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Original Research Paper

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TO STUDY THE TERMINAL DEVISION OF RECURRENT LARYNGEAL NERVE AND ITS VARIATION IN COMPARISION OF INFERIOR THYROID ARTERY

Dr Rahul Yadav	JR, Dept of ENT IMS BHU Varanasi
Dr Siva S	Assistant Prof, Dept of ENT IMS BHU Varanasi
Dr Ram Raj Yadav	SR, Dept of ENT IMS BHU Varanasi
Dr Vivek Mishra	JR Dept of ENT IMS BHU Varanasi
Dr Sanjay Saroj	Assistant Prof, Dept of ENT ASMC Mirzapur
Dr Swati N Chandel	JR, Dept of ENT IMS BHU Varanasi
Dr Achambou Pamei	JR, Dept of ENT IMS BHU Varanasi
Dr Shikhar Srivastava	JR, Dept of ENT IMS BHU Varanasi
Dr Mayur Birhade	JR, Dept of ENT IMS BHU Varanasi
Dr Aman Singh	JR, Dept of ENT IMS BHU Varanasi
Dr Varsha	JR, Dept of Ophthalmology, BRDMC Gorakhpur
Prof Royana Singh	Prof, Dept of Anatomy IMS BHU Varanasi
Prof Rajesh Kumar	Prof, Dept of ENT IMS BHU Varanasi

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INTRODUCTION

The vagus nerve, which supplies the larynx with motor, sensory, and parasympathetic fibers, branches into the recurrent laryngeal nerve (RLN) and Superior Laryngeal nerve. Before ascending behind the inferior constrictor to the nerve's entry location into the larynx, the RLN is regularly seen in close relation to the inferior thyroid artery and its branches. This association is a significant turning point in its identification in thyroid surgery patients. However, one well-known risk factor for RLN injury after thyroid surgery is anatomic abnormalities of the RLN. Acute airway obstruction and stridor in cases of bilateral damage are two signs of RLN paralysis, which can result from injury to the RLN and range from nearly undetectable hoarseness in unilateral lesions. [1,2] About 3-8% of cases result in transient post-operative RLN paralysis, while 0.3–3% of cases result in chronic paralysis. [3-5] Therefore, in order to protect the nerve and its function during surgery, it is critical to recognize the anatomical variations of the RLN. While advancements in monitoring have made it possible to lower the incidence of RLN injury with intraoperative neuromonitoring, visual identification of the RLN remains the gold standard for RLN injury avoidance[6]. In order to do thyroid surgery, it is crucial to ascertain the RLN's anatomical location. The recurrent laryngeal nerves innervate the majority of the muscles involved in vocal cord movement. any lesion along the vagal nerves' route above the recurrent laryngeal nerves' branching or along the recurrent laryngeal nerves themselves can result in vocal cord paralysis (VCP). Due to the vagal nerve's close relationship to other cranial nerves at this level, an adverse lesion located in the brainstem or skull base typically results in several cranial nerve impairments. Isolated laryngeal complaints are often caused by pathology involving the recurrent laryngeal nerves and/or the extracranial vagal nerves. Numerous pathological conditions might result in VCP because of the vagal and recurrent laryngeal nerves' lengthy anatomical courses. VCP can be brought on by surgery, cancer, trauma, infection, and inflammation. The most common cause of VCP, according to a survey of over 800 patients, is iatrogenic damage during mediastinal and neck surgery. [7] laryngoscopy can be used to evaluate vocal cord function. During this procedure, a stroboscopic light can be used to confirm that the afflicted side is immobile. Hoarseness, vocal tiredness, loss of voice pitch, dyspnea, and aspiration are among the signs and symptoms of VCP. [8] Nonetheless, between 30 and 40 percent of patients with unilateral VCP have no symptoms. [9, 10] While the recurrent laryngeal nerve is the main efferent branch of the vagus nerve, the external branch of the superior laryngeal nerve is particularly significant because it can sustain damage from post-operative inflammation, tethering, or scarring, or from surgical injury during thyroid or carotid endarterectomy. [11, 12] Due to the loss of efferent fibers to the cricothyroid muscle (CT), iatrogenic injury to the external branch of the superior laryngeal nerve (EBSLN) typically causes hoarseness, poor sound, and vocal fatigue. [13] The frequency of EBSLN injury varies from 0% to 58% as a result of differing postoperative assessments and surgical procedures. [14] Furthermore, there aren't many trustworthy anatomical landmarks in the area. [15]

Significance Of Study

This study provides a comprehensive microscopic examination of the microscopic variations of the recurrent laryngeal nerve (RLN) through surgical dissection. The findings highlight significant anatomical variations that have critical implications for surgical practice and patient outcomes. The comparison between recurrent and non-recurrent laryngeal nerves, as well as the detailed observation of their relationships with surrounding structures, underscore the importance of meticulous surgical techniques to preserve nerve function. Postoperative functional assessments further emphasize the necessity of understanding these variations to minimize complications and enhance recovery. Ultimately, this research contributes valuable insights that can inform and improve surgical strategies, aiming to optimize patient care and outcomes in procedures involving the RLN.

Aims

- To study terminal bifurcation of recurrent laryngeal nerves (RLN) with its usual direction to enter into larynx.
- To observe the relationship of recurrent laryngeal nerve with inferior thyroid artery.
- Comparison between recurrent and non-recurrent laryngeal nerve.

Review of Litrature-

1. Anatomy of the Recurrent Laryngeal Nerve (RLN)

The RLN travels a distinct path on each side. Starting at the level of the first segment of the subclavian artery, it loops beneath it before ascending in the direction of the transoesophageal groove and eventually entering the larynx on the right. On the other hand, the vagus nerve at the aortic arch is where the RLN begins on the left. It loops around the aortic arch, goes beneath the ligamentum arteriosum, and then re-enters the neck through the transoesophageal groove. After that, it reaches the larynx posterior to the inferior constrictor, innervating the intrinsic laryngeal muscles both sensory and motor, with the exception of the cricothyroid muscles. On the other hand, an uncommon anatomical variation of the RLN is the nonrecurrent laryngeal nerve (NRLN). The NRLN, It was first noted by Steadman in 1823, and it is typically restricted to the right side and extremly rare on left side. The inferior thyroid artery (ITA), a terminal branch of the subclavian artery, is the most often utilized landmark in thyroid surgery to identify the RLN. The ITA originates from the thyrocervical trunk, the subclavian artery's initial branch and supplied blood to thyroid gland and asend close proximity to RLN. Three widely used variants of the RLN in connection to the ITA will be employed in this investigation: a) Anterior to ITA, b) RLN between ITA branches and c) posterior to ITA [16, 17]. A branch of the vagus nerve (CN X) is the recurrent laryngeal nerve (RLN). It transports parasympathetic, motor, and sensory fibers to the laryngeal tissues.[18] With the exception of the cricothyroid, which is innervated by the external laryngeal nerve, it is the primary motor nerve of all intrinsic laryngeal muscles. The RLN follows distinct routes on the left and right sides of the body, looping around the subclavian artery at the base of the neck on the right side and the arch of the aorta beneath the ligamentum arteriosum on the left. The RLN enters the larynx on both sides by following the tracheoesophageal groove and looping deeply to the appropriate arteries before reaching the inferior pharyngeal constrictor muscle. [18,19] Before laryngeal entrance, the RLN divided along its cervical path. Intraoperatively, comparable or nearly sized branches were seen macroscopically. Each of these cervical branches enters the larynx independently. Thomas et al. show that the RLN's branching pattern and course vary significantly; 89% of right RLNs and 74.6% of left RLNs showed two to five extra-laryngeal branches. [28] These results are consistent with earlier research [29–31] that found notable diversity in RLN branching patterns. The incidence of NRLN is 0.04% on the left side and 0.6 to 0.8% on the right. [32,33]

2. Anatomy of the External Branch of the Superior Laryngeal Nerve (EBSLN)

The cricothyroid muscle is innervated by the EBSLN, injury to this nerve may cause superenergetic phonation and voice fatigue often, which can have a detrimental effect on a patient's quality of life following surgery. The significance of protecting this nerve has thus been underlined. [20–25] The inferior ganglion of the tenth cranial nerve is the source of the superior laryngeal nerves, which descend down the pharynx posterior to the internal carotid artery and subsequently divide into a larger internal branch and a smaller exterior branch. In order to nourish the inferior constrictor and cricothyroid muscle, the EBSLN descends posteriorly to the sternothyroid muscle and the superior thyroid artery. [26] Cernea type I EBSLN, which is defined as a nerve crossing the STA more than 1 cm above the thyroid lobe, varies greatly from 7.3% to 92%, while the reported incidence of type IIa, which is defined as a nerve crossing the STA less than 1 cm above the thyroid lobe, likewise varies considerably from 12% to 60%, Friedman's type 2 incidence range greatly, from 11% to 77%[27]. The external branch of the SLN (EBSLN), and its job is to tighten the ipsilateral vocal cords during high-pitched phonation, up to 58% of patients having thyroidectomies have damage to the EBSLN. [59] Patients' quality of life is negatively impacted by these EBSLN damage symptoms, particularly those of professional voice users and women. [55]

3. Postoperative Functional Assessment

This is done by indirect laryngoscopy, fibro-optic laryngoscopy, GRBAS scale and VoiSS scale.

Relevent Studies

1. SC Liu et al., (2014) [60] examined the anatomical connection between the third tracheal ring and the recurrent laryngeal nerve (RLN), which was crucial for quickly identifying the RLN in our hands. Initially, eight fresh cadavers were used for this study—four of them female and four of them male. Measurements were made of the transverse nerve's location from the third trachea and its anterior surface depth. In addition, we looked at the topography of RLN in respect to the trachea in 60 patients who underwent 46 lobo-isthmectomies and 14 complete thyroidectomies at the Buddhist Tzu Chi General Hospital, Taipei Branch, Taiwan, between November 2008 and January 2011. Compared with the traditional method, our inferior-superior strategy, which uses the third ring as guidance, provides an additional benefit in safely and swiftly detecting the RLN.
2. T Shao et al., (2016) [18] evaluated the structural differences of the RLN in Chinese patients undergoing thyroid surgery was the aim of this prospective investigation. 2,404 Chinese patients were admitted to hospitals between January 2007 and December 2013 for thyroid surgery that involved unilateral or bilateral RLN dissection. The patients' median age was 45.0 years; there were 1,894 women and 510 men among them. A total of 3,275 RLNs were dissected, comprising 1,576 nerves on the left side and 1,699 on the right. 305 left- and 385 right-side RLNs were among the 690 RLNs in which the anatomical differences were found. In Chinese patients, we found up to seven different anatomical variants in the RLN.
3. XY Ling et al., (2016) [17] discussed thyroid surgery has becoming more common as thyroid cancer quickly rises to the top of the endocrine cancer spectrum. A frequent and crippling risk associated with thyroid surgery is paralysis of the recurrent laryngeal nerve (RLN), which can cause glottal blockage and restrict the airway. 38,568 recurrent laryngeal sides and only 221 (0.57%; 95%CI 0.5, 0.65) NRLN recorded were found in the second search. In relation to the ITA, the posterior location of the RLN is most frequently observed. The NRLN is rare, affecting approximately 0.57% of the population.
4. AS Potenza et al., (2017) [12] studied the cricothyroid muscle (CTM), which is innervated by the external branch of the superior laryngeal nerve (EBSLN), facilitates the thinning and lengthening of the vocal fold, which raises voice pitch. Every time the thyroid's superior pole is dissected, the EBSLN is at risk because to its tight relationship with the superior thyroid veins (STV). After passing lateral to the thyroid cartilage and the inferior pharyngeal constrictor muscle (IPCM), it descends to innervate the CTM. As it gets closer to its entry place, the muscle fibers covering it finally cover it. The EBSLN twists and crosses the STV posteriorly as it descends. The risk of surgical nerve damage due to transection, traction, trapping, heat damage, or disturbed blood supply increases with the location of this crossing in the neck.

5. M Shaffer et al., (2018) [34] studied a disorder known as exercise-induced laryngeal obstruction causes improper glottic or supraglottic blockage, which limits breathing during exercise. Exercise-induced laryngeal blockage can be effectively treated with behavioral treatment administered by a speech-language pathologist, according to the research. Education, relaxation training, guided exercise, and the application of different breathing techniques to maximize laryngeal aperture are all part of the treatment plan. Given their clinical expertise in the laryngeal mechanism and ability to facilitate long-term behavioral change, speech-language pathologists may be able to provide intervention for patients with exercise-induced laryngeal blockage.
6. M Uludag et al., (2018) [35] studied the cricothyroid muscle, which is the tensor muscle of the vocal cord, receives motor innervation from the external branch of the superior laryngeal nerve (EBSLN), whereas the abductor and adductor muscles of the vocal cord receive motor innervation from the recurrent laryngeal nerve (RLN). Due to their near physical proximity to the thyroid, the RLN and EBSLN are both vulnerable to damage after thyroidectomy. To guarantee that the vocal cord's functionality is not compromised during surgery, these two laryngeal nerves must be meticulously maintained. As of right now, total exposure of the RLN during thyroidectomy is recognized as the optimal technique to preserve RLN.
7. AM Thomas et al., (2020) [36] evaluated the proper understanding of the anatomical variations of the recurrent laryngeal nerve (RLN) can help to steer optimal clinical and surgical techniques and prevent unintentional intraoperative harm. The purpose of this study is to evaluate the possible anatomical variability of RLN with respect to its route, branching pattern, and connection to the inferior thyroid artery, which puts it at risk during neck surgery. Fifty-five cadavers preserved with formalin underwent meticulous dissection and examination, and the course of the RLN was meticulously assessed and recorded on both sides. The knowledge acquired from this research highlights the necessity of doing ACDF surgery using left-sided techniques whenever feasible.
8. SK Ng et al., (2020) [11] ascertained whether the external branch of the superior laryngeal nerve (EBSLN) can be accurately located during thyroidectomy by placing the sternothyroid muscle insertion onto the oblique line of the thyroid cartilage. This set of cases is prospective and descriptive. During thyroid surgery, the EBSLN was located and verified using a nerve stimulator. The measurement was taken of the EBSLN's entry position into the inferior constrictor/cricothyroid muscle in reference to the anterior border and insertion of the sternothyroid muscle. The vertical distance (VD) of the nerve entry point (NEP) was defined as the perpendicular distance from the insertion of the sternothyroid muscle onto the oblique line, and the horizontal distance was defined as the perpendicular distance from the anterior border of the sternothyroid muscle. Ninety patients had procedures
9. B Schiedermayer et al., (2020) [37] looked at the effects of the definition of dysphagia on the incidence and overall prevalence of the condition in individuals with UVP (unilateral vocal fold paralysis), categorized by cause. study of medical charts in retrospect. From 2013 to 2018, information on patient demographics, overall scores on the dysphagia questionnaire, clinical evaluation dysphagia symptoms, and instrumental swallow assessment results were gathered from the records of people with UVP diagnoses. Based on five operational definitions of dysphagia, counts and percentages were computed for the annual incidence and overall prevalence of dysphagia by cause. A total of 415 people satisfied the study's inclusion requirements. Estimates of the annual prevalence varied based on the dysphagia criteria applied, from 19% to 55%.
10. A Moradi et al., (2021) [38] discussed the Vagus nerve is the intrathoracic source of the recurrent laryngeal nerve (RLN). It travels through the neck's tracheoesophageal groove (TEG), and many variants have been noted in this area. The most vulnerable area to damage during thyroid surgery is the RLN. As a result, understanding variances is crucial to successfully reducing harm. A fifty-year-old woman with no thyroid-related problems other than a swollen thyroid gland that bothered her during neck movement and for cosmetic reasons in the last year and a half. With the exception of a multilobulated enlarged thyroid gland, the medical, surgical, pharmaceutical, irradiation history, laboratory, and physical examination results were all unremarkable.
11. H Masuoka et al., (2022) [39] studied vocal cord paralysis is frequently the result of thyroid cancer's invasion of the recurrent laryngeal nerve (RLN). In these patients, curative surgery is typically required to resect the invading section of the RLN. In these situations, we execute sharp dissection in an effort to protect the nerve. In cases where thyroid cancer completely engulfs the RLN or if the vocal cord's ability to respond to electric stimulation of the RLN is lost, the affected area of the RLN is excised along with the tumor, and reconstructive procedures are used to restore it. The vocal cord on the side that receives a unilateral RLN resection becomes paralyzed. Short phonation, mis-swallowing, and hoarseness are some of the symptoms.
12. S Bourabaa et al., (2024) [40] studied the external laryngeal nerve, sometimes known as the EBSLN, is less well understood in terms of its route and connection to the thyroid gland than the recurrent laryngeal nerve. The purpose of this prospective intraoperative investigation is to determine the anatomical variability of the EBSLN with respect to the superior thyroid pedicle, the IPC, and the STA crossing point. The paper also attempts to suggest a technical process for its preservation. We studied 50 patients (a total of 100 nerves) prospectively while they underwent complete thyroidectomies at the Ibn Sina Hospital in Rabat's Department of Surgery "B." Improved knowledge of the surgical anatomy of the neck preserves the external and recurrent laryngeal nerves, improving the outcome of thyroidectomies.

MATERIAL AND METHODS

This is a observational prospective study carried out at a tertiary care centre, in a duration of 18 months (2022-2024), on a sample size of 100.

Selection Criteria:

- Patients with operable thyroid swelling attending outpatient department (OPD) in the Department of Otorhinolaryngology, IMS, BHU will be screened.
- Written informed consent taken for participation in the study.

Inclusion Criteria
• Euthyroid patients • Normal preoperative indirect laryngoscopy • Patients of all age groups included • Both sexes will be included
Exclusion Criteria
• Patients who are not willing to give consent for surgery • Patients having any systemic disorder causing neuropathy • Patients with altered thyroid function • Patients with abnormal vocal cord mobility

METHODOLOGY

- After approval of the Institute Ethical Committee, the study will be done including patients diagnosed with Thyroid Swelling.
- Written informed consent will be obtained from the patient/guardian.

- A total of 100 patients who are diagnosed with THYROID SWELLING will be enrolled in the study.
- All the sites diagnosed with Thyroid Swelling will undergo FNAC, Ultrasonography of the neck, thyroid hormone status and routine blood investigations preoperatively, and Laryngoscopy done before and after surgery.

Intra-Op:
The patient will be planned for Hemithyroidectomy /Total thyroidectomy under Local Anesthesia/ General Anesthesia. Recurrent laryngeal nerve and Superior laryngeal nerve anatomy will be seen under microscopic guidance.

Statistical Analysis
Data was entered in Microsoft Excel and analyzed using statistical software SPSS version 26 (SPSS Inc., Chicago, IL, USA).

OBSERVATION AND RESULTS

Table: 1. Age Distribution of Study Participants

Age distribution	number	%
20-29	30	30%
30-39	29	29%
40-49	28	28%
50 and above	13	13%
total	100	100%

The majority fall within the younger age groups. Specifically, 30% of the participants are aged 20-29 years, making this the largest age group in the study. This is closely followed by participants aged 30-39 years, who comprise 29% of the total. The 40-49 age group accounts for 28% of the participants. In contrast, only 13% of the study population is aged 50 and above years.

Table: 2 Gender Distribution of Study Participants

GENDER DISTRIBUTION	Number	%
Female	87	87.00%
Male	13	13.00%
Total	100	100.00%

The gender distribution of the study participants shows a significant predominance of females. Out of the total 100 participants, 87% are female, while only 13% are male.

Table: 3 Laterality Distribution of Study Participants

LATERALITY	Number	%
Left	31	31.00%
Right	69	69.00%
Total	100	100.00%

The laterality distribution of the study participants indicates that the majority of the cases involve the right side. Specifically, 69% of the participants have right-sided involvement, whereas 31% have left-sided involvement.

Table: 4 FNAC Findings of Study Participants

FNAC Findings	Number	%
Benign cyst	7	7.00%
Benign follicular nodule	7	7.00%
Benign nodule	1	1.00%
Colloid Goitre	56	56.00%
Cystic colloid goitre	2	2.00%
Follicular neoplasm	13	13.00%
Follicular nodule	4	4.00%
Lymphocytic Thyroiditis	1	1.00%
Papillary carcinoma	9	9.00%
Total	100	100.00%

The Fine Needle Aspiration Cytology (FNAC) findings among the study participants show a diverse range of thyroid pathologies. The most common finding is Colloid Goitre, present in 56% of the participants. Follicular neoplasm accounts for 13% of the cases, making it the second most prevalent finding. Papillary carcinoma is identified in 9% of the participants. Benign cysts and benign follicular nodules are each found in 7% of the cases, while follicular nodules are seen in 4%. Cystic colloid goitre and lymphocytic thyroiditis are less common, each accounting for 2% and 1% respectively.

Table: 5 Distribution of FNAC Findings According to TIRADS Classification

FNAC Findings	N	%
TIRADS 1	13	13.00%
TIRADS 2	20	20.00%
TIRADS 3	45	45.00%
TIRADS 4	16	16.00%
TIRADS 5	6	6.00%
Total	100	100.00%

The FNAC findings based on the Thyroid Imaging Reporting and Data System (TIRADS) classification indicate that the majority of the study participants fall into the lower risk categories. Specifically, 45% of the participants are classified as TIRADS 3, and 20% are classified as TIRADS 2, suggesting a predominantly benign or low-risk profile. TIRADS 4, which indicates a higher suspicion of malignancy, accounts for 16% of the cases. TIRADS 5, representing the highest risk category, is found in 6% of the participants. Notably, another 13% are also classified as TIRADS 1, possibly indicating a recording duplication. Overall, the data shows that a significant proportion of the study population falls into the lower risk TIRADS categories.

Table: 6 Distribution of Recurrent Laryngeal Nerve Findings

RLN	Number	%
Above	43	43.0%
Below	57	57.0%
total	100	100%

The RLN passing above the ITA in 43 cases while in 57 cases it crosses underneath the artery.

RLN	Number	%
Undivided	67	67%
Before ITA	8	8%
After ITA	23	23%
entangled	2	2%
Non RLN	0	0%
Total	100	100%

The RLN is remains undivided in 67 cases while it devideds before crossing ITA in 8 cases while in 23 cases it devides after crossing, in 2 case it is entangled by the branches of ITA. NRLN is not seen in any case of the study group.

Table: 7 Distribution of Recurrent Laryngeal Nerve (RLN) Palsy

RLN PALSY	N	%
IMMEDIATE		
L VC paresis	1	1.0%
R VC paresis	2	2.0%
DELAYED		
L VC palsy	0	0.0%
R VC palsy	1	1.0%
Total	100	100.00%

The RLN immediate paresis is seen in3 cases (1 left and 2 right) while delayed palsy seen in 1 case (right side).

Table: 8 Pre-Operative Findings of Vocal Cord (VC) Mobility

PRE-OP Larygoscopy	N	%
B/L VC mobile	98	98.00%
R VC Palsy	2	2.00%
Total	100	100.00%

The pre-operative (PRE-OP) status of vocal cord (VC) mobility in 100% cases.

Table: 9 Post-Operative Findings of Vocal Cord (VC) Mobility

POST-OP FOL	Number	%
IMMEDIATE		
L VC palsy	1	1.0%
R VC palsy	2	2.0%
B/L VC Mobile	97	97.0%
At 1 month		
L VC palsy	0	0.0%
R VC palsy	1	1.0%
B/L VC Mobile	99	99.0%
At 3 months		
L VC palsy	0	0.0%
R VC palsy	1	1.0%
B/L VC Mobile	99	99.0%

Immediately after the operation, 1 cases (1.0%) had left VC palsy, 2 cases (2.0%) had right VC palsy, and 97 cases (97.0%) had bilaterally mobile VCs. At 1 month, the incidence of left VC palsy decreased to zero, and right VC palsy decreased to 1 case (1.0%), with 99 cases (99.0%) having bilaterally mobile VCs. At 3 months the results same as at one month.

DISCUSSION

The vagus nerve supplies motor, sensory, and parasympathetic fibers to the larynx, branching into the recurrent laryngeal nerve, which ascends behind the inferior constrictor and is typically located above the inferior thyroid artery. Identification of RLN anatomical variations is crucial in thyroid surgery to prevent injury, a significant risk factor for RLN paralysis, resulting in symptoms ranging from mild hoarseness to severe airway obstruction.[1,2] Post-operative RLN paralysis occurs transiently in a small percentage of cases and chronically in others.[3-5] Visual RLN identification remains the gold standard during surgery despite advances in neuromonitoring, ensuring safe dissections as RLN lesions can lead to vocal cord paralysis, impacting speech and airway function.[6,7] Symptoms include hoarseness, vocal fatigue, and aspiration, though 30-40% of unilateral VCP cases are asymptomatic.[9,10] Proper laryngeal function, essential for phonation and reflexes, depends on the innervation from the 10th cranial nerve.[61-65] The EBSLN is crucial and can be damaged by inflammation, scarring, or surgery during thyroid or carotid endarterectomy.[11-12] Injury to the EBSLN, which supplies the cricothyroid muscle, often results in hoarseness, poor sound quality, and vocal fatigue.[13] In the present study, the majority of the study participants were in the younger age groups. Specifically, 30% of the participants were aged 20-29 years, making this the largest age group, followed by 30-39 years (29%). The 40-49 age group accounted for 28%. Notably, only 13% of participants were in the 50–59-year age bracket. There was a significant gender disparity, with females making up 87% of the participants, while males accounted for just 13%. Additionally, the majority of cases, 69%, involved the right side, with 31% affecting the left side. Ng S et al.[11] studied 90 patients, of whom 60 were female. The mean age in their cohort was 53.5 years, with an age range of 18–91 years. They also found right-side involvement to be more prevalent (69 cases) compared to the left side (61 cases). In the study by Masuoka and Miyauchi [39], 88 patients aged between 18-78 years were included, with a predominant female representation of 72 participants. Casella C et al.[30] examined 115 patients with a mean age of 55 years, where 67.8% were women. Cetin F et al.[41] included 36 patients with an average age of 51.8 years (ranging from 27 to 70 years), among whom 30 (83.3%) were female. Sarma M et al.[42] reported on 171 cases, noting that the most common age group for surgery was 31-40 years, making up 38% of the patients, with a dominant female presence of 90%. Haddadin S et al.[43] included 255 participants aged 21–59 years, with an average age of 39 years; females constituted 70.98% of their study population. In the present study, FNAC findings showed that the most common finding was Colloid Goitre (56%). Follicular neoplasm accounted for 13% of the cases, followed by Papillary carcinoma (9%). Benign cysts and benign follicular nodules were each found in 7% of the cases, while follicular nodules were seen in 4%. Cystic colloid goitre, benign nodule and lymphocytic thyroiditis were less common, accounting for 2%, 1% and 1%, respectively. The FNAC findings based on the TIRADS classification indicated that the majority (45%) of the participants were classified as TIRADS 3, and 20% were classified as TIRADS 2, suggesting a predominantly benign or low-risk profile. TIRADS 4, which indicates a higher suspicion of malignancy, accounted for 16% of the cases. TIRADS 5, representing the highest risk category, was found in 6% of the participants. Notably, another 13% were classified as TIRADS 1. Similarly, Sarma M et al. [42] found that the most common pathology according to preoperative FNAC was colloid goitre, accounting for 61.4% of cases, followed by multinodular goitre, papillary carcinoma thyroid, follicular neoplasm, cystic nodule, and medullary carcinoma thyroid. Correspondingly, Casella C et al. [30] reported multinodular goitre in 73 patients, benign thyroid nodules in 23 (including 4 toxic adenomas and 19 nontoxic nodules), thyroid cancer in 16, and Grave-Basedow disease in 3 patients. Additionally, Ng S et al. [11] noted that malignancy was the most common finding, present in nearly half of the cases (44 out of 90). Non-toxic multinodular goitre was the second most common diagnosis (23 cases), followed by non-toxic solitary nodules (14 cases). Other indications, including toxic conditions and various other diagnoses, comprised the remaining cases. Furthermore, Haddadin S et al. [43] recorded follicular lesion (32.2%) as the most common FNAC finding, followed by papillary lesions, atypia of undetermined significance, colloid nodule, Hurthle cell (10.98%), thyroiditis with laryngeal disease, medullary lesions, and multinodular goitre. Regarding anatomical patterns of the RLN, we noted that in 67% of the cases RLN was undivided. The nerve was positioned above the ITA in 43% of the participants and below the ITA in 57%. Notably, 8% of the nerves were devides before the ITA, and another 23% were after the ITA. Entanglement of the nerve was observed in 2% of the cases. There were no instances of a Non RLN. Correspondingly, Casella C et al. [30] reported that 18.5% nerves displayed extra laryngeal branching, with 25.5% occurring on the right side and 10.1% on the left side. Trifurcation of the RLN was found in 1%. Bilateral bifurcations were noted in 3.7% patients. Cetin F et al. [41] found three branches of the RLN in two dissections (1%), both on the right side, and bilateral bifurcated RLN in 3.7% of patients undergoing bilateral procedures. They noted that left RLN was more common (28 cases) than right RLN (18 cases). Additionally, Ardito G et al. [44] showed that approximately 72% of RLN branched before entering the larynx. RLN injury, although avoidable, results from severing, clamping, or stretching of the nerve during surgery and can lead to severe complications for the patient. [9] The majority of patients have the division point located between the ITA crossing and the laryngeal artery. [45-47] Routine exposure of the RLN throughout its course has been shown to reduce the rate of nerve injury. [48] By adopting this principle, a nerve injury rate of zero has been reported in the literature even after total thyroidectomy for thyroid cancer. [49] Conversely, when the nerve is not clearly identified, the reported injury rate is three to four times higher. [9] In the present study, the incidence of RLN palsy was analyzed based on the side of the vocal cord affected and the timing of the occurrence, whether immediate or delayed. Immediate left vocal cord (VC) paresis was observed in 1% of cases, while immediate right VC paresis occurred in 2% of cases. Similarly, delayed left VC palsy was noted in 0% of cases, and delayed right VC palsy was seen in 1%. Overall, the data suggested that right VC palsy was more prevalent than left VC palsy. Preoperatively, 100% of cases had bilaterally mobile vocal cords. Immediately post-operation, 1% of cases exhibited left VC paresis, 2% had right VC paresis, and 97% had bilaterally mobile VCs. One-month post-operation, the incidence of left VC palsy decreased to 0%, right VC palsy to 1%, and 99% of cases had bilaterally mobile VCs. At the three-months, results similar as one month.

Similarly, Casella C et al. [30] reported a 2.1% incidence of unilateral clinically permanent RLN palsies. Correspondingly, Sarma M et al. [42] identified immediate unilateral vocal cord palsy in 1.75% of cases. Additionally, multiple studies have highlighted the high frequency of RLN bifurcation before entering the larynx, with figures reaching up to 58%. [50-53] Furthermore, Aytec and Karamercan [54] reported transient and permanent RLN injury rates of 3.5% and 1.2%, respectively. Moreover, Hayward N et al. [55] noted that permanent RLNP occurs in 0.3-3% of cases, with transient palsies in 5-8% of cases. Similarly, Haddadin S et al. [43] found that 90.2% of cases had bilateral mobile RNL, followed by 25 instances of palsy, with 3.9% on the left, 2.7% on the right, and 3.1% bilateral. The incidence of RLN injury was higher in malignant lesions (17.1%) compared to benign lesions (4.7%), with transient vocal cord paralysis occurring in 5.5% and permanent paralysis in 0.4% of cases. Conversely, Shah and Khan [56] reported a 13.5% rate of permanent RLN injury. The incidence of RLN injury was approximately 6.9% in another study. [48] Proper exposure of the nerve and meticulous dissection, especially in the region of the ligament of Berry, are critical for the functional and structural preservation of the nerve. Intraoperative nerve monitoring significantly reduces the incidence of RLN palsy and ensures better thyroid clearance, as evidenced by post-operative radio iodine scans. [57] However, there is no significant difference in the incidence of nerve injury between intraoperative nerve identification and visualization of the nerve alone. [58].

CONCLUSION

- The majority of study participants were aged 20-29 years, making up 30% of the sample.
- Female participants predominated, comprising 87% of the study population.
- Most cases involved the right side, with 69% showing right-sided involvement.
- Colloid Goitre was the most common FNAC finding, present in 56% of participants.
- The majority of participants were classified as TIRADS 3 and 2, indicating a predominantly low-risk profile.
- In 67% of cases, the RLN was undivided, and the nerve's position varied, with 43% superficial the ITA and 57% deep the ITA.
- Right vocal cord palsy was more common than left, with a higher incidence of delayed onset palsy.
- Before surgery, 100% of cases had bilaterally mobile vocal cords.
- Immediately post-operation, 3% had VC paresis, but this improved over time, with 99% having bilaterally mobile VCs at 3 months.

The findings of this study could lead to improved surgical outcomes in thyroid surgery by enhancing understanding of recurrent laryngeal nerve anatomy and its variations. This knowledge may aid in reducing the incidence of vocal cord palsy post-surgery and improving patient safety. Additionally, insights into superior laryngeal nerve variations could contribute to refined surgical techniques and minimize complications related to thyroid gland surgery.

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