Utility of 3D-Printed Cutting Guides in Improving Margin Status in Head and Neck Oncologic Surgery

Introduction

- **Margin status** is a **key prognosticator of survival** in head and neck cancer
- In advanced cases involving the **mandible or maxilla**, tumor visualization can pose significant challenges in predicting resection margins
- **Virtual surgical planning** (**VSP**) using **3D-printed cutting guides** is a surgical innovation that may help improve tumor visualization and ablation
- **Limited** research exploring the impact of VSP **on the adequacy of resection**

Aim: To assess the utility of VSP using 3D-printed cutting guides in improving margin status during mandibular and maxillary resections

Methodology

- **Single centre ambispective cohort study,** incorporating both retrospective data (2019–2022) and prospective data (2023–2025) of patients undergoing mandibulectomy or maxillectomy at **Mount Sinai Hospital**

VSP Group
(3D-Printed Cutting Guides)

vs

Control Group
(Conventional Surgery)

Baseline demographics, oncologic characteristics, pathology reports, operative data

Primary outcome: Margin status
Clear (>5mm), close (1-5mm), positive (<1mm)
Mucosal & bony margins were additionally collected at the microscopic level

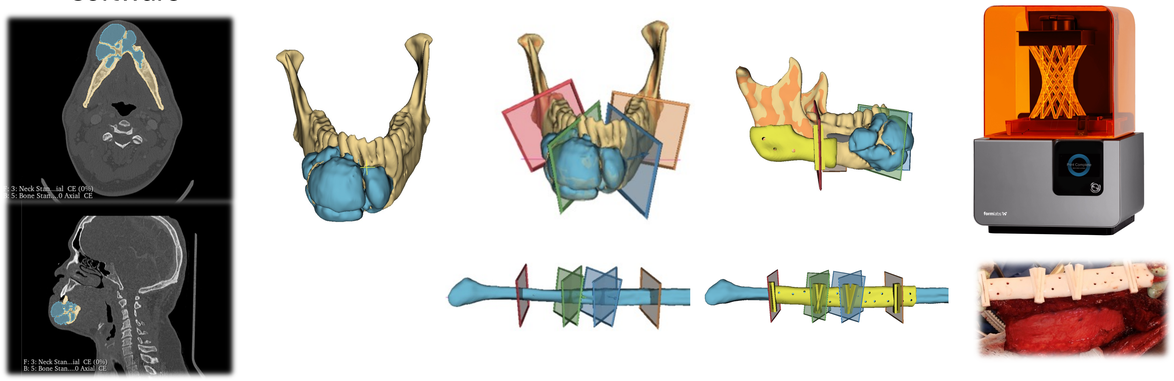
Step 1: Input CT Scan into volume rendering software

Step 2: Isolate region of interest

Step 3: Design virtual cutting angles

Step 4: Create cutting guide

Step 5: Stereolithography printing



Results

Total Sample
n=68

VSP Group
n=34

Control Group
n=34

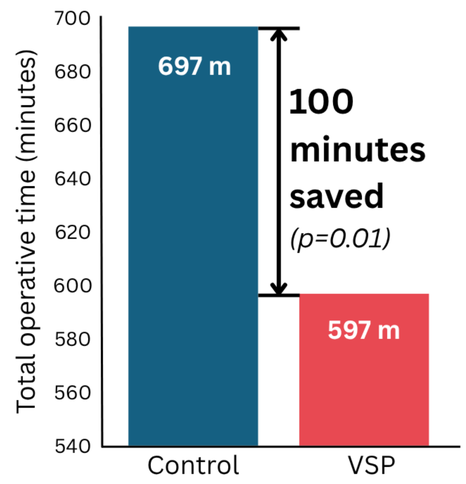
No significant difference in baseline demographics or oncologic characteristics:

Age (p=0.56), Sex (p=0.13), Smoking (p=1.00), Alcohol Use (p=0.36), Diabetes (p=0.40), Neoadjuvant Therapy (p=0.51)
AJCC Staging (p=0.28), Primary Pathology (p=0.74), Primary Site (p=0.30), PNI (p=0.11), LVI (p=0.07), ENE (p=0.45)

Table 1: *Rate of positive surgical margins in the VSP versus control group*

	VSP	Control	p-value
Positive Margin	1/34 (3%)	9/34 (26%)	***p=0.01**
Mucosal Margin	0/34 (0%)	6/34 (18%)	***p=0.01**
Bony Margin	1/34 (3%)	4/34 (12%)	p=0.16
Gross Bony Margin	0/34 (0%)	4/34 (12%)	***p=0.04**

Figure 1: *Mean total operative time (in minutes) in the VSP versus control group*



Conclusion

- 3D-printed cutting guides **may improve margin status** and **reduce total operative time** in mandibular and maxillary resections
- **Promising capability to enhance surgical precision** and **tumor visualization**
- Further prospective follow-up will evaluate its impact on **oncologic outcomes** including **rates of cancer recurrence and survival**

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