**Introduction**

Individuals who suffer from chronic rhinosinusitis (CRS) may undergo functional endoscopic sinus surgery (FESS) if nasal sprays do not alleviate their symptoms. Nasal sprays are used to manage this condition before and after surgery. This study aims to analyze how well a nasal spray penetrates into the nasal pathways using the current administration instructions and a bottle orientation determined using line-of-sight within each subject’s nasal passage. A new metric of spray area (SA) is developed and compared to the penetration depth. An improvement in performance of the spray could result in improved effectiveness of treatments with the goal of decreasing the need for FESS.

**Study Design and Methods**

- Nasal spray was administered at a depth of 5 mm with a forward head tilt of 22.5°.
- Steady inspiratory air flow rate was determined by the subjects’ weights.
- The nasal spray was labeled with Tc99m and images were taken using a 2D gamma camera.
- Images were processed in ImageJ (Schneider et al., 2012) by constructing a region of interest (ROI) referenced to fixed American sources on the model.
- The projected area coated by the nasal spray was defined as being cells with greater than three times the background activity, and normalized to the total possible spray area determined by a flood of the model.
- LOS scores were determined qualitatively by inspection within the numerical modeling space.

**Results**

Nasacort deposition results in the Pre- and Post-FESS models showed that the fraction of drug sprayed in the nostril depositing posterior to the nasal valve was increased with the line-of-sight method, and Post-FESS. For both models 50-60% of deposition remains in the anterior nares.

No deposition occurred > 86 mm into the nasal model or in the maxillary sinuses.

**Model Development**

Sinus CT scans of patients before and after FESS were digitally reconstructed and used to print rigid 3D models of the entire nasal cavity. The cavity posterior to the internal nasal valve was printed with rigid material, while the area anterior to the nasal valve was printed with soft, flexible material. A nozzle-positioning tool was printed for a current use (CU) case and line-of-sight (LOS) case for each model.

**Discussion and Conclusions**

- The line-of-sight method leads to better penetration to the posterior nasal cavity and greater percent coverage of internal nasal tissue.
- Drug delivered by nasal spray is not reaching the maxillary sinus, therefore minimizing its effectiveness in this region.
- The nozzle positioning tool likely has a large impact on the variance in results.
- Greater line-of-sight score leads to greater improvement from CU to LOS deposition.

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