

performed at 30L/min to simulate turbulent sniffing conditions using computational fluid dynamics. Odorant transport simulations were then performed for limonene, dinitrotoluene, and acetaldehyde. Results: Olfactory flux for all three odorants was greatest in standard phenotypes with a median of $9.100\text{pg/cm}^2\text{-s}$ for acetaldehyde, $3.71 \times 10^{-2}\text{pg/cm}^2\text{-s}$ for limonene, and $1.15 \times 10^{-4}\text{pg/cm}^2\text{-s}$ for dinitrotoluene. Diffusion of odorant flux for standard phenotypes was elevated in the inferior, anterior area of the olfactory cleft. On the other hand, diffusion of odorant flux was elevated in the more medial and superior regions of the olfactory cleft for notched subjects. Conclusions: Each odorants' physical properties impact its transport to the olfactory cleft. Additionally, nasal morphological variations impact the region of maximal odorant deposition in the olfactory cleft.

8:55 Automated Sinonasal Computed Tomography Segmentation for Applications in Rhinology: A Deep Learning Framework

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Educational Objective: At the conclusion of this presentation, the participants should be able to 1) describe the current applications of medical imaging in rhinology; 2) understand the utility of a novel deep learning platform in automatically segmenting structures of the nasal cavity on sinonasal computed tomography scans; and 3) explain the significance of this framework for integration into surgical navigation systems and using automated large volume segmentations for quantifying large population variations.

Objectives: The integration of nasal cavity segmentations with surgical navigation systems requires manual segmentation and is prone to variability. The objective of this study was to construct a deep learning platform which using sinonasal computed tomography (CT) scans automatically segments critical structures within the nasal cavity. Study Design: Retrospective cohort study. Methods: Manual annotations of the regions of interest were performed on 17 CT scans of healthy adults via an open source software, 3D slicer. We included three ground truth segmentations: nasal septum, inferior turbinate (IT), and maxillary sinus (MS). Deep Atlas, a neural network, was thereafter used for training of a segmentation network. The Dice Similarity Coefficient (DSC) and Average Hausdorff Distance (AHD) were calculated to quantify the performance of the DL framework on the test CT volumes. Results: The training was performed on 12 CT scans and predictions were assessed on 5 test CT volumes. DSC of the segmentation network for MS, IT, and septum were 0.88, 0.92, and 0.94 respectively. The AHD for the three respective structures were 0.47mm, 0.34mm, and 0.42mm. A heat map demonstrated decreased accuracy alongside the anterior and posterior aspect of the septum as well as the posterior end of the IT. Conclusions: Traditional segmentation frameworks require many training scans. However, we have developed a novel platform for automatically seg-

menting structures of the nasal cavity achieving submillimeter accuracy meanwhile using a low number of training scans. This pipeline has the potential to interface with image guidance navigation systems, augment preoperative planning, and construct statistical shape models to quantify population variations.

9:00 Five Year EuroQol 5 Dimension (EQ-5D) Outcomes after Endoscopic Sinus Surgery

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Educational Objective: At the conclusion of this presentation, the participants should be able to describe the impact of endoscopic sinus surgery on quality of life among patients with chronic rhinosinusitis.

Objectives: The EuroQol 5 dimension (EQ-5D) is a general health survey that is quick to administer, widely used internationally among many medical specialties and directly convertible to health utility values. We aim to describe the five year EQ-5D outcomes among patients who undergo surgical treatment for chronic rhinosinusitis (CRS). **Study Design:** Prospective observational cohort study. **Methods:** Patients with CRS completed the EQ-5D questionnaire preoperatively and annually for five years following endoscopic sinus surgery. Paired t test univariate analyses and McNemar's tests were used to compare preoperative and postoperative scores. Mixed effects modeling was used for multivariate analysis. **Results:** Among 667 patients enrolled at baseline, 474 (71.1%) and 231 (34.6%) completed the postoperative surveys at one and five years, respectively. The frequency of patients reporting problems in the EQ-5D domains of pain/discomfort and anxiety/depression decreased at one year postoperatively (74.8% vs. 50.4%, and 48.7% vs. 33.3%, respectively, $p < 0.05$) and was sustained at five years (59.3% and 37.7%, respectively, $p < 0.05$). Frequency of problems reported in the usual activities domain decreased at one year (31.3% vs. 18.1%, $p < 0.001$) and was sustained through year four (18.7%, $p = 0.002$), but rebounded at year five (26.0%, $p = 0.90$). The self-care and mobility domains did not improve postoperatively. Controlling for other variables, male sex ($p < 0.001$) and the presence of nasal polyps ($p = 0.01$) were associated with significantly improved EQ-5D values over time. **Conclusions:** Patients with chronic rhinosinusitis experience improvements in health related quality of life that are measurable via the EQ-5D instrument and sustained at five years.

9:05 Proton Radiation Therapy for Nasopharyngeal Carcinoma: A Population Based Analysis

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Educational Objective: At the conclusion of this presentation, the participants should be able to understand the effectiveness of proton and photon radiotherapy