Transforming Healthcare

INTROPERATIVE SURGICAL NAVIGATION AS A PRECISION MEDICINE TOOL

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Challenges in sinonasal and craniofacial malignancies
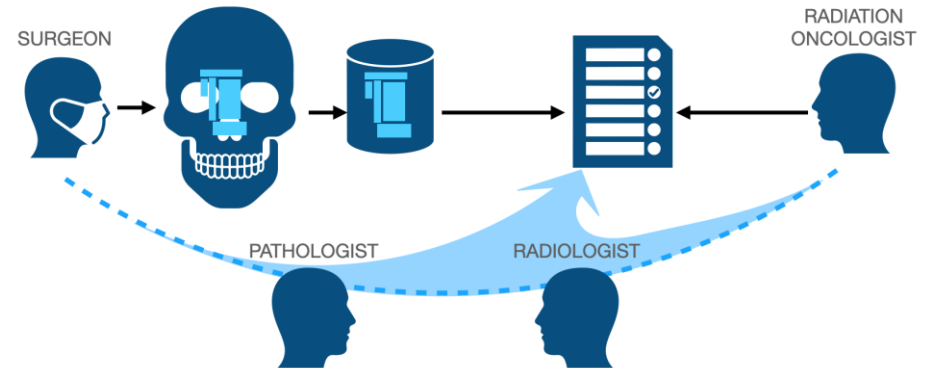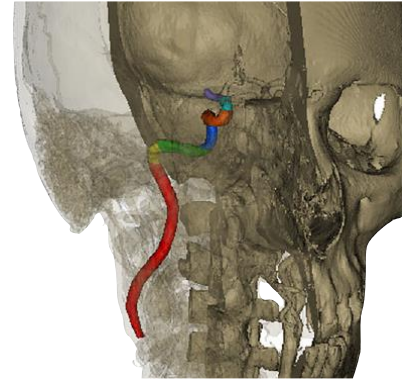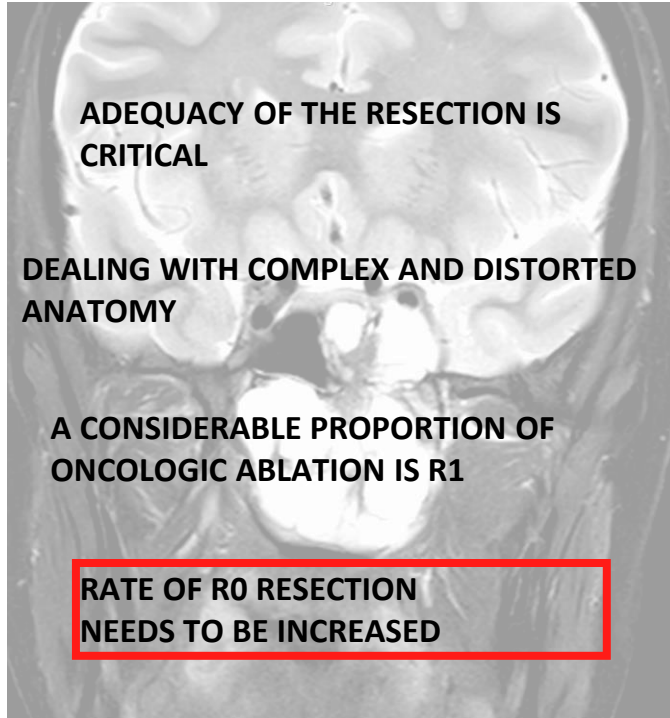
ADEQUACY OF THE RESECTION IS CRITICAL
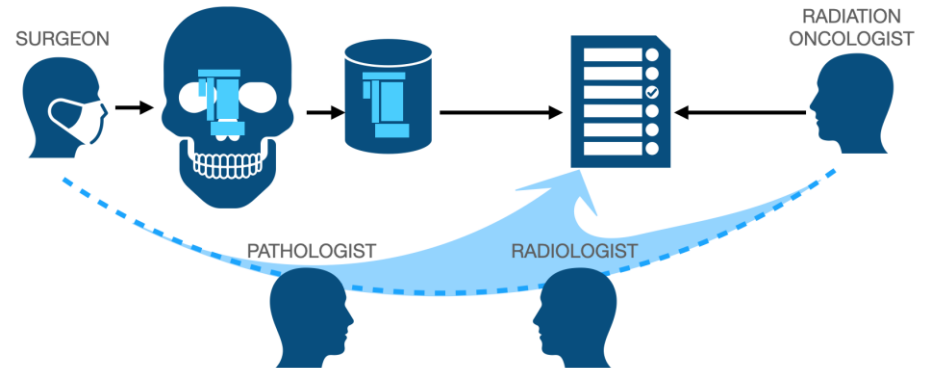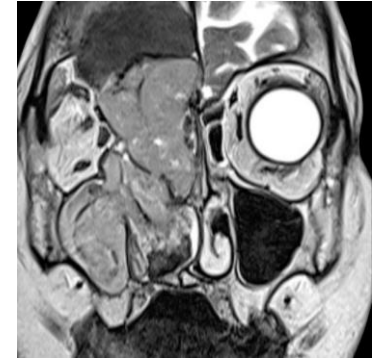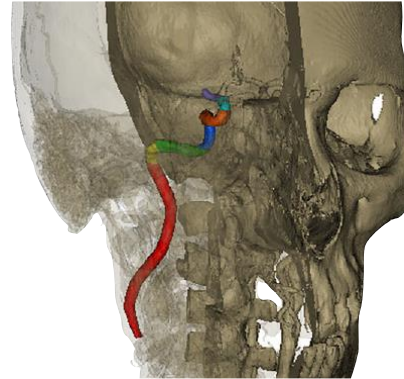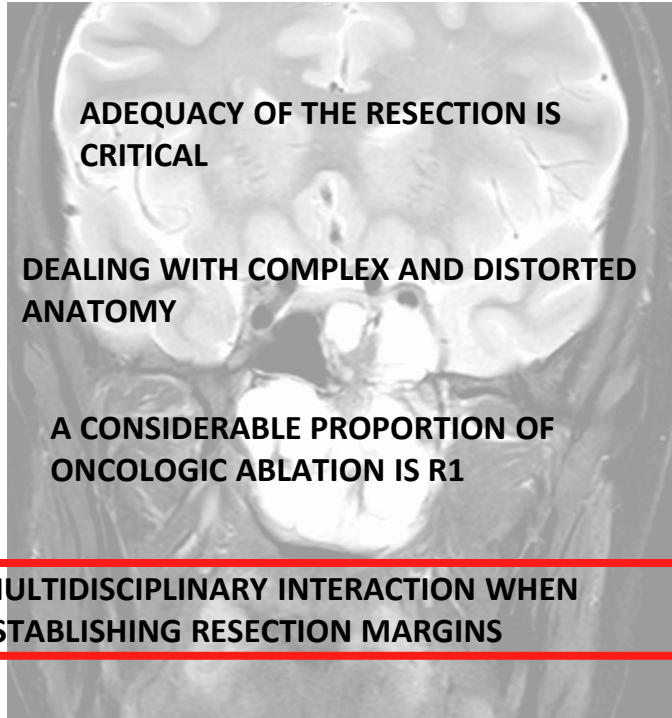
DEALING WITH COMPLEX AND DISTORTED ANATOMY

A CONSIDERABLE PROPORTION OF ONCOLOGIC ABLATION IS R1

RATE OF R0 RESECTION NEEDS TO BE INCREASED

SURGEON

PATHOLOGIST

RADIOLOGIST

RADIATION ONCOLOGIST

Challenges in sinonasal and craniofacial malignancies

ADEQUACY OF THE RESECTION IS CRITICAL

DEALING WITH COMPLEX AND DISTORTED ANATOMY

A CONSIDERABLE PROPORTION OF ONCOLOGIC ABLATION IS R1

MULTIDISCIPLINARY INTERACTION WHEN ESTABLISHING RESECTION MARGINS

SURGEON

RADIATION ONCOLOGIST

PATHOLOGIST   RADIOLOGIST

Electromagnetic navigation system (StealthStation S8 Surgical Navigation System; Medtronic®, Dublin, Ireland)

IN PRECLINICAL SETTING

Navigation-guided osteotomies improve margin delineation in tumors involving the sinonasal area: A preclinical study

Marco Ferrari[a,b,c], Michael J. Daly[c], Catriona M. Douglas[a,c], Harley H.L. Chan[c], Jimmy Qiu[c], Alberto Deganello[b], Stefano Taboni[b], Carissa M. Thomas[a], Axel Sahovaler[a], Ashok R. Jethwa[a], Wael Hasan[a], Piero Nicolai[b], Ralph W. Gilbert[a], Jonathan C. Irish[a,c,*]

[a] Department of Otolaryngology – Head and Neck Surgery/Surgical Oncology, Princess Margaret Cancer Centre/University Health Network, Toronto, Ontario, Canada
[b] Unit of Otorhinolaryngology – Head and Neck Surgery, University of Brescia, Brescia, Italy
[c] Guided Therapeutics (GTx) Program, Techna Institute, University Health Network, Toronto, Ontario, Canada

Oral oncology, 2019

Frontiers in oncology, 2021

Navigation-Guided Transnasal Endoscopic Delineation of the Posterior Margin for Maxillary Sinus Cancers: A Preclinical Study

Stefano Taboni[1,2,3,4,5], Marco Ferrari[1,2,3,4,6*], Michael J. Daly[3], Harley H. L. Chan[3], Donovan Eu[1,3], Tommaso Gualtieri[1,3,7], Ashok R. Jethwa[1], Axel Sahovaler[1,3,8], Andrew Sewell[1], Wael Hasan[1,3], Ilyes Berania[1], Jimmy Qiu[3], John de Almeida[1], Piero Nicolai[2], Ralph W. Gilbert[1] and Jonathan C. Irish[1,3]

Development of a cadaveric head and neck cancer model and three-dimensional analysis of margins in surgical navigation-aided ablations

Marco Ferrari[a, b, c, *], Stefano Taboni[a, b, d], Andrea L.C. Carobbio[a], Barbara Buffoli[e], Vittorio Rampinelli[c, f], Davide Mattavelli[f], Alberto Schreiber[f], Vincenzo Verzeletti[a], Marco Ravanelli[g], Michael J. Daly[h], Harley H.L. Chan[h], Axel Sahovaler[h, i, j], Leonardo Franz[a, h, i], Tommaso Gualtieri[b, f], Rita Rezzani[e], Roberto Maroldi[g, 1], Alberto Signoroni[k, 1], Alberto Deganello[f, 1], Jonathan C. Irish[h, i, 1], Piero Nicolai[a, 1]

Eur J Surg Oncol 2021

Analysis of simulation cuts
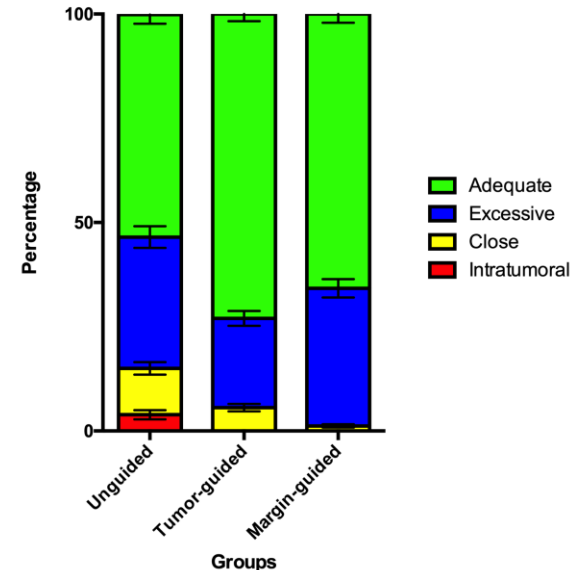
Legend:
- Adequate
- Excessive
- Close
- Intratumoral

Electromagnetic navigation system *(StealthStation S8 Surgical Navigation System; Medtronic®, Dublin, Ireland)*

> ***IN CLINICAL SETTING:*** *translating surgical navigation guided ablations into the operating rooms*

1) Quantify the feasibility and benefits for patients being treated with the aid of SN

2) Development of a system for recording and mapping intraoperative biopsies that can be shared with other clinicians

3) Evaluation of the discrepancy in identifying anatomical structures on preoperative imaging by different H&N clinicians

CLINICAL APPLICATION - OUTCOME EVALUATION

Pilot, optimization phase in humans

24 Patients recruited

Open surgery (n=6)

Endoscopic surgery (n=18)
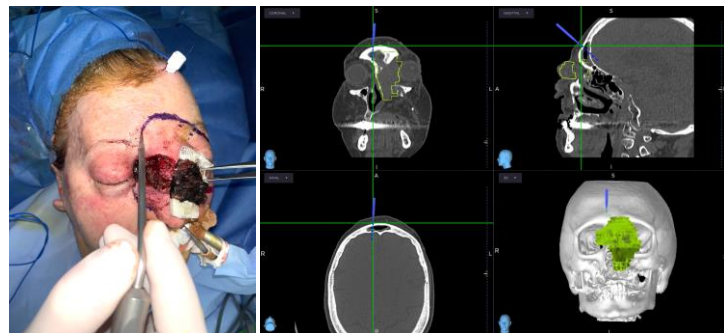
Outcomes:
FEASIBILITY
BENEFIT

Set-up duration
Spatial error at set-up
Loss of accuracy Preparation timing
Duration of surgery
GTR rate, margin involvement, OS, DSS, LRFS
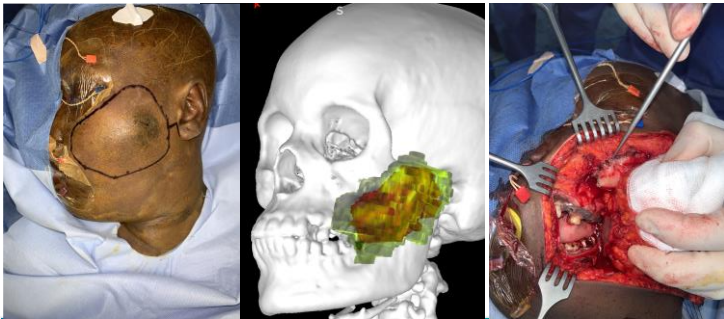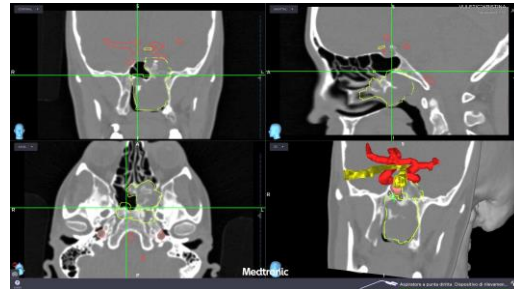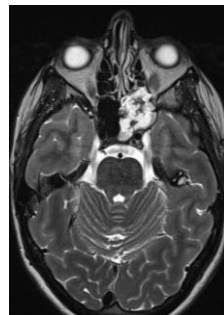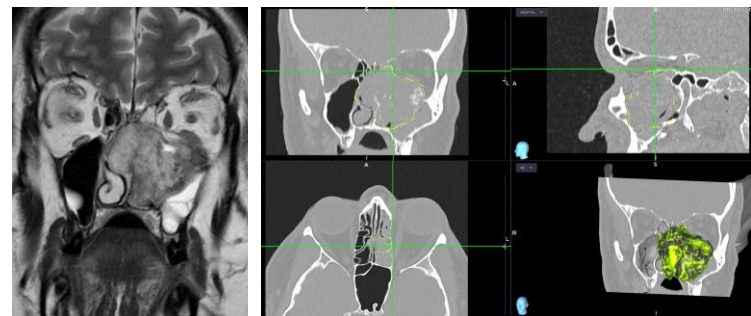
Pilot, optimization phase in humans

Patients recruited: 24

Control cohort (standard of care)
1:1 Pair-matching

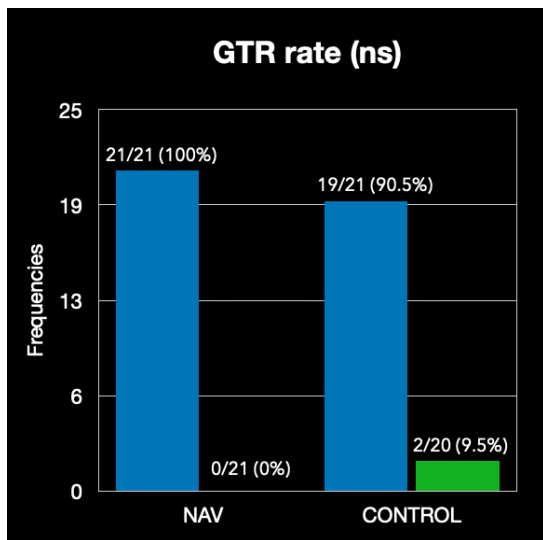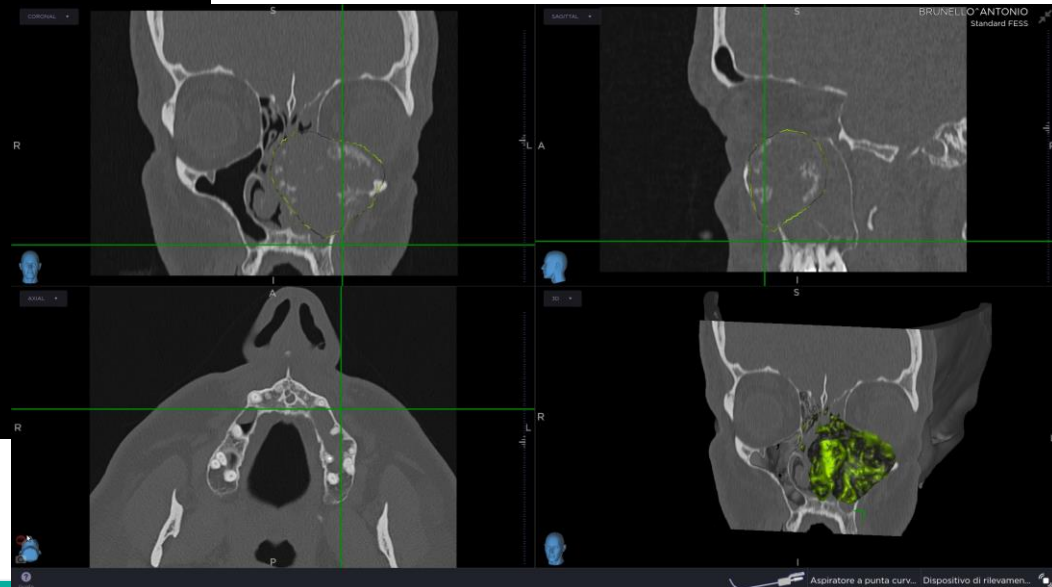| Variable	Simmetry
Histology	95.2%
Presentation	85.7%
Epicenter/extention	85.7%
pT category	85.7%
N category	90.5%
Type of surgery	95.2%
Adjuvant treatment	61.9%

Feasibility
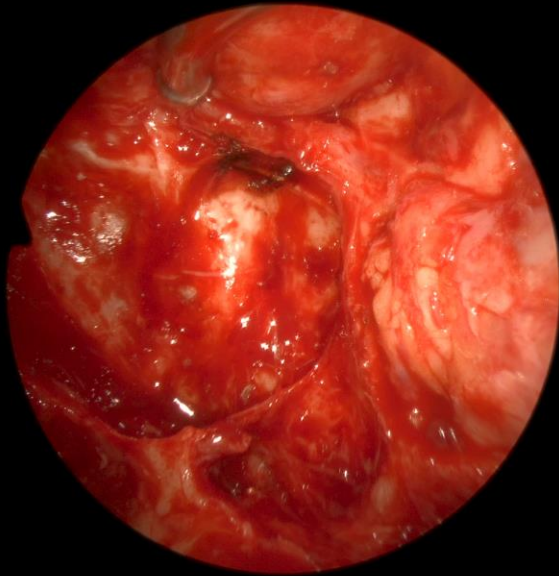
Set-up time: <10 minutes (all cases)
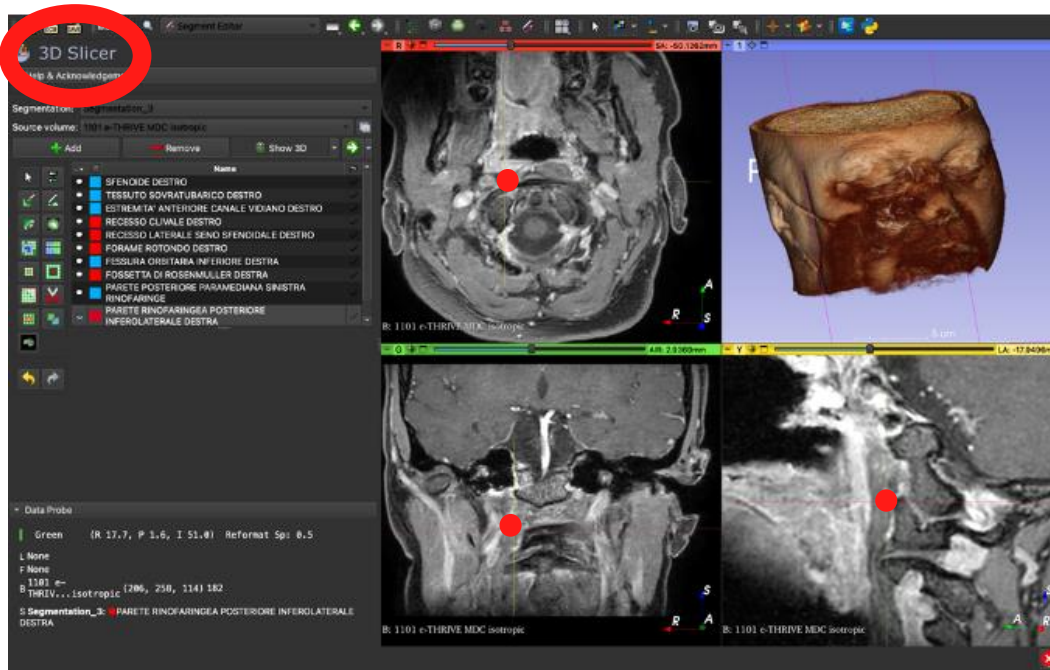Loss of accuracy during/after resection: 2 (after the resection)

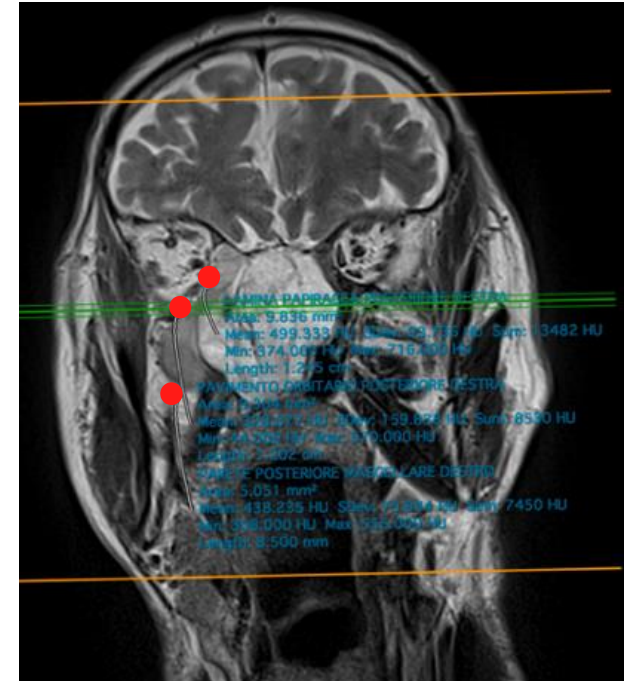# CLINICAL APPLICATION - OUTCOME EVALUATION
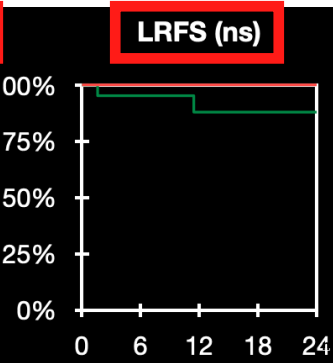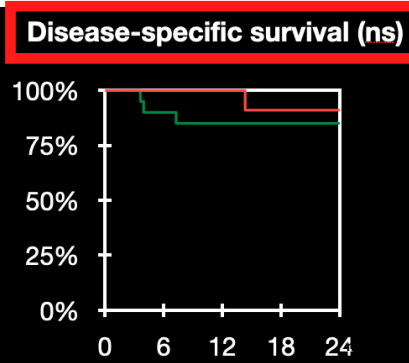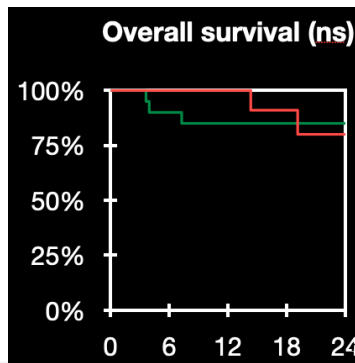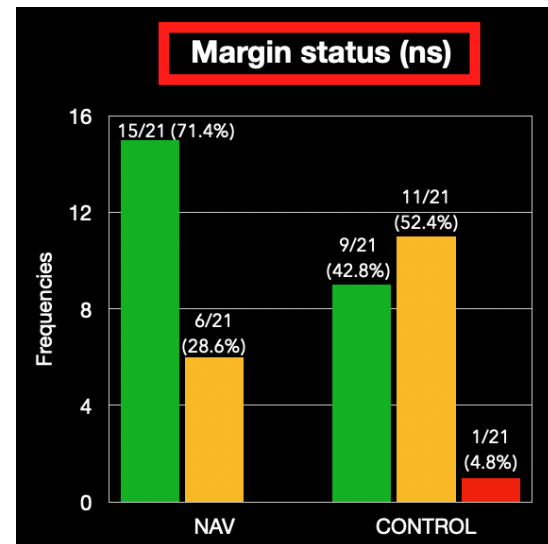
POST-ABLATION MAPPING

3D COORDINATES WERE TRANSFERRED IN THE PREOPERATIVE MRI THROUGH THE SEGMENTATION SYSTEM OF *"3D SLICER"*
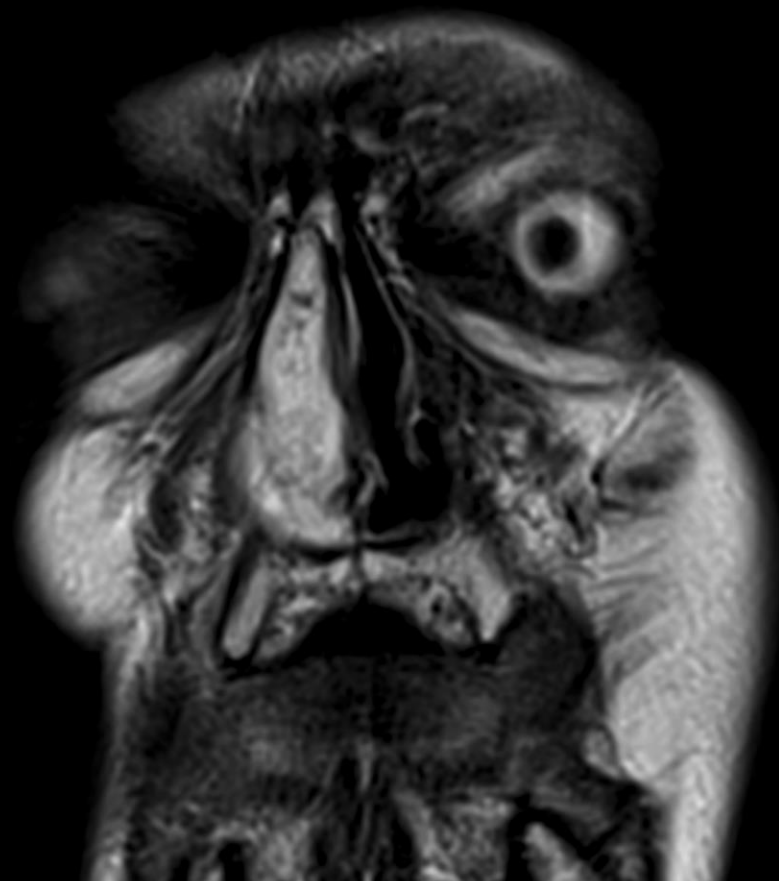

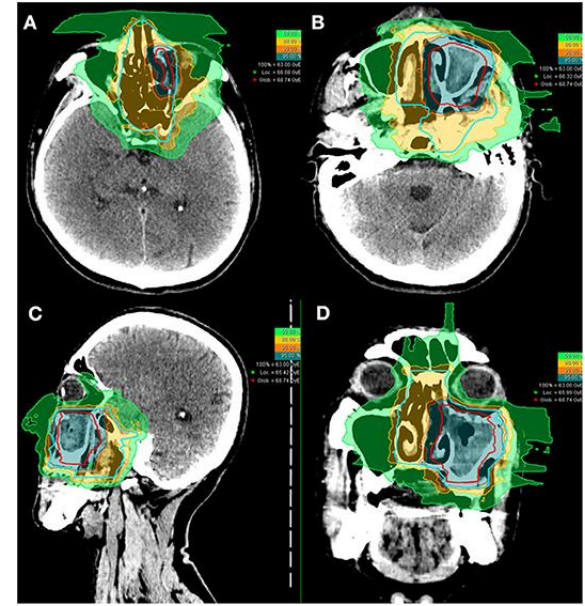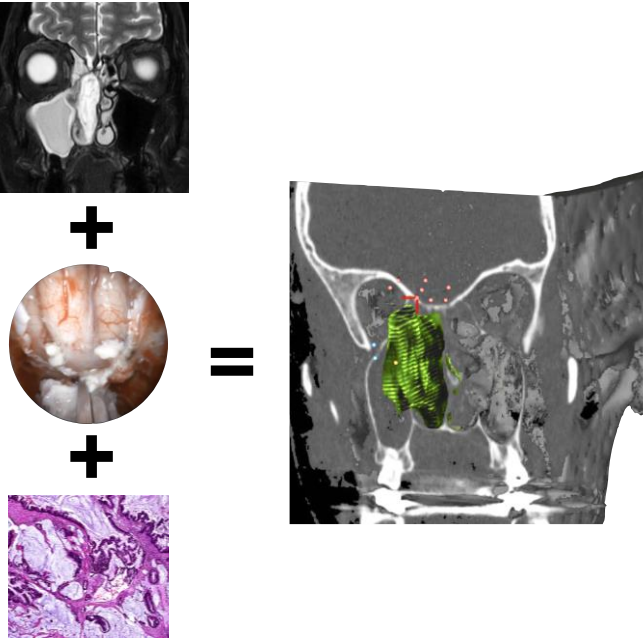
(HTTP://WWW.SLICER.ORG)

This model was exported as a DICOM file and uploaded to our archives

mage size: 1538 x 1538
View size: 2396 x 1532

49967675 (- , -
Unnamed
5360

MORE ACCURATE DEFINITION OF SURGICAL MARGINS
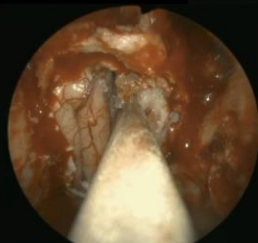
TOPOGRAPHICALLY-RELIABLE MDT DISCUSSION

MORE PRECISE PLANNING OF IRRADIATION FIELDS

OPTIMISED TREATMENT

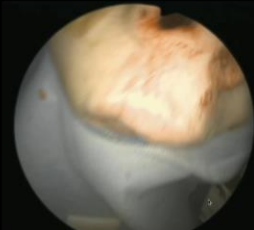ANTERIOR DURAL MARGIN   FALX   OLFACTORY TRACT   VIDIAN NERVE   LACRIMAL DUCT
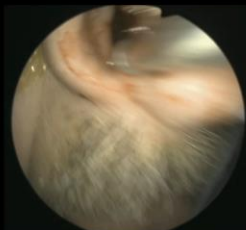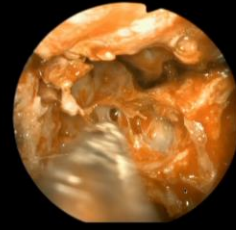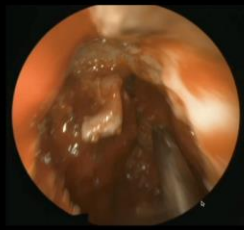
POSTERIOR ORBITAL FLOOR   NASAL FOSSA FLOOR   SPHENOPALATINE FORAMEN   TENSOR TYMPANI MUSCLE   FRONTAL SINUS MUCOSA
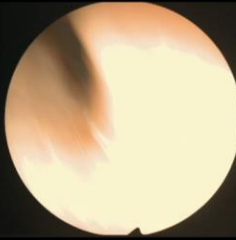
MEDIAL PTERYGOID MUSCLE   POSTERIOR DURAL MARGIN   MAXILLARY OSTIUM MUCOSA   ROSTRUM   V2

24 clinicians

19 surgeons

5 radiotherapists

Discrepancy analysis

Spatial coordinates detected by SN

(Reference measure)

VS

Coordinates identified by the clinicians

in the preoperative MRI (Spatial error)

MAXIMUM ERROR: 46,87 MM

AVERAGE ERROR: 9,19 MM

MINIMUM ERROR: 0,86 MM
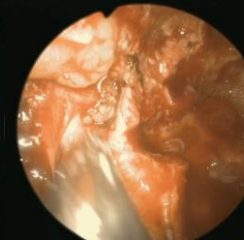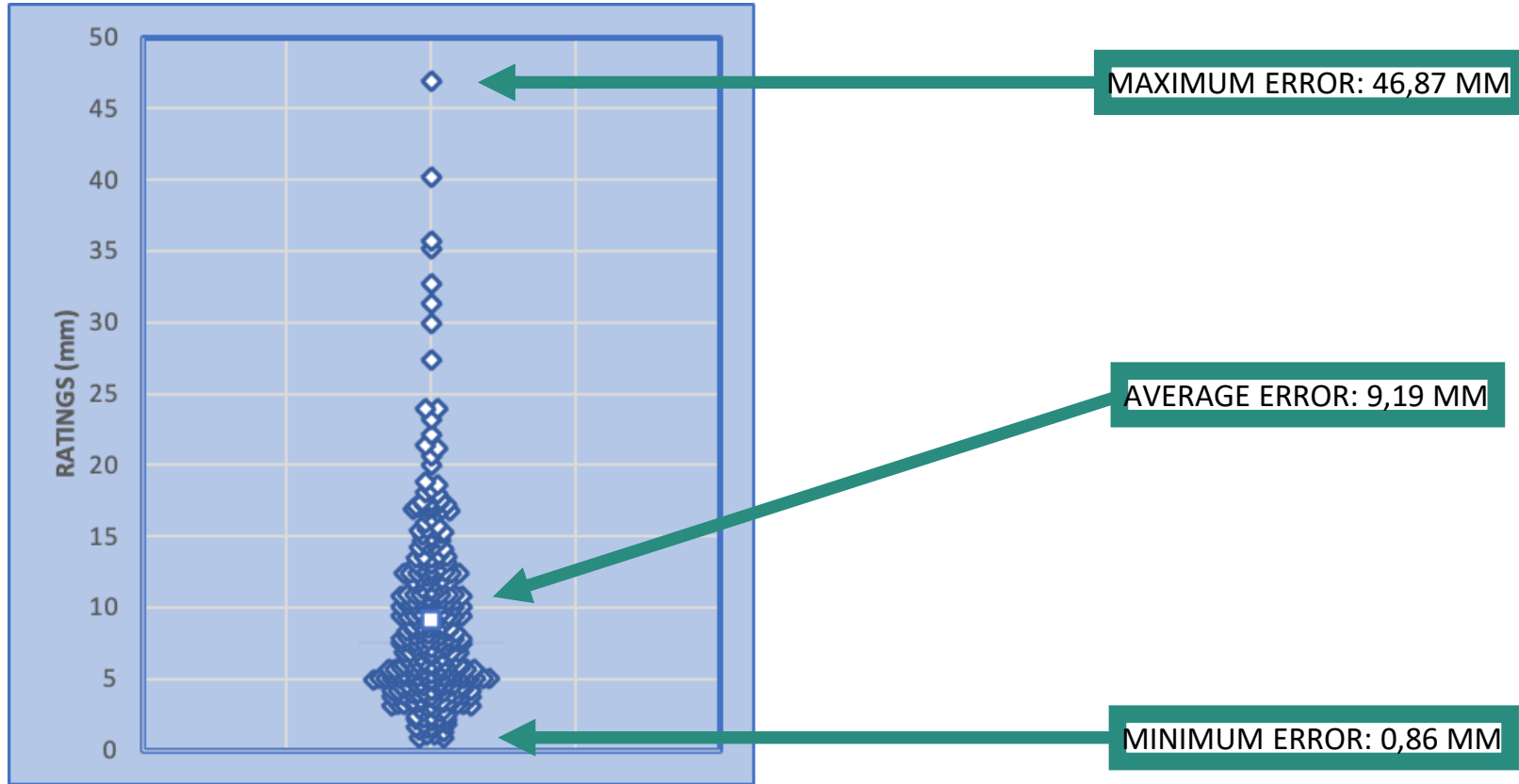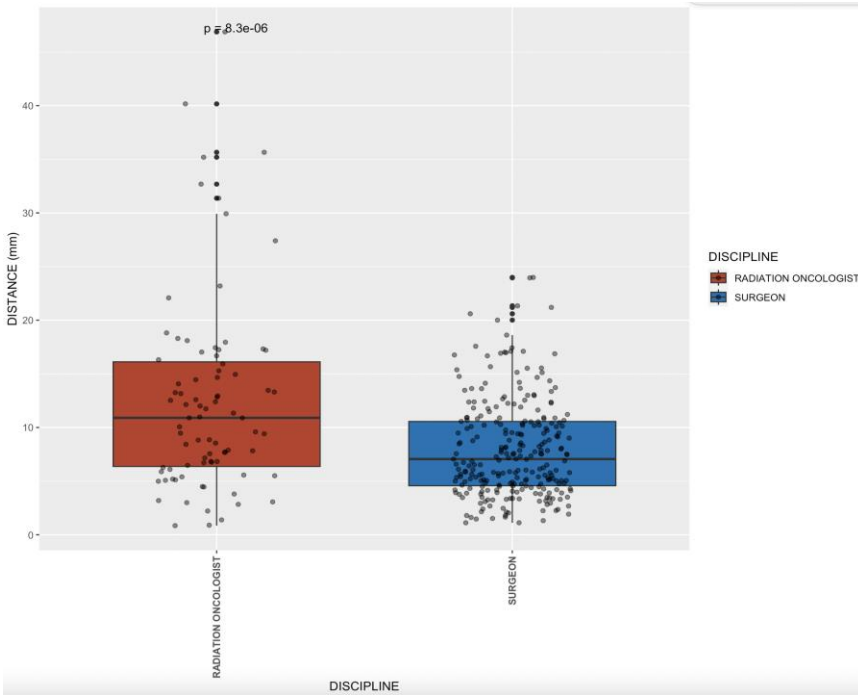
MEDIAN OF THE ERROR:

Radiation oncologists: 12.46 mm
Surgeons: 7.06 mm

p < 0,0001

Better confidence of the surgeon with the identification of structures (exploiting landmarks)?

The importance of **surgeon involvement**

Need for a **closer collaboration** between surgeons and radiation oncologists

1) Developement of a system for recording and mapping intraoperative biopsies through the SN that can be shared and consulted with pathologists, oncologists, and radiotherapists

2) Evaluation of the discrepancy in identifying anatomical structures on preoperative MRI by different H&N clinicians

3) Quantify the feasibility and benefits for patients being treated with the aid of SN versus patients treated with standard unguided protocols in terms of (i) preoperative preparation, (ii) surgery duration, (iii) margin status, (iv) gross total resection rate, (v) overall survival, (vi) disease-specific survival, and (vii) local recurrence free survival
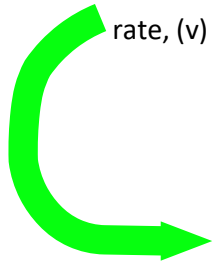
With the future inclusion of a larger number of patients, we may have the chance to demonstrate the advantages and benefits of SN in oncologic ablations for locally advanced head and neck cancers