Research Article ISSN 2833-0390

International Journal of Research in Oncology

Medial to Superior Surgical Approach to Sparing Recurrent Laryngeal Nerve and Avoid its Injury and Association Complications during Total Thyroidectomy- Prospective Study

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Received: 30 Nov 2025; **Accepted:** 01 Jan 2026; **Published:** 12 Jan 2026

Citation: Samir Yeslam Baothman, Salah Ahmed Binziad, Mohammed Abdulla Baamer. Medial to Superior Surgical Approach to Sparing Recurrent Laryngeal Nerve and Avoid its Injury and Association Complications during Total Thyroidectomy- Prospective Study. Int J Res Oncol. 2026; 5(1): 1-6.

ABSTRACT

Background: *Injury to the recurrent laryngeal nerve (RLN) remains a significant and potentially debilitating complication of thyroid surgery. This prospective study evaluates the safety and efficacy of a medial-to-superior surgical approach for RLN identification and preservation during total thyroidectomy.*

Methods: *A total of 347 patients undergoing thyroidectomy between January 2013 and March 2025 were prospectively enrolled across three surgical centers in Hadhramout, Yemen. Patients underwent Total Thyroidectomy (TT; n=198), TT with Modified Radical Neck Dissection (TT+MRND; n=138), or Completion Thyroidectomy (n=11), utilizing a standardized medial-to-superior approach to RLN dissection. Postoperative complications, including hypocalcemia, hematoma, seroma, vocal changes, and hypertrophic scarring, were documented and analyzed using chi-square tests for association.*

Results: *The cohort was predominantly female (87.6%). Multinodular goiter (46.7%) and papillary thyroid carcinoma (37.8%) were the most prevalent diagnoses. The overall complication rate was 2.6%, with hypocalcemia (0.85%) and seroma (0.85%) being most frequent. No cases of confirmed RLN injury were recorded. Completion thyroidectomy had the highest complication rate (18.2%) compared to TT (1.5%) and TT+MRND (2.8%). A statistically significant association was identified between the type of surgery performed and the incidence of postoperative complications ($\chi^2 = 19.086$, $p = 0.039$).*

Conclusion: *The medial-to-superior surgical approach offers a reliable and anatomically sound technique for RLN preservation during thyroidectomy. Its implementation is associated with low complication rates and may serve as a safe alternative in settings where intraoperative neuromonitoring is not routinely available.*

Keywords

Recurrent laryngeal nerve, Thyroidectomy, Nerve preservation, Complication rate, Hypocalcemia, Medial-to-superior dissection.

Introduction

Thyroidectomy is a cornerstone in the management of a wide range of thyroid diseases, including benign multinodular goiter

(MNG), Hashimoto's thyroiditis, and differentiated thyroid carcinomas such as papillary and follicular thyroid cancer. Over the last few decades, advancements in surgical techniques, especially recurrent laryngeal nerve (RLN) identification and intraoperative monitoring, have contributed to improved safety profiles. However, postoperative complications remain a significant concern, especially in resource-limited settings [1-3]. Common complications following thyroidectomy include hypocalcemia (transient or permanent), recurrent laryngeal nerve injury resulting in voice changes, postoperative hematoma, seroma, and hypertrophic or keloid scarring [4]. The incidence of these complications varies depending on multiple factors, such as the extent of surgery, presence of malignancy, surgeon expertise, patient comorbidities, and availability of intraoperative nerve monitoring [5,6].

Particularly, total thyroidectomy (TT) and radical thyroidectomy with modified radical neck dissection (MRND) are associated with higher risks of complications compared to less extensive procedures like hemithyroidectomy or subtotal resections. These risks are especially pronounced in patients with invasive thyroid cancer or lymph node metastases, where dissection of adjacent structures is often required [7,8].

In high-income countries, widespread use of intraoperative neuromonitoring (IONM), preoperative risk stratification, and post-surgical calcium monitoring protocols have reduced complication rates. In contrast, such technologies may not be routinely available in lower-middle-income settings like Yemen, making surgical expertise and procedural selection all the more critical [9,10].

Purpose of the Study

Thyroidectomy is the cornerstone of thyroid cancer management, but complications like RLN injury and hypocalcemia persist. RLN-sparing techniques aim to reduce morbidity, yet outcomes in underserved regions like Hadramout, Yemen, remain understudied. The present study was conducted to investigate the new surgical approach to avoid injury of recurrent laryngeal nerve and sparing nerve during Total thyroidectomy among thyroid patients whom underwent total thyroidectomy with or without modified lymph node dissection.

Materials and Methods

Study Design and Population

This Prospective study was conducted on 347 patients, presented of Multiple or single thyroid nodules, at Hadhramout National Cancer Center, Al Arab University Hospitals, and Alburj Consultant Hospital in Hadhramout, Yemen, during the period from January 2013 to march 2025. The study aimed investigate the new surgical approach to avoid recurrent laryngeal nerve injury and performed nerve sparing during total thyroidectomy to avoid and minimized post-operative total thyroidectomy complications.

- **Inclusion Participants:** 347 patients with thyroid nodules (single/multiple) undergoing RLN-sparing during total thyroidectomy, Radical Thyroidectomy + MRND, and Completion Thyroidectomy.
- **Exclusion:** hemi or Partial thyroidectomies, previous RLG injury or preoperative affected RLN.

Ethical considerations

Ethical approval (HUCOM-2013-06) and informed consent were obtained and the post-operative complication was obtained by independent person.

Preoperative Workup

All patients were submitted for the following:

Thorough history taking

Patients' details, Epidemiological data, Associated co-morbidity as Diabetes mellitus (D.M.), vascular disease (i.e., arteritis), Medication as chronic steroid usage, Previous neck irradiation or surgery, History of cerebrovascular incidents and Bleeding disorder.

General examination

- All subjected patients were submitted to meticulous clinical examination including chest, heart, liver with special attention to hypertension and peripheral vascular disorder.

Local examination

- Meticulous thyroid examination with neck lymph nodes with preoperative sonogram to evaluate the mobility of thyroid and neck lymph nodes or masses.

Laboratory investigations including

TSH, T4, T3, Complete blood picture, Erythrocyte sedimentation rate, Prothrombin time and concentration, bleeding time, clotting time, Liver and kidney functions, Fasting blood sugar, Serum albumin, Blood group for possible blood transfusion.

ECG and Echocardiography for cardiac patient

Radiological examination

A. Neck Ultrasound to evaluate the thyroid and lymph node.
B. Computed tomography (CT) for assessment of primary thyroid lesion, involvement and neck lymph node and retrosternal extension.

Biopsy taking: Representative FNAC was taken under ultrasound guided from thyroid nodule or FNAC of neck lymph node if present and histopathological examination of the biopsy.

Metastatic work up in malignant cases: Including CT scan head, neck, chest, abdominopelvic and bone scan.

Surgical Procedures

– The operations had been done under general anesthesia where 198 patients underwent Total Thyroidectomy, 138 patients underwent Radical Thyroidectomy + MRND and 11 patients underwent Completion Thyroidectomy.
– The operating room was equipped with the usual surgical instrument.
– The patient is positioned supine with the head supported on a ring and neck extended by a sandbag under the shoulder. The

surgical site is sterilized with betadine, spirit and draped with towel.

Same surgical team, operated simultaneously in all the studied cases.

Surgical technique

The collar incision was created in a curvilinear fashion within a skin crease approximately 1 finger-breadths above the superior edge of the clavicle and sternal notch (Figure 1). The dissection is carried through skin, the subcutaneous fat to the platysma, and continues by monopolar cautery, subplatysmal flaps are elevated superiorly and inferiorly. After elevating the subplatysmal flaps, up to sub hyoid space and downward until the suprasternal notch was used to allow adequate exposure without causing stretch injury to the surrounding skin then fixed it by silk on the towel above and skin below to give good exposure see (Figure 2).

Figure 1: A curvilinear collar incision.

Figure 2: Subplatysmal flaps are elevated superiorly and inferiorly.

In the midline cervical Linea alba fascia between the strap muscles (Figure 2), was identified and dissected by monopolar diathermy through this fascia superiorly and inferiorly along the length of the sternohyoid muscle and deep to overlying thyroid fascia was identified. care should be taken to dissect the overlying strap muscles off of the thyroid gland without injuring the subcapsular vessels.

We start releasing the inferior pole by dissection of the inferior isthmus vessel and ligated it then the inferior thyroid artery and vein was dissected and ligated near the thyroid capsule. The inferior parathyroid gland was identifying usually a 1 cm radius around the inferior pole of the glands, they should be carefully dissected from the thyroid and left in the thyroid bed.

Releasing the superior pole

The isthmus lobe was dissected and releasing after ligated its vessels (Figure 3) then care should be taken to dissect the overlying strap muscles off of the upper lobe without injuring the subcapsular vessels and continuous dissection of isthmus and upper pole until avascular space (Figure 4) between the cricothyroid muscle and the upper pole was identified and dissected to release and give mobility of thyroid and this step is our corner approach to release the upper pole from posteromedial aspect and from berry ligament to avoid recurrent nerve injury later on.

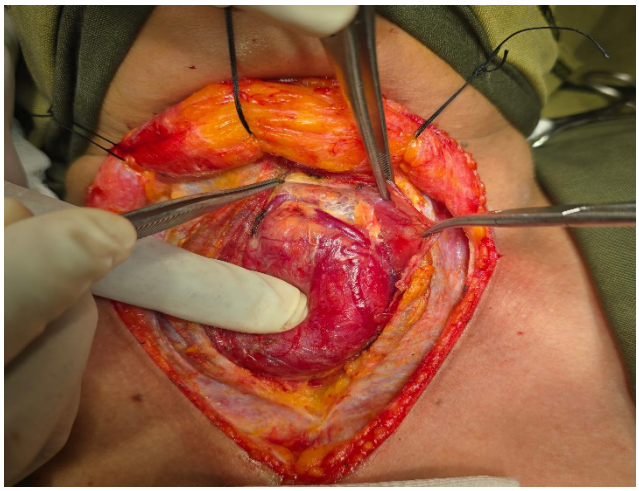

Figure 3: Isthmus lobe was dissected and releasing.

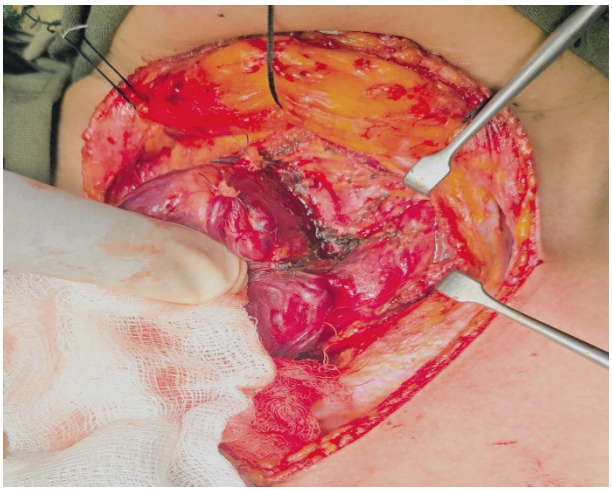

Figure 4:

By retracting the thyroid inferiorly and medially, and using a small Richardson retractor to retract the strap muscles superiorly and laterally, the dissection of the posterior medial aspect of the

thyroid lobe begins, identify the superior pedicle, ligated After dissecting both laterally and medially (cricothyroid space) to the superior pole, the superior pedicle divided then we identifying the superior parathyroid gland cephalad to the tubercle of Zuckerkandl or adjacent to the superior pole and dissected toward the upper thyroid vessel and lifted above the cricothyroid muscle.

lateral aspect dissected bluntly and capsular dissection should be carried to meet the carotid sheath fascia. Once the lateral border of the dissection has been performed, the carotid artery identified, blunt dissection may be carried out superiorly. The medial parathyroid gland was dissected and lifted at thyroid bed and the thyroid glad was retracted superomedial to identification the inferior thyroid artery and the recurrent laryngeal nerve.

Identifying the recurrent laryngeal nerve

The Medial-to-superior approach to identify the RLN after retracted the gland superomedial by meticulous dissecting of inferior thyroid artery and its branches by mesquite forceps then dissected medial to medial parathyroid gland, and identification of RLN and sparing it at this point, we ligated the inferior thyroid artery with its branches then continue the dissection above the RLN toward the cricothyroid until its entrance under the cricothyroid muscle and Berry's ligament identified with transfixed of small vessels pass underneath the RLN. Then downward dissection until the nerve completely dissected and lifted at the tracheoesophageal groove without tension. The course of the nerve should be bluntly dissected using the artery forceps.

Removing the thyroid gland (Figure 7) after identifying recurrent laryngeal nerve (Figures 5 & 6). The total lobe was dissected by monopolar cautery posteromedially with facial attachments from Berry's ligament and peritracheal fascia toward the midline and dissection was continued by cautery util the berry ligament of another lobe appears then start the contralateral upper lobe dissection of the other lobe by same previous manor. All thyroid gland tissue and lymph nodes was removed.

After obtained good hemostasis in the thyroid bed by monopolar cautery we put 10 or 12 French drains routinely in all cases and remove it after 24 or 48 hours. The neck is then closed in a layered fashion with a meticulous skin closure.

Figures 5 & 6: identifying recurrent laryngeal nerve.

Figure 7: Remove of Total thyroid gland.

Postoperative Workup

- Immediate and delay Postoperative complication (Hematoma, seroma, hypocalcemia, low-pitch voice, and keloid scarring) was recorded and evaluated.

Data Collection

- Demographics: Age, gender
- Pathology: Diagnosis, presence of lymph node metastasis
- Surgical details: Type of thyroidectomy
- Complications: Hematoma, seroma, hypocalcemia, low-pitch voice, and keloid scarring

Statistical Analysis

- Descriptive statistics summarized demographic and clinical data.
- A Pearson Chi-square test assessed association between thyroidectomy type and complications.
- A p-value < 0.05 was considered statistically significant.
- Analysis was conducted using SPSS v26.0.

Results

Demographics and Clinical Characteristics

- From The total 347 cases underwent total thyroidectomy in which about 304 of patients (87.6%) was female and 43 patients (12.4%) was male Table 1.
  - Age: 29.4% were aged 31–40 years.
  - Common diagnoses: Multinodular goiter (46.7%), papillary thyroid carcinoma (37.8%)

Table 1: Patients Gender.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**Male**	43	12.4	12.4	12.4
	Female	304	87.6	87.6	100.0
	Total	347	100.0	100.0	

Tumor Characteristics

The post-operative histopathology in this study revealed 162 (46.7%) of patients were benign M.N.G, 131(37.8%) of patients had Papillary thyroid cancer, 29(8.7%) of patients had Hashimoto Thyroiditis, 18(5.2%) of patients had Follicular thyroid cancer, 4(1.2%) of patients had Anaplastic cancer and 3(0.9%) of patients had MALT lymphoma see Table 2 below.

Table 2: Post-operative Pathology.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**Papillary thyroid cancer**	131	37.8	37.8	37.8
	Follicular thyroid cancer	18	5.2	5.2	42.9
	Anaplastic cancer	4	1.2	1.2	44.1
	Hashimoto Thyroiditis	29	8.4	8.4	52.4
	M.N.G	162	46.7	46.7	99.1
	MALT lymphoma	3	.9	.9	100.0
	Total	**347**	**100.0**	**100.0**	

- **Lymph node metastasis**: Found in 16.4% of patients
- **Capsular invasion**: Found in 4.6%

Postoperative Complications by Surgery Type

The post-operative complications was found in 9 patients (2.6%) of all 347 cases, were 3 patients (0.85%) had subcutaneous seroma treated by conservative therapy, 3 patients (0.85%) had post-operative temporal hypocalcemia treated by in-patient calcium gluconate for to 2 days followed by out-patient oral calcium for 14 days after discharge, 1 patient (0.3) had hematoma subside by conservative treatment, 1 patient (0.3) had low pitch voice subside by conservative treatment and 1 patient (0.3) had hypertrophic scar was treated by wound-eaz cream see Table 3.

- **Complication Rates:**) Completion thyroidectomy had the highest rate (18.2%), followed by Total thyroidectomy +MRND (2.8%).
- **Most Common Complications:** Hypocalcemia (0.84%) and seroma (0.84%).

Chi-Square Analysis

- The Surgery type significantly correlated with complications (χ^2=19.086, *df*=10, *p*=0.039) and the association between surgery type and postoperative complications was statistically significant, so **A Pearson Chi-square Test Result:** *p*=0.039 (was significant association), see Table 4.

Table 4: Chi-Square Tests.

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	19.086[a]	10	.039
Likelihood Ratio	10.732	10	.379
Linear-by-Linear Association	4.315	1	.038
N of Valid Cases	347		
a. 14 cells (77.8%) have expected count less than 5. The minimum expected count is .06.			

- Pearson χ^2 = 19.086
- Degrees of Freedom = 10
- p-value = 0.039

Discussion

The current study demonstrated a statistically significant association between the extent of thyroidectomy and the likelihood of developing postoperative complications ($\chi^2 = 19.086, p = 0.039$). Patients who underwent radical thyroidectomy with MRND and completion thyroidectomy had notably high complication rates compared to those who received standard total thyroidectomy. This finding aligns with international evidence indicating that more extensive surgical intervention inherently increases the risk of injury to surrounding structures and parathyroid glands [3,7].

Hypocalcemia, the most common complication in our study (0.85%) temporal hypocalcemia, has been widely reported in the literature as a leading post-thyroidectomy morbidity. It is especially prevalent in total and radical resections due to devascularization or inadvertent removal of the parathyroid glands [11-13]. Christou and Mathonnet reported hypocalcemia rates of up to 30%, with permanent hypoparathyroidism occurring in 1–3% of cases. Our findings fall within the lowest end of this spectrum, likely reflecting the benefits of RLN and parathyroid preservation strategies.

Table 3: Type of Operation * Post Thyroidectomy complication Crosstabulation.

Post-operative Complication	Total Thyroidectomy (n=198)	Total Thyroidectomy +MRND (n=138)	Completion Thyroidectomy (n=11)	Total (n=347)
Keloid/Hypertrophic Scar	1 (0.5%)	0	0	1 (0.3%)
Hematoma/Bleeding	0	1 (0.7%)	0	1 (0.3%)
Seroma	2 (1.0%)	1(0.7%)	0	3 (0.85%)
Low-Pitch Voice	0	0	1 (9.1%)	1 (0.3%)
Hypocalcemia	0	2 (1.4%)	1 (9.1%)	3 (0.85%)
No Complication	195 (98.5%)	134 (97.2%)	9 (81.8%)	338(97.4%)
Total Complications	3 (1.5%)	4 (2.8%)	2 (18.2%)	9 (2.6 %)

Recurrent laryngeal nerve injury, were evaluated directly via immediate post-operative laryngoscope by anesthesia specialist with no injury confirmation was found in our study, and the voice change on the second postoperative day was inferred from postoperative voice changes (0.3%). This is consistent with rates reported in other observational studies, which range from 0.5% to 5% depending on the use of IONM and surgical experience [14,15]. Given the lack of routine IONM in many Yemeni surgical centers, the low rate of voice change in our data likely indicates cautious dissection techniques and a focus on RLN-sparing approaches.

Postoperative seroma and hematoma occurred in 0.86% and 0.3% of patients, respectively. Hematoma, although infrequent, is one of the most feared early complications due to the potential for airway obstruction. Its low occurrence in our cohort suggests effective intraoperative hemostasis protocols. Seroma, meanwhile, may be more frequent in radical neck dissections due to lymphatic disruption [16].

Implications for Clinical Practice

Our results highlight the importance of tailoring the surgical approach based on tumor characteristics, patient risk factors, and available surgical resources. While the medial to upper approach methods we performed to identify and the RLN-sparing during total thyroidectomy remains good and safe approach, otherwise it's a safe approach also during more extensive procedures such as TT+MRND and completion thyroidectomy that require additional caution.

Moreover, our findings of medial to upper approach of identify the RLN to avoid nerve injury was support international guidelines that advocate for surgeon experience and procedural volume as determinants of surgical safety. Studies have shown that high-volume thyroid surgeons report lower complication rates, even in complex surgeries [17]. In Hadramout and similar regions, investing in specialized surgical training and adopting simplified protocols for nerve and parathyroid identification could substantially improve patient outcomes.

Conclusion

The medial-to-superior approach for recurrent laryngeal nerve (RLN) identification and preservation during thyroidectomy demonstrates excellent safety and efficacy in resource-constrained settings. In this prospective study of 347 patients, the overall complication rate was **2.6%**, with **zero confirmed RLN injuries** – highlighting the technique's reliability for nerve sparing. Procedure-specific analysis revealed low complication rates for total thyroidectomy (**1.5%**) and total thyroidectomy with modified radical neck dissection (**2.8%**), though completion thyroidectomy carried higher risk (**18.2%**). Hypocalcemia (0.85%) and seroma (0.85%) were the most frequent complications, all managed conservatively.

These outcomes underscore that meticulous surgical technique – including early RLN identification via medial-to-superior dissection, capsular vessel control, and parathyroid preservation – can mitigate risks even without intraoperative neuromonitoring. The approach is particularly valuable in low-resource regions like Yemen, where advanced technologies are scarce. Future efforts should focus on standardized training in nerve-sparing protocols to further optimize thyroid surgery safety worldwide.

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