

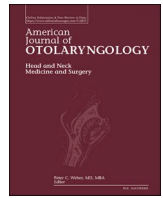


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## Expanded use of telemedicine for thyroid and parathyroid surgery in the COVID-19 era and beyond

Roger W. Boles, Melissa Zheng, Daniel Kwon\*

Department of Otolaryngology – Head and Neck Surgery, Keck Medicine of the University of Southern California, 1450 San Pablo St., Suite 5800, Los Angeles, CA 90033, USA

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### ABSTRACT

**Background:** The COVID-19 pandemic has greatly expanded the use of telemedicine in healthcare. Surgical thyroid and parathyroid diseases are uniquely suited for comprehensive telemedicine. The objective of this study was to compare the safety and efficacy of telemedicine with in-person preoperative visits in patients undergoing thyroid and parathyroid surgery.

**Methods:** Prospective cohort study of patients undergoing thyroid and parathyroid surgery at a tertiary care center in a COVID-19 hotspot from March 2020 to October 2020. Patients were divided into a telemedicine cohort, with preoperative consultation and surgical decision-making conducted via telemedicine, and a conventional in-person cohort.

**Results:** Of 94 patients, 28 were enrolled in the telemedicine cohort and 66 were enrolled in the conventional cohort. Telemedicine patients were more likely to have parathyroid disease (50% versus 24%,  $p = 0.02$ ) compared with the conventional cohort, but there was no significant difference in surgery for malignancy (43% versus 56%,  $p = 0.27$ ). There were no significant differences in surgical outcomes or postoperative complications between cohorts, including intraoperative blood loss (19.4 mL versus 35.5 mL,  $p = 0.06$ ), postoperative length of stay (1.3 days versus 1.2 days,  $p = 0.93$ ), persistent hypocalcemia (3.6% versus 0%,  $p = 0.30$ ), and true vocal fold paresis (0% versus 4.5%,  $p = 0.55$ ).

**Conclusions:** With careful selection, many patients undergoing thyroid and parathyroid surgery may be safely treated using comprehensive telemedicine.

### 1. Introduction

The Coronavirus Disease 2019 (COVID-19) pandemic has led to an abrupt and profound transformation in the delivery of healthcare. Mandated shelter-in-place orders, mitigation strategies such as physical distancing, and the overload of health care centers made routine healthcare impossible. This was particularly relevant in otolaryngology clinics, where evaluation of the upper aerodigestive system posed increased exposure risk. [1–3] In fact, several early health-care related COVID-19 deaths were attributed to otolaryngologic surgery in an infected patient. [4] In response, healthcare systems as well as health-care payors rapidly expanded telehealth or telemedicine services and restricted in-person interactions and procedures. As the pandemic lessens, it is becoming clear that telemedicine will continue to retain some role.

Telemedicine is broadly defined as the use of telecommunication technology to remotely deliver care to patients. Historically, telemedicine has been relatively limited to fields such as psychiatry, primary care and diabetes counseling, primarily to provide care for remote patient populations. [5–8] While some otolaryngology pilot programs using virtual care have been associated with high patient satisfaction, increased access to care, and significant cost savings, [3,9–11] surgical specialties including otolaryngology have been generally slow to adopt telemedicine due to substantial reliance on physical exam as well as the use of specialized instruments and diagnostic procedures. [12,13]

Thyroid and parathyroid disease may be uniquely well-suited to telemedicine. Previous studies have reported on the feasibility of telemedicine in caring for postoperative thyroid and parathyroid patients, as such visits typically involve only wound inspection and discussion of pathology results. [11,14,15] While a thorough history and physical

\* Corresponding author at: Department of Otolaryngology–Head and Neck Surgery, Keck Medicine of University of Southern California, 1450 San Pablo Street, Suite 5800, Los Angeles, CA 90033, USA.

E-mail address: [Daniel.kwon@med.usc.edu](mailto:Daniel.kwon@med.usc.edu) (D. Kwon).

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remains a cornerstone of pre-surgical assessment, many surgical thyroid and parathyroid cases rely more on imaging and laboratory assessments than physical exam findings. [16,17] Furthermore, surgical management of thyroid and parathyroid disease has trended towards referrals to high-volume hospitals, which can pose a geographic challenge for many patients. [18] However, there is a lack of research on the utilization of telemedicine in the preoperative assessment of these patients. At our medical center, the COVID-19 pandemic necessitated expanded use of telemedicine care.

The objective of this study was to compare the safety and efficacy of telemedicine with in-person preoperative visits in patients undergoing thyroid and parathyroid surgery. Our pilot experience demonstrates that comprehensive telemedicine care may be safely used in selected patients undergoing thyroid and parathyroid surgery.

## 2. Methods

### 2.1. Study cohort

This was a prospectively enrolled cohort study of patients undergoing thyroid and parathyroid surgery. The surgeries were performed by fellowship-trained head and neck surgeons at a high-volume academic tertiary care medical center in an urban COVID-19 hotspot. The study protocol was approved by the institutional review board. Patients were enrolled from March 2020 until October 2020, the time period in which our institution's mandatory COVID-19 telemedicine protocol was in effect whereby all new patients were offered an initial telemedicine consultation but were given options for in-person appointment by request. Telemedicine patients were screened for in-person evaluation based on clinical presentation such as large tumors, advanced cancers, voice or swallow changes. Strict efforts were made to have laboratory results and imaging available for review prior to telemedicine evaluation.

The telemedicine cohort comprised patients who had preoperative evaluation exclusively conducted via telemedicine and proceeded directly to surgery. In-person evaluation in the telemedicine cohort was limited to the day of surgery. Patients who opted into an in-person consultation or were converted to an in-person visit for any reason were placed into the conventional control cohort. Surgeon directed conversion to in-person evaluation was based on clinical judgement and was especially considered for patients with previous central neck surgery, history of voice or swallowing changes, or signs of high-risk thyroid cancer such as lymph node metastases or extra-thyroidal extension. Patients who had thyroid surgery secondary to another larger surgery (e. g. laryngectomy) or were inpatient transfers from outside hospitals were excluded. A negative SARS-CoV-2 polymerase chain reaction test within 48 h was required for all patients undergoing surgery.

### 2.2. Data collection

Clinical data were gathered to determine demographic information, clinical disease factors, operative metrics, and postoperative complications with at least 6 months of follow up. Patients who were lost to follow up were excluded. We also specifically recorded clinical reasons for conversion from telemedicine to in-person visits. A conversion was defined as any pre- or postoperative visit that was switched to in-person after an initial attempt via telemedicine. Study data were collected and managed using REDCap electronic data capture tools hosted at our institution. [19,20]

With respect to postoperative complications, persistent hypocalcemia was defined as persistent high dose calcium replacement or calcitriol on last follow up with the exception of patients with renal hyperparathyroidism. Recurrent laryngeal nerve (RLN) paralysis was defined as documented injury or postoperative vocal fold immobility confirmed by laryngoscopy. Laryngeal paresis or dysphonia was defined as documented voice changes on exam, documented paresis through

laryngoscopy, and/or requiring referral for voice therapy. Transient voice change was described as patient reported voice changes that were self-limited within the immediate postoperative phase. Swallow changes were defined as documented dysphagia requiring intervention or change in diet.

### 2.3. Statistical analysis

Statistical analysis was performed using RStudio (RStudio PBC, Boston, Massachusetts) and significance was set to  $P \leq 0.05$ . Analyses for numerical data used Student's *t*-test after confirming normal distribution with the Shapiro-Wilk test and Mann-Whitney *U* test for non-normal data. Analyses for categorical data were performed with contingency tables using Fisher's exact test.

## 3. Results

A total of 94 patients were included in the study. Twenty-eight had their preoperative care exclusively conducted through telemedicine and were in the telemedicine cohort. The remaining 66 patients had at least a portion of their preoperative care in-person and were in the conventional control cohort, with six of these having had their preoperative visit converted from an initial telemedicine evaluation to an in-person evaluation.

Demographic and clinical factors were compared between the two cohorts (Table 1). There were no differences with respect to gender, ethnicity/race, and insurance status between the cohorts. Patients in the telemedicine cohort tended to be younger (47 vs 53 years), but this difference was not significant ( $p = 0.12$ ). There was a significant difference with respect to availability of imaging and pathology. Telemedicine patients were less likely to have imaging within our institution (50% vs 73%,  $p = 0.05$ ) and were more likely to have a preoperative diagnosis of parathyroid disease (50% versus 24%,  $p = 0.02$ ) compared with the conventional cohort. While telemedicine patients were more likely to undergo parathyroidectomy (50% vs 22.7%,  $p = 0.01$ ), patients in the conventional cohort had significantly more total thyroidectomies (15.2% vs 0%,  $p = 0.03$ ). There was no significant difference in surgery for malignant pathology with 56% of patients having surgery for cancer in the conventional cohort compared to 43% in the telemedicine cohort ( $p = 0.27$ ). With respect to comorbidities, there was a significantly lower prevalence of hypertension in the telemedicine cohort compared with the conventional cohort (17.9% vs 40.9%,  $p = 0.03$ ), but no other recorded comorbidity or overall presence of comorbidities were significantly different.

Comparisons of surgical metrics and postoperative complications between the two cohorts are summarized in Table 2. There were no differences between the two cohorts in duration of surgery, postoperative length of stay, or postoperative complications. There was a trend towards less intraoperative blood loss for surgeries performed on the telemedicine cohort compared with the conventional cohort (19 mL vs 36 mL), but this did reach statistical significance ( $p = 0.06$ ).

Fig. 1 shows the dispositions of pre- and postoperative visits for the entire study cohort. Sixty patients were preoperatively seen in-person, 28 via telemedicine, and six had their preoperative visit converted from telemedicine to in-person for a variety of reasons (see Table 3 below). Regarding postoperative follow up, most patients opted for telemedicine visits, with 61 patients seen via telemedicine, 30 patients seen in-person, and three had their postoperative visit converted from telemedicine to in-person. More than half ( $n = 37$ , 56%) of the conventional cohort opted to utilize telemedicine for postoperative follow up.

Whereas most of the patients seen in-person self-selected into this cohort initially, we examined clinical reasons for conversion by the surgeon to an in-person evaluation after an initial telemedicine appointment (Table 3). Preoperatively, two patients were converted to in-person evaluation for substernal disease, two for preoperative voice

**Table 1**

Patient demographics, characteristics, comorbidities, and surgeries. (Values indicate number of patients and percentage of study population unless otherwise stated).

Variable	All Patients (n = 94)		Conventional (n = 66)		Telemedicine (n = 28)		p value
	No.	(%)	No.	(%)	No.	(%)	
Age, mean (SD)		51.5 (17.8)		53.3 (18.1)		47.1 (16.4)	0.12
Sex	Male	27 (28.7)		21 (31.8)		6 (21.4)	0.46
	Female	67 (71.3)		45 (68.2)		22 (78.6)	0.46
Race	White	37 (39.4)		26 (39.4)		11 (39.3)	1.0
	Hispanic	25 (26.6)		15 (22.7)		10 (35.7)	0.21
	Black	1 (1.1)		1 (1.5)		0	1.0
	Asian	11 (11.7)		7 (10.6)		4 (14.3)	0.73
Insurance Status	Other	20 (21.3)		17 (25.8)		3 (10.7)	0.17
	Private	54 (57.4)		38 (57.6)		16 (57.1)	1.0
	Public	38 (40.4)		26 (39.4)		12 (42.9)	0.82
Pre-Op Diagnosis	Uninsured	2 (2.1)		2 (3.0)		0	1.0
	Compressive Goiter	14 (14.9)		11 (16.7)		3 (10.7)	0.54
	Indeterminate Nodule(s)	15 (16.0)		13 (19.7)		3 (10.7)	0.38
Imaging	Thyroid Cancer	38 (40.4)		28 (42.4)		10 (35.7)	0.65
	Parathyroid Disease	29 (39.2)		15 (22.7)		14 (50.0)	0.01*
Laryngeal Exam	Within Institution	63 (67.0)		49 (74.2)		14 (50.0)	0.03*
	Outside Institution	27 (28.7)		15 (22.7)		12 (42.9)	0.08
Comorbidities	Scope	45 (47.9)		42 (63.6)		3 (10.7)	<0.001*
	Any Comorbidity	48 (51.1)		37 (56.1)		11 (39.3)	0.18
	HTN	32 (34.0)		27 (40.9)		5 (17.9)	0.03*
Procedure	Diabetes I or II	16 (17.0)		11 (16.7)		5 (17.9)	1.0
	Non-H&N Malignancy	5 (5.3)		4 (6.1)		1 (3.6)	1.0
	Liver Failure	4 (4.3)		3 (4.5)		1 (3.6)	1.0
	ESRD	8 (8.5)		4 (6.1)		4 (14.3)	0.23
Path diagnosis	Thyroid Lobectomy	18 (19.2)		12 (18.2)		6 (21.4)	0.78
	Total Thyroidectomy	10 (10.6)		10 (15.2)		0	0.03*
	TT + Neck Dissection	26 (27.7)		18 (27.3)		8 (28.6)	1.0
	Completion Thyroidectomy	15 (16.0)		12 (18.2)		3 (10.7)	0.54
	Parathyroidectomy	29 (30.9)		15 (22.7)		14 (50.0)	0.01*
	Revision Surgery	21 (22.3)		16 (24.2)		5 (17.9)	0.60
Path diagnosis	Thyroid Cancer	48 (51.1)		37 (56.1)		12 (42.9)	0.27
	Benign Goiter	17 (18.1)		14 (21.2)		3 (10.7)	0.38
	Toxic Nodule	1 (1.1)		1 (1.5)		0	1.0
	Parathyroid Disease	27 (28.7)		14 (21.2)		13 (46.4)	0.02*

Abbreviations: SD, Standard deviation; Pre-op, Preoperative; HTN, Hypertension; H&N, Head and neck; ESRD, End-stage renal disease; TT, Total thyroidectomy; Path, Pathologic.

\* Indicates statistical significance  $p \leq 0.05$ .

complaints, and one for high-risk thyroid cancer. Additionally, one patient was preoperatively converted to in-person evaluation by reason of patient preference for a total of six conversions. We also examined reasons for conversion of postoperative visits from telemedicine to in-person. Three patients initially seen with telemedicine postoperatively were converted to in-person evaluations: two for voice changes and one with concern for neck swelling.

#### 4. Discussion

In this study, exclusive use of telemedicine for consultation and surgical selection in patients undergoing thyroid and parathyroid surgery was feasible and resulted in similar outcomes to receiving care with conventional in-person visits. Broadly, there were not many statistical differences between the cohorts with respect to patient factors, disease factors, or outcomes. We observed that telemedicine patients tended to be younger, healthier, and undergoing parathyroid surgery, though only a few of these factors reached significance. Importantly, when examining rates of surgery for malignancy, there were no significant differences between the two groups, demonstrating that telemedicine can be effectively employed for these patients as well. Similarly, there were no differences in surgical metrics or postoperative complications. In fact, the telemedicine cohort had only one postoperative complication of transient voice changes reported by the patient and one case of asymptomatic but persistent hypoparathyroidism in a case of revision parathyroidectomy on last follow up. Overall, our experience and data demonstrate that telemedicine outpatient care for thyroid and parathyroid surgery can be safe and viable.

These results also suggest that a mixed mode of care employing both in-person and telemedicine evaluation is feasible. While 70% of the study cohort received preoperative evaluation in-person, this proportion nearly reversed postoperatively as 65% of patients were seen via telemedicine. The majority of patients, including 37 from the conventional cohort, chose to have their postoperative care remotely. This is consistent with previous studies that have shown successful postoperative management of patients undergoing endocrine surgery. [11,14,15]

Telemedicine has quickly become an accepted method of healthcare delivery by both providers and patients with relatively high rates of satisfaction. [21] This has occurred alongside a widespread shift towards virtual and remote interaction in society such as working from home and distanced learning due to the COVID-19 pandemic. In the field of sub-specialty surgery, telemedicine has largely been viewed as an acceptable but inferior way to deliver health care. However, for many patients who are geographically remote or time constrained, telemedicine can improve care by improving access to tertiary care providers and preventing delay of care. In addition, certain aspects of telemedicine may be superior to conventional outpatient care, such as the ability to conduct multidisciplinary conference calls with other physicians or family members and easily review digital information including imaging.

In the field of otolaryngology, telemedicine has many inherent limitations due to anatomy and reliance on lighted or endoscopic equipment required for physical exam. Thyroid and parathyroid patients are uniquely suited to telemedicine based on relatively less reliance on specialized exam and greater emphasis on other diagnostic modalities such as imaging and lab values. For surgical thyroid disease, workup and

**Table 2**  
Summary of surgical metrics and postoperative complications between cohorts. (Values indicate number of patients and percentage of study population unless otherwise stated).

Variable	All participants (n = 94)	Conventional (n = 66)	Telemedicine (n = 28)	p value
	No. (%)	No. (%)	No. (%)	
Intraoperative blood loss (mL), mean (SD)	30.3 (49.6)	35.5 (56.7)	19.4 (26.4)	0.06
Surgery duration (min), mean (SD)	105.1 (45.1)	105.6 (47.5)	104.1 (38.7)	0.68
Length of stay (days), mean (SD)	1.2 (2.0)	1.2 (1.9)	1.3 (2.1)	0.93
Postoperative complication, any	8 (8.5)	6 (9.1)	2 (7.1)	1.0
Persistent hypocalcemia	1 (1.1)	0	1 (3.6)	0.30
Permanent TVF paralysis/ RLN transection	0	0	0	
TVF paresis	3 (3.2)	3 (4.5)	0	0.55
Transient dysphonia	4 (4.3)	3 (4.5)	1 (3.6)	1.0
Swallow changes	0	0	0	
Post-op infection (e.g. UTI, PNA)	0	0	0	
General medical complication	0	0	0	
Readmission	0	0	0	

Abbreviations: mL, milliliters; SD, Standard deviation; min, minutes; TVF, True Vocal Fold; RLN, Recurrent laryngeal nerve; Post-op, Postoperative; UTI, Urinary tract infection; PNA, pneumonia.

treatment are well defined and relatively standardized by guidelines such as the American Thyroid Association guidelines. [22] The mainstay of thyroid disease evaluation is ultrasonography and cytology, often done prior to surgical consultation. Similarly, parathyroid disease is almost exclusively evaluated with laboratory values and imaging.

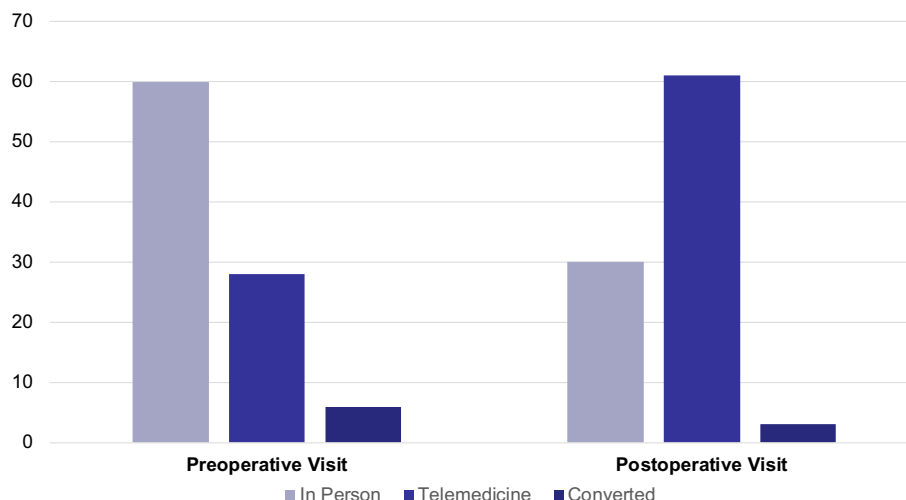
One major consideration to address in patients undergoing evaluation for surgery, particularly in patients with thyroid cancer, is laryngeal evaluation. The importance of a vocal or laryngeal evaluation is well established in guidelines for treatment of thyroid cancer. Some

guidelines recommend “voice evaluation” while others recommend a flexible endoscopic exam for all patients being considered for surgery. [22,23] In the setting of COVID-19, our institution adopted severe restrictions of potentially aerosolizing procedures such as in-office laryngoscopy. We relied primarily on clinical voice evaluation protocols and flexible laryngoscopy was used when appropriate for patient reported voice/swallow changes, high risk cases such as signs of extra-thyroidal extension or lymph node metastases, and previous surgery as recommended by the ATA guidelines. [22] It was also done for other indications based on clinical judgement such as large substernal goiter. While the routine use of in-office laryngoscopy is returning to pre-pandemic practices in many areas, we felt that limited use based on screening was safe and adequate.

There were several inherent limitations to this study. The first is selection bias, as younger, healthier patients with lower-risk or parathyroid disease tended to be more likely to have comprehensive telemedicine visits. Similarly, any patient who presented with any higher risk findings were converted to an in-person visit for further assessment including endoscopic laryngeal exam. While this may be expected to influence outcomes, it supports our notion that clinical judgement is needed for careful selection of appropriate candidates. Another limitation was that the study cohort was heterogenous with regard to pathology (both thyroid and parathyroid disease) and surgical procedure. However, given very similar risk profiles, we felt that it was appropriate to include them for examination of safety and feasibility. Finally, our study population was relatively small. This was almost entirely due to the significant slow-down and deferral of non-emergent surgeries during the pandemic as was advocated by numerous governing bodies. Nevertheless, the unique situation provided this valuable experience which may allow this to be further studied and expanded in the future. With the continued use of telemedicine, future multi-centered studies will provide valuable additional data.

**Table 3**  
Clinical reasons for conversion from telemedicine to in-person by surgeon.

	No.
Preoperative conversions	5
Substernal goiter	2
Vocal complaints	2
High-risk cancer	1
Postoperative conversions	3
Vocal complaints	2
Neck swelling	1



**Fig. 1.** Dispositions of pre- and postoperative visits for the entire study cohort (n = 94).

## 5. Conclusion

With careful selection, many patients who are undergoing thyroid and parathyroid surgery may be safely treated using comprehensive remote care including consultation and postoperative care.

## Declaration of competing interest

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. There are no competing financial interests to disclose.

The preliminary data from this study were presented at the 10th International Conference of Head and Neck Cancer.

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