examiner assessments. According to the Dahlberg values, all the results of the measurement error were at an acceptable level. From Bland-Altman, the inter-examiner results for total UA showed 90% (9/10) differences placed lower than 0, which suggests there is a consistent systematic error. These results are confirmed by the paired *t*-test ($P = 0.013$). The MCS and HD were reliable measurements, with a minimal ICC of 0.922 and more restricted 95% limits of agreement.

Conclusions: These novel three-dimensional methods to segment and analyse NC and UA are reliable. The minimal cross-sectional area and minimal hydraulic diameter associated with the UA centerline demonstrated excellent reliability, which is critical to detect the collapsible part of the UA. The separation of the oropharynx from the voids close to the retroglossal area is not trivial and should be taken with caution.