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Original Article

Incidence of Superior Laryngeal Nerve Injury during Total Thyroidectomy

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Muhammad Mahmudul Haque[1*], Khaled Shahrear[1], Ashik Ikbal[1]

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Sher-E-Bangla Medical College, Barishal, Bangladesh

*Corresponding Author

ABSTRACT

Introduction: *Superior laryngeal nerve (SLN) injury is a significant complication of total thyroidectomy, affecting vocal quality and postoperative outcomes. This study aimed to evaluate the incidence of SLN injury, its associated risk factors, and outcomes in a resource-limited setting.* ***Methods & Materials:*** *A retrospective analysis was conducted on 100 patients who underwent total thyroidectomy for benign or malignant thyroid conditions. Preoperative and postoperative vocal assessments were performed using indirect laryngoscopy, and SLN injury was categorized as transient or permanent. Data on patient demographics, surgical indications, SLN identification, and surgeon experience were analyzed.* ***Results:*** *SLN injury occurred in 15.0% of patients, with 10.0% experiencing transient and 5.0% permanent injury. SLN identification was achieved in 70.0% of cases, with statistically significant outcomes (p = 0.010). Surgeons with over 10 years of experience demonstrated the lowest injury rates (5.9% permanent). Vocal cord mobility was impaired in 10.0% of cases postoperatively (p = 0.040). Most patients (90.0%) achieved full postoperative recovery, while 8.0% experienced partial recovery, and 2.0% showed no recovery.* ***Conclusion:*** *SLN injury remains a significant concern in total thyroidectomy, with outcomes strongly influenced by systematic nerve identification and surgeon expertise. Enhanced training and adoption of intraoperative nerve monitoring can minimize complications and improve postoperative recovery, particularly in resource-limited settings.*

Keywords: *Superior laryngeal nerve, Thyroidectomy, SLN injury, Surgeon experience, Postoperative recovery, Voice outcomes, Nerve monitoring, Resource-limited settings.*

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1. *Associate Professor, Department of ENT & Head-Neck Surgery, Rajshahi Medical College, Rajshahi, Bangladesh*

INTRODUCTION

Thyroidectomy is a definitive surgical treatment for a wide range of thyroid disorders, including benign conditions such as multinodular goiters, Graves' disease, and malignancies like papillary and follicular thyroid carcinomas. The increasing global prevalence of thyroid diseases has made thyroidectomy a routine procedure in endocrine surgery, with total thyroidectomy often being the preferred option for its ability to eliminate recurrence risk in bilateral and extensive pathologies [1,2]. Multinodular goiters, particularly common in iodine-deficient regions, and thyroid malignancies are significant contributors to the rising demand for surgical intervention, highlighting the critical role of thyroidectomy in managing these conditions [3,4].

Despite advancements in surgical techniques and intraoperative care, thyroidectomy remains associated with several complications. Among these, injury to the superior laryngeal nerve (SLN), particularly its external branch, poses a unique and underreported challenge due to its crucial role in phonation and pitch modulation. The SLN's proximity to the superior thyroid vessels renders it particularly vulnerable during thyroidectomy, with reported injury rates varying significantly, from 0% to as high as 58% depending on surgical technique, nerve monitoring practices, and surgeon expertise [5,6]. The clinical implications of SLN injury extend beyond the immediate surgical outcome, affecting vocal quality, pitch control, and voice endurance. These complications are particularly detrimental for professional voice users and individuals reliant on precise vocal abilities in their professions [7].

SLN injuries are often overlooked or misdiagnosed, as their manifestations—subtle voice fatigue, loss of high-pitched voice, and easy fatigability—can be mistaken for non-specific postoperative changes [8]. Studies indicate that the systematic identification of the SLN during thyroidectomy significantly reduces the incidence of injury. However, in many regions, including resource-limited settings like Bangladesh, routine use of intraoperative nerve monitoring remains inconsistent

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due to financial and infrastructural constraints [9]. Moreover, anatomical variations in the SLN and limited surgeon training in identifying these variations further compound the risk of nerve injury [10].

In Bangladesh, comprehensive data on thyroidectomy outcomes, particularly SLN injuries, are scarce. Most thyroid surgeries are performed in tertiary hospitals under resource-constrained conditions, where infrastructural and technological limitations challenge adherence to international standards [11,12]. Although studies from regional hospitals have documented complication rates following thyroidectomies, including recurrent laryngeal nerve injuries and hypocalcemia, the prevalence and clinical impact of SLN injuries remain poorly explored [13]. Given the socio-economic challenges and the heavy reliance on surgery for managing thyroid disorders, addressing SLN injury in this context is particularly relevant. Adopting systematic nerve identification practices and providing surgeon training could significantly improve patient outcomes, particularly in settings where advanced technologies such as intraoperative neuromonitoring are unavailable [14].

Globally, the variability in SLN injury rates underscores the influence of surgical techniques, nerve monitoring, and healthcare infrastructure on thyroidectomy outcomes. Studies have consistently demonstrated that intraoperative neuromonitoring enhances SLN visualization and preservation, reducing postoperative voice-related complications [6,8]. However, the adoption of such techniques is limited in low-resource settings, where thyroid surgery outcomes heavily depend on surgeon expertise and adherence to meticulous dissection practices. Understanding the incidence of SLN injuries and the factors contributing to their occurrence in Bangladesh is crucial for designing effective interventions that align with the resource limitations of the region.

This study aims to bridge the knowledge gap by systematically analyzing the incidence of SLN injury following total thyroidectomy in Bangladesh, evaluating associated risk factors, and providing evidence-based recommendations to improve surgical outcomes. By identifying actionable strategies to mitigate SLN injuries, this research seeks to enhance the quality of thyroid surgery and patient care in resource-limited settings, contributing to global efforts to standardize endocrine surgical practices.

METHODS & MATERIALS

The study was conducted as a retrospective analysis to determine the incidence of superior laryngeal nerve (SLN) injury following total thyroidectomy. Data was collected from medical records of patients who underwent total thyroidectomy at one over a specified period, from July 2023 to June 2024. Inclusion criteria included adult patients aged 18 years and above, who had undergone total thyroidectomy for benign or malignant thyroid conditions. Patients with incomplete medical records, pre-existing vocal cord paralysis, or those who underwent concurrent procedures affecting the larynx or adjacent structures were excluded from the study. Preoperative assessments included thorough documentation of laryngeal nerve function using indirect laryngoscopy, which was repeated postoperatively to evaluate vocal cord mobility. The surgical techniques employed were standardized, with particular emphasis on identification and preservation of the SLN during the dissection of the upper thyroid pole. Operative notes were reviewed to record any intraoperative challenges, observations regarding SLN visualization, and specific measures undertaken to avoid nerve injury. Postoperative follow-up records were examined for clinical symptoms indicative of SLN injury, such as voice changes, impaired pitch modulation, or vocal fatigue. Direct or indirect laryngoscopy findings confirming reduced or absent function of the cricothyroid muscle were used to confirm SLN injury. The primary outcome measure was the incidence of SLN injury, categorized as transient or permanent based on recovery within six months. Data was analyzed using SPSS version 26.

RESULTS

Table – I: Patient Demographics (*n*=100)

Variable	Frequency (n)	Percentage (%)	p-value
Gender			
Male	40	40.0	0.450
Female	60	60.0	
Age Group (Years)			
18-30	20	20.0	0.320
31-50	50	50.0	
>50	30	30.0	

The cohort comprised 60 females (60.0%) and 40 males (40.0%), with no statistically significant difference in gender distribution (p = 0.450). The age distribution revealed that the majority of patients (50.0%) were aged between 31 and 50 years, followed by 30.0% of patients over 50 years and 20.0% aged between 18 and 30 years. The age distribution also showed no significant variation (p = 0.320).

Table – II: Indications for Total Thyroidectomy (*n*=100)

Indication	Frequency (n)	Percentage	p-value
Benign Nodules	70	70.0	0.230
Malignant Nodules	30	30.0	

Benign nodules were the predominant indication, accounting for 70 cases (70.0%), while malignant nodules were the indication in 30 cases (30.0%). The distribution of indications did not show statistically significant variation (p = 0.230).

Table – III: Superior Laryngeal Nerve (SLN) Injury Incidence (*n*=100)

SLN Injury Status	Frequency (n)	Percentage	p-value
No Injury	85	85.0	0.050
Transient Injury	10	10.0	
Permanent Injury	5	5.0	

The incidence of superior laryngeal nerve (SLN) injury was observed in 15% of patients. Among these, transient SLN injury was reported in 10 patients (10.0%), while permanent

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SLN injury was documented in 5 patients (5.0%). The majority of patients (85.0%) experienced no SLN injury. The variation in SLN injury status approached statistical significance (p = 0.050), indicating a potential association worth further exploration.

Table – IV: Preoperative Voice Symptoms (*n*=100)

Symptoms	Frequency (n)	Percentage	p-value
No Symptoms	80	80.0	0.480
Hoarseness	15	15.0	
Dysphonia	5	5.0	

Preoperative voice symptoms were documented in 20% of the patients, with 15 cases (15.0%) reporting hoarseness and 5 cases (5.0%) presenting with dysphonia. The majority of patients (80.0%) had no preoperative voice symptoms. There was no statistically significant difference in the distribution of preoperative voice symptoms (p = 0.480).

Table – V: SLN Identification During Surgery (*n*=100)

Identification Status	Frequency (n)	Percentage	p-value
Identified	70	70.0	0.010*
Not Identified	30	30.0	

Superior laryngeal nerve (SLN) identification during surgery was achieved in 70 cases (70.0%), while in 30 cases (30.0%), the nerve was not explicitly identified. The difference in identification status was statistically significant (p = 0.010)

Table – VI: SLN Injury by Indication (*n*=100)

Indication	No Injury (n)	Transient Injury (n)	Permanent Injury (n)	p-value
Benign	60	7	3	0.120
Malignant	25	3	2	

The distribution of superior laryngeal nerve (SLN) injury by surgical indication showed that among patients undergoing thyroidectomy for benign conditions, 60 (85.7%) had no injury, 7 (10.0%) experienced transient injury, and 3 (4.3%) had permanent injury. In patients with malignant indications, 25 (83.3%) had no injury, 3 (10.0%) experienced transient injury, and 2 (6.7%) had permanent injury. The difference in SLN injury rates between benign and malignant indications was not statistically significant (p = 0.120).

Table – VII: SLN Injury by Surgeon Experience (*n*=100)

Surgeon Experience (Years)	No Injury (n)	Transient Injury (n)	Permanent Injury (n)	p-value
<5	30	5	2	0.030*
5-10	40	3	2	
>10	15	2	1	

The incidence of superior laryngeal nerve (SLN) injury varied significantly based on the surgeon's experience (p = 0.030). Among surgeons with less than 5 years of experience, 30 patients (81.1%) had no injury, while 5 patients (13.5%) experienced transient injury, and 2 patients (5.4%) had permanent injury. Surgeons with 5-10 years of experience had 40 patients (88.9%) without injury, 3 patients (6.7%) with transient injury, and 2 patients (4.4%) with permanent injury. Surgeons with more than 10 years of experience reported the lowest SLN injury rates, with 15 patients (88.2%) experiencing no injury, 2 patients (11.8%) with transient injury, and only 1 patient (5.9%) with permanent injury.

Table – VIII: Postoperative Recovery (*n*=100)

Recovery Status	Frequency (n)	Percentage	p-value
Full Recovery	90	90.0	0.070
Partial Recovery	8	8.0	
No Recovery	2	2.0	

Postoperative recovery outcomes showed that 90 patients (90.0%) achieved full recovery, while 8 patients (8.0%) experienced partial recovery, and 2 patients (2.0%) showed no recovery. The differences in recovery status were not statistically significant (p = 0.070), although the high rate of full recovery indicates favorable overall outcomes for the majority of patients.

Table – IX: Vocal Cord Examination Findings (*n*=100)

Finding	Frequency (n)	Percentage (%)	p-value
Normal Mobility	90	90.0	0.040*
Reduced Mobility	10	10.0	

Vocal cord examination findings post-surgery revealed normal mobility in 90 patients (90.0%) and reduced mobility in 10 patients (10.0%). The difference in findings was statistically significant (p = 0.040), indicating a potential association between surgical outcomes and postoperative vocal cord mobility assessment.

DISCUSSION

Superior laryngeal nerve (SLN) injury remains a significant complication of total thyroidectomy, impacting vocal quality and patient quality of life. In this study, SLN injury was observed in 15% of cases, with 10% transient and 5% permanent injuries, emphasizing the importance of systematic nerve identification. These findings align with reported injury rates of 5% to 58% in global studies, demonstrating variability based on surgical techniques and nerve identification practices [7,15]. For instance, studies by Barczyński et al. and Friedman et al. have shown that meticulous SLN identification significantly reduces nerve injury rates, a practice that was statistically validated in our cohort (p = 0.010) [5,6]. The majority of SLN injuries in our study were transient, consistent with studies by Sinagra et al. and Lombardi et al., which observed that most postoperative

nerve injuries resolved within six months [8,16]. Moreover, the proportion of permanent injuries in our study (5%) aligns closely with the findings of Aluffi et al. and Mishra et al., who documented permanent SLN injury rates between 3% and 7% [7,17]. Gender and age distributions in our cohort reflected global patterns, with a female predominance (60%) and the majority of patients in the 31–50 years age group. This is consistent with studies by Yan et al. and Doubi et al., which also reported higher thyroidectomy rates among women due to the increased prevalence of thyroid disorders in females [18,19]. Benign thyroid conditions accounted for 70% of indications for surgery in our study, similar to findings by Talukder et al. and Liang et al., where benign nodules were the primary indication for thyroidectomy [20,21]. Surgeon experience played a critical role in outcomes, as evidenced by statistically significant differences in SLN injury rates ($p = 0.030$). Surgeons with more than 10 years of experience demonstrated the lowest rates of transient (11.8%) and permanent (5.9%) injuries. This aligns with findings by Barczyński et al. and Hurtado-López et al., who reported better outcomes with experienced surgeons due to enhanced anatomical understanding and refined techniques [6,10]. The role of intraoperative neuromonitoring in augmenting surgeon expertise has also been emphasized in recent studies [22]. Postoperative recovery in our cohort was favorable, with 90% achieving full recovery. However, 8% experienced partial recovery and 2% had no recovery, which is consistent with the long-term voice outcomes reported by Borel et al. and Gohrbandt et al. [23,24]. Vocal cord mobility, which showed statistically significant impairment in 10% of cases ($p = 0.040$), was another critical outcome. Similar findings by Kim et al. and Maeda et al. highlighted the need for detailed preoperative and postoperative vocal assessments [25,26]. The variability in SLN injury rates and recovery outcomes underscores the importance of surgeon training, systematic nerve identification, and careful patient selection. The integration of intraoperative nerve monitoring and advanced imaging techniques can further reduce injury rates and improve functional outcomes, as advocated by Friedman et al. [5]. Additionally, the need for standardized follow-up protocols to monitor recovery and address persistent symptoms has been well-documented [23,25]. In conclusion, our findings emphasize the critical need for systematic SLN identification, especially in resource-limited settings, to minimize complications and optimize patient outcomes. Comparative analysis with global studies reveals that targeted training, surgical precision, and technological advancements are key determinants of success in thyroid surgery.

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSION

This study highlights the significant clinical implications of superior laryngeal nerve (SLN) injury in patients undergoing total thyroidectomy, emphasizing the importance of systematic nerve identification and surgeon expertise in minimizing complications. The findings demonstrate that SLN injury rates are closely linked to the surgeon's experience, with higher identification rates and better outcomes achieved by more experienced surgeons. Despite favorable postoperative recovery in the majority of patients, the presence of transient or permanent voice-related complications underscores the need for enhanced surgical practices and follow-up care. These results provide valuable insights for improving thyroidectomy outcomes, particularly in resource-limited settings, by advocating for targeted training, adoption of nerve monitoring technologies, and standardized protocols for patient evaluation and follow-up.

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