



# Thermal Ablation for Benign Thyroid Nodules: Radiofrequency

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## Introduction

Nodular thyroid disease is common in adult population. Although most thyroid nodules are benign and treatment is often not necessary, some patients require treatment due to pressure symptoms or cosmetic complaints [1]. Unfortunately, levothyroxine therapy presents a significant reduction of the initial size only in a limited group, while a number of nodules continue to grow progressively. Whilst these studies refer to the treatment of uninodular goiter, clinical data regarding the efficacy of levothyroxine therapy on multi-nodular goiter are less specific. Moreover, only one randomized study seems to confirm a certain efficacy, although without no long-term data. Further long-term levothyroxine suppression treatment in elderly patients is associated with adverse effects on bones and on the cardiovascular system. In addition, radioiodine therapy may be ineffective in large non-hyperfunctioning nodules [2,3].

Numerous case report and prospective randomized controlled trials with different treatment algorithms have confirmed the clinical effectiveness and safety of thermal ablation therapies, in particular laser therapy (LT) and radio frequency thyroid ablation (RTA) for the management of benign thyroid lesions. In particular, LA investigated primarily that the treatment of solid nodules is successful in reducing the volume of treated thyroid nodules by 40% to 80%. In patients followed for more than 5 years, LA results in a satisfactorily mid to long-term clinical response in the majority of cases [4-6]. RTA, introduced in 2006, has been reported to be a safe, effective treatment for benign thyroid nodules [7]. In this short review, we aim to describe the advantage of using RTA for the treatment of thyroid nodules.

## Technique

At the beginning, thyroid nodules should be confirmed as benign on at least two separate ultrasound (US)-guided

fine needle aspirations and/or core needle biopsies. We do not advise the treatment of follicular neoplasm (classified as Ty3 according to the British and Italian reporting system for thyroid cytopathology that corresponds to Bethesda Categories III and IV nodules) since there is a high risk of malignancy. Caution should be taken in performing RTA on benign nodules with ultrasound characteristics of malignancy. RTA offers the opportunity of using cooled needles of different thicknesses and lengths. In particular, the most common electrodes used in Italy are 14 gauge, 10cm long, with 4 to 9 hooks, expandable to 3.5-4.0cm, and a 17 gauge electrode, 15cm long, with a 1cm active point. The latest version is a thinner 18 gauge electrode with various sized active points, ranging from 0.5 to 1.5cm. Regarding the hook-umbrella technique where hooked needles are fixed inside the thyroid nodule, both the 17 and 18 gauge needles are used with the "moving shot" technique, described by Beak [8]. The thyroid nodule is generally subdivided in many small units and the therapist performs thermal ablation of each unit by moving the radiofrequency electrode. It is initially positioned in the deepest part of the nodule and subsequently shifted laterally and across the isthmus. The treatment usually starts with 30W and, as soon as a hyperechogenic area appears (i.e., proving necrosis), the needle is removed to ablate the next area. If the hyperechogenic area does not appear after 5 to 10 seconds of treatment, the power is increased by 10W until a maximum of 100-110W is reached. The treatment is considered completed when all the subunits of the nodule have been treated and show the classic post-ablation hyperechogenic tissue.

## Discussion

US-guided minimally invasive procedures represent an alternative to surgery for the treatment of thyroid nodules, which grow and become symptomatic due to compressive symptoms.

RTA has been used since 2006 to treat compressive thyroid nodules, mostly in Korea and in Italy [7,9-11]. We are currently leading multiple studies aiming to demonstrate clear efficacy of RTA on volume reduction of thyroid nodules. A significant

reduction of thyroid nodule volume has been described by several studies-from 50 to 80% from baseline volume, depending on the study [11-13].

**Table 1:**Thyroid nodule volume (mL) in radiofrequency ablation group.

	Baseline	6 Months	12 Months
Whole group (n = 48)			
TN vol.	23.5 ± 18.6	8.5 ± 9.0***	7.6 ± 8.7***
TN vol. variation (%) from baseline		-66.8 ± 13.6	-71.1 ± 14.3
TN vol. variation (%) from 6 months			-13.7 ± 17.1
Small (n = 12)			
TN vol.	7.4 ± 2.6	2.0 ± 1.1***	1.6 ± 0.9*
TN vol. variation (%) from baseline		-73.5 ± 10.8	-78.7 ± 1
TN vol. variation (%) from 6 months			-18.7 ± 18.8
Medium (n = 24)			
TN vol.	18.3 ± 4.2	6.2 ± 2.6***	5.6 ± 2.7***
TN vol. variation (%) from baseline		-65.8 ± 13.7	-69.0 ± 14.4
TN vol. variation (%) from 6 months			-10.8 ± 13.4
Large (n = 12)			
TN vol.	49.8 ± 18.4	19.7 ± 11.6***	17.5 ± 12.3*
TN vol. variation (%) from baseline		-62.0 ± 14.3 -	-67.7 ± 15.9
TN vol. variation (%) from 6 months			-14.7 ± 21.80
Differences are considered between baseline and 6 months and between 6 and 12 months.			
* p ≤ 0.05; *** p ≤ 0.001.			

Our recent data regarding the efficacy of RTA at six months and at one year on thyroid nodules demonstrated that a single RTA treatment is effective in reducing benign, non-functional thyroid nodule volume, especially those small and medium sized [14,15] (Table 1). According to our research, RTA is effective in reducing the thyroid nodule volume, but, as the best reduction rate was seen in small thyroid nodules, such efficacy may be size-dependent. Therefore, more treatment is expected to treat larger nodules. Furthermore, several studies showed that larger nodules are often subjected to more treatments [10,16]. This may occur because a part of them showed a trend of recurrence. In very large thyroid nodules, RTA efficacy could be even less as the treatment is not uniformly distributed to the entire lesion [9,17]. At the moment, we do not have a common consensus on the definition of a small, medium or large nodule. Yet, we believe nodules with volume ≤ 10ml should be considered small, whilst those bigger than 30ml should be considered large. Most clinical studies on RTA have been performed on benign thyroid cold nodules. We have less data about RTA efficacy on hot thyroid

nodules. Recently, a multicentre study validated the efficacy of RTA in the latter, but it was necessary more than one single treatment in every nodule treated [17]. We believe radioiodine therapy remains the gold standard for the treatment of these nodules, RTA is effective only in the treatment of small-medium hot nodules. Moreover, when performed in experienced centres, RTA is a rapid, inexpensive, and safe method for inducing a clinically significant nodule volume reduction.

### Conclusion

RTA represents a valid approach in patients with nodular goiter who are not eligible or failed conventional treatments, or have refused to be cured. RTA can be considered a safe and effective therapeutic option in combination with laser ablation. In our opinion, RTA is most suitable for small and medium thyroid nodules; we need more data (particularly large and prospective studies) to evaluate the effectiveness of this procedure for the treatment of larger thyroid nodules.

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