

## The Pattern of Anatomical Location of the Parathyroid Glands: A Prospective Study

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### Abstract

**Introduction:** The origin of parathyroid glands is from branchial pouches. As the fetus grows the parathyroid drift to their location near to the thyroid gland, but the final destination of the parathyroid glands are very variable. The knowledge of the location of the glands is very important in either thyroid surgery or parathyroid surgery as their identification poses a very difficult situation intra-operatively owing to their small size and the texture resembling the surrounding tissue. So the objective of this study was to revisit the knowledge on the anatomical location of the parathyroid glands. **Materials and Methods:** A prospective study was conducted from 2013 to 2017 at department of general surgery, Victoria hospital, Bangalore. A total of 277 cases were studied which included cases of both thyroid surgery and the parathyroid surgery as well. The locations of both superior and inferior parathyroid on both sides were noted. **Results:** The common location of the inferior parathyroid was close to the tubercle of Zuckerkandl 58% right side and 61% on the left side. The superior parathyroids were also close to tubercle but comparatively little farther than the inferior. Right side 55% and left 49%. The relation of parathyroids with lateral surface of the thyroid gland was next consistent location. **Conclusion:** The surgeon must be always cautious during thyroidectomies due to the close relation of the parathyroids. The various locations of the parathyroids make them unpredictable. With

some light on the key locations through this study, it can help the surgeon to locate the parathyroids with some ease and preserve them.

**Keywords:** Parathyroid; Tubercle of Zuckerkandl; RLN (recurrent laryngeal nerve).

### Introduction

The thyroid and parathyroid glands are the endocrine glands that have different functions but anatomically located very close to each other. The parathyroid glands originate from the third and fourth pharyngeal pouches and are usually located next to the thyroid gland.

Even though there were records about the identification of the parathyroid in the early 1800s, it was Ivar Sandstorm, who in 1887 described its structures in detail. He dissected around 50 human bodies and identified the anatomical appearance and location. But the functions of these glands were still not understood. Later a physiologist named Eugene Gley first discovered the function of the parathyroid glands. The thyroid gland in comparison to the parathyroid glands is more frequently subjected to surgical removal, but often the parathyroid glands face the brunt. They are most often inadvertently removed. This is due to the inconsistent location of the parathyroid gland and further the identification also poses a challenge to the surgeon. The knowledge of the precise location therefore would be very valuable.

There have been many studies on cadaver about the location of the parathyroids. These studies only have concluded about the inconsistent location. Majority of the population have four parathyroids i.e., 2 superior and 2 inferior.

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The aim of this study is to give the surgeon a review on the anatomy and understand the pattern of the location of the parathyroid glands and to discuss the importance of the variations during surgery.

**Materials and Methods**

A prospective study was conducted from 2013 to 2017 in the department of general surgery, Victoria hospital, Bangalore. Ethical committee clearance was obtained from the institutional ethical committee prior to the study. Consent was taken from all the patients included in the study. A total of 277 cases were studied which included cases of both thyroid surgery and the parathyroid surgery as well. The locations of both superior and inferior parathyroid on both sides were noted. And the recorded data was analyzed. Thyroid malignancies were excluded. Patients diagnosed with parathyroid adenoma were not included in the study. Patients who were undergoing any revision thyroid surgery or previously operated in the neck region were excluded as the anatomy would be distorted. Whenever the parathyroids were noticed in the regular thyroidectomy dissection a prospective data was collected intraoperatively about the location of the glands, relation to land marks like tubercle of Zuckerkandl, relation to recurrent laryngeal nerve (the distance from RLN), and relation to the posterior border of the thyroid. Thyrothymic ligament, if

present, was inspected for any parathyroid embedded in them. The parathyroid glands could not be visualized in all cases of thyroidectomy and no effort was made to look for these glands. Standard methods of data collection were used, using a proforma and data was analyzed.

**Results**

In our study, the location of the parathyroid glands varied and there was no prominent pattern noted. The inferior parathyroid glands were more consistent with their location, while the location of superior parathyroid glands varied. The common location of the inferior parathyroid was close to the RLN, 58.4% on the left side. The superior parathyroids were also close to RLN but comparatively little farther than the inferior 45.7% on the left side. The relation of inferior parathyroid glands with lower border of the thyroid gland was the next consistent location. The other locations were also recorded. Thyrothymic ligament was not found in any case. (Figure 1).

In total of 277 cases, a total of 183 (66%) inferior parathyroids were noted and 221 (79%) superior parathyroids were noted. In around (L) 9.6% and (R) 15.2% cases, superior parathyroids were not visualized and (L) 10.1% and (R) 7.4% of inferior parathyroid couldn't be identified. (Table 1 , 2 and Graph 1-4).

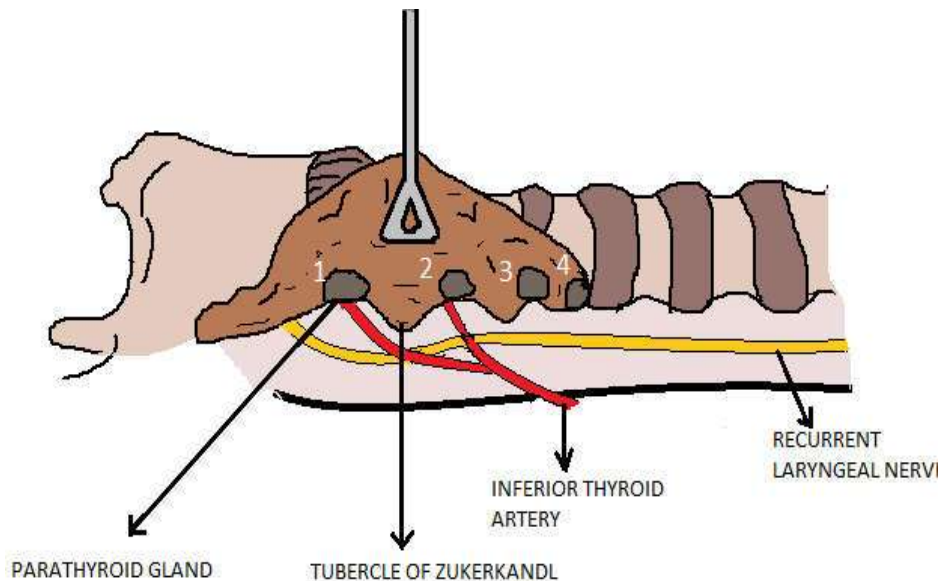


Fig. 1: Illustration of location of parathyroid glands

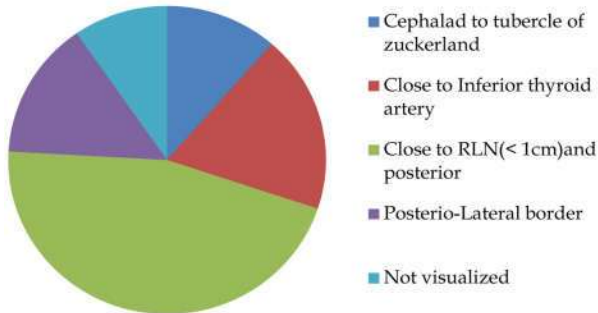
Table 1: Distribution of Parathyroid gland-Inferior (n=183/277)

	Left (n=89)	Right (n=94)
Caudal to tubercle of zuckerland	11(12.3%)	14(14.8%)
Close to Lower border of thyroid	14(15.7%)	49(55.0%)
Postero-Lateral border of thyroid	3(3.37%)	11(11.7%)
Close to RLN(<1cm)and anterior	52(58.4%)	13(13.8%)
Not visualized	9 (10.1%)	7(7.4%)

**Table 2:** Distribution of Parathyroid gland-Superior (n=221/277)

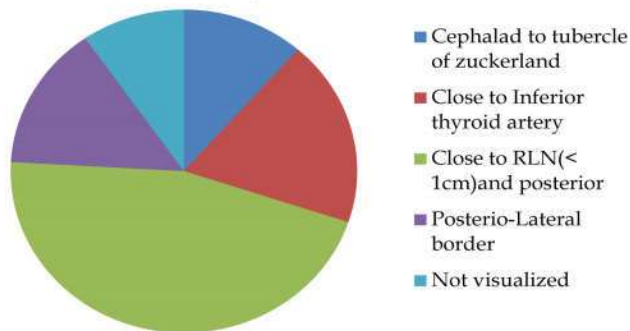
	Left (166)	Right (138)
Cephalad to tubercle of zuckerland	19(11.4%)	12(8.6%)
Close to Inferior thyroid artery	31(18.6%)	29(21.0%)
Close to RLN(< 1cm)and posterior	76(45.7%)	20(14.4%)
Posterioro-Lateral border	24(14.4%)	56(40.5%)
Not visualized	16 (9.6%)	21(15.2%)

**Left inferior (n=89)**



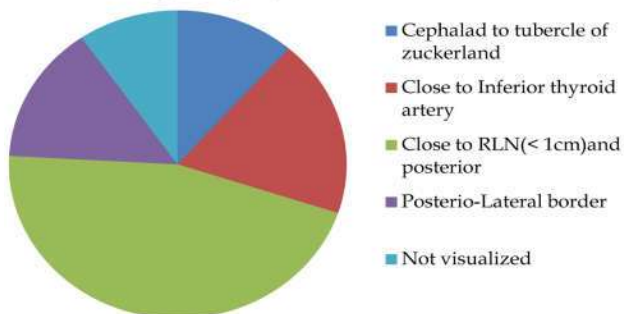
**Graph 1:**

**Right inferior (n=94)**



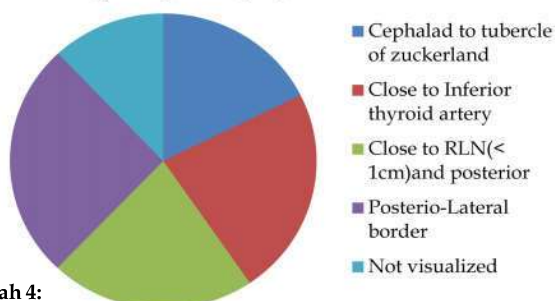
**Graph 2:**

**Left superior(166)**



**Graph 3:**

**Right superior (138)**



**Grpah 4:**

## Discussion

Preoperative investigations for thyroidectomies involve blood investigations and further sonological studies of the thyroid gland, but the sonologists usually do not comment on the parathyroid glands as it is very difficult to map the location. So the thyroid surgeon basically goes ahead with surgery without any prior information of the location of the parathyroid glands. The surgical ability and precision of the operating surgeon is the sole dependence for avoiding injury to the parathyroid glands. The surgeon usually predicts the location based on the knowledge of the common anatomical position as described in the literature. There is not much literature on the variations or pattern of the location of the parathyroid glands. Any little information on the different locations of the gland can make the surgeon be wary of the injury which he may inadvertently do to the parathyroid glands.

It is quite clear that most of the time the location of the glands is influenced by their embryological origin and their movement during birth. So during the surgery the surgeon can use the landmarks like the tubercle of Zuckerland, recurrent laryngeal nerve and inferior thyroid artery. These may help and guide the surgeon to locate the parathyroid glands.

The size of the parathyroids is very small, average 5 mm. The color of the parathyroid glands being grey to yellow makes it more difficult for on-table identifications. Sometimes they can be confused with fat tissue. This can be clarified by using dip test.

The superior parathyroid glands are usually cephalad and the inferior are caudal in location. Anatomical variations in location are frequent and they can be found even in the mediastinum near the thymus. Sometimes multiple parathyroid glands can be present in the thyro-thymic ligament remnants. But the thyrothymic ligament is usually not identified during thyroid procedures. In difficult cases the surgeon's dissection techniques play a very important role in probability of identifying the parathyroid glands.

It is also very important to stress on the technique of dissection during thyroid surgery. The blunt dissection of the capsule is accepted and helps in preserving the parathyroid glands.

## Conclusion

The surgeon must be always cautious during thyroidectomies due to the close relation of the parathyroid glands. The various locations of the parathyroid glands make them unpredictable. With some light on the key locations through this study, it can help the surgeon to locate the parathyroid glands with some ease and preserve them.

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