

A Study on the Measurement of Follicular Diameter of Female Thyroid in Population of Lower Assam

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Abstract

Background and Aims: The thyroid gland is characterized by numerous and variable sized follicles that are filled with colloid which are lined by a single layer cell called follicular cell. Thyroid hormones and the colloid are synthesized by these follicular cells. Disorders of thyroid function are more common in females e.g. hypothyroidism, hyperthyroidism, Graves disease and simple goitre. In India, goitre and cretinism were found to be in significant extent in the Himalayan goitre belt. The mean annual incidence rate of autoimmune hypothyroidism is up to 4/1000 women and 1/1000 men. Subclinical hypothyroidism is found in 6% - 8% of women (10% over the age of 60 years) and 3% in men. Now a days, thyroid related pathology and infertility among females are growing at an alarming rate. These pathological conditions can only be understood on the basis of thorough knowledge of thyroid structure. Considering the above mentioned factors in mind the present study on measurement of follicular diameter of female thyroid in different stages of life in female was conducted in the following groups namely "Prepubertal", "Reproductive" and "Postmenopausal". **Materials and Methods:** The study was focused on measurement of follicular diameter of female thyroid. The study was conducted in the Department of Anatomy, Gauhati Medical College, Guwahati. The specimens were divided in three age groups (0 to 10 years, more than 10 years to less than 51 years and 51 years and above). The collected specimens were cut into pieces of approximately three mm to five mm thickness and then they were subjected to routine processing. The stained sections were examined thoroughly under light microscope using both low and high power magnification. **Results:** In present study the average follicular diameter of thyroid follicles are $68.24 \pm 10.58\mu$ in "Prepubertal" group, $192.49 \pm 7.34\mu$ in "Reproductive" group and $116.31 \pm 7.30\mu$ in "Postmenopausal" group respectively. **Conclusion:** The follicular diameter of thyroid gland increases with a high significance ($p < 0.01$) from "Prepubertal" group to "Reproductive" group and decreases with a high significance ($p < 0.01$) from "Reproductive" group to "Postmenopausal" group. Knowledge of normal values might be helpful in different disease condition of the thyroid gland in female.

Keywords: Thyroid; Average Follicular Diameter.

Introduction

The Thyroid gland derived its name from its topographic relationship to the laryngeal thyroid cartilage whose shape resembles a Greek shield or thureos [1]. The gland is characterized by numerous

and variable sized follicles that are filled with colloid. Thyroid follicle is consists of single layer of cell called the follicular cell. These follicular cells usually cuboidal, but the shape varies depending on the functional status of the follicle. In actively secreting follicle, the amount of colloid decreases and the cell lining the follicle become tall. In less active follicle the amount of colloid is more and lining cell become flat. Thyroid hormones and the colloid are synthesized by these follicular cells. Parafollicular cells seen adjacent to the follicular cells are larger in size and oval shaped with lighter staining cytoplasm [2]. Thyroid follicle shows polymorphism according to the region of the gland. Larger follicles full of colloid may be found alongside smaller ones lined by

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prismatic epithelium [3].

Disorders of thyroid function are more common in females e.g. hypothyroidism, hyperthyroidism, Graves disease and simple goitre. Hypothyroidism in childhood delays the onset of puberty. In reproductive age group, hypothyroidism may cause infertility [4]. Goitre continues to be a serious thyroid related health problem in many countries and is present in considerable magnitude in India (much more than the magnitude found in 1960 which was about 9 million) and the neighbouring countries. In India, goitre and cretinism were found to be in significant extent in the Himalayan goitre belt (world's biggest goitre belt) affecting from Jammu & Kashmir, Himachal Pradesh, Punjab, Haryana, Uttar Pradesh, Bihar, West Bengal to Assam and north eastern states [5]. The mean annual incidence rate of autoimmune hypothyroidism is up to 4/1000 women and 1/1000 men. Subclinical hypothyroidism is found in 6% - 8% of women (10% over the age of 60 years) and 3% in men. Iodine deficiency is prevalent in many mountain regions and in Central Africa, Central South America and North Asia. In areas of relative iodine deficiency there is increase prevalence of goitre and when deficiency is severe, hypothyroidism and cretinism occurs. Cretinism is often seen in children born to mother with iodine deficiency [6]. Now a days, thyroid related pathology and infertility among females are growing at an alarming rate. These pathological conditions can only be understood on the basis of thorough knowledge of thyroid structure.

Considering the above mentioned factors in mind the present study on measurement of follicular diameter of female thyroid in different stages of life in female was conducted in the following groups namely "Prepubertal", "Reproductive" and "Postmenopausal".

Materials and Methods

The study on human thyroid gland in female of different stages of life was conducted in the Department of Anatomy, Gauhati Medical College, Guwahati. between April 2013 to October 2014. The study was approved by Institutional Ethics Committee of Gauhati Medical College and Hospital.

The thyroid glands were obtained from following sources- From Department of Forensic Medicine, Gauhati Medical College, Guwahati following autopsies after observing all medicolegal formalities. Specimens with no obvious pathological changes and decomposition were collected from the cadavers

within six hours of death and from the donated bodies in the Department of Anatomy, Gauhati Medical College, Guwahati within six hours of death before embalming. Specimens were collected from female cadavers in different stages of life irrespective of socio-economical and educational status. Cases with pathology related to thyroid gland, deviations from normal female reproductive physiology, pregnant women, women who had given birth within 1 year of death or death due to hanging, strangulations or any injury to neck were excluded.

The specimens of thyroid gland were divided into three groups, 0 to 10 years female cadavers is named as "Prepubertal" group, more than 10 years to less than 51 years female cadavers is named as "Reproductive" group, and female cadavers of age 51 years and above is named as "Postmenopausal" group.

This grouping is done based on following reference: Puberty; WHO identifies adolescence as a period from 10 to 19 years with the onset of puberty marking the passage from childhood to adolescence [7]. Menopause: The average age of a woman having her last period, menopause, is 51 years [8].

The collected specimens were first washed in normal saline, dried with blotting paper. Tissues were cut into pieces of approximately three mm to five mm thickness and were fixed in 10% formalin saline for 24-48 hours. They were subjected to routine processing by dehydration in graded alcohols, clearing in xylol and were embedded in paraffin sections. Sections of 5 μm thickness were cut and stained with hematoxylin and eosin. The stained sections were examined thoroughly under light microscope using both low and high power magnification.

For measuring the diameter of thyroid follicles, only those follicles which were round or nearly round were taken into consideration to avoid possible error. Total twenty five clearly visible thyroid follicles from five microscopic fields of each thyroid lobe and isthmus were selected randomly. The diameter of the thyroid follicle was measured across the minor and major axis, and the mean diameter obtained. Diameters of the thyroid follicles were measured using calibrated scale by adjusting ocular micrometer and stage micrometer.

Results and Discussion

Results obtained in the present study were compared with the established findings of other

authors (Table 5). In present study the average follicular diameter of thyroid follicles are $68.24 \pm 10.58\mu$ in "Prepubertal" group, $192.49 \pm 7.34\mu$ in "Reproductive" group and $116.31 \pm 7.30\mu$ in "Postmenopausal" group respectively (Table 4, Fig. 4).

The average follicular diameter of thyroid follicle is highest in Reproductive group and it is lowest in "Prepubertal" group (Table 4, Fig. 4).

The "Prepubertal" group consists of 8 number of specimen from 2 days to 10 years. The follicular diameter of thyroid follicles ranges from 34.62μ to 111.82μ with a mean value of 68.24μ ; standard deviations (S.D.) $\pm 29.93\mu$ and standard error of mean (S.E.M.) $\pm 10.58\mu$ respectively. The lowest diameter is observed at 2 days (34.62μ) and highest diameter is observed at 10 years (111.82μ). The follicular diameter of thyroid follicles increases with age in this group (Table 1, Fig. 1).

The "Reproductive" group consists of 12 number of specimen from 13 years to 50 years. The follicular diameter of thyroid follicles ranges from 153.67μ to 232.34μ with a mean value of 192.49μ ; standard deviations (S.D. $\pm 25.42\mu$) and standard error of mean (S.E.M.) $\pm 7.34\mu$ respectively. The lowest diameter is observed at 50 years (153.67μ) and highest diameter is observed at 33 years (232.34μ). The follicular diameter of thyroid follicles increases from 13 years to 33 years and it decreases from 33 year onwards in this group (Table 2, Fig. 2).

The "Postmenopausal" group consists of 10 number of specimen from 52 years to 78 years. The follicular diameter of thyroid follicles ranges from 86.08μ to 150.09μ with a mean value of 116.31μ ; standard deviations (S.D. $\pm 23.09\mu$) and standard error of mean (S.E.M.) $\pm 7.30\mu$ respectively. The lowest diameter is observed at 78 years (86.08μ) and highest

diameter is observed at 52 years (150.09μ). The follicular diameter of thyroid follicles decreases with age in this group (Table. 3, Fig. 3).

The follicular diameter of thyroid gland increased with a high significance ($p < 0.01$) from "Prepubertal" group to "Reproductive" group and the same decreased with high significance ($p < 0.01$) in "Postmenopausal" group (Table 6).

William Hobson [9] found considerable reduction in size of follicles of human thyroid gland with age since old age did not require much activity of the gland and that it regressed. Ham [10] commented that in the embryo, thyroid follicles were small and with growth all the components of the follicle increased in size and occasional new follicles are formed.

In the present study variations had been found based on the shape of thyroid follicles. Follicles in "Prepubertal" group and "Reproductive" group were spherical, round to ovoid in shape whereas in "Postmenopausal" group it appeared somewhat irregular in shape. This was similar to the findings of Ham [10], who said that in young when the follicles were small, the gland had uniform appearance and in old age, previously spheroid follicle often take irregular appearance.

In the present study, thyroid follicles varied in amount of colloid. In "Prepubertal" group the colloid amount was moderate and in "Reproductive" groups colloid was present in scanty amount within the follicles whereas in "Postmenopausal" groups follicles are distended with abundant amount of colloid thereby flattening the lining epithelium into squamous epithelium (Figure 5,6,7,8,9,10 and 11). These observations could be correlated with the data presented by Junquera [3], Passmore and Robson [11], Illingworth [12], Sahana [13], Last [14], Mohan [15].

In the present histological study, numerous

Table 1: Table showing average diameter of Thyroid follicles in "Prepubertal" group

Age	Follicular diameter
2 days	34.62 μ
18 days	38.57 μ
1 year	45.09 μ
2 years	54.46 μ
4 years	68.34 μ
7 years	92.23 μ
9 years	100.78 μ
10 years	111.82 μ
Mean	68.24μ
Standard Deviation	$\pm 29.93\mu$
Standard Error Mean	$\pm 10.58\mu$

In "Prepubertal" group diameter of thyroid follicles ranged from 34.62μ to 111.82μ with a mean value of $68.24 \pm 10.58 \mu$, as evident in fig. no.1.

Table 2: Table showing average diameter of Thyroid follicles in “Reproductive” group:

Age	Follicular Diameter
13 years	158.87μ
16 years	173.88μ
21 years	189.96μ
25 years	204.52μ
29 years	218.23μ
33 years	232.34μ
37 years	220.176μ
39 years	209.70μ
43 years	194.14μ
45 years	186.93μ
48 years	167.52μ
50 years	153.67μ
Mean	192.49μ
Standard Deviation	± 25.42μ
Standard Error Mean	± 7.34μ

In “Reproductive” group diameter of thyroid follicles ranged from 153.67 μ to 232.34 μ with a mean value of 192.49 ± 7.34 μ, as evident in Fig. 2.

Table 3: Table showing average diameter of thyroid follicles in “Postmenopausal” group

Age	Follicular Diameter
52 years	150.09μ
55 years	145.67μ
58 years	138.35μ
60 years	130.86μ
61 years	123.04μ
63 years	117.58μ
66 years	103.49μ
67 years	97.77μ
71 years	92.17μ
78 years	86.08μ
Mean	116.31μ
Standard Deviation	± 23.09μ
Standard Error Mean	± 7.30μ

In “Postmenopausal” group diameter of thyroid follicles ranged from 150.09 μ to 86.08 μ with a mean value of 116.31 ± 7.30 μ, as evident in Fig. 3.

Table 4: Table showing average diameter of Thyroid follicle in “Prepubertal”, “Reproductive” and “Postmenopausal” group

Groups	Average diameter of Thyroid follicle
“Prepubertal”	68.24 μ
“Reproductive”	192.49 μ
“Postmenopausal”	116.31 μ

Average diameter of Thyroid follicle in “Prepubertal”, “Reproductive” and “Postmenopausal” groups

Average diameter of Thyroid follicle in “Prepubertal” group

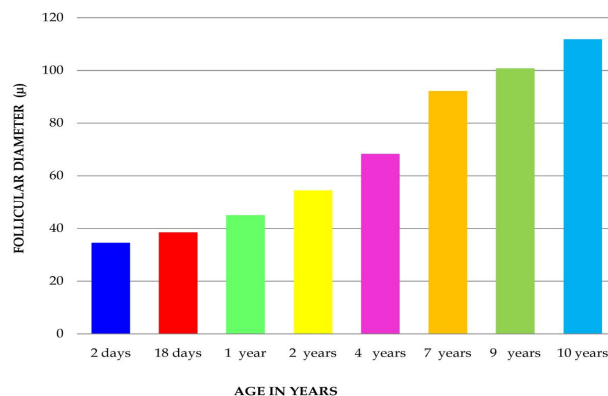


Fig. 1: Column diagram showing average diameter of Thyroid follicle in “Prepubertal” group

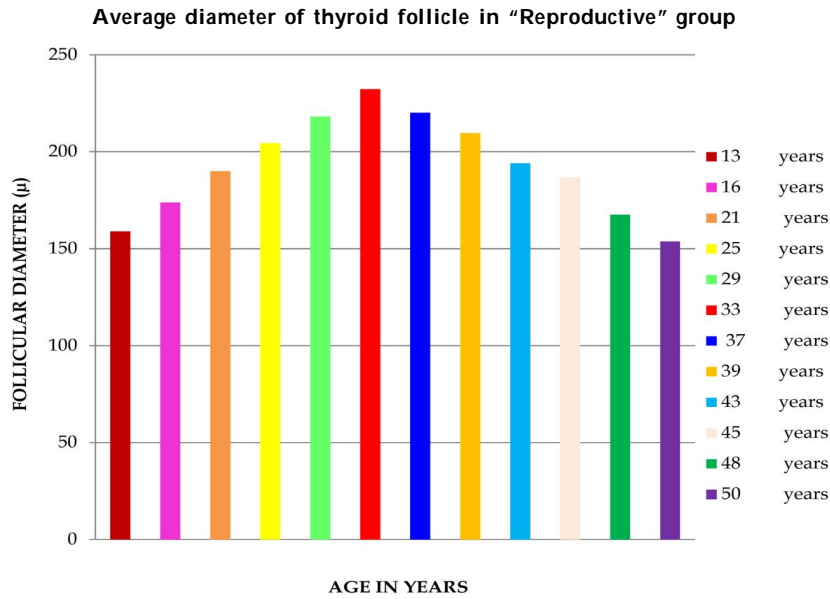


Fig. 2: Column diagram showing average diameter of Thyroid follicle in "Reproductive" group

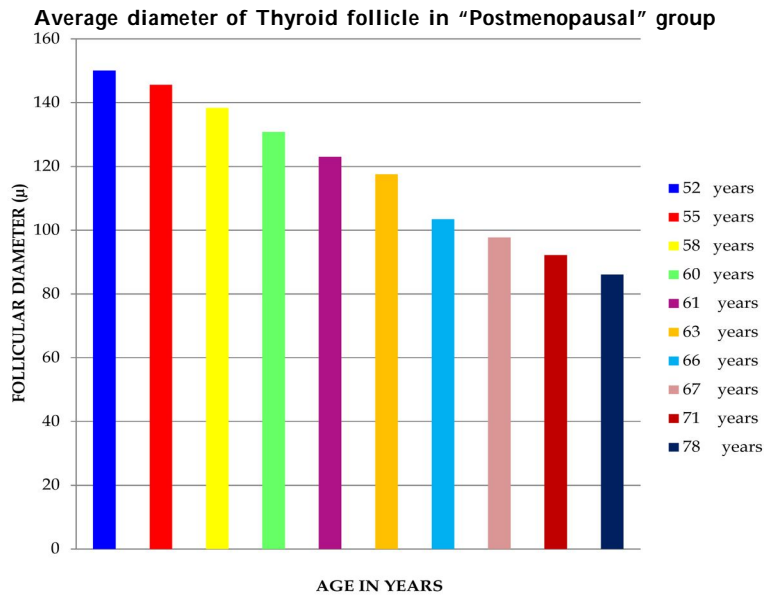


Fig. 3: Column diagram showing average diameter of Thyroid follicle in "Postmenopausal" group

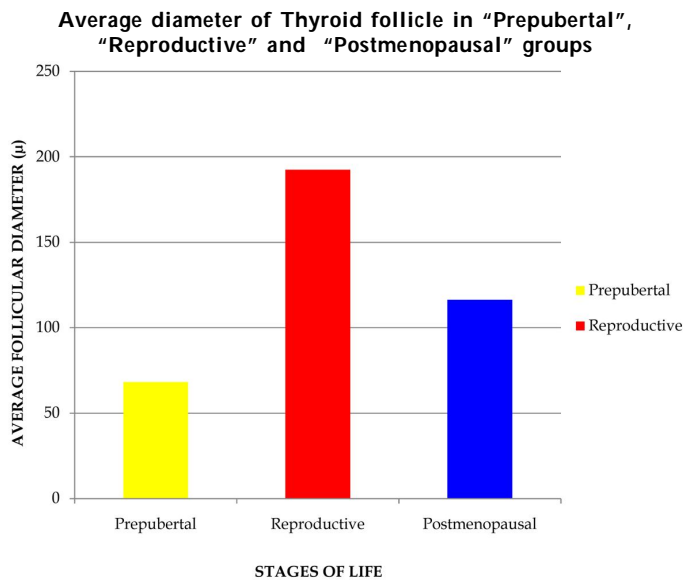


Fig. 4: Column diagram showing average diameter of Thyroid follicle in "Prepubertal", "Reproductive" and "Postmenopausal" groups.

Table 5: Table showing diameter of thyroid follicle by Workers

Sl. No.	Name of Workers	Year	Diameter of Thyroid Follicle
1	Subrahmanyam and Kutty	1977	15 μ to 500 μ
2	Ledingham et al	1980	200 μ to 300 μ
3	Chatterjee	2003	15 μ to 150 μ
4	Berne et al	2004	200 μ to 300 μ
5.	Hall and Guyton	2011	200 μ to 300 μ

Table 6: Table showing level of significance of difference in diameter of Thyroid follicle in different groups

Dependent variable	Main group	Comparing group	"p" value
Diameter of thyroid follicle	"Prepubertal"	"Reproductive"	.000**
		"Postmenopausal"	.001**
	"Reproductive"	"Prepubertal"	.000**
		"Postmenopausal"	.000**
	"Postmenopausal"	"Prepubertal"	.001**
		"Reproductive"	.000**

** significance at 0.01., * significance at 0.05.

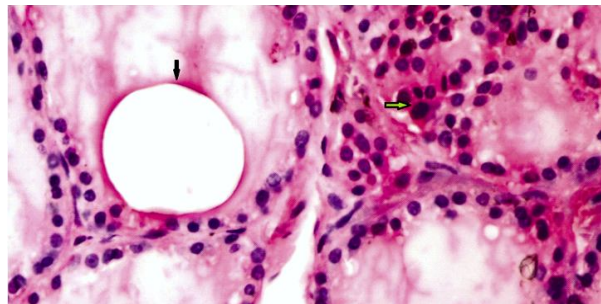


Fig. 5: Photomicrograph showing thyroid follicle with lacunae (black arrow) and Parafollicular cell (green arrow) (H & E x 400)

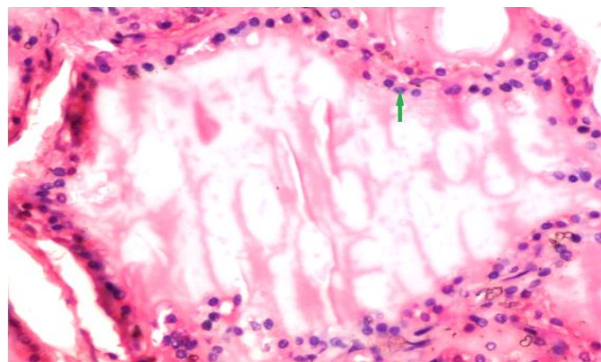


Fig. 6: Photomicrograph showing thyroid follicle filled with colloid (light pink) and lining follicular cells (green arrow) (H & E x 400).

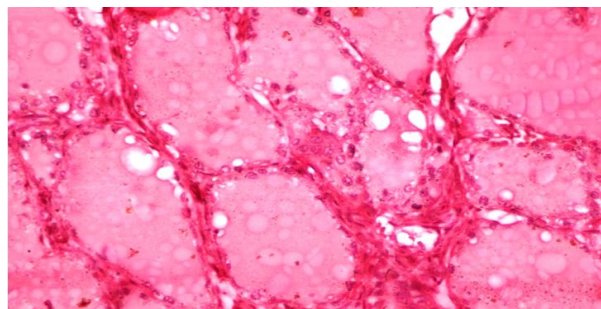


Fig. 7: Photomicrograph showing colloid filled thyroid follicles with lining follicular cells of a female in " Prepubertal" group (H & E x 400)

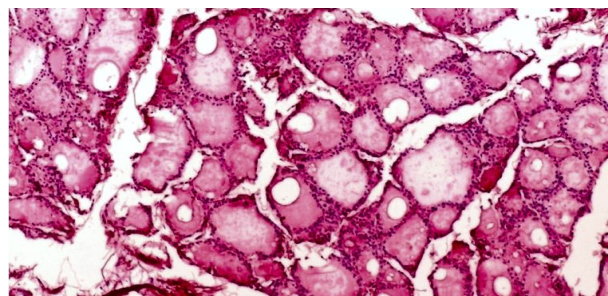


Fig. 8: Photomicrograph showing thyroid follicles of a female in "Reproductive" group (H & E x 100)

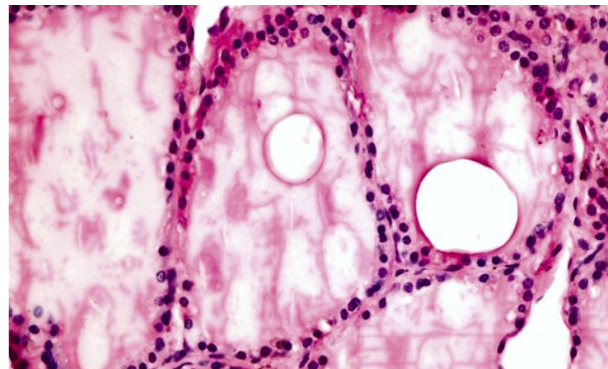


Fig. 9: Photomicrograph showing thyroid follicles with lacunae and lining follicular cells of a female in "Reproductive" group (H & E x 400)

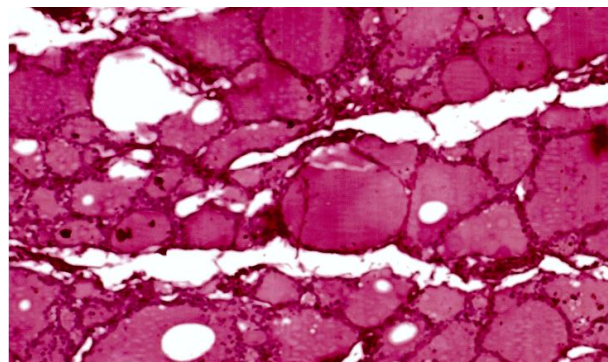


Fig. 10: Photomicrograph showing thyroid follicles of a female in "Postmenopausal" group (H & E x 100)

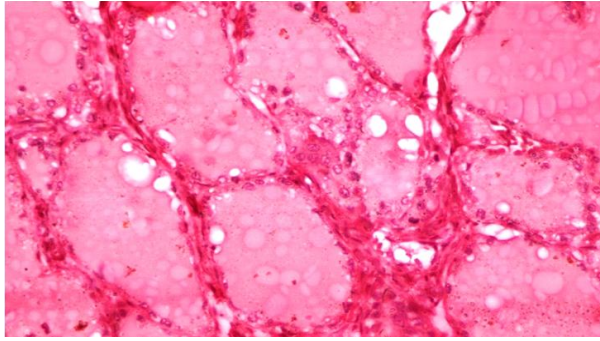


Fig. 11: Photomicrograph showing thyroid follicles with abundant colloid and lining follicular cells of a female in "Postmenopausal" group (H & E x 400)

vacuoles/ lacunae were seen in follicles of "Reproductive" group in contrast to "Prepubertal" and "Postmenopausal" group and this observation could be justified by the observation of Foster [16] that with high activity of thyroid gland there was usually little colloid and vacuoles often occurred around the periphery of such colloid masses indicating a resorption of stored secretion in soluble form (Figure 5,6,7,8,9,10 and 11).

In the present study, parafollicular cells were found more in "Prepubertal" group and "Reproductive" group than in "Postmenopausal" group (Figure 5,6,7,8,9,10and11), and this observation corresponded to the findings of Felice and Lauro [17].

Conclusion

The follicular diameter of thyroid gland increases with a high significance ($p < 0.01$) from "Prepubertal" group to "Reproductive" group and decreases with a high significance ($p < 0.01$) from "Reproductive" group to "Postmenopausal" group.

Assam being situated in the sub Himalayan goiter belt, goiter is a common problem here. Many studies, as discussed in the review of literature revealed that subclinical and clinical hypothyroidism is prevalent in this region and is more common in females. Thyroid disorders in females pose a serious risk to the succeeding generation ranging from infertility, spontaneous abortion, premature delivery to developmental and mental disorders in the offspring. Hence to rule out thyroid disorders in females is of outmost importance. Thus the knowledge of human thyroid histomorphology and histophysiology is need of the hour. Most of the previous studies on human thyroid histomorphology were conducted without gender distinction. As not many studies were carried out on human thyroid gland of females in different age group in this region, the present study

was undertaken to find out if any significant changes were present in the follicular diameter of the human thyroid gland in the different stages of life in females and to compare these findings with the previously laid down scientific data. Studying all the characteristics and parameters related to histology of the human thyroid was beyond the scope of the present study and hence it is advisable that further studies are necessary to look into the details of the different aspects of thyroid histophysiology and histomorphology.

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