

# Surgical Anatomy of Recurrent Laryngeal Nerve: Its Relationship with Inferior Thyroid Artery

Sonika Kanotra, Nitika Gupta, Rohan Gupta

## Abstract

The current study was undertaken to study the Surgical anatomy of recurrent laryngeal nerve and Its relationship with inferior thyroid artery. In the present study, on the right side the recurrent laryngeal nerve or its branches were posterior to the artery in 57(57%) cases, anterior in 32(32%) cases and in between in 11 (11%) cases. On the left side the RLN or its branches were posterior to ITA or its branches in 67(71.28%) cases, in between the branches of the artery in 14(14.89%) cases and anterior in 13(13.83%) cases. Overall the nerve or its branches were posterior to artery or its branches in 124(63.91%) cases anterior in 45(23.20%) cases and in between the branches of the artery in 25(12.89%). The RLN and its branches must be identified and preserved in order to prevent nerve injury.

## Key Words

Surgical Anatomy, Recurrent Laryngeal NervE, Thyroid Artery

## Introduction

Lahey FH (1) emphasized the importance of identification and routine display of Recurrent Laryngeal Nerve (RLN) while performing thyroid surgeries. Prevalence of temporary and permanent paralysis of RLN after thyroid surgery has been reported to be as high as 7.1% - 11%. (2) Careful exploration and exact identification of the RLN reduce the risk of accidental nerve damage substantially.

An accurate knowledge of the course of the Recurrent Laryngeal nerve, its relationship with the Inferior Thyroid Artery (ITA) are fundamentals to thyroid surgery.

The most frequent sites of damage of Recurrent laryngeal nerve are: the crossing point with the inferior

thyroid artery, the segment related to the gland capsule, the segment which passes through the berry's ligament, the point of penetration into the larynx, below (3) or between (4) the fibers of the cricopharyngeal part of the inferior constrictor muscle. The trunks and branches of the ITA cross the RLN as it ascends toward the larynx. (5) Various studies report different relationships of the nerve and artery. (6, 7, 8)

Even though various anatomic and surgical studies have been performed, the present study is aimed at studying the anatomy and relationship of RLN by dissecting the nerve in cadavers as well as in patients undergoing thyroid surgery, so that this information helps us to avoid possible injury to the RLN and its branches.

From the Deptt. of ENT, SMGS, Govt. Medical College, Jammu.(J&K), India

Correspondence to : Dr Nitika Gupta Senior Resident, SMGS, Department of ENT, Govt. Medical College, Jammu. (J&K), India

## Materials and Methods

The present study was conducted in the Department of ENT and Head and Neck Surgery, SMGS Hospital, and in the mortuary under the supervision and control of the Department of Forensic Medicine and Toxicology, Government Medical College, Jammu after seeking proper permission and authority from the Department of Forensic Medicine and Toxicology, as well as the investigating agencies and the relatives of the deceased for a period of 1 year from Nov 2013-Oct 2014. The study was done on both cadavers autopsied in morgue in the Department of Forensic Medicine and on patients undergoing thyroid surgeries [lobectomy, hemithyroidectomy, subtotal thyroidectomy and total thyroidectomy] in the Department of ENT and Head and Neck Surgery, GMC, Jammu. The branching pattern of RLN and ITA was noted and relationships of RLN and ITA was tabulated as:

Nerve or its branches anterior to the inferior thyroid artery or its branches.

**Table 1. Showing Male And Female Distribution in the Study**

	Males	Females	Total
Cadavers	52	8	60
Patients	7	43	50
<b>Total</b>	<b>59</b>	<b>51</b>	<b>110</b>

**Table 2. Showing Type of position of RLN in relation to ITA in Cadavers**

Side	Type			Total
	Anterior	Posterior	In Between	
Right	23 (38.33%)	31 (51.67%)	6 (10%)	60
Left	13 (21.67%)	41 (68.33%)	6 (10%)	60
<b>Total</b>	<b>36</b>	<b>72</b>	<b>12</b>	<b>120</b>

**Table3. Showing Type of Position of RLN in Relation to ITA In Patients**

Side	Type			Total
	Anterior	Posterior	In Between	
Right	9 (22.5%)	26 (65%)	5 (12.5%)	40
Left	0	26 (76.47%)	8 (23.53%)	34
<b>Total</b>	<b>9</b>	<b>52</b>	<b>13</b>	<b>74</b>

Nerve or its branches in between the branches of inferior thyroid artery.

Nerve or its branches posterior to inferior thyroid artery or its branches. In the present study we dissected 60 cadavers and studied recurrent laryngeal nerve on both the sides. This included 52 males and 8 female cadavers whose mean age was 37.67 ± 10.3 years. We also studied recurrent laryngeal nerve and inferior thyroid arteries in 50 patients undergoing thyroidectomies in our department, which included 43 female patients and 7 male patients with the mean age being 39.3 ± 9.76 years.

## Results

Out of the 50 patients undergoing thyroidectomies, 22 patients underwent hemithyroidectomy (12 patients underwent right hemithyroidectomy and 10 left hemithyroidectomy), 11 patients underwent subtotal thyroidectomy, 8 underwent near total thyroidectomy while 9 underwent total thyroidectomy.

The relationship of RLN and ITA was studied according to the position of the nerve or its branches with respect to the ITA and its branches. Out of the 120 nerves studied

**Table 4. Showing Type of Position of RLN In Relation to ITA in Our Study**

Side	Type			Total
	Anterior	Posterior	In Between	
Right	32(32%)	57 (57%)	11 (11%)	100
Left	13 (13.83%)	67 (71.28%)	14(14.89%)	94
<b>Total</b>	<b>45(23.20%)</b>	<b>124 (63.91%)</b>	<b>25 (12.89%)</b>	<b>194</b>

**Table. 5 Relationship of RLN with ITA studied by different authors**

S. No.	Author	No. of Nerves Studied	Anterior	Posterior	In Between
1	Reed AF (1943) <sup>10</sup>	506	18.6%	39.1%	36.5%
2	Al-Salihi AR et al. (1989) <sup>11</sup>	212	23.11%	53.78%	23.11%
3	Hirata K (1992) <sup>12</sup>	784	18.65%	46.25%	35.1%
4	Jauregui E et al. (2000) <sup>13</sup>	110	32.65%	60.85%	6.3%
5	Campos BA et al. (2000) <sup>14</sup>	143	27.97%	24.47%	46.88%
6	Poyraz M et al. (2001) <sup>15</sup>	52	17.2%	37.2%	45.6%
7	Hisham AN et al. (2002) <sup>16</sup>	444	16.2%	83.8%	
8	Ardito G et al. (2004) <sup>17</sup>	2626	6.95%	69.2%	23.75%
9	Uen YH et al. (2006) <sup>18</sup>	120	14.15%	65.8%	20.05%
10	Suresh NM et al. (2008) <sup>8</sup>	100	18%	42%	40%
11	Makay O et al. (2008) <sup>19</sup>	501	21.9%	67.8%	6.7%
12	Sunanda H et al. (2010) <sup>20</sup>	46	9%	61%	24%
13	Rimi KR et al. (2010) <sup>21</sup>	114	16.10%	44.07%	39.83%
14	Matubis JS et al. (2011) <sup>22</sup>	108	29.6%	59.25%	11.15%
15	Tang WJ et al. (2012) <sup>23</sup>	160	41.25%	48.13%	3.13%
16	Pradeep PV et al. (2012) <sup>6</sup>	584	25.5%	64.3%	8.2%
17	Chandrakala SP et al. (2013) <sup>24</sup>	110	51.22%	27.66%	21.12%
18	Idris SA et al. (2013) <sup>25</sup>	164	37.2%	38.4%	24.4%
19	Ozguner G et al. (2014) <sup>26</sup>	400	31.5%	53.75%	2.25%
20	PRESENT STUDY	194	23.20%	63.91%	12.89%

in cadavers, 60 nerves on the right side showed that RLN or its branches were anterior to the artery or its branches in 23(38.33%) cases and posterior to the artery in 31(51.67%) cases. Nerve or its branches were in between in 6 dissections (10%). Out of the 60 nerves studied on the left side, the RLN or its branches were anterior to the ITA or its branches in 13(21.67%), posterior in 41(68.33%) and in between the branches of the artery in 6(10%) cases. Overall, 36 nerves or its branches were anterior to the artery or its branches whereas 72 nerves

or its branches were posterior to the artery or its branches. Only 12 nerves or its branches were in between the branches of the artery. In patients, on the right side 40 nerves were studied and out of these, recurrent laryngeal nerve or its branches were anterior to the artery or its branches in 9(22.5%) cases while it was posterior to the artery in 26(65%) cases and was in between in 5(12.5%) patients. On the left side out of the 34 nerves studied, the RLN or its branches were not seen anterior to the ITA or its branches, but were posterior to ITA or its branches

in 26(76.47%) cases and was in between the branches of the artery in 8(23.53%) cases. Overall in patients, 9 nerves or its branches were anterior to the artery or its branches. 52 nerves or its branches were posterior to the artery or its branches and 13 nerves or its branches were in between the branches of the artery.

Out of the 100 nerves studied on the right side, RLN or its branches were anterior to the artery or its branches in 32(32%). Nerve and/or its branches were posterior to the artery in 57(57%) nerves. Nerve or its branches were in between in 11 dissections (11%). On the left side out of the 94 nerves studied in our study, the RLN or its branches were anterior to the ITA or its branches in 13(13.83%), posterior to ITA or its branches in 67(71.28%) and in between the branches of the artery in 14(14.89%).

Recurrent laryngeal nerves or their branches dissected in the study were mainly posterior to the inferior thyroid artery or its branches i.e 124 (63.91%) nerves. 45(23.20%) nerves or their branches were anterior to the artery or its branches and 25 nerves (12.89%) or the branches were in between the branches of the artery.

### Discussion

Thyroid surgery was associated with high mortality rates in the early nineteenth century and this high mortality (20%) was attributed to the lack of meticulous dissection techniques and asepsis. (9-26) It was of so much concern, that in the year 1850 the French Academy of Medicine banned thyroid surgery. With the advent of aseptic techniques and antibiotics the mortality due to sepsis has disappeared. Now mostly the morbidity following thyroid surgery is due to technical failure to identify the vital structures and the variations in the surgical anatomy when the gland is pathologically enlarged. The RLN has extralaryngeal branching and this can be damaged if the individual branches are not taken care of by meticulous dissection. In the present study we have observed the RLN and its relationship with inferior thyroid artery.

In the present study the relationship of recurrent laryngeal nerve with inferior thyroid artery was seen in 60 cadavers and 50 patients undergoing thyroid surgery. A

total of 100 nerves were dissected on the right side and 94 on the left side.

In the present study, on the right side the recurrent laryngeal nerve or its branches were posterior to the artery in 57(57%) cases, anterior in 32(32%) cases and in between in 11 (11%) cases. On the left side the RLN or its branches were posterior to ITA or its branches in 67(71.28%) cases, in between the branches of the artery in 14(14.89%) cases and anterior in 13(13.83%) cases.

Overall the nerve or its branches were posterior to artery or its branches in 124(63.91%) cases anterior in 45(23.20%) cases and in between the branches of the artery in 25(12.89%).

Relationship of RLN with ITA studied by different authors is given in table below:

The results of the present study were consistent with the studies done by Al Salihi AR *et al.* (1989),(11) Jauregui E *et al.* (2000), (13) Ardito G *et al.* (2004), (17) Uen YH *et al.* (2006),(18) Makay O *et al.* (2008), (19) Sunanda H *et al.* (2010), (20) Matubis JS *et al.* (2011), (22) Pradeep PV *et al.* (2012) (6) and Ozguner G *et al.* (2014) (26) who in their respective studies also found that the nerve was commonly posterior to the artery. But the results were not consistent with those of Poyraz M *et al.* (2001) (15) who found the position of the nerve both on the right and left sides mostly in between the branches of ITA and Chandrakala SP *et al.* (2013) (24) who in their study reported the nerve to be mostly anterior to artery.

Thus, this information regarding the relationship of the recurrent laryngeal nerve and the inferior thyroid artery in our population will guide us for exposure of the nerve and mobilization of the gland in the various stages of thyroid surgeries. In mobilization of the gland, the relationship of the nerve and the artery is important while placing ligature in the inferior thyroid artery, to safeguard the nerve in all cases. The RLN and its branches must be identified and preserved in order to prevent nerve injury.

**References**

- 1 Lahey FH. A technique of thyroidectomy. *Surg Gynecol Obstet* 1923; 22: 825-29.
- 2 Dralle H, Sekulla C, Lorenz K, Brauckhoff M, Machens A. Intraoperative monitoring of the recurrent laryngeal nerve in thyroid surgery. *World J Surg* 2008; 32: 1358-66.
- 3 Biller HF, Lawson W. Identification of the recurrent laryngeal nerve. *Laryngoscope* 1978; 88: 697-700.
- 4 Armstrong WG, Hinton JW. Multiple divisions of the recurrent laryngeal nerve. *Arch Surg* 1951; 62: 532-39.
- 5 Monfared A, Gorti G, Kim D. Microsurgical anatomy of the laryngeal nerves as related to thyroid surgery. *Laryngoscope* 2002; 112: 386-92.
- 6 Pradeep PV, Jayashree B, Skandha S, Harshita. A closer look at laryngeal nerves during thyroid surgery: A descriptive study of 584 nerves. *Anatomy Research International* 2012; 83: 209-25.
- 7 Kulekci M, Karaaltin AB, Saatci O, Uzun I. Relationship between the branches of the recurrent laryngeal nerve and the inferior thyroid artery. *Ann Otol Rhinol Laryngol* 2012; 121(10): 650-56.
- 8 Suresh NM, Renukara ARJ, Raghupathy. Patterns of relationship between recurrent laryngeal nerve and inferior thyroid artery. *Anatomica Karnataka* 2008; 4: 47-52.
- 9 Bliss RD, Gauger PG, Delbridge LW. Surgeon's approach to the thyroid gland: Surgical anatomy and the importance of technique. *World J Surg* 2000; 24(8): 891-97.
- 10 Reed AF. The relations of the inferior laryngeal nerve to the inferior thyroid artery. *Anatom Record* 1943; 85: 17-23.
- 11 Al-Salihi AR, Dabbagh AW. Anatomy of the recurrent laryngeal nerve in normal Iraqis. *Acta Anat* 1989; 135: 245-47.
- 12 Hirata K. Relationship between the recurrent laryngeal nerve and the inferior thyroid artery in Japanese. *Kaibogaku Zasshi* 1992; 67(5): 634-641.
- 13 Jauregui E, Sezin M, Rodriguez P, Moya Encinas N, Di Rienzo A. Recurrent laryngeal nerve and inferior thyroid artery: Anatomico-surgical considerations. *Rev Fac Cien Med Univ Nac Cordoba* 2000; 57(2): 181-5.
- 14 Campos BA, Henriques PRF. Relationship between the recurrent laryngeal nerve and the inferior thyroid artery: A study in corpses. *Rev Hosp Clin Fac Med S Paulo* 2000; 55(6): 195-200.
- 15 Poyraz M, Calguner E. Bilateral investigation of the anatomical relationships of the external branch of the superior laryngeal nerve and superior thyroid artery, and also the recurrent laryngeal nerve and inferior thyroid artery. *Okajimas Folia Anat Jpn* 2001; 78(2-3): 65-74.
- 16 Hisham AN, Lukman MR. Recurrent laryngeal nerve in thyroid surgery: A critical appraisal. *ANZ J Surg* 2002; 72(12): 887-89.
- 17 Ardito G, Revelli L, Alatri LD, Lerro V, Guidi ML, Ardito F. Revisited anatomy of the recurrent laryngeal nerves. *Am J Surg* 2004; 187: 249-53.
- 18 Uen YH, Chen TH, Shyu JF, *et al* . Surgical anatomy of the recurrent laryngeal nerves and its clinical applications in Chinese adults. *Surgery Today* 2006; 36(4): 312-15.
- 19 Makay O, Icoz G, Yilmaz M, Akyildiz M, Yetkin E. The recurrent laryngeal nerve and the inferior thyroid artery- Anatomical variations during surgery. *Langenbecks Arch Surg* 2008; 393(5): 681-85.
- 20 Sunanda H, Tilakeratne S, De Silva KPVR. Surgical anatomy of the recurrent laryngeal nerve; A cross-sectional descriptive study. *Galle Medical Journal* 2010; 15(1): 14-6.
- 21 Rimi KR, Bose BK. Position of terminal branches of inferior thyroid arteries in relation to recurrent laryngeal nerve. *Dinajpur Med Col J* 2010; 3 (2): 47-54.
- 22 Matubis JS, Dumlaio KJP, Carrillo RJC. The recurrent laryngeal nerve in relation to the inferior thyroid artery in adult Filipino cadavers. *Philipp J Otolaryngol Head And Neck Surg* 2011; 26 (2): 13-17.
- 23 Tang WJ, Sun SQ, Wang XL, Sun YX, Huang HX. An applied anatomical study on the recurrent laryngeal nerve and inferior thyroid artery. *Surg Radiol Anat* 2012; 34(4): 325-32.
- 24 Chandrakala SP, Mamatha Y, Thejaswini KO. Variations in the origins of inferior thyroid artery and the relation of the artery with recurrent laryngeal nerve. *NJCA* 2013; 2(1): 11-5.
- 25 Idris SA, Ali QM, Hamza AA. Incidence and variations in the relationship between the recurrent laryngeal nerves to the inferior thyroid arteries in Sudanese subjects. *Sch J App Med Sci* 2013; 1(5): 575-80.
- 26 Ozguner G, Sulak O. Arterial supply to the thyroid gland and the relationship between the recurrent laryngeal nerve and the inferior thyroid artery in human fetal cadavers. *Clin Anat* 2014; 27(8): 1189-92.