

# Head and Neck Surgery

## Guided Therapeutics (GTx) Research Program

**Jonathan Irish (GTx Program Leader/Director, Clinical Faculty, TECHNA Research Institute)**

### GTx Program Staff:

**Jason Townson, PhD (manager/scientist), Michael Daly, PhD (staff scientist and engineer), Harley Chan, PhD (engineer), Robert Weersink, PhD (physicist), Daniel Lin (engineer), Jimmy Qiu (engineer)**

### GTx International Scholar Scientist:

**Dr Nidal Muhanna MD PhD**

### GTx Fellows:

**Drs. Axel Sahovaler, Donovan Eu, Catriona Douglas and Wetchayan Chansarn**

### GTx Visiting Residents

#### (Italy-Toronto Collaboration):

**Drs. Marco Ferrari, Stefano Taboni, Tommaso Gualtieri**

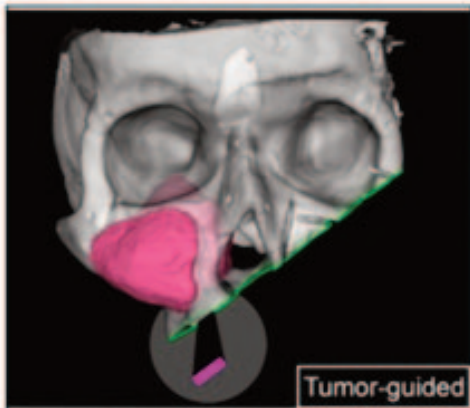
The GTx Research Program, part of UHN's TECHNA Institute, continues to lead and support research, run translational clinical trials and develop new technologies and interventions in head and neck, skull base, thoracic and sarcoma cancer surgery. This research is completed by our multidisciplinary team of surgeons, radiation physicists, engineers, programmers, chemists, cancer biologists, and imaging specialists, using the key GTx infrastructure consisting of the GTx Operating Room (GTx-OR at the Toronto General Hospital) and the GTx-Lab (at Princess Margaret Cancer Research Tower). During the past year, the GTx Program focused on translational research and development of a broad range of new and continuing research projects:

- The GTx Program continues to collaboratively work on the development and translational

research of nanoparticles for imaging and therapeutic use. This includes the GTx Program's continued research and development of porphyrin nanoparticles (developed by and in collaboration with Dr. Gang Zheng) as an imaging and therapeutic (theranostic) agent for thyroid and oral cavity cancers (Figure, Muhanna et al, 2020). This research is part of the \$5.5M 7-year Terry Fox New Frontiers Program Project Grant for "Porphyrin Nanoparticle-Enabled Image-Guided Cancer Interventions" which was announced in September of 2017. As part of this research effort, the GTx program (in collaboration with other research groups at UHN and Sunnybrook) has continued to advance porphyrin-enabled photodynamic therapy (PDT), and more recently photothermal therapy (PTT), as a potential treatment option for papillary thyroid cancer. Nanoparticle production scale up and preclinical studies completed as part of this collaboration in prior years has laid the groundwork for first in human studies to begin in 2021;

- Developing upon the research completed as part of the Terry Fox New Frontiers Program Project, the GTx program has continued studies to determine the safety, efficacy and feasibility of using porphyrin nanoparticles for PDT or PTT treatment and fluorescence image guided surgery for sarcoma, oral cavity and oropharynx cancers;
- Developing a three-dimensional fluorescence imaging system for head and neck surgical guidance (OHNS Raymond Ng & Wendy Chui Innovation Fund);
- Developing and translating image-guidance and 3D intraoperative imaging technologies for open and endoscopic sinonasal and maxilla resection;
- Development of 3-dimensionally printed stem

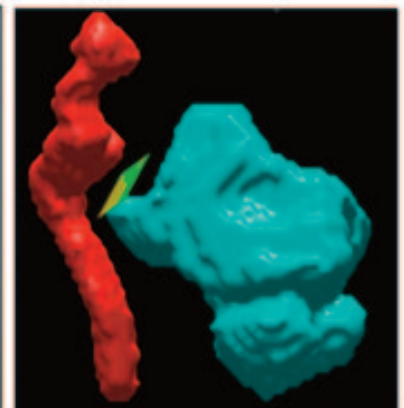
- cell scaffolding for bone reconstruction—a collaboration between University of Brescia (Italy) and UHN (Irish/Gilbert/GTx);
- Improving reconstruction through new 3D modelling and multi-material printing capabilities;
- Creation of a silicone rubber-based tongue simulator for use in surgical training and evaluation of novel preclinical devices (see figure – Eu et al.);
- Evaluating custom augmented reality (AR) and virtual reality (VR) technologies for surgical training and guidance;
- Evaluating cone-beam CT imaging for otology applications;
- Replacement of the aging cone beam CT used by the GTx lab will be completed in 2020;
- Applying machine learning techniques to recognize surgeon hand gestures for intraoperative visualization of 3D imaging in a sterile surgical environment.
- Continuing ongoing collaboration with Sinai Health surgeons to translate GTx surgical navigation technology to Sinai Health ORs for osteosarcoma surgeries. This past year, a new 2D-3D image registration algorithm has been evaluated in animal models.



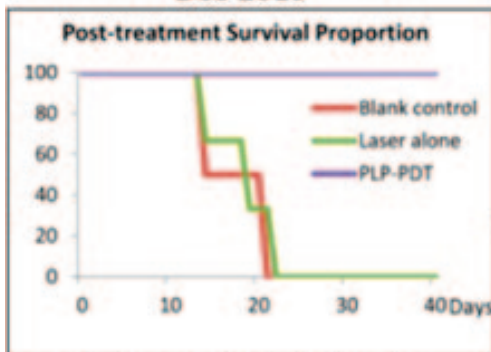
Ferrari et al, *Oral Oncology*, Dec 2019



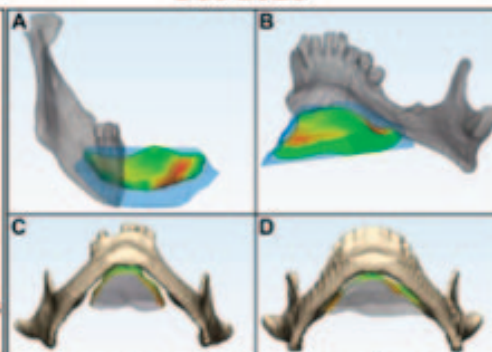
Eu et al, *AHNS*, Dec 2020



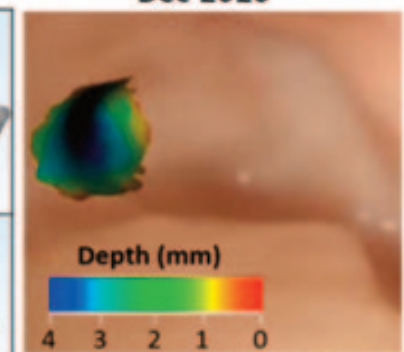
Taboni et al, *AHNS*, Dec 2020



Muhanna et al, *Endocrine Related Cancer*, Feb 2020



Ferrari et al, *Oral Oncology*, June 2020



Daly et al, *SPIE BiOS*, Feb 2020



# GTx Program: At a glance

## PATIENT OUTCOMES AND EXPERIENCE



- 9 cancer related clinical trials
- 3 non-cancer related clinical trials (26 patients)
- >200 cases in the GTx OR

## KNOWLEDGE GENERATION



- 64 refereed papers
- 100+ published abstracts and presentations
- 4 licensable technologies

## KNOWLEDGE TRANSFER



- 50+ GTx OR open houses and tours
- 1 GTx Surgery Program Website
- 6 site-group specific GTx Fellowships
- 8 Undergraduate medicine and engineering summer students

- >20 multi-disciplinary team members involved
- [GTx Research & Operational Oversight Committee](#); reporting to [GTx Governance Committee](#) and Innovation OR Committee

- [GTx Lab](#) (TMDT), the [GTx OR](#) (TGH), and the [Research MR Suite](#) (TGH) as key infrastructure
- 4 site group users to date
- [GTxOR](#) now mixed clinical and research use

## PEOPLE



## INFRASTRUCTURE, OPERATIONS AND INTEGRATION

