

Changing practice patterns in Head & Neck Oncologic Surgery in the early COVID-19 era

Stephen Y. Lai, MD, PhD¹

¹The University of Texas MD Anderson Cancer Center

April 28, 2020

Kimberley L Kiong MBBS 1 , Theresa Guo MD 1 , Christopher MKL Yao MD 1 , Neil D Gross MD 1 , Matthew M Hanasono MD 2 , Renata Ferrarotto, MD 3 , David I Rosenthal MD 4 , Jeffrey N Myers MD 1 , Ehab Y Hanna MD1, Stephen Y Lai MD 1

1 Department of Head and Neck Surgery, The University of Texas MD Anderson Cancer Center, Houston, TX, United States 2 Department of Plastics and Reconstructive Surgery, The University of Texas MD Anderson Cancer Center, Houston, TX, United States 3Department of Thoracic Head and Neck Medical Oncology, The University of Texas MD Anderson Cancer Center, Houston, TX, United States. 4Department of Radiation Oncology, The University of Texas MD Anderson Cancer Center, Houston, TX, United States

Corresponding author: Stephen Y Lai, MD PhD

Professor

Patient Safety Quality Officer

The University of Texas MD Anderson Cancer Center

Department of Head and Neck Surgery

Division of Surgery

1515 Holcombe Blvd, Unit 1445

Houston, TX 77030 sylai@mdanderson.org

This work did not receive any grant support and has not been presented at any meeting Running title: Changing Head & Neck surgical practice during COVID-19

Keywords : Otolaryngology, Oncology, SARS-CoV2

Abstract: Background: The COVID-19 pandemic has changed healthcare, challenged by resource constraints and fears of transmission. We report the surgical practice pattern changes in a Head and Neck Surgery department of a tertiary cancer care center and discuss the issues surrounding multidisciplinary care during the pandemic. Methods: We report data regarding outpatient visits, multidisciplinary treatment planning conference, surgical caseload, and modifications of oncologic therapy during this pandemic and compared this data to the same interval last year. Results: We found a 46.7% decrease in outpatient visits and a 46.8% decrease in surgical caseload, compared to 2019. We discuss the factors involved in the decision-making process and perioperative considerations. Conclusions: Surgical practice patterns in head and neck oncologic surgery will continue to change with the evolving pandemic. Despite constraints, we

strive to prioritize and balance the oncologic and safety needs of patients with head and neck cancer in the face of COVID-19.

Introduction

The rapid spread of the novel coronavirus 2019 (COVID-19) has disrupted healthcare systems globally. Some of the biggest challenges include shortage of hospital beds, healthcare workers and personal protective equipment (PPE). Given these constraints, there has been a simultaneous push for a reduction in elective clinical practice, to further reduce transmission and conserve resources ¹.

Cancer care is generally not considered elective and decision making about when to initiate or delay treatment during the pandemic has raised complex ethical and resource utilization issues. Yet amidst the pandemic, patients continue to develop and seek treatment for cancer. Head and neck cancers (HNC) can challenge essential functions such as eating, speaking and breathing. Tumor doubling time ranges between 15 to 99 days ^{2,3} and delaying treatment decreases survival and contributes to adverse outcomes ^{4,5}. As such, there are recommendations for prompt initiation of treatment of HNC after diagnosis and to reduce the total treatment package time ^{6,7}. In an effort to limit the potential adverse effects of delaying cancer treatment during this pandemic, an increasing number of oncology guidelines have been developed, both general and specific to HNC ^{8,9}.

At the University of Texas MD Anderson Cancer Center (MDACC), our Head and Neck surgical practice has gradually changed as a result of evolving internal and external guidelines (Table 1). Harris County, Texas reported its first COVID-19 case on March 5th, 2020. Since then, the number of cases has been steadily rising with the current incidence at 35 per 100,000 residents in Texas ¹⁰. At the institutional level, MDACC has taken many pre-emptive actions and policy changes in response to the growing pandemic (Table 1).

The institutional policies described have served to limit hospital attendances in anticipation of a surge in COVID-19 cases in the region. The number of new patients visits to the institution have decreased from 782/week in the first week of March to 207/week in the last week of March (-73.5%) while systemic treatment appointments, indicative of patients already in the process of treatment, have remained fairly stable (3864 to 3288 visits, -14.9%). As a downstream effect, the number of diagnostic imaging visits has decreased from 9616 to 3971 (first and last weeks of March respectively, -58.7%). Surgeries within the institution have shown a more drastic decrease, from 463 to 149 cases per week (-67.8%). Current institutional census at the time of writing (April 7th, 2020) shows 55% general bed occupancy and 35% ICU occupancy. The numbers will continue to change in response to the development of COVID-19 within the region, as we have not yet reached the peak of infection. Predictive models have suggested that the peak in COVID-19 cases will occur at the end of April¹¹ and there are institutional plans on standby to repurpose physical facilities and the workforce to shift focus from oncology care to COVID-19 treatment if needed.

In the context of the developing pandemic and tightening institutional guidelines, we seek to understand the early impact of the COVID-19 pandemic on head & neck oncologic surgery practices. We performed a review of outpatient clinic and surgical caseload within the MDACC Head and Neck Surgery department during the pandemic and compared this to the same time period in the preceding year, along with the deviations in management of patients due to COVID-19.

Clinical audit

The number of outpatient visits, patients presented during weekly multidisciplinary treatment planning conferences and treatment recommendations were recorded for 6 weeks, from March 1 (first COVID-19 case in county) to April 9, 2020 (Table 2). The surgical caseload was recorded over a 3-week period, starting on March 23rd, 2020 (first COVID case in the institution). Similar numbers were derived from the same time period of 6 and 3 weeks respectively from 2019. Modifications of oncologic treatment strategies were recorded.

The total number of outpatient visits in the head and neck center dropped from 6836 to 3628 (-46.7%) from

2019 to 2020. The greatest decrease was in the follow-up visits (-51.1%), consistent with the postponement of routine follow-up visits in stable, treated patients. The number of cases presented at weekly multidisciplinary treatment planning conference decreased by 21.7%. Over the same period, recommendations for surgical treatment declined from 103 (34.4% of total) to 57 (24.4% of total), representing a 44.7% decrease. On the other hand, the percentage of cases recommended for neoadjuvant treatment prior to surgery slightly increased from 3.3% to 4.7%.

The number of head and neck surgeries performed over 3 weeks (starting March 23) decreased from 111 to 59 (-46.8%). This decline coincides with the initiation of the Division of Surgery (DoS) Surgical Posting Review Committee on March 25th to review all case postings, and a simultaneous development of specific guidelines within the department.¹² Modifications of oncologic treatment are presented in Table 3. The majority of adjustments were postponement of surgeries, and there were alterations of the surgical procedure in three cases – in one case a free flap reconstruction was not performed, and in two other cases tracheostomies were successfully avoided.

Perioperative considerations

The data presented above reflect changing surgical practice in the early days of the COVID-19 pandemic. The issues surrounding the decision-making process and surgery itself in Head and Neck cancer patients are discussed below:

Pre-operative considerations

Starting with a reduction in outpatient clinic visits, all routine follow-up appointments (in asymptomatic patients who have recovered from cancer treatment) have been postponed until May 2020 or later. Additionally, all new patient visits are screened to determine urgency. Along with the institutional and regional policies listed in Table 1, these measures drastically reduced the number of patients seen at outpatient clinics. Greater effort has been made to bundle patients' multidisciplinary appointments on the same day, to reduce the frequency of outpatient visits.

The weekly multidisciplinary treatment planning conference plays a crucial role in achieving consensus recommendations for oncologic therapy¹³. In compliance with social distancing and stay home orders, teleconference facilitates discussion on the optimal treatment for each individual patient in the context of the pandemic. Additionally, a discussion should be held with the patient regarding the potential increased risk of adverse outcomes of active cancer treatment during the pandemic. There is recent evidence to suggest that if surgery is performed in an asymptomatic patient during the incubation period of COVID-19, the incidence of ICU stay and mortality is extremely high, at 44.1% and 20.5% respectively¹⁴. Therefore, the decision for surgery needs to be weighed against the risk of complications, and other non-surgical treatment options may be considered. However, there are unanswered questions regarding potential challenges and possible increased risk of both radiation therapy and systemic therapy during the COVID-19 pandemic that are discussed below.

Currently, most institutions likely have general guidelines on the tiered urgency of surgical cases. At MDACC, a DoS Surgical Posting Review Committee has been established to assess all planned surgeries. The goals of the committee are to reduce bed utilization and optimize resource utilization relative to the expected surge in COVID-19 cases. Institutional oversight is crucial in managing the allocation of resources such as ICU beds, ventilators, blood products and PPE such as N95 masks. Specific departmental guidelines for treatment of site-specific cancers of the head and neck have also been developed¹². Based on these guidelines, less aggressive cancers or early-stage disease can have surgery deferred, potentially with weekly telehealth visits to assess for change in clinical condition. More aggressive cancers at risk of progression are favored to proceed to surgery while advanced stage tumors are considered for non-surgical options or neoadjuvant therapy if surgery is preferred. If the decision for surgery has been approved, all patients undergo COVID-19 testing 24 hours prior to surgery, regardless of symptoms. While we have not encountered a pre-operative test positive situation yet, there is departmental consensus that oncologic treatment will be delayed until the patient recovers from COVID-19.

Intra-operative considerations

Major head and neck oncologic surgeries often require radical resection with flap reconstruction. Reconstructive selection is a complex process, even in the non-pandemic environment. On the one hand, microvascular free tissue transfer reconstruction provides greater diversity of tissue quality when reconstructing head and neck defects, and can be associated with improved quality of life outcomes (pain, swallowing, speech) and lower rates of wound complications (infection, dehiscence)¹⁵. On the other hand, free flaps may be associated with longer operative times, higher cost, require more intensive post-operative monitoring and potentially longer hospital stay. Regional flaps or pedicled flaps can achieve similarly excellent outcomes when selected appropriately^{16, 17}. We continue to offer free tissue transfer reconstruction at this time, having previously reported fairly low complications rates and over 98% success rate for the flaps¹⁸. However, we acknowledge that regional flaps may be preferred during this pandemic, particularly where resources are constrained. In situations where the defect has been deemed to be borderline and there is low risk of communication with the neck wound, for example, a partial glossectomy defect, another option could be skin graft reconstruction, primary closure or delayed healing. When free tissue transfer reconstruction is needed, a two-team approach with simultaneous starts can lead to decreased operative time, and anesthesia time, while also allowing each team to focus on a particular element of the case¹⁹. This appears to be the case in the United States where 98.5% of programs report a two-team approach at least some of the time, and has been widely adopted in 82% of hospitals in the United Kingdom^{19,20}.

The use of tracheostomy for airway protection postoperatively is well established. If a tracheostomy is not performed, the patient is either extubated or in some institutions, remains intubated in an ICU setting for a variable duration. While tracheostomies are indicated whenever there is anticipated airway obstruction or difficulty handling secretions, they can also lengthen hospital stay²⁰. Where it is safe to do so, such as in the small lateral tongue, buccal or palatal defect, there should be consideration to avoid tracheostomies. At this time, it is unknown whether patients with tracheostomies are at higher risk for acquiring COVID-19 given the direct route to the patient's airway. When elective tracheostomies are being performed, we adhere to recommendations outlined by those with experience during the Severe Acute Respiratory Syndrome (SARS) outbreak²¹.

There have been a number of excellent guidelines published on recommended PPE for health care professionals performing head and neck cancer surgery. At MDACC, all health care professionals have undergone recent updated mask fitting for N95 respirators, and are using them for all surgeries on the upper aerodigestive tract regardless of COVID-19 testing status. Despite pre-operative testing, it is known that the sensitivity of nasal swab for detection of COVID-19 patients is 60-70% in early studies.^{22,23} Therefore, all patients should still be treated as if they are potential asymptomatic carriers.²⁴ Surgeons are also required to wear eye-protection²⁵. During major complex ablative procedures, we are keeping a minimum number of personnel in the operating room. The use of high-speed oscillating and reciprocating saws remain in use at this time, as they are deemed critical in performing safe, expeditious ablative procedures. The use of high-speed drilling procedures with a cutting or diamond burr has been discouraged in light of evidence of significant aerosol contamination²⁵.

Post-operative considerations

Changes in inpatient post-operative management are focused on reduction of potential exposure to all persons in the hospital, as well as conservation of PPE. For major head and neck reconstruction, free tissue transfer reconstruction patients should be cared for in a unit with nursing staff experienced in flap monitoring and tracheostomy care or if in the ICU they should be moved out as soon as possible. Not only does this reduce utilization of ICU, but also decreases potential exposure to COVID-19 patients receiving ICU level care. For these reasons, in Lombardy, Italy, oncologic surgery requiring ICU level post-operative care and prolonged hospitalization was relocated to COVID-19 free institutions.²⁶

Patients who undergo tracheostomy and laryngectomy represent significant source of aerosolization and high potential for viral transmission based on studies performed during the 2013 SARS outbreak.^{27,28} Droplet

precautions are recommended for all patients with tracheostomy or open airway during this pandemic period, with the addition of N95 masks and protective eyewear for any staff performing airway manipulation including suctioning, tracheostomy exchange or nebulizer treatment.^{27,29} To reduce droplet production during spontaneous cough, laryngectomy stomas and tracheostomies should be covered when possible with a heat and moisture exchanger (HME) which provides significant viral filtration,²⁸ or cap when possible. Early decannulation should be considered, and in suitable candidates, patients may be transitioned immediately to decannulation, rather than changing to cuffless tracheostomy, with a capping trial to reduce airway manipulation.

Streamlining care is recommended with examination of mucosal sites limited only to essential staff. When possible, rounding teams should be reduced to essential personnel and video- or photo-documentation can be used to communicate clinical findings to those not present at bedside. Similar to the outpatient setting, telemedicine should be utilized when possible, including consultations that do not require physical exam, such as management of some medical therapy, nutrition counseling and discharge coordination services.

Visitors should be restricted to reduce potential transmission from outside the hospital. While there is a no-visitor policy currently in place at our institution, exceptions for a single visitor have been granted to patients with limited communication, including aphonic patients from laryngectomy, tracheostomy, and major oral cavity reconstruction, severely disabled patients as well as non-English speaking patients who have family members that assist in translation for daily care. Visitors are required to shelter in place at the hospital to reduce outside exposure, and are subject to daily temperature checks and screening.

Upon discharge, post-operative appointments are bundled, and deferred to telehealth visits if possible. A single follow-up visit to assess wound healing after reconstruction is scheduled if required. and coordinated with post-operative swallow evaluation or other aspects of multi-disciplinary appointments to reduce frequent travel for patients.

Special considerations

Non-surgical treatment modalities can play a role in reducing surgical volume in the treatment of patients with HNC. In patients requiring surgery, neo-adjuvant therapies can be used to defer surgical treatment until the peak of the pandemic has passed. However, potential associated risks with these modalities should be considered as well.

Chemotherapy/immunotherapy

A study of 1590 patients diagnosed with COVID-19 in China, showed that about 1% of these patients had concurrent diagnosis of cancer, and these patients were at higher risk for significant complications from viral infection (ICU admission, ventilator dependence or death).³⁰ Chemotherapy agents can lead to immunosuppression and deconditioning that may leave patients more susceptible to COVID-19 infection. Furthermore, those undergoing active treatment, with recent surgery or cytotoxic chemotherapy, were at highest risk of complications.³⁰ Consideration should be given for the use of less myelosuppressive agents and for the use of granulocyte colony-stimulating factors to avoid infectious complications.

The potential interaction between COVID-19 infection and treatment with immune checkpoint inhibitors (ICI) is not known.^{30,31} There may be potential benefits derived from boosting the immune system for protection from infection. However, there is also potential for pulmonary complications. While immune related adverse events in checkpoint inhibitors are very low, pneumonitis represents the most severe potential complication responsible for a majority of deaths (79%).³² Therefore, concurrent ICI-related pneumonitis with ARDS lung damage from COVID-19 could cause significant morbidity. In addition, some morbidity of severe COVID-19 infection has been attributed to immune hyperactivation and cytokine storm,³³ which could be worsened by immune checkpoint inhibition. No reports have been published on outcomes of ICI therapy with concurrent COVID-19 infection³¹, but potential risks should be considered and discussed with patients.

Clinical trials

During the study period, a majority of clinical trials (64%, 25 of 39) run through the head and neck multidisciplinary group were put on hold. Our institution continues to place a high value on advancing cancer care, and select trials remain open. For head and neck cancer patients, selected trials were prioritized to stay open based on the opportunity to deliver novel therapy and/or defer surgical intervention. Trials recommended to stay open included 6 immunotherapy protocols, and 4 radiation therapy protocols. For trials that remain open, selected research procedures including consent were IRB-approved for remote management on an individual trial basis. Translational analysis of all specimens is currently on hold.

Radiation therapy

Radiation therapy may help avoid high-aerosol generating surgery and an inpatient admission, particularly in patients with early stage laryngeal or oropharyngeal cancers. However, radiation treatment may increase exposure risk to both patients and healthcare workers because of the requirement for daily travel to hospital-based facilities for 6-7 weeks. Additionally, HNC patients may have tracheotomies, open stomas after laryngectomy, or require manipulation of the oral cavity for dental stents that increase staff exposure risk.

With these considerations in mind, an American Society for Radiation Oncology (ASTRO)/European Society for Radiotherapy and Oncology (ESTRO) consensus statement has been developed to give treatment recommendations for RT in HNC ³⁴. Based on responses from an international panel of experts, there is agreement that radical RT is of high priority while adjuvant RT for minor risk factors is of lower priority. Depending on the scenario (early risk mitigation versus late pandemic where there are severely reduced RT resources), hypofractionated RT schedules that reduce those courses by 1-2 weeks, can be used if necessary.

Beyond being prepared for a COVID-19 surge with altered fractionation schedules, our radiation oncology team has made other anticipatory moves. Anecdotal reports from radiation treatment centers with earlier COVID-19 surges/peaks suggest that up to about 35% of radiation oncology staff could be off work due to quarantine or illness. We reduced the number of patients under treatment in the main campus, so as to be able to maintain treatment continuity even with manpower shortages. The department achieved this by transferring daily radiation therapy to satellites healthcare facilities while monitoring their progress by telemedicine, and encouraging out-of-state patients that comprise a significant portion of our practice to seek radiation treatment locally. Current institutional guidelines require out-of-state patients to self-quarantine for 14 days and have a negative COVID-19 test before being seen here, so select patients or those with complex cancers may continue RT treatment at MDACC. The ability to treat patients at a local satellite facility also helps to reduce traffic to the main hospital that cares for an often immunocompromised, at-risk patient population.

Lastly, potential for treatment breaks could occur if a patient is under investigation for COVID-19 (PUI) or develops COVID-19 during multi-week radiation therapy. It is well known that treatment time factors are important for local control and survival in RT for head and neck cancers³⁵. Some guidelines recommend that RT be stopped for PUI until they achieve a negative COVID-19 test. This may be compensated for by giving second daily fractions to catch up. In the recent ASTRO/ESTRO consensus guidelines, there is agreement not to interrupt RT after week 2 for mild COVID-19 related symptoms in test positive patients, but there is strong agreement to interrupt RT for severe symptoms ³⁴. These patients are at highest risk for prolonged, detrimental treatment interruptions.

Transoral robotic surgery (TORS) for oropharyngeal cancer

Some institutions have restricted TORS cases for oropharyngeal cancer³⁶, with the knowledge that radiation or chemoradiation have comparable survival outcomes ³⁷. We continue to offer TORS to patients who we anticipate have a high likelihood of requiring single modality treatment. During the reported three-week period, two such TORS cases were performed and did not require further treatment while two other cases where TORS could have been part of multimodality treatment were ultimately recommended for chemoradiation. TORS may be an option in selected patients, allowing a single hospital stay versus a 6-7 week course of daily treatment. However, some cases thought to require surgery only may be pathologically

upstaged and may require adjuvant radiation or chemoradiation. Also, we acknowledge that the opportunity to offer TORS may be limited by available resources and institutional guidelines³⁶.

We recognize that resource availability can differ largely between institutions. Our institution is dedicated to treating cancer patients, whereas other institutions that provide general care may be inundated with COVID-19 positive patients. On the other hand, oncology patients have been proven to be a vulnerable population that our institution is determined to protect. Also, different regions have or will reach their COVID-19 surge or peak at different times, affecting how they are able to practice.

Conclusion

The measures that have been put in place during the COVID-19 pandemic have clearly impacted our surgical practice and overall management of head and neck cancer patients. We present the experience of our institution in the initial COVID-19 period where guidelines are constantly evolving. As such, it is essential to track patient outcomes at this crucial period in time, with long term follow-up to evaluate the impact of the pandemic on patients' outcomes. Currently, national and multinational efforts are collating data regarding the impact of COVID-19 on oncology patients. We will continue to strive to treat those most in need, while protecting our patients, healthcare workers and our community.

References

- [1] American Academy of Otolaryngology. Position Statement : Otolaryngologists and the COVID-19 Pandemic. <https://www.entnet.org/content/aao-hns-position-statement-otolaryngologists-and-covid-19-pandemic> Accessed 7th April 2020.
- [2]: Jensen AR, Nellemann HM, Overgaard J. Tumor progression in waiting time for 116 radiotherapy in head and neck cancer. *Radiother Oncol.* 2007;84(1):5-10. 117 doi:10.1016/j.radonc.2007.04.001
- [3]: Wyatt RM, Beddoe AH, Dale RG. The effects of delays in radiotherapy treatment on tumour control. *Phys Med Biol.* 2003;48:139–55
- [4]: Murphy CT, Galloway TJ, Handorf EA, et al. Survival impact of increasing time to treatment initiation for patients with head and neck cancer in the United States. *J Clin Oncol.* 2016;34:169–78.
- [5]: Coca-Pelaz-A, Takes RP, Hutcheson K et al. Head and Neck Cancer: A review of the impact of treatment delay on outcome. *Adv Ther.* 2018 Feb;35(2):153-160. doi: 10.1007/s12325-018-0663-7
- [6]: Schutte HM, Heutink F, Wellenstein DJ et al. Impact of Time to Diagnosis and Treatment in Head and Neck Cancer: A Systematic review. *Otolaryngol Head Neck Surg.* 2020 Feb 25;194599820906387. doi: 10.1177/0194599820906387
- [7]: DeGraff LH, Platek AJ, Iovoli AJ et al. The effect of time between diagnosis and initiation of treatment on outcomes in patients with head and neck squamous cell carcinoma. *Oral Oncol.* 2019 Sep;96:148-152. doi: 10.1016/j.oraloncology.2019.07.021.
- [8]: COVID-19: Elective Case Triage Guidelines for Surgical Care. <https://www.facs.org/covid-19/clinical-guidance/elective-case>. Accessed 7th April 2020
- [9]: Canadian Association of Head & Neck Surgical Oncology (CAHNSO) guidelines for management of Head & Neck Cancer during the COVID-19 Pandemic. Accessed 7th April 2020.
- [10]: Mapping 2019-nCoV. <https://systems.jhu.edu/research/public-health/ncov/>. Accessed 7th April 2020.
- [11]: Covid-19 projections assuming full social distancing through May 2020. <https://covid19.healthdata.org/united-states-of-america/texas>. Accessed 11th April 2020
- [12]: MD Anderson Head and Neck Surgery Treatment Guidelines Consortium. Head and neck surgical oncology in the time of a pandemic: Subsite-specific triage guidelines during COVID-19. *Authorea* . April 2020

- [13]: Shellenberger TD, Weber RS. Multidisciplinary Team Planning for Patients with Head and Neck Cancer. *Oral Maxillofac Surg Clin North Am* 2018 Nov;30(4):435-444. doi: 10.1016/j.coms.2018.06.005
- [14]: S Lei, Jiang F, Su W et al. Clinical characteristics and outcomes of patients undergoing surgeries during the incubation period of COVID-19. *EClinicalMedicine* (2020). <https://doi.org/10.1016/j.eclinm.2020.100331>
- [15]: Gabrysz-Forget F, Tabet P, Rahal A, et al. Free versus pedicled flaps for reconstruction of head and neck cancer defects: a systematic review. 2019. *J Otolaryngol head Neck Surg.* 48(13): doi: 10.1186/s40463-019-0334-y
- [16]: Hanasono MM, Friel MT, Klem C, et al. Impact of reconstructive microsurgery in patients with advanced oral cavity cancers. *Head Neck* 2009;31: 1289–1296.
- [17]: Kozin ED, Sethi RK, Herr M et al. Comparison of Perioperative Outcomes between the Supraclavicular Artery Island Flap and Fasciocutaneous Free flap. *Otolaryngo Head Neck Surg* 2016 Jan;154(1):66-72
- [18]: Corbitt C, Skoracki RJ, Yu P, Hanasono MM. Free flap failure in head and neck reconstruction. 2014. *Head Neck* 36(10):1440-5.
- [19]: Kovatch KJ, Hanks JE, Steven JR and CL Stucken. Current practices in microvascular reconstruction in otolaryngology-head and neck surgery. *Laryngoscope.* 2019. 129:138-145.
- [20]: Leiser Yoav, Barak M, Ghantous Y, et al. Indications for elective tracheostomy in reconstructive surgery in patients with oral cancer. 2017. *J Craniofac Surg.* 28(1): e18-22.
- [21]: Tay JK, Khoo MLC and WS Loh. Surgical Considerations for Tracheostomy During the COVID-19 Pandemic. 2020. *JAMA Otolaryngol Head Neck Surg.* Doi:10.100./jamaoto.2020.0764
- [22]: World Health Organization. (2020). Laboratory testing for coronavirus disease 2019 (COVID-19) in suspected human cases: interim guidance, 2 March 2020. World Health Organization. <https://apps.who.int/iris/handle/10665/33>. Accessed 7th April 2020
- [23]: Wang W, Xu Y, Gao R et al. Detection of SARS-CoV-2 in Different Types of Clinical Specimens. *JAMA* 2020 Mar 11. Doi:10.1001/jama.2020.3786
- [24]: Chen X, Liu J, Li N et al. Otolaryngology providers must be alert for mild and asymptomatic COVID-19 patients. *JAMA Oto.* <https://www.entnet.org/content/oto-journal-covid-19-accepted-papers>
- [25]: Workman AD, Welling DB, Carter BS, et al. Endonasal instrumentation and aerosolization risk in the era of COVID-19: simulation, literature review, and proposed mitigation strategies. 2020. *Int Forum Allergy Rhinol.* Doi: 10.1002/alr.22577.
- [26]: Maria SA, Fabiana A, Biglioli F, Giovanni F. Role of management of a head and neck department during the COVID-19 Outbreak in Lombardy. *JAMA Oto.* <https://www.entnet.org/content/oto-journal-covid-19-accepted-papers>
- [27]: Kligerman MP, Vukkadal N, Tsang R et al. Managing the Head and Neck Cancer Patient with Tracheostomy or Laryngectomy During the COVID-19 Pandemic. *Head & Neck.* <https://authorea.com/instant/20973>
- [28]: Tran K, Cimon K, Severn M, Pessoa-Silva CL, Conly J. Aerosol generating procedures and risk of transmission of acute respiratory infections to healthcare workers: A systematic review. *PloS One.*2012;7(4)
- [29]: Chan JYK, Wong EWY, Lam W. Practical Aspects of Otolaryngologic Clinical Services During the 2019 Novel Coronavirus Epidemic: An Experience in Hong Kong. *JAMA Otolaryngology– Head & Neck surgery.* 2020. Mar 20. Doi:10.1001/jamaoto.2020.0488
- [30]: Liang W, Guan W, Chen R, et al. Cancer patients in SARS-CoV-2 infection: a nationwide analysis in China. *Lancet Oncol.* 2020;21(3):335-337.

- [31]: Bersanelli M. Controversies about COVID-19 and anticancer treatment with immune checkpoint inhibitors. *Immunotherapy*. 2020 Mar 26
- [32]: Sun X, Roudi R, Dai T et al. Immune-related adverse events associated with programmed cell death protein-1 and programmed cell death ligand 1 inhibitors for non-small cell lung cancer: a PRISMA systematic review and meta-analysis. *BMC Cancer*. 2019 Jun 10;19(1):558.
- [33]: Mehta P, McAuley DF, Brown M et al. COVID-19: consider cytokine storm syndromes and immunosuppression. *Lancet*. 2020 Mar 28;395(10229):1033-1034.
- [34]: Thomson DJ, Palma D, Guckenberger M et al. Practice recommendations for risk-adapted head and neck cancer radiotherapy during the COVID-19 pandemic: an ASTRO-ESTRO consensus statement. *Int J Radiat Oncol Biol Phys*. <https://www.astro.org/Daily-Practice/COVID-19-Recommendations-and-Information/Journal-Articles>
- [35]: Rosenthal DI. Consequences of mucositis-induced treatment breaks and dose reductions on head and neck cancer treatment outcomes. *J Support Oncol* 2007 Oct;5(9 Suppl 4):23-32
- [36]: Patel RJ et al. Early Institutional Head and Neck Oncologic and Microvascular Surgery Practice Patterns Across the United States during the SARS-CoV-2 (COVID-19) Pandemic. *Authorea* . April 2020
- [37]: Parsons JT, Mendenhall WM, Stringer SP et al. Squamous cell carcinoma of the oropharynx: surgery, radiation therapy, or both. *Cancer*. 2002;94(11):2967-80
- [38]: COVID-19: Recommendations for Management of Elective Surgical Procedures. <https://www.facs.org/covid-19/clinical-guidance>. Accessed 7th April 2020
- [39]: Stay Home, Work Safe Order. <https://www.readyharris.org/Stay-Home>. Accessed 7th April 2020
- [40]: TMB Passes Emergency Rules to Enforce Gov. Abbott's Executive Order GA-09 <http://www.tmb.state.tx.us/dl/27277A2F5E-1395-E868-98D48D432C1A>. Accessed 7th April 2020
- [41]: Information for Travelers Impacted by Governor Abbott's Executive Order Mandating 14-Day Quarantine for Travelers Coming into Texas by Air and Road. <https://www.dps.texas.gov/COVIDtravel/> Accessed 7th April 2020
- [42]: Governor Abbott Issues Executive Order Implementing Essential Services And Activities Protocols. <https://gov.texas.gov/news/post/governor-abbott-issues-executive-order-implementing-essential-services-and-activities-protocols>. Accessed 7th April 2020
- [43]: COVID-19 direct. <https://covid-19.direct/county/TX/Harris?graph=cases>. Accessed 11th April 2020.

Hosted file

HED-20-0531_Table_1 (1).docx available at <https://authorea.com/users/312328/articles/443227-changing-practice-patterns-in-head-neck-oncologic-surgery-in-the-early-covid-19-era>

Hosted file

HED-20-0531_Table_2 (1).docx available at <https://authorea.com/users/312328/articles/443227-changing-practice-patterns-in-head-neck-oncologic-surgery-in-the-early-covid-19-era>

Hosted file

HED-20-0531_Table_3 (1).docx available at <https://authorea.com/users/312328/articles/443227-changing-practice-patterns-in-head-neck-oncologic-surgery-in-the-early-covid-19-era>