ABSTRACT

Objectives - As part of an on-going clinical trial studying pre and post-FESS nasal airflow, this study alters the antrostomy size virtually in a three-dimensional (3D), post-FESS numerical algorithms to compute fluid flow across a surface using computer software. Accurate three-dimensional (3D) reconstructions of the nasal airway can be analyzed with CFD techniques for objective measurement of surgical outcomes. Much of the existing literature involves nasal airway obstruction; Functional Endoscopic Sinus Surgery (FESS) has been less widely studied.

Methods – 3D nasal reconstructions were made from a post-FESS CT scan using Mimics™ software. The existing bilateral 1.5 cm antrostomies were enlarged to 2.5 cm, with (“maga”) or without (“widen”) partial removal of the inferior turbinates. Steady-state inspiratory airflow and sprayed particle transport were simulated using ICEM-CFD™ and Fluent™ with a particle size distribution of 10 µm to 110 µm and spray speeds of 1 or 10 m/s. Particle deposition on anterior and posterior sinus walls and antrostomy regions was normalized by surface area.

Results – In all simulations, less than 10% of sprayed particles by-passed the nasal passages; Majority of particle deposition in the anterior nose; Within the target regions, greater deposition on right side than left both in magnitude and when normalized to surface area; Particle deposition visualized outside of target regions could not be quantified in this study; Greater overall deposition in target regions at spray speed of 1 m/s than at 10 m/s; particle deposition in selected regions in the virtual antrostomy models unaffected by antrostomy size.

Conclusion – Preliminary data suggests a clear qualitative improvement in particle deposition post-FESS; Antrostomy position may have more impact on particle deposition to the sinus than size; Future analyses will include entire sinus and antrostomy for quantification of particle deposition; Virtual surgery modeling with CFD analysis may be useful for optimizing outcomes of FESS.

REFERENCES


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