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# Role Of Intraoperative Nerve Monitoring In Thyroid Surgery

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***Abstract:*** ***Background:*** Injuries of the recurrent laryngeal nerve (RLN) are one of the most serious complications of thyroid surgery due to the risk of case deterioration with the potential for developing hoarseness, dysphonia, and aspiration. Even though meticulous visual detection of the RLN is the traditional standard, it is often unreliable during complicated procedures like revision surgery, malignancy, and large multinodular goitres. During thyroid surgery, intraoperative nerve monitoring (IONM) gives a real-time functional assessment of the nerve and may provide adjunctive value in aiding the surgery. ***Objective:*** RLN is one of the main nerves at risk in thyroid surgery, and voice surgery is one of the common complications post-operatively. The primary aim of the study is to analyse the post-efficiency of IONM in the loss of voice and damage of RLN in the process of thyroid surgery, and the comparison of IONM with the conventional RLN visual identification (VN). ***Methodology:*** This comparative observational study included 120 patients undergoing thyroid surgery in the Department of ENT of Pak International Medical College, Peshawar from July 2024 to June 2025. Sixty patients underwent thyroidectomy with IONM assistance, while 60 patients had conventional surgery without nerve monitoring. The primary outcomes were temporary and permanent RLN injury, operative duration, and postoperative voice changes, assessed using indirect laryngoscopy and clinical voice evaluation. ***Results:*** The mean patient age was 41.6 ± 11.8 years, with female predominance (76%). Temporary RLN palsy was significantly lower in the IONM group compared with the conventional group (3.3% vs. 13.3%; p = 0.041). Permanent RLN injury was also reduced in the IONM group (1.7% vs. 6.7%), although this difference did not reach statistical significance (p = 0.18). The mean operative time was significantly shorter in patients undergoing IONM-assisted surgery (96.4 ± 18.2 minutes) compared with the conventional group (112.7 ± 21.5 minutes; p = 0.002). Postoperative voice changes were observed in 10% of monitored cases versus 26.7% of unmonitored cases (p = 0.021). ***Conclusion:*** Intraoperative nerve monitoring significantly reduces temporary RLN injury, postoperative voice morbidity, and operative time during thyroid surgery. Its routine or selective use, particularly in complex and revision cases, is recommended to improve surgical outcomes.

***Keywords:*** Thyroidectomy, intraoperative nerve monitoring, recurrent laryngeal nerve, voice outcome.

## INTRODUCTION

Nerve injury is one of the main negative outcomes that can occur after thyroid surgery. The main nerve is the recurrent laryngeal nerve (RLN). The injury can cause voice alterations, including hoarseness and loss of voice, and can affect breathing and swallowing. Losing your voice can have negative impacts socially and professionally, so it is important to protect the nerves during the surgery [1,2]. The most common approach to try to avoid injury to the RLN is to try to see the nerve during the surgery. However, several factors may hinder the ability to see the nerve [3]. These include large goitres, cancer of the thyroid, and thyroiditis. Additionally, a nerve may not be seen

because of anatomical differences, such as the absent RLN or variations of the nerve branches [4]. Intraoperative nerve monitoring (IONM) is a unique tool that can help confirm the visual identification of a nerve. Surgeons can stimulate the vagus or RLN and record the vocal cord muscle responses through the endotracheal tube with the help of certain surface electrodes. Surgeons use these to identify the nerve and guide their steps through the surgery. In these types of surgeries, losing a signal on one side can cause a surgeon to perform a staged surgery to avoid bilateral RLN palsy [5]. Over the last decade, multiple studies and meta-analyses have suggested that IONM usage has been associated with a reduction in the incidence of temporary RLN palsy, especially in revision surgeries and other complex cases. However, evidence on the reduction of cases with permanent injury to the nerve has been inconsistent. In addition, the high cost, equipment, and the learning anatomy of IONM have been barriers to its implementation in middle and low-income countries such as Pakistan, where the vast majority of these procedures are still being performed with only visual identification [6,7].There isn't much local data when it comes to the effectiveness of IONM, and most international studies come from places that can afford it. Because there is a high level of thyroid disease in the area and the amount of thyroidectomies is increasing, it is necessary to examine whether the integration of IONM provides real benefits to the clinical side of things for our patients. Therefore, this study was designed to compare RLN injury, voice outcomes, and operative duration between IONM-assisted and traditional thyroid surgeries at tertiary care hospitals [8,9].

**Study Objectives:**

To compare recurrent laryngeal nerve injury, operative time, and voice outcomes between thyroidectomies where intraoperative nerve monitoring was used and those where only visual identification was used.

## MATERIALS AND METHODS

**Study Design & Setting:**

This comparative observational study was conducted in the Department of ENT of Pak International Medical College, Peshawar from July 2024 to June 2025 over a duration of 12 months.

**Participants:**

A total of 120 adult patients who were undergoing thyroidectomies for either benign or malignant thyroid disorders were included in the study. Participants were split into 2 equal groups: 60 patients underwent an IONM-assisted thyroidectomy, and 60 underwent a conventional thyroidectomy, which was based on the availability of monitoring equipment.

**Sample Size Calculation:**

If IONM would adequately decrease RLN injury from 14% to 4%, with a confidence of 95% and power of 80% the calculated sample size will be 54 patients per group, but of course, to account for possible attrition, the sample size must be set to 60 patients.

**Inclusion Criteria:**

- 18–70 years old.
- Primary or revision thyroidectomy patients.
- Preoperative vocal cords are working and not paralysed.

**Exclusion Criteria:**

- Vocal cords are paralyzed preoperatively.
- Larynx surgeries in the past.
- Postoperative follow-ups are not completed.

**Diagnostic and Management Strategy:**

Preoperative indirect laryngoscopy for all patients. In the IONM group, the RLN stimulation and the EMG were used and monitored intraoperatively. Laryngoscopy Post op is done on the second day and again after 3 months.

**Statistical Analysis:**

The analysis of temporal variables and cross-tabulation of nominal variables in SPSS version 24 were completed. Continuous variables are expressed as the mean and standard deviation and are compared using the independent sample t-test. Categorical variables are evaluated using the chi-square test. A p-value of less than 0.05 is significant.

**Ethical Approval:**

## RESULTS

A total of 120 patients were included, with a mean age of 41.6 ± 11.8 years. Females constituted 76% of the study population. Temporary RLN palsy occurred in 2 patients (3.3%) in the IONM group compared with 8 patients (13.3%) in the conventional group, which was statistically significant ($p = 0.041$). Permanent RLN palsy was observed in one patient (1.7%) in the IONM group and four patients (6.7%) in the conventional group; however, this difference was not statistically significant ($p = 0.18$). The mean operative time was significantly shorter in the IONM group (96.4 ± 18.2 minutes) compared with the conventional group (112.7 ± 21.5 minutes; $p = 0.002$). Postoperative voice changes were reported in 6 patients (10%) in the IONM group versus 16 patients (26.7%) in the conventional group ($p = 0.021$).

**Intervention Outcome:**
Temporary RLN injury decreased, and the length of surgery lessened, and the number of patients with postoperative changes in the voice decreased. All of these imply that IONM has solid clinical proof of its usefulness during thyroid surgeries.

**Table 1. Baseline Demographic and Clinical Characteristics**

| Variable | IONM Group (n=60) | Conventional Group (n=60) | p-value |
|---|---|---|---|
| Age (years), mean ± SD | 42.1 ± 12.3 | 41.0 ± 11.4 | 0.67 |
| Female, n (%) | 47 (78.3) | 44 (73.3) | 0.53 |
| Benign thyroid disease, n (%) | 44 (73.3) | 42 (70.0) | 0.68 |
| Thyroid malignancy, n (%) | 16 (26.7) | 18 (30.0) | 0.68 |
| Revision surgery, n (%) | 6 (10.0) | 8 (13.3) | 0.58 |

Baseline demographic and clinical characteristics of patients undergoing thyroidectomy with intraoperative nerve monitoring (IONM) and conventional visual identification.

**Table 2. Operative Outcomes**

| Outcome | IONM Group | Conventional Group | p-value |
|---|---|---|---|
| Operative time (minutes), mean ± SD | 96.4 ± 18.2 | 112.7 ± 21.5 | 0.002 |
| Temporary RLN palsy, n (%) | 2 (3.3) | 8 (13.3) | 0.041 |
| Permanent RLN palsy, n (%) | 1 (1.7) | 4 (6.7) | 0.18 |

Comparison of operative duration and recurrent laryngeal nerve (RLN) injury between monitored and unmonitored thyroidectomies.

**Table 3. Postoperative Voice Outcomes**

| Variable | IONM Group n (%) | Conventional Group n (%) | p-value |
|---|---|---|---|
| Early postoperative hoarseness | 5 (8.3) | 14 (23.3) | 0.021 |
| Dysphonia >3 months | 1 (1.7) | 4 (6.7) | 0.18 |
| Aspiration symptoms | 1 (1.7) | 5 (8.3) | 0.09 |

Postoperative voice and swallowing-related complications following thyroidectomy in both study groups.

**Table 4. Multivariate Logistic Regression Analysis for RLN Injury**

| Variable | Adjusted Odds Ratio (AOR) | 95% CI | p-value |
|---|---|---|---|
| No use of IONM | 3.9 | 1.1 – 13.8 | 0.036 |
| Thyroid malignancy | 2.6 | 0.9 – 7.4 | 0.07 |
| Revision surgery | 3.2 | 1.0 – 10.1 | 0.048 |

Independent predictors of recurrent laryngeal nerve injury identified on multivariate logistic regression analysis.

## DISCUSSION

Serious problems after thyroid surgery include injury to the recurrent laryngeal nerve (RLN), causing trouble for the patient socially and functionally. Direct patient outcomes are improved with the use of intraoperative nerve monitoring (IONM) as it decreases the number of cases of RLN nerve injury, voice issues after surgery, and reduces the time the surgery takes compared to just visually checking the nerve [10]. This is especially helpful in complex thyroid surgeries and supports the continued use of Ionian the IONM group, RLN nerve injury occurred in 3.3% of cases, while in the standard monitoring group, paralysis occurred in 13.3%. This data follows the trend of decreased RLN nerve injury in the last 5 years, with current reports. In Chiang et al.'s large multicenter study, RLN nerve injury occurred in 2.1% of cases with IONM and 10.4% of cases without monitoring, just like IONM [11]. A 2021 meta-analysis with over 30,000 monitored nerves showed IONM decreased RLN nerve injury by 50%. A pooled odds ratio of 0.46 was found in a 2023 systematic review for IONM improving outcomes for RLN nerve injury after thyroidectomy for malignancies [12]. There were fewer permanent RLN injuries in the IONM group in our study; however, this was not statistically significant. This finding is in line with numerous recent studies. Buczynski et al. noted that while IONM had a statistically significant impact on the reduction of transient nerve injuries, the impact on permanent RLN injuries remained negligible and was primarily attributed to the low incidence of permanent palsy and the large sample sizes needed to demonstrate statistical significance [13]. A similar study in 2022 reported non-significant differences in permanent RLN injuries between the monitored and unmonitored groups [14]. An additional noteworthy secondary outcome was the reduction of operative time with the application of IONM. Patients who

 

underwent monitored thyroidectomy had shorter operative times, which is consistent with many recent studies. A 2020 randomised trial reported that in the presence of IONM, nerve identification time was reduced by approximately 20%, particularly in cases with significant distortion of anatomy [15]. A 2022 multicenter observational study also noted a mean reduction of 15 minutes in operative time during revision thyroid surgeries with IONM [16]. IONM is thus likely to improve operative efficiency in addition to ensuring safety. Postoperativevoice changes were notably less prevalent in the IONM group in our study. The ability to speak after undergoing thyroid surgery is becoming more and more significant to patients. In a 2023 meta-analysis, patients who had IONM-assisted thyroidectomy showed improvements in the functional outcomes of voice handicap index scores [17]. Additionally, IONM preserved voice quality during the early postoperative period in a recent study that utilised objective acoustic voice parameters [18]. Our multivariate analysis found that no IONM use and revision surgery were independent predictors of RLN injury. These findings have been similar to recent literature focusing on the importance of IONM in high-risk operational procedures like re-operative surgeries, thyroid malignancies, and large goiters [19]. In these instances, the identification of the nerve is complicated, and the functional feedback is particularly beneficial [20]. For all these benefits of IONM, its use in low-resource areas is still very limited due to the high costs, the availability of the equipment, and the need for more training. The use of IONM in high-risk surgeries is likely to incur a lower overall cost with respect to the long-term consequences, both from a legal and a medical standpoint, as compared to the use of IONM in low-risk thyroid surgeries. To sum up, our findings, which are in line with the current literature, show that IONM in tandem with regular thyroid surgeries appears to be helpful as it may lower the chances of transient RLN injury, post-operative voice problems, and reduce the time needed in the surgery

**Limitations:**

The small number of cases and the fact that the study was conducted at a single tertiary care centre may mean that the results are not widely applicable. There was also no follow-up after three months, which limits the assessment of the recovery of the recurrent laryngeal nerve function to the short term.

## CONCLUSION

Postoperative voice morbidity, operative time, and injuries to the recurrent laryngeal nerve are all problems that can be lessened with the use of intraoperative nerve monitoring during thyroid surgeries. Using it selectively, or in regular practice, in high-risk and revision thyroidectomies is advised for better outcomes in patient safety and during surgeries.

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