

Laryngeal Complications After Thyroidectomy

Is It Always the Surgeon?

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Hypothesis: Laryngeal dysfunction after thyroidectomy is a common complication. However, few data are available to differentiate whether these complications result from injury to the recurrent nerve or to the vocal folds from intubation.

Setting: University medical center.

Patients: Seven hundred sixty-one patients who underwent surgery to the thyroid gland from 1990 to 2002. Of these patients, 8.4% underwent a revision thyroidectomy.

Intervention: Preoperative and postoperative laryngostroboscopic examination.

Main Outcome Measure: Laryngostroboscopic evaluation of laryngeal complications.

Results: The overall rate of laryngeal complications was 42.0% (320 patients). Complications from an injury to the vocal folds occurred in 31.3% of patients. Weakness or paresis of the recurrent nerve was initially present in 6.6% and was related to the nerves at risk. This rate was higher in revision thyroidectomies than in primary surgical interventions (6.2% vs 11.6%; $P = .04$). The rate of laryngeal injuries was higher in patients older than 65 years (39.8% vs 30.8%; $P = .03$).

Conclusions: These data suggest that laryngeal complications after thyroidectomies are primarily caused by injury to the vocal folds from intubation and to a lesser extent by injury to the laryngeal nerve. We recommend documentation of informed consent, especially for patients who use their voice professionally, such as singers, actors, or teachers.

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LARYNGEAL COMPLICATIONS AFTER thyroidectomy are a common problem.¹⁻⁵ The leading cause of the problem is injury to the recurrent nerve. Studies performed on large groups of patients show a prevalence for permanent palsy of the recurrent nerve ranging from 0%

going thyroidectomy, the descriptions of vocal fold injury are missing. In smaller groups of patients undergoing thyroidectomy, laryngeal dysfunction was noted by Stojadinovic et al¹⁶ in 2 of 15 symptomatic and 2 of 30 asymptomatic patients and by de Pedro Netto et al¹⁷ in 28 of 100 patients. In the present study, we sought to determine the incidence and characteristics of intubation-related vocal fold injuries after thyroidectomy in a large group of patients.

See Invited Critique at end of article

after primary surgery to 20% after revision surgery.¹⁻⁵ Tracheal intubation can lead to hoarseness as well.^{6,7} The incidence of laryngeal injuries caused by intubation is considered to be about 6% to 70% after surgical procedures not adjacent to the larynx.^{6,8-13} To date, there are few data concerning injuries to the vocal folds after surgery in close relationship to the larynx. Although Musholt et al¹⁴ and Lombardi et al¹⁵ report that hoarseness is increased and videolaryngoscopy was performed in patients under-

METHODS

A total of 1001 patients were included in the study between 1990 and 2002. All patients scheduled for thyroidectomy underwent preoperative evaluation of the vocal folds. Overall, 240 patients failed to appear for postoperative examination of the vocal folds at our university medical center (reasons included refusal of reexamination, subjective rejection of reevaluation because of good vocal quality, or reevaluation by an otolaryngologist at another institution) and were excluded from the analysis.

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Table 1. General Data for 761 Study Patients

Variable	No. (%)
Sex	
Female	528 (69.4)
Male	233 (30.6)
Age, y	
Median	51
Range	7-87
≤64	600 (78.8)
≥65	161 (21.2)
Lateralization of surgery	
Total bilateral	46 (6.0)
Total unilateral	70 (9.2)
Subtotal bilateral	413 (54.3)
Subtotal unilateral	77 (10.1)
Total on one side, subtotal on the other side	115 (15.1)
Bilateral node extirpation	32 (4.2)
Unilateral node extirpation	6 (0.8)
Resection at the isthmus	2 (0.3)
First thyroidectomy	697 (91.6)
Revision thyroidectomy	64 (8.4)

Table 2. Histopathologic Findings at Thyroidectomy

Finding	No. (%) ^a
Malignant lesion	59 (7.8)
Follicular	21 (35.5)
Papillary	19 (32.2)
Lindsay tumor ^b	6 (10.2)
Anaplastic	1 (1.7)
Medullary	9 (15.3)
Paraganglioma	1 (1.7)
Metastasis	2 (3.4)
Benign lesion	702 (92.2)
Nodular goiter and adenoma	576 (82.1)
Thyroiditis	70 (10.0)
Hyperparathyroidism	54 (7.7)
Oncocytoma	2 (0.3)

^aThe percentages for the main categories "Malignant lesion" and "Benign lesion" are based on the entire cohort of 761 patients; the percentages for the subcategories are based on 59 and 702 patients, respectively.

^bAlso known as follicular differentiated papillary thyroid carcinoma.

In each of the remaining 761 patients (**Table 1**), preoperative and postoperative endoscopic laryngostroboscopy (Timcke Elektromedizinische Geräte, Hamburg, Germany) was performed by an experienced otolaryngologist. Compared with laryngoscopy, laryngostroboscopy provides more detailed information about vocal fold oscillations such as amplitudes and mucosa waves and the glottic closure¹⁸ and is more sensitive for detection of even small alterations. The postoperative examination was performed on day 3 or 4 after surgery.

Laryngeal complications were defined as newly discovered findings at the vocal folds after surgery compared with the preoperative status. Specific attention was placed on findings described in the literature^{6,9-14,16,19} such as edema, granulations, hematomas, dislocation of the arytenoid cartilage, and fibrinous laryngitis or thickening of the vocal folds. All of these conditions resulted in incomplete closure of the rima glottidis or changes in the amplitude of the vocal fold vibration or movements of the mucosa wave and, therefore, caused hoarseness.^{6,9-14,16,19} Apart from these complications, weakness and pa-

Table 3. Preoperative and Postoperative Laryngostroboscopic Findings in 761 Patients

Diagnosis	No. (%)
Preoperative findings ^a	
Laryngitis	52 (6.8)
Edema	21 (2.8)
Cyst	1 (0.1)
Granuloma	1 (0.1)
Polyp	6 (0.8)
Leukoplakia	2 (0.3)
Sulcus vocalis	1 (0.1)
Hyperfunction	15 (2.0)
Hypofunction	21 (2.8)
Hyperplasia of ventricular folds	5 (0.7)
Palsy of recurrent nerve	14 (1.8)
Postoperative findings ^b	
Hematoma	70 (9.2)
Granuloma	68 (8.9)
Thickening of mucosa	104 (13.7)
Edema	29 (3.8)
Subluxation of arytenoid cartilage	1 (0.1)
Recurrent nerve palsy	84 (11.0)

^aTwo patients had 2 different kinds of laryngeal changes.

^bThree hundred fifty-six alterations were noted in 320 patients.

alysis of the recurrent nerve were considered separately because their origin after thyroidectomy (because of the surgical procedure or intubation) is still unclear.

In all patients, age, sex, histopathologic diagnosis, and report of the surgical procedure were analyzed (**Table 1** and **Table 2**). For comparison between groups, the χ^2 test and Kendall τ -b rank correlation were used. Statistical significance was defined with a 95% confidence interval ($P < .05$).

RESULTS

At preoperative stroboscopic examination, we found 139 alterations of the vocal folds in 137 patients (18.0%; **Table 3**). Fourteen patients (1.8%) had preexisting palsy of the recurrent nerve. Eight of these patients had previously undergone a surgical procedure with a nerve at risk (thyroid gland [$n=7$] or transcervical approach to the spinal cord [$n=1$]). In 2 patients, the paresis was caused by a malignant lesion and, in 4 patients, the cause was unknown.

The total number of nerves at risk was 1365. In 2 patients, only resection in the area of the thyroid isthmus was performed, without any risk of damage to the laryngeal recurrent nerve.

The histopathologic findings revealed a malignant lesion in 59 patients (7.8%) (**Table 2**). Two patients had thyroid metastasis from primary tumors in a kidney and in the stomach. In 21 patients (2.8%), surgical complications during or after thyroidectomy were cited in the surgical reports, with the most prevalent complication being bleeding in the surgical area in 10 patients (47.6% of surgical complications). No descriptions of injury to the recurrent nerve were noted in the surgical reports.

The overall rate of postoperative laryngeal complications after surgery was 42.0%. Thirty-six patients exhibited 2 different kinds of laryngeal complications. The rate of vocal fold injury was estimated at 31.3% (**Table 3**). Only

1 patient experienced subluxation of the arytenoid cartilage, which was repositioned in a subsequent surgical procedure that resulted in good improvement in vocal function. No statistically significant occurrence of lateralization of granulomas occurred ($P = .63$) (Figure, A). Although edema was more unilateral than bilateral ($n = 20$ vs $n = 9$; $P = .04$), there was no dominance of one side over the other ($P = .37$). Only hematomas (Figure, B) were more prevalent unilaterally (left side, $n = 46$; right side, $n = 20$; bilateral, $n = 4$; $P < .001$).

Patients with preoperative alteration of the vocal folds did not demonstrate a statistically significant higher rate of postoperative vocal fold injury compared with patients without any alterations ($P = .06$). Patients with preoperative superficial laryngitis, characterized by injection of vessels, did not have a statistically significant higher rate of postoperative hematoma ($P = .31$). There was no significant difference associated with the patients' sex ($P = .15$). Older patients (≥ 65 years) exhibited more alterations in the vocal folds than did younger patients (39.8% vs 30.8%; $P = .03$).

Overall weakness or paralysis of the recurrent nerve was noted in 78 patients unilaterally and in 6 patients bilaterally. There was no injury to the superior laryngeal nerve. For the 1365 nerves at risk, the rate of recurrent nerve palsy was 6.6%. No significant difference was noted in the rate of recurrent nerve palsy associated with malignant lesions ($P = .13$) or age ($P = .23$). According to the surgical reports, there were descriptions of preparation of the recurrent nerves in 1345 nerves at risk (98.5%). In our data, the kind of dissection (total dissection, partial dissection, or no dissection) compared with the nerves at risk had no significant influence on the rate of recurrent nerve palsy ($P = .10$). Only revision surgery was associated with higher rate of impairment of the recurrent nerve (6.2% vs 11.6%; $P = .04$).

COMMENT

To our knowledge, in the present study, we demonstrated for the first time in a large group of patients that damage to the recurrent nerve is not the most prevalent cause of laryngeal complications after thyroidectomy. Approximately 40% of our patients had impairment in vocal function overall; however, 3 to 4 days after surgery, injury to the vocal folds was noted about 3 times more often than palsy of the recurrent nerve.

We found injury to the vocal folds, presumably caused by intubation or extubation, in 31% of our patients. Compared with findings in older studies that found laryngeal injuries of 6.2% to 16.3%, our data suggest a much higher rate for these complications.^{9,13,20} Previous authors who examined intubation-related complications chose a longer interval after surgery and used laryngoscopy or mirror stroboscopy rather than endoscopic laryngostroboscopy. Endoscopic laryngostroboscopy is a more sensitive method for detecting small alterations in the vocal folds. Pröschel and Eysholdt,⁶ who investigated short-term alterations of the larynx after intubation, examined the vocal folds 1 to 2 days after surgery and found an even higher rate of complications (73%) than we did.

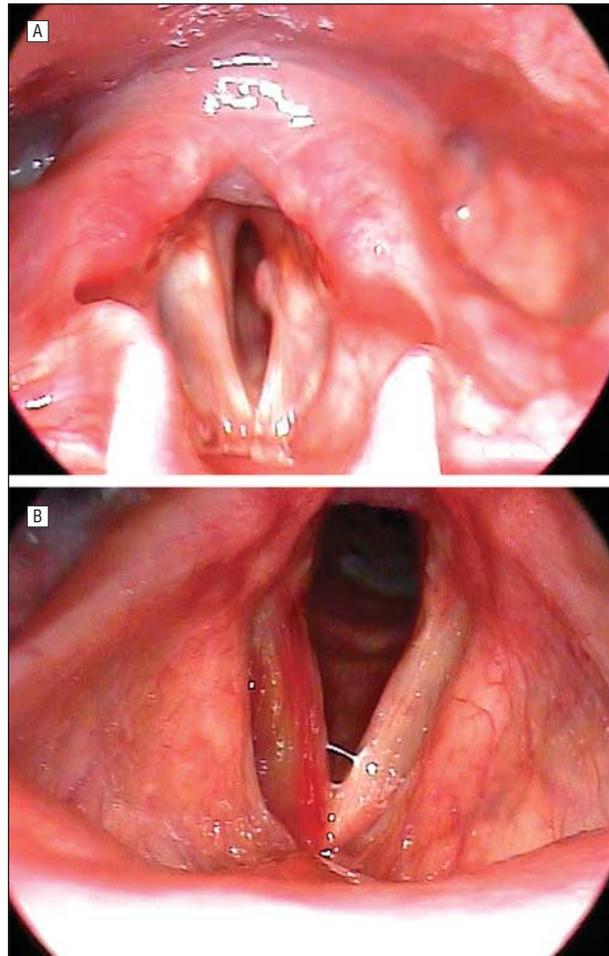


Figure. Indirect laryngoscopic views of a granuloma on the left vocal fold at the vocal process (A) and a hematoma on the right vocal fold (B).

The reason for this might be the earlier performance of laryngostroboscopy. Compared with recent prospective studies in smaller patient groups, our data reflect a similar frequency of intubation-related laryngeal injuries.^{10,12} However, these studies excluded patients who underwent an operation performed close to the larynx. The comparable number of laryngeal injuries led the authors to believe that, compared with intubation and extubation, thyroidectomy causes minor risk to the larynx.¹⁰⁻¹² Similar findings were reported in a smaller group of patients undergoing thyroidectomy.¹⁷

Among many risk factors for injury to the vocal folds caused by intubation are cuff pressure, size of the tube, movement of the tube, physical trauma, intubation environment, duration of intubation, gastroesophageal reflux, and mucociliary mechanism.^{10,21} However, previous studies found no significant influence of the drug used for relaxation after rapid-sequence induction and no reduction in vocal fold injury using neuromuscular monitoring.^{11,12} In contrast to our findings, Weymuller²² found higher rates of hoarseness in women. Other authors were unable to confirm a relationship between the size of the tube and changes in the acoustic signal.²³ We found more vocal fold injuries in older patients, presumably due to a decrease in flexibility and atrophy of the vocal tissues.²⁴ In this study, other potential risk factors such as nicotine use, ethanol abuse,

and gastroesophageal reflux were not evaluated. It is possible that these potential risk factors increase the risk of intubation-related complications.

Similar to other studies,^{6,10,12} the most common finding in our study was thickening of the mucosa in the posterior parts of the vocal folds, followed by hematoma. Whether these alterations are caused by laceration or by gastroesophageal reflux remains unclear. However, alterations in the posterior part of the vocal folds have been thought to be induced by the tube or by an adduction reaction of the vocal folds caused by superficial anesthesia.⁶ Subluxation of the arytenoid cartilage was found in only 1 patient, and only rarely has dislocation of the arytenoid cartilage been reported.²⁵ Similar to our findings, Kambic and Radsel⁹ found such dislocation in only 1 of 1000 patients. To avoid ankylosis of the cricoarytenoid joint, early surgical mobilization is recommended.¹⁹

Our data confirm findings in the subgroup of hematomas in which a higher rate of laryngologic complications was found on the left side, presumably due to the anesthesiologist being right-handed.^{9,13} Granulations and thickening were primarily found bilaterally in the posterior part of the vocal folds, presumably more the result of chronic irritation by the endotracheal tube.

It has been suggested that vocal fold injuries are frequently noted in the first days after surgery but that they heal quickly.^{6,8} Peppard and Dickens¹³ described healing of glottal hematomas within 4 weeks in 21 of 22 patients. Analysis of hoarseness with acoustic or perceptual measurements¹⁴⁻¹⁷ cannot be offered because of the large number of patients. However, because of the risk of persisting alterations with long-term impairment of the voice, we recommend laryngologic follow-up examinations for patients who use their voice professionally (eg, professional singers, actors, or teachers).

There is comprehensive literature about the prevalence of recurrent nerve palsy after thyroidectomy. Studies with a large number of patients show prevalence for permanent paresis to be between 0% after primary surgery and 20% after revision surgery.¹⁻⁵ Our findings are within this range.

In the present study, no intraoperative monitoring of the laryngeal recurrent nerve was performed. There is still controversy about the use of intraoperative recurrent nerve monitoring. Despite some publications recommending monitoring, recent studies could not show lower incidences of postoperative recurrent nerve palsy with monitoring.^{26,27} Similar to our data, Steurer et al²⁸ showed that surgical dissection of the recurrent nerve did not increase the total risk of temporary and permanent palsy. Furthermore, the risk of permanent impairment of recurrent nerve function was reduced. Therefore, dissection should be recommended.

Although there is much more risk of damaging the nerve during thyroidectomy, it should be mentioned that the nerve can be injured during intubation as well.²⁹ Still, it does not seem possible to differentiate between the damage done by thyroid surgery and anesthesia in most cases.

Beyond the postoperative results, it was also interesting that the incidence of preoperative laryngeal findings was so high. Our patients did not see any reason to visit an otolaryngologist because of their voice. In 4 patients,

we preoperatively found idiopathic recurrent nerve palsy. It is presumed that recurrent nerve palsy would be considered a surgical complication after thyroidectomy without any preoperative laryngologic examination. This emphasizes the need for preoperative laryngoscopy before thyroidectomy, at least for medicolegal reasons.

Our data suggest that laryngeal complications caused by injury to the vocal folds occur much more frequently than impairment of the recurrent nerve function, thus confirming findings in smaller patient groups. We recommend documentation of informed consent, especially for patients who use their voice professionally, such as singers, actors, or teachers.

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Author Contributions: Dr Echternach had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design:* Echternach, Maurer, and Mencke. *Acquisition of data:* Echternach and Schilling. *Analysis and interpretation of data:* Echternach, Maurer, Mencke, Verse, and Richter. *Drafting of the manuscript:* Echternach, Verse, and Mencke. *Critical revision of the manuscript for important intellectual content:* Echternach, Maurer, Mencke, Schilling, Verse, and Richter. *Statistical analysis:* Echternach, Mencke, and Verse. *Administrative, technical, and material support:* Echternach, Maurer, Verse, and Richter. *Study supervision:* Maurer, Mencke, Schilling, Verse, and Richter.

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Additional Information: This study was performed at the Departments of Otolaryngology (Drs Echternach and Verse), Surgery (Drs Maurer and Schilling), and Anesthesiology (Dr Mencke) at Saarland University Medical Center, Homburg, Germany.

Additional Contributions: Volker Barth, MD, acquired data and examined patients; Thomas Fuchs-Buder, MD, supervised the study; and Kenan Demiroglu performed statistical analysis and acquired data.

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INVITED CRITIQUE

Hoarseness is a dreaded complication after thyroidectomy. Even in the most experienced hands, significant postoperative voice changes occur in more than 5% to 10% of patients. Echternach et al report that 42% of patients undergoing thyroidectomy at their institution experienced a laryngeal complication. Most of these complications were unrelated to injury to the recurrent nerve by the surgeon but caused by trauma to the vocal folds after intubation. While these findings are enlightening (and relieving!) to those of us who perform thyroid operations, there are still unresolved issues and questions about the data in this study. First, there are no data about patient symptoms associated with the laryngeal complications. If most patients did not have symptoms, what is the clinical importance of the findings? Second, do we know for certain that most of the vocal fold injuries were caused by endotracheal intubation rather than intraoperative abrasions or trauma from pulling on the thyroid and trachea during removal

of the gland? Is the incidence of vocal fold trauma in patients undergoing operations on the outside of the neck similar? A control group such as this would have provided this information. Third, there are no data in this article to suggest that recognizing laryngeal dysfunction preoperatively or postoperatively affects patient outcomes. Fourth, because only 23.8% of patients with laryngeal injuries received long-term follow-up, we do not know the long-term implications of these injuries. It is hoped that additional data from this group and others will shed light on these important issues.

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of air via the colonoscope to test the anastomosis, data supporting its use as a method of ensuring anastomotic integrity is, at best, inconclusive. This large study of left-sided colorectal anastomoses reveals that, indeed, anastomotic leak testing is beneficial and that an airtight anastomosis may be a reliable indicator of anastomotic integrity. Three very important conclusions are brought to the forefront. First, an airtight anastomosis does not guarantee that anastomotic disruption will not occur postoperatively. Second, primary repair of a colorectal anastomosis that does not subsequently leak on testing also does not guarantee a subsequent postoperative anastomotic leak. Third, these data seem to suggest that an initial positive anastomotic leak test that either repair with fecal diversion or resecting the initial anastomosis and performing a new colorectal anastomosis will offer the best chance of not encountering a postoperative leak. Al-

though the data presented did not comment on details such as the circumferential nature of the initial leak, the percentage of the anastomosis that had to be primarily repaired (perhaps number of 3-0 silks used), or the pre-existing comorbidities of these patients related to risk of an anastomotic leak, the data from this article proposes an algorithmic approach to the results of the intraoperative anastomotic leak testing following colorectal resection and directs the surgeon to the need to repair, re-resect, or divert.

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Correction

Middle Initial Missing From Author Name. In the article titled "Laryngeal Complications After Thyroidectomy: Is It Always the Surgeon?" by Echternach et al, published in the February issue of the *Archives* (2009; 144[2]:149-153), the second author's middle initial was omitted from the byline on page 149. It should have read as follows: Christoph A. Maurer, MD.