

# Calculation of Thyroid Dose with Planner System and Evaluation of Thyroid Function after Radiotherapy for Patients with Breast Cancer

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## ABSTRACT

**Background:** Much research has widely been conducted into thyroid hormones levels following radiotherapy for breast cancer. Consequently, in this study, we evaluated to relate the rate of thyroid hormones levels with the dose distribution among breast cancer patients.

**Material and Methods:** Thirty patients were treated with 4-field breast cancer radiotherapy. The dose volume histograms, the volume percentage of the thyroid absorbing respectively 20, 30, 40 and 50 Gy were then estimated (V20, V30, V40 and V50) together with the individual average thyroid dose over the whole gland derived from their computed tomography-based treatment plans. Then, in serum samples triiodothyronine [T3], thyroxine [T4], thyroid-stimulating hormone [TSH] of the patients were measured before and after radiotherapy.

**Results:** There were no significant differences in thyroid hormones levels before and after radiotherapy for patients with breast cancer (P value >.05).

**Conclusion:** On the balance, we understood that thyroid stimulating hormones levels did not change before and after cancer breast radiotherapy.

## Keywords

Thyroid, Breast Cancer, Radiotherapy

## Introduction

Nowadays, early breast cancer is widely increasing and it can involve node-positive disease and local lymph nodes. One of the most important procedures for its therapy is surgery. However, it is possible that after surgery the remaining deposits of neoplastic disease locally or at distant sites are present [1, 2]. Therefore, radiotherapy plays a major role in the local deposit of breast cancer. Even though, radiotherapy greatly reduced the incidence of local deposits [3, 4], it has side effects on the rest of organs particularly on the sensitive organs such as thyroid gland, testes, etc. [5, 6]. Since thyroid gland is very sensitive, important and the largest pure endocrine gland in our body [7] and more importantly its hormones (triiodothyronine (T3) and thyroxine (T4)) play a very significant role in metabolism, development, growth, overall energy expenditure and a large number of body organs functions [7-9], an endless list of studies have been conducted so that these show incidence of hypothyroidism, Graves' disease, thyroid can-

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cer and benign adenoma after surgery and radiotherapy for patients with various cancers particularly head and neck cancer [5, 10-16]. Overall, these studies have been done but yet we witness unrecognized correlation between thyroid hormones levels after cancer radiotherapy [17]. As a result, we performed this study with the objective of defining the association between breast cancer radiotherapy and thyroid hormone level changes.

## Material and Methods

### Patients

This study was conducted in Reza treatment center at Mashhad University Medical of Sciences. We chose 30 patients with cancer breast. All characteristics of the patients and their treatment are summarized in Table 1.

### Radiation Therapy

Before receiving dose patients, all patients were treated by using a three-dimensional computer-based treatment planning system and computed tomography (CT) scans. Then, dose delivery was performed using ETAR (Equivalent Tissue to Air Ratio) algorithm

with a dose voxel size of  $2 \times 2 \times 2 \text{ mm}^3$ . Radiotherapy technique is explained elsewhere. The breast received a dose of 60 Gy in 30 fractions and radiation dose was 1.8 or 2.0 Gy/d. Radiation delivered with a Linac accelerator 6- MV photons. Regional lymph nodes (supraclavicular, axillary, or internal mammary nodes or a combination of these) (Figures 1 and 2) were irradiated to a maximal dose of 60 Gy at the discretion of the radiation oncologist. Treatment procedures and received dose were the same in all patients.

### Measurement of Thyroid Hormone Level

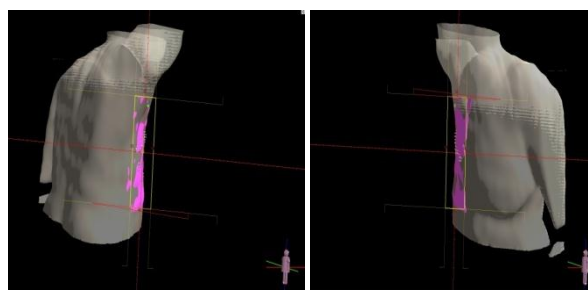
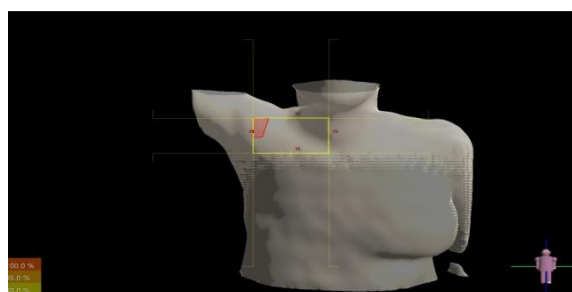
Serum samples were obtained from blood patients to determine levels of thyroid-stimulating hormone TSH, T3 and T4 levels before and after cancer breast radiotherapy. Then, we compared thyroid hormone levels before and after its therapy. In addition, this study was done during a 3 month therapy.

### Statistical Analysis

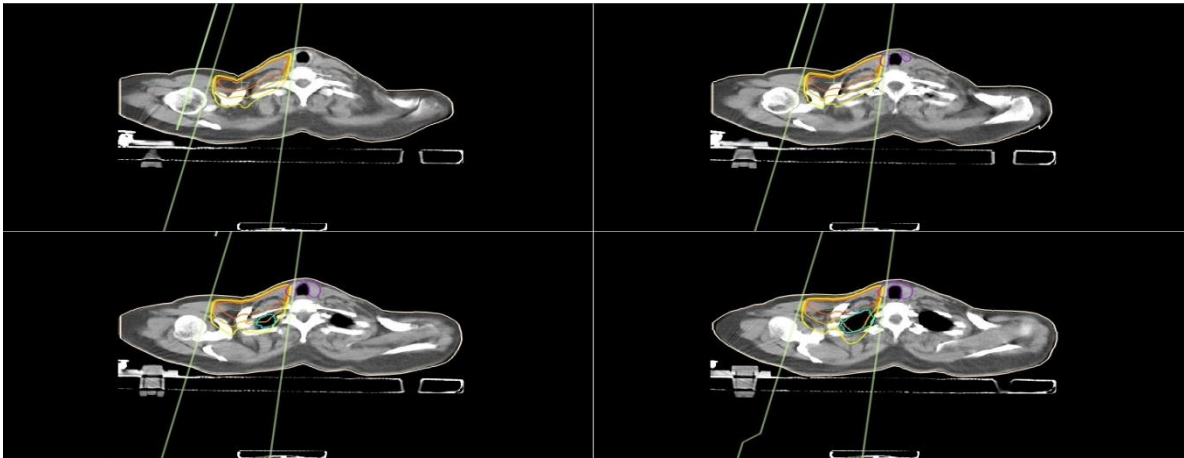
Results of this study were analyzed by a T-

**Table 1:** Characteristics of patients and their treatment

No. of patients	30
Range of age	25-38
Range of weight	70-83
sex	Female
Stage	III
Range of total radiation volume (cGy)	600 - 900
Volume Total of thyroid (cc)	9.5 -10.5
Range of dimension of the radiation in supra-clavicular field (cm <sup>2</sup> )	15.2 x 9.0
Range of dimension of the radiation in axillary field (cm <sup>2</sup> )	18.6 x 7.0
With surgery	30
With chemotherapy	30



**Figure 1:** Regional lymph nodes in the supraclavicular and axillary



**Figure 2:** Contour of thyroid gland in radiotherapy for patients with breast cancer

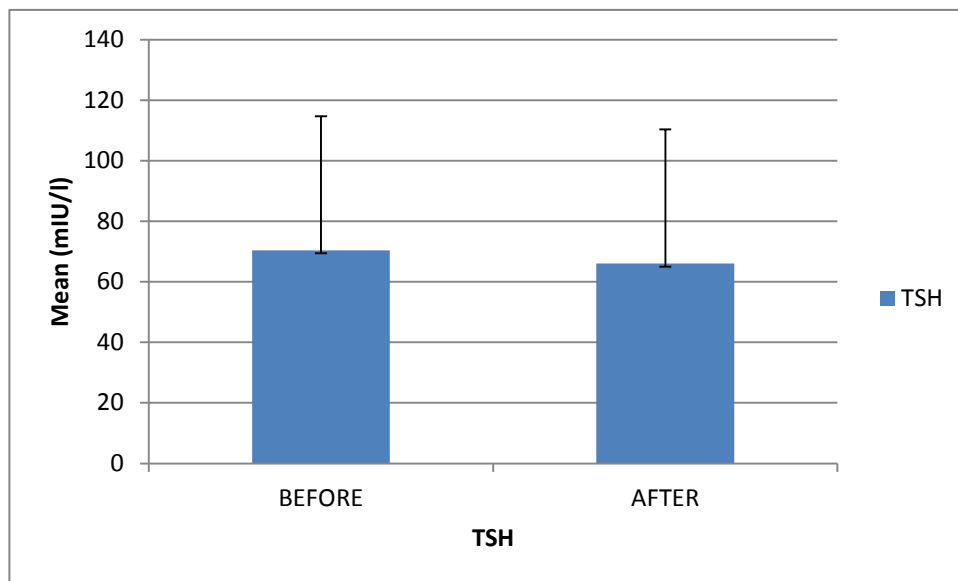
test and compared thyroid hormone level.

**Results**

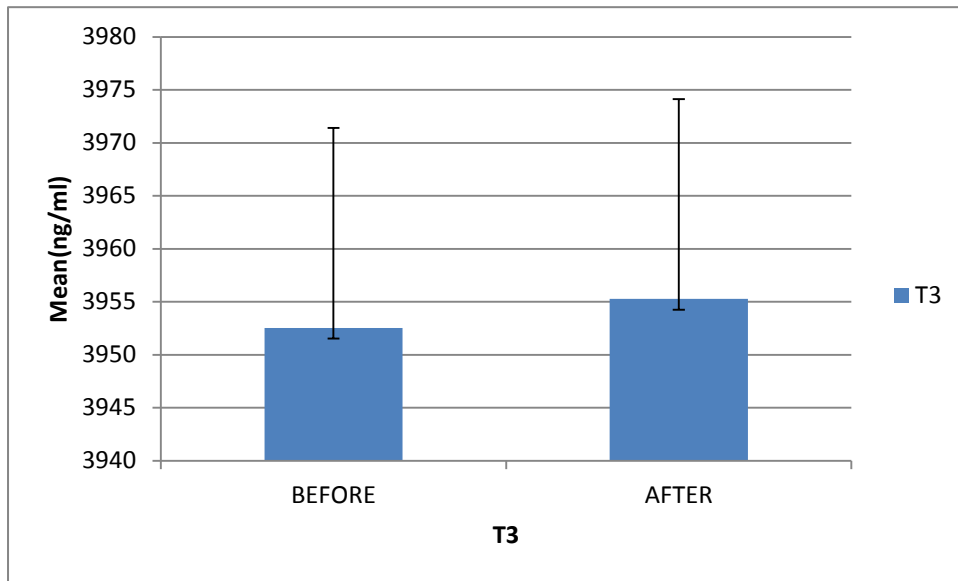
According to Figures 3, 4 and 5, there was no significant relation for TSH, T<sub>3</sub> and T<sub>4</sub> levels before and after cancer breast radiotherapy during 3 months of therapy. Also, Dose Volume Histogram received by thyroid is shown in Figure 6.

**Discussion**

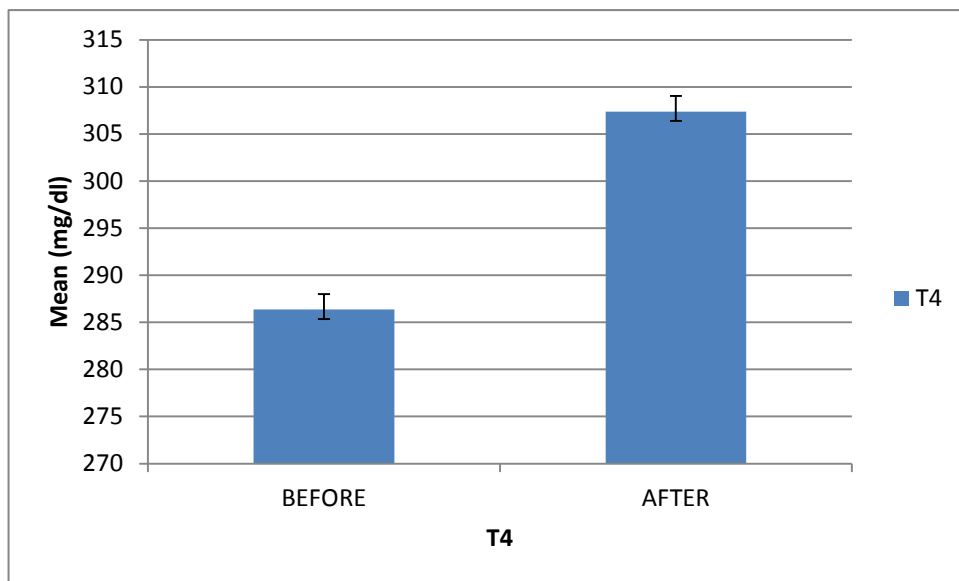
Before and after study dates, thyroid hormones were almost the same in this study. A wide variety studies shows that glandular cells of the thyroid gland are considered resistant to radiation [18], but there is a possibility that extensive radiation over the permissible dose enhances the aberrant production of thyroid hormone or the generation of neoplasms and cysts [10]. Scientists are conducting research



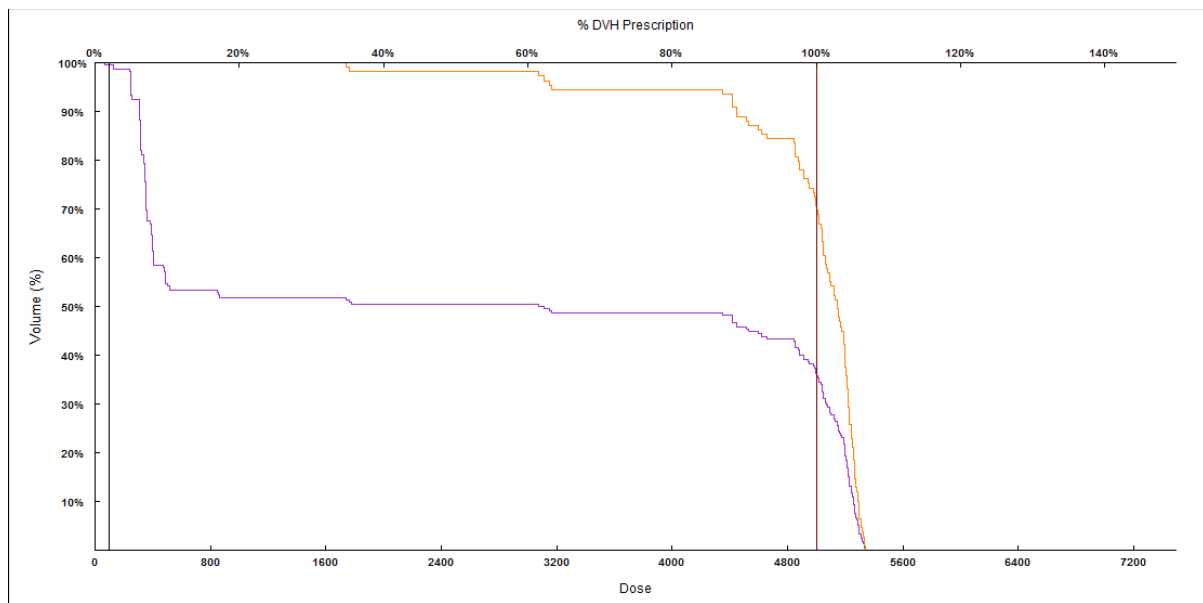
**Figure 3:** Mean of TSH levels before and after breast cancer radiotherapy



**Figure 4:** Mean of  $T_3$  level before and after breast cancer radiotherapy



**Figure 5:** Mean of  $T_4$  levels before and after breast cancer radiotherapy



**Figure 6:** Dose Volume Histogram of thyroid

into changes of thyroid hormone levels during radiotherapy from kinds of various cancers to show the incidents of hypothyroidism after cancer radiotherapy [10, 19, 20] and other scientists do not believe that incidents of hypothyroidism after radiotherapy and also say that hypothyroidism is categorized as a late disturbance of radiation [21]. Thus, patients who have a long interval after radiotherapy are at high risk of hypothyroidism. In addition, our results did not reveal any changes of TSH,  $T_3$  and  $T_4$  levels before and after radiotherapy. As a result, we can say that one of the most important factors for their changes is the number of months that we follow up patients after radiotherapy. Moreover, Garcia-Serra et al. offered a suggestion that serum TSH levels can be checked every 6 months for the first year [22]. It is well known that primary radiation induces thyroid hormonal changes and may enhance different damages [23]. Also, we can say that thyroid is prone to secondary radiation in breast cancer radiotherapy. Therefore, receiving dose is low.

## Conflict of Interest

None

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