Annals of Radiation Therapy and Oncology

Short Communication
Published: 30 Mar, 2022

Initial Results of Study of Functional Imaging of Thyroid Gland Comparing Scintigraphy Findings with Thermal Images in Clinical Environment

Vandana K Dhingra[1], Mayank Goswami[2] and Ashok Kumar[3]*

[1]*Department of Nuclear Medicine, AIIMS Rishikesh, India*

[2]*Department of Biophysics, IIT Roorkee, India*

[3]*Department of Nuclear Medicine, JIPMER Puducherry, India*

Abstract

Thermal imaging has been around for many decades; however it has not been used much for imaging of the thyroid gland. Thermal imaging is specifically useful in imaging of superficial structures due to its limited penetrability in deep tissue. Radioisotopes are routinely used in imaging of the thyroid gland for its function. However, it involves isotopes and requires expensive equipment; also it may not be accessible at all locations. In many clinical situations thermal imaging may be utilized for imaging of the thyroid. This needs to be further explored. In this article we discuss the early results of imaging of the thyroid gland with thermal camera for normal and abnormal thyroid glands and comparing them with scintigraphy.

Keywords: Thyroid; Thermal imaging; Infrared (IR) imaging; Radioisotope imaging

Introduction and Background

Human eye is sensitive to light between 0.4 to 0.76-micron spectral ranges. Most of the spectrum gets reflected thus have limited penetration depth. Thermal camera can produce images

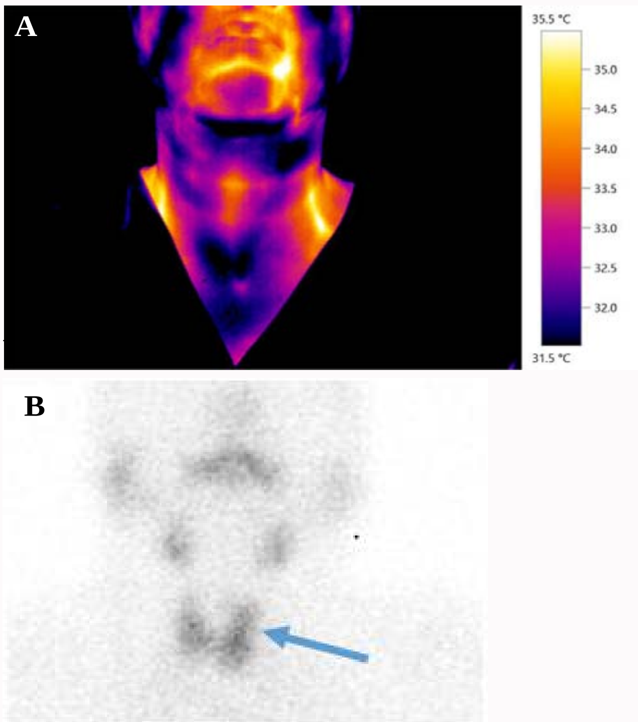


Figure 1: Images A & B represent side by side thermal and scintigraphy images of a normal patient. Blue arrow represents location of thyroid gland.

OPEN ACCESS

Correspondence:
Vandana K Dhingra, Department of Nuclear Medicine, AIIMS Rishikesh, Uttarakhand, India,
E-mail: modisbanu@yahoo.com

Received Date: *07 Feb 2022*
Accepted Date*: 05 Mar 2022*
Published Date*: 30 Mar 2022*

Citation:
Dhingra VK, Goswami M, Kumar A. Initial Results of Study of Functional Imaging of Thyroid Gland Comparing Scintigraphy Findings with Thermal Images in Clinical Environment. Ann Radiat Ther Oncol. 2022; 3(1): 1020.

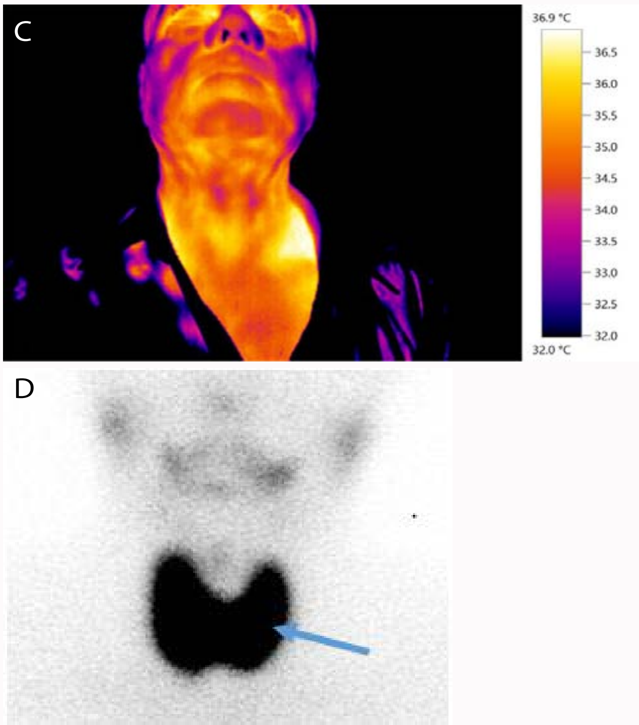


Figure 1: Image C & D represent thermal and scintigraphy image of a hyperthyroid (Graves' Disease) patient. Blue arrow represents location of thyroid gland.

in spectral range of 8 to 12 micron thus having better penetration depth than visual spectrum and forms a visual assessment map based on temperature of the imaged area. Thermal cameras convert the electromagnetic radiation within the sensor's range of sensitivity into a temperature-based image known as the thermal image [1]. Thermal Imaging (Infrared Imaging) of the human body utilizes the heat signatures at various parts of the human body surface and this heat signature varies at specified locations depending on the metabolic activity of the organs beneath the skin. Depending on the organs health level the heat signature varies accordingly and using the thermal imaging modality disease conditions of those organs can be picked up.

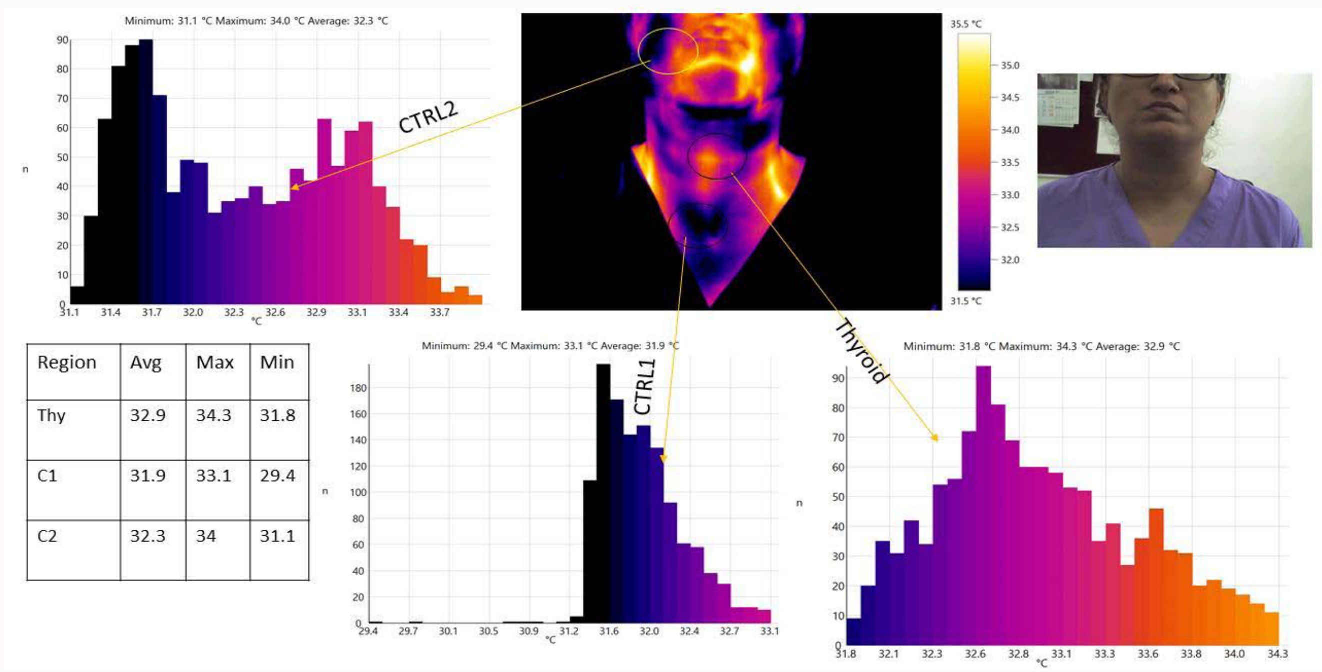
Radioisotope imaging involves images of gamma radiation acquired after internal administration of radioisotopes. Both methods have potential for imaging based on function. About 42 million people in India suffer from thyroid diseases. Iodine deficiency leading cause of goiter in the sub-Himalayan region and Himalayan region. It has been seen that despite iodization, the prevalence of goiter has not dramatically declined. Thyroiditis (inflammation of the thyroid) has been seen very commonly effecting school going girls [2-4]. The commonest disorders of the thyroid are: (1) hypothyroidism, (2) hyperthyroidism, (3) goiter and iodine deficiency disorders, (4) Hashimoto's thyroiditis, and (5) thyroid cancer

Thyroid disorders in pregnancy and childhood are common and challenging.

- Biochemical Tests (Blood Tests): Thyroid Hormones (T3, T4, TSH), Anti-TPO levels, Thyroglobulin levels
- Imaging Tests: Ultrasound, Thyroid Scan, Positron Emission Tomography Scan, Computerized Tomography Scan
- Pathological Tests: Fine Needle Aspiration Biopsy, Excision Biopsy
- Non-Imaging Tests: Thyroid uptake tests

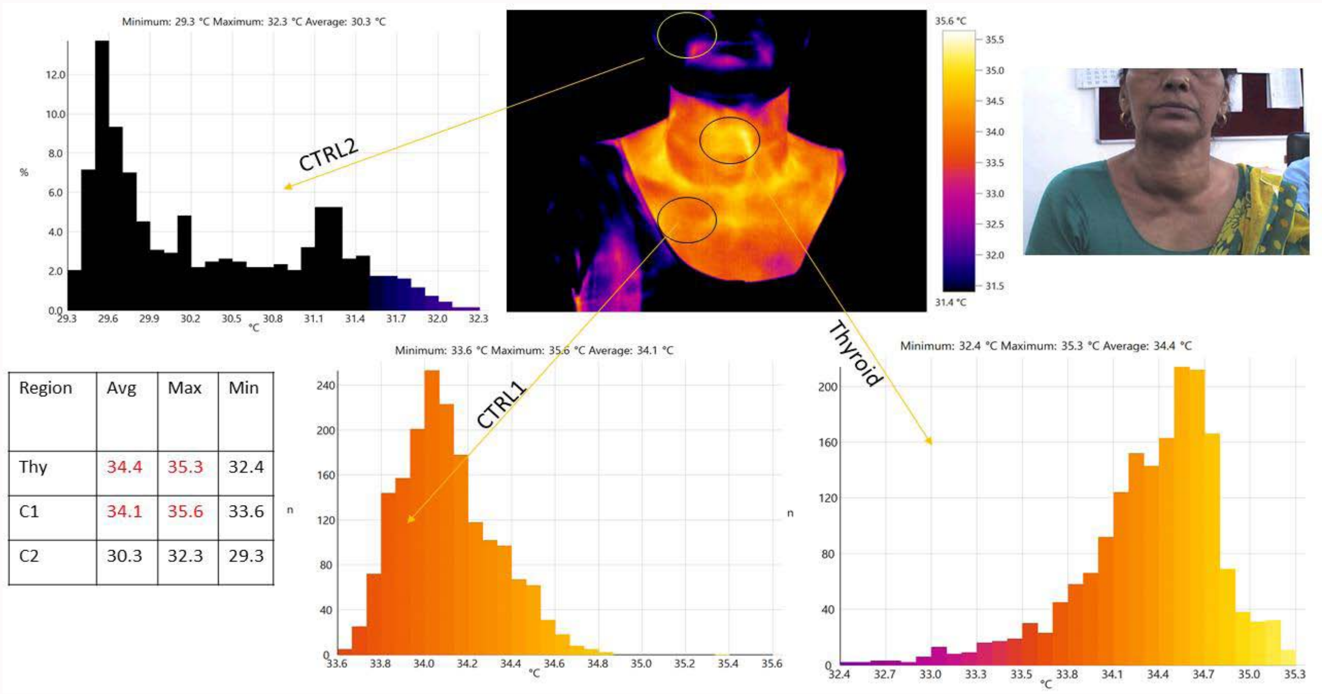
Materials and Methods

We have used a commercially available Thermal Camera for Infrared (IR) imaging of thyroid gland of patients visiting our thyroid clinic. We have taken data for patients with known hyperthyroidism (hyper functioning thyroid gland) in various phases of the disease. Data for healthy persons was also recorded as control. Thyroid scan



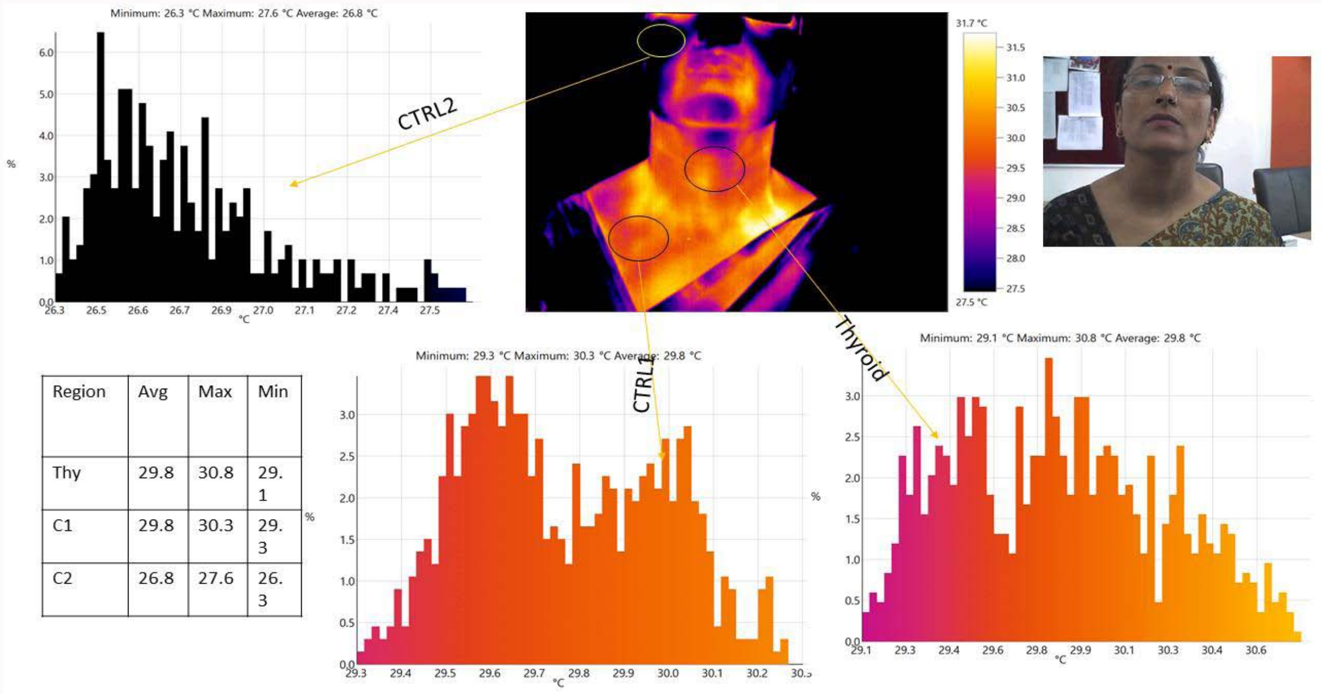
Region	Avg	Max	Min
Thy	32.9	34.3	31.8
C1	31.9	33.1	29.4
C2	32.3	34	31.1

Figure 2: Quantitative analysis in a normal person.



Region	Avg	Max	Min
Thy	34.4	35.3	32.4
C1	34.1	35.6	33.6
C2	30.3	32.3	29.3

Figure 3: Quantitative analysis in a hyperthyroid patient.



Region	Avg	Max	Min
Thy	29.8	30.8	29.1
C1	29.8	30.3	29.3
C2	26.8	27.6	26.3

Figure 4: Quantitative analysis in a hyperthyroid patient controlled with medications on day of imaging.

with radioisotope was already performed for the same patients for their routine evaluation. IR images and radioisotope images were qualitatively compared with each other and with clinical data - symptoms, thyroid biochemical profile and medication status. IR images were quantitatively analyzed using regions of interest (imaging markers) located in the thyroid bed (T1), adjoining region (but outside the thyroid) in the neck (C1) and a region on the face (C2).

Results

We performed the study in a total of 24 cases with 4 healthy controls. All 20 patients were hyperthyroid with increased radiotracer uptake on thyroid scintigrams (Figure 1A, 1B). Controls had normal radiotracer uptake on thyroid scintigrams (Figure 1C, 1D). On qualitative analysis overall thermal image spectrum of the IR image was higher in subjects with biochemical hyperthyroidism on the day of the IR imaging (16/20) in comparison to the others who were biochemically normal on the day of IR image (4/20). On quantitative analysis of readings of imaging markers of IR Images it was seen that the difference in values for healthy person, difference between imaging marking values of region T1 and C1 is high (Figure 2), however for patient with hyperthyroidism it was less (IM1) (Figure 3). Using same marking values, the difference between region T1 and C2 (IM2) is high in patients, however for healthy person its less. Thus the quantitative analysis shows variations with respect to thyroid function status, whether active disease is present.

Discussion

It has been shown that medical thermography is a safe and non-invasive tool with many potential clinical applications [5]. Recently a systemic analysis on use of thermal imaging for monitoring/measuring physiological parameters has shown that the major advantage of thermal imaging is its non-contact methodology which is most relevant in the recent pandemic era [6]. However, to the best of our knowledge this is the first study based on comparison of thermal imaging and scintigraphy. Our work shows that the non-invasive tool of thermal imaging or infrared imaging may have potential to be used for detection and follow-up of thyroid disorders like thyroid nodules, hyperthyroidism and hypothyroidism which produce various metabolic alterations which can be monitored with thermal imaging as well (Figure 4). Thermal imaging has been used in diagnosis of ocular involvement in thyroid disease i.e. opthalmopathy [7]. Brown adipose also has been imaged with thermal imaging in hypothyroidism [8]. Few studies on thyroid nodules have shown potential of thermal imaging to detect thyroid nodules and characterize them [9,10]. Thermal imaging was introduced to clinical medicine in 1957. Dr. R. Lawson observed that patients with certain diseases like breast cancer had higher temperatures over the skin in the area of the tumor [5]. Improvement from very crude instruments to highly advanced and sensitive instruments with high thermal sensitivity Noise Equivalent Temperature Difference (NETD) of 50 mK are used in most clinical applications [6]. Presently thermal imaging has use in dermal imaging, vascular disorders, oncology and rheumatology. Its full potential in clinical medicine is yet to be evaluated. This tool may be also being useful in remote areas through an application software and telemedicine. Our study has shown that functional changes in thyroid gland like increased thyroid hormone production as observed in thyrotoxicosis is seen as increased tracer uptake on isotope scintigraphy as well as increased temperature on thermal images whereas normal thyroid gland have shown normal isotope uptake and lower temperatures on thermal images. These have been confirmed both quantatively as well as qualitatively in our study.

Conclusion

To our knowledge this is the first study to correlate scintigraphy images with thermal/IR images. Initial results have shown that qualitatively as well as quantitatively there appears to be difference in thermal images of patients with known hyperthyroidism on radioisotope scintigraphy. These results are encouraging to further study larger number of patients for statistically sound conclusions.

References

1. Tattersall GJ. Infrared thermography: A non-invasive window into thermal physiology. Comp Biochem Physiol A Mol Integr Physiol. 2016;202:78-98.
2. Unnikrishnan AG, Menon UV. Thyroid disorders in India: An epidemiological perspective. Indian J Endocrinol Metab. 2011;15(Suppl 2):S78-81.
3. Marwaha RK, Tandon N, Gupta N, Karak AK, Verma K, Kochupillai N. Residual goitre in the postiodization phase: Iodine status, thiocyanate exposure and autoimmunity. Clin Endocrinol (Oxf). 2003;59(6):672-81.
4. Marwaha RK, Tandon N, Karak AK, Gupta N, Verma K, Kochupillai N. Hashimoto's thyroiditis: Countrywide screening of goitrous healthy young girls in postiodization phase in India. J Clin Endocrinol Metab. 2000;85(10):3798-802.
5. Mikulska D. Contemporary applications of infrared imaging in medical diagnostics. Ann Acad Med Stetin. 2006;52(1):35-9.
6. Manullang MCT, Lin YH, Lai SJ, Chou NK. Implementation of thermal camera for non-contact physiological measurement: A systematic review. Sensors (Basel). 2021;21(23):7777.
7. Dave TV, Patodi P, RichhariyaA, Dave VP. Thermal imaging of the ocular surface in thyroid eye disease: A comparison between active, inactive and healthy eyes. Curr Eye Res. 2021;46(10):1482-8.
8. Costa APC, Maia JM, Brioschi ML, de MeloMafra Machado JE. Investigation of thermal changes in the thyroid gland region of individuals with hypothyroidism and fibromyalgia by analyzing the temperature of brown adipose tissue. Sci Rep. 2021;11(1):6526.
9. González JR, Damião C, Conci A. An infrared thermal images database and a new technique for thyroid nodules analysis. Stud Health Technol Inform. 2017;245:384-7.
10. Damiao CP, Montero JRG, Moran MBH, da Cruz Filho RA, Fontes CAP, Lima GAB, et al. On the possibility of using temperature to aid in thyroid nodule investigation. Sci Rep. 2020;10(1):21010.