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ORIGINAL ARTICLE

The effect of robot-assisted transaxillary thyroidectomy (RATT) on body image is better than the conventional approach with cervicotomy: a preliminary report

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Abstract

Background Cosmetic satisfaction is not only based on the patient's perception of the scar itself but is also related to body image self-evaluation. Cosmetic superiority of Robot-assisted transaxillary thyroidectomy (RATT) over conventional thyroidectomy (CT) has not yet been clearly demonstrated. Aim of our study was to compare body image in patients undergoing CT versus RATT.

Methods The study included 160 (80 CT and 80 RATT) patients undergoing thyroidectomy between August 2014 and March 2018 at the Endocrine Surgery Department. The inclusion criteria were age 18 to < 60 years, female sex, thyroid volume < 30 mL, and nodule diameter < 5 cm. Scar length, operative time, and complications were analyzed. The body image questionnaire (BIQ) was used 3 months postoperatively. The Student *t* test was used for statistical analysis.

Results Age was lower in RATT group (38.2 vs 41.4 years) ($P < 0.0001$). The nodule diameter was larger in RATT group (27.1 vs 23.1 mm) ($P = 0.028$). Operative time was longer in RATT group (93.7 vs 47.6 min) ($P < 0.0001$). The scar was longer in RATT group (59.9 vs 37.7 mm) ($P < 0.0001$). The groups had similar complication rates. BIQ showed that RATT patients answered more favorably to question 2, "Do you feel the operation has damaged your body?" ($P = 0.042$) and to question 3, "Do you feel less attractive as a result of your treatment?" ($P = 0.024$). Also self-global satisfaction was better in RATT group ($P = 0.019$).

Conclusions In our experience, RATT has a significantly better impact on body image than the conventional approach.

Introduction

The gold standard approach in thyroid surgery is the conventional cervical approach, but many other techniques have been developed in recent years. We introduced the minimally invasive video-assisted thyroidectomy [1], and more than 20 different successful thyroidectomy surgical techniques have been described [2–11]. In the era of minimal access thyroid surgery, these techniques can be broadly classified into three types: (1) non-endoscopic mini-incision thyroid surgery, (2) partly endoscopic surgery, and (3) purely endoscopic surgery [12]. RATT belongs to the third type, which provides

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patients with thyroid surgery free of a neck scar since the access is remote.

Robot-assisted thyroid surgery was used for the first time in Korea in 2007, and since then, has spread worldwide. Robot-assisted thyroidectomy was found to yield a better patient outcome, including an increased cosmetic satisfaction. Aesthetic results from the operation are increasingly important to young women, who currently represent a major proportion of the patients affected by thyroid diseases. Aesthetic results can be addressed as "body image," defined as person's perception of, satisfaction with, and attitudes toward his or her body in general and to particular areas of the body. The aim of our study was to compare body image in women who underwent open conventional thyroidectomy (CT) versus robot-assisted transaxillary thyroidectomy (RATT) [13, 14].

Materials and methods

This prospective study was conducted of 160 women who underwent total thyroidectomy at the University Hospital of Pisa Endocrine Surgery Department between August 2014 and March 2018. The inclusion criteria were age 18 to < 60 years, female sex, preoperative ultrasound-estimated thyroid volume < 30 mL, dominant nodule diameter < 5 cm, and first-time bilateral total thyroidectomy. Exclusion criteria were an invasion of any or all of the trachea, larynx, esophagus, or recurrent laryngeal nerve, suspicious lateral neck nodes at the preoperative ultrasound imaging, hyperthyroidism, or previous neck irradiations or neck surgery.

CT or RATT were proposed to all patients fulfilling the inclusion criteria and consecutively selected until a sample of 80 women per group was reached. This resulted in a robust statistical number of patients (80 CT and 80 RATT) to be enrolled in the study.

All of the patients voluntarily agreed to participate in our study and provided written informed consent. The University Hospital of Pisa Institutional Review Board approved the study protocol.

All patients completed the study and were evaluated with the body image questionnaire (BIQ) 3 months postoperatively. We also collected data for operative time, transient hypocalcemia, recurrent laryngeal nerve injury (evaluated with a direct laryngoscopy 48 h postoperatively in case of clinical evidence of dysphonia), final histology, and neck scar length.

Operative method

CT was performed with the patient placed supine with the neck extended. A 4- to 5-cm cervical Kocher incision was made, and subplatysmal flap dissection was performed. The midline between the strap muscles was divided, and the thyroid gland was exposed. The thyroid gland dissection proceeded from the superior pole to the inferior pole. The inferior thyroid vessels were ligated individually, close to the thyroid gland, to preserve the parathyroid glands. The entire cervical course of the ipsilateral laryngeal nerve was traced and preserved. The same maneuvers were used to dissect the contralateral thyroid gland.

RATT was performed as previously described [15]. The patient was placed supine with the neck slightly extended. The arm on the side of the access was extended cephalad and flexed at the elbow, and the wrist was positioned over the forehead in the modified Ikeda arm position. An incision was made along the posterior border of the pectoralis major muscle, well disguised in the axilla. The working space was created by elevating a subcutaneous flap above the pectoralis major muscle all the way to the neck. A special retractor was introduced to maintain the working space throughout the entire procedure.

Three arms of the da Vinci robot (intuitive surgical) were introduced, and the fourth arm remained folded. A three-dimensional endoscope, a harmonic scalpel, and a Maryland dissector were placed in the middle, upper corner, and lower corner of the incision, respectively. After this preparatory step, the procedure was performed from the console, with a bedside assistant providing counter traction or suction as required. The thyroid lobe was resected and delivered in an endoscopic specimen retrieval bag to protect against potential seeding along the surgical tract.

The contralateral lobe was resected from the same access. The trachea was pushed medially and inferiorly by the assistant's suction device, and the pedicle was made first. The lobe was completely freed from the contralateral muscles, and the middle vein was cut. The lobe was grasped by the Maryland dissector, lifted, and medialized to expose the thyrotracheal groove. The nerve and parathyroids were identified and preserved. The lobe was resected. After a final hemostasis check, a drain was left in the thyroid bed, and the wound was closed with subcutaneous stitches and intradermal suture [3, 16–28].

Postoperative assessment

The BIQ (Table 1) is a brief and validated psychometric measure of subjective body image for use in surgically treated breast cancer patients and surgically treated patients with Crohn disease [13, 14]. The 9-item scale is composed of three sections:

First section: Self-global satisfaction, questions (Q) Q1 to Q4: each item is rated on a 4-point scale ranging from 1 (not at all) to 4 (very much).

Table 1 Body image questionnaire: sections and questions

Section	Questions	Answers
First section: self global satisfaction	1. Are you less satisfied with your body since the operation? 2. Do you feel the operation has damaged your body? 3. Do you feel less attractive as a result of your treatment? 4. Do you feel less feminine as a result of your treatment?	No, not at all = 1; A little bit = 2; Pretty much = 3; Yes = 4
Second section: scar appearence	5. On a scale from 1 to 7, how satisfied are you with your incisional scar? 6. On a scale from 1 to 7, how would you describe your scar? 7. Could you score your own incisional scar on a scale from 1 to 10?	1 = totally unsatisfied; 7/10 = extremely satisfied
Third section: self-confidence	8. How confident were you before your operation? 9. How confident are you after your operation?	1 = not at all; 10 = extremely confident

Second section: Scar appearance, Q5, Q6, and Q7: each item for Q5 and Q6 is rated on a 7-point scale ranging from 1 (not at all) to 7 (very much); Q7 is rated on a 10-point scale ranging from 1 (not at all) to 10 (very much).
Third section: Self-confidence, Q8 and Q9: each item is rated on a 10-point scale ranging from 1 (not at all) to 10 (very much).

The final score is the sum of all 9 items, with a higher score indicating a better body image and a better cosmetic outcome.

Statistical analysis

The clinical and pathologic characteristics of the patients in the two operative techniques were compared. Continuous quantitative data are expressed as mean values ± standard deviations, and categorical quantitative data are expressed as frequencies and percentages. The Kolmogorov–Smirnov test was initially performed to check the normality of data distribution to assess whether to use parametric tests. Successively, the Hartley test was performed, and heteroscedasticity of the distribution was assured. The Mann–Whitney test and the *t* test were performed for the continuous variables, and the χ^2 test with Yates correction was used for categorical variables. Data were entered into an Excel database (Microsoft) and were subsequently imported into R 2.12.1 software (The R Foundation for Statistical Computing) for statistical analysis. Values of $P < 0.05$ were considered statistically significant.

Results

The 160 patients undergoing total thyroidectomy were divided into two groups: 80 patients underwent CT and 80 patients underwent RATT. The clinical characteristics were compared between the two groups.

The preoperative diagnosis in the RATT group was multinodular goiter in 25 patients, single microfollicular nodule in 45, and a suspicious or certain well-differentiated thyroid cancer in 10. The CT group included 9 patients with multinodular goiter, 41 with single microfollicular nodules, and 30 with suspicious or certain well-differentiated thyroid cancer. At the final histology, all cases of suspicious or certain well-differentiated thyroid cancer, assessed by preoperative fine-needle aspiration biopsy sample, were confirmed in both groups. Incidental thyroid carcinoma with papillary histology was found in 2 patients in the RATT group and in 1 patient in the CT group. In the RATT group, 10 of the microfollicular thyroid nodules were determined to be papillary thyroid carcinoma, 6 were papillary thyroid microcarcinomas, and 2 were follicular thyroid carcinoma. In the CT group, 26 of 41 cases of single microfollicular nodule were determined to be papillary carcinoma, 1 was a follicular thyroid carcinoma, and 6 were papillary microcarcinomas (Table 2).

The RATT group (38.2 2 ± 9.85 years) was significantly younger than the CT group (41.4 ± 12.5 years) ($P < 0.0001$), and nodule diameter was significantly larger (27.17 ± 18.18 mm) than in the CT group (23.15 ± 13.29 mm) ($P = 0.028$). Operative time was significantly longer in the RATT group (93.77 ± 31.70 min) vs the CT group (47.65 ± 12.7 min) ($P < 0.0001$). The scar length was significantly longer in the RATT group (59.97 ± 6.56 mm) than in the CT group (37.73 ± 3.69 mm) ($P < 0.0001$; Table 3).

Our analysis of the BIQ results showed the overall BIQ score was similar in both groups. We then analyzed every question individually and found significant differences between the two groups for two of the questionnaire items: RATT group patients answered significantly more favorably than the CT group to Q2 "Do you feel the operation has damaged your body?" ($P = 0.042$) and to Q3: "Do you feel less attractive as a result of your treatment?" ($P = 0.024$). We also analyzed the three questionnaire sections separately and found that even when the scar appearance (second section)

Table 2 Preoperative cytologically assessed diagnosis and postoperative histologically assessed diagnosis

Variable	RATT group ($n=80$) No. (%)	CT group ($n=80$) No. (%)
Preoperative diagnosis		
Multinodular goiter	25 (31.25)	9 (11.25)
Single microfollicular nodule	45 (56.25)	41 (51.25)
Suspicious or certain well-differentiated thyroid cancer	10 (12.5)	30 (37.5)
Final histology		
Multinodular goiter	51 (63.75)	16 (20.00)
Papillary thyroid carcinoma	21 (26.25)	57 (71.25)
Papillary thyroid microcarcinoma	6 (7.50)	6 (7.50)
Follicular thyroid cancer	2 (2.50)	1 (1.25)

RATT robot-assisted transaxillary total thyroidectomy, *CT* open conventional thyroidectomy

Table 3 Results comparing clinical characteristics in the two groups

	RATT group Mean ± SD	CT group Mean ± SD	*P* value
Age (years)	38.22 ± 9.85	41.4 ± 12.5	< 0.0001
Nodule diameter (mm)	27.17 ± 18.18	23.15 ± 13.29	0.028
Operative time (min)	93.77 ± 31.7	47.65 ± 12.7	< 0.0001
Scar length (mm)	59.97 ± 6.56	37.73 ± 3.69	< 0.0001

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and the self-confidence (third section) scores were similar in both groups, the self-global satisfaction (first section) was significantly better in the RATT group ($P=0.019$) (Tables 4, 5).

Postoperative complications early after the operation did not differ significantly between the two groups. A hematoma developed in 1 patient in the RATT group that was confined to the thoracic region and was not located in the thyroid space. For this reason, it did not cause compression on the airways and being of a modest size, it was treated conservatively by observation and medical care. Transient

Table 4 Body image questionnaire single questions results

Question	RATT group Mean ± SD	CT group Mean ± SD	*P*
1. Are you less satisfied with your body since the operation?	1.6 ± 1.062	1.775 ± 1.078	0.159
2. Do you feel the operation has damaged your body?	1.225 ± 0.550	1.425 ± 0.742	0.042
3. Do you feel less attractive as a result of your treatment?	1.075 ± 0.382	1.175 ± 0.414	0.024
4. Do you feel less feminine as a result of your treatment?	1.075 ± 0.382	1.1125 ± 0.355	0.240
5. On a scale from 1 to 7, how satisfied are you with your incisional scar?	5.725 ± 1.622	5.65 ± 1.623	0.689
6. On a scale from 1 to 7, how would you describe your scar?	5.8875 ± 1.414	5.725 ± 1.449	0.444
7. Could you score your own incisional scar on a scale from 1 to 10?	7.85 ± 2.485	7.675 ± 2.243	0.334
8. How confident were you before your operation?	7.7625 ± 2.44	7.3375 ± 2.412	0.150
9. How confident are you after your operation?	8.4 ± 2.072	8.38 ± 1.817	0.663

RATT robot-assisted transaxillary total thyroidectomy, *CT* open conventional thyroidectomy

Table 5 Body Image Questionnaire total score and scores on the three sections

Body image questionnaire	RATT group Mean ± SD	CT group Mean ± SD	*P*
Total score	40.6125 ± 6.45	40.25 ± 6.22	0.641
First section: self-global satisfaction (Q 1–4)	4.9875 ± 1.77	5.475 ± 1.73	0.019
Second section: scar appearance (Q 5–7)	19.4625 ± 5.29	19.05 ± 5.11	0.400
BIQ third section: self-confidence (Q 8–9)	16.165 ± 3.24	15.725 ± 3.44	0.446

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recurrent laryngeal nerve injury occurred in 1 patient in both groups, which was assessed 48 h postoperatively by direct laryngoscopy, and resolved within 1 month. We observed only 2 patients with transient hypocalcemia, and both were in the CT group. (Table 6).

At follow-up, the 29 patients in the RATT group with final histology positive for carcinoma and who had undergone total thyroidectomy were free from disease (structural and biochemical). Their serum thyroglobulin concentration value was 1.1 ± 1.7 ng/mL before radioiodine ablation. In patients undergoing radioiodine ablation according to final histology, the radioiodine dose used for ablation was 47.2 ± 34.8 mCi.

Discussion

Thyroid diseases, whether benign or malignant, are more likely to affect young women. The anterior neck is frequently visible during social activities, and neck scars can be very distressing for the patient. For this reason, thyroid surgeons have been developing new techniques to obtain the same surgical completeness and the same safety as the open procedure but with a better cosmetic outcome [29–31].

RATT was developed in 2007 by Prof. W.Y. Chung, in South Korea, to avoid the neck scar, especially in women. Because of cultural factors, a neck scar has a negative social connotation for Asian women and is very concerning [9]. RATT is now a well-known surgical technique, performed worldwide, and has been proven to have the same safety level and the same oncologic radicality as the conventional open procedure [29, 32].

Our series confirmed the safety of RATT with a very low rate of complications. We observed 1 subcutaneous hematoma limited to the subcutaneous thoracic area as a result of postoperative bleeding. Postoperative ultrasound imaging confirmed there was no hematoma in the thyroid bed level and, therefore, no compression of the airways. This allowed us to treat this complication conservatively, and the hematoma completely resolved in 10 days.

We did not observe transient hypoparathyroidism among patients undergoing total thyroidectomy by RATT. After performing a considerable number of cases, we were able to perform total thyroidectomy in our series without macroscopic remnant on both sides. Therefore, preservation of the parathyroid glands might be due to fine dissection and better visualization with the magnified three-dimensional vision provided by the robot.

Table 6 Postoperative complications

	RATT group ($n=80$)	CT group ($n=80$)	*P* value
Transient hypocalcemia	0	2	0.496
Transient recurrent laryngeal nerve injury	1	1	1
Postoperative hematoma	1	80	1

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The cosmetic aim was the primum movens of RATT being developed, but only a few studies have used a validated and standardized questionnaire to assess patient cosmetic satisfaction with the technique. In fact, choosing the correct test or questionnaire to measure cosmetic satisfaction is not easy. When only the cosmetic satisfaction for the scar itself is considered, then results between RATT and CT are similar. Some authors who used the modified Vancouver Scar Scale (VSS) reported an advantage until 9 postoperative months in favor of CT [33], whereas using a visual analog scale, other authors reported a long-lasting advantage for RATT beginning 3 months postoperatively for 4 years of follow-up [17].

In another study, we used the Professional Styles and Attitudes Questionnaire to compare RATT with techniques other than CT. We found that our patients preferred to have a minimally invasive video-assisted thyroidectomy scar (1.5–2.5 cm cervical incision) rather than a RATT scar [31].

Other authors compared cosmetic satisfaction in patients affected by well-differentiated thyroid cancer operated on with RATT vs CT using only a system of 5 levels of cosmetic satisfaction, 3 months postoperatively, which resulted in an advantage for RATT [33].

The only other study, by Lee et al., was conducted using the global BIS questionnaire. They compared two groups of patients operated on for papillary thyroid cancer, both with VSS and BIS, and their results clearly showed that BIS item scores were superior over the CT group even if the VSS scores were considered better in the CT group in the early postoperative period [32].

Arora et al. extended the importance of body image to quality of life, because the quality of life has been proven to be better in patients operated on by RATT than by CT [17].

Because of the subjective perception of one's body, built by self-observation and the reactions of other people, the patient may be bothered by a poor body image. We used the BIQ for our study because it seemed to us the most reliable for evaluating body image after surgery for malignant or benign diseases. BIQ is a validated questionnaire that was first used for the assessment of body image in breast cancer patients who had undergone surgery and, in a second study, for patients operated on for Crohn disease. It is a brief psychometric evaluation that covers self-consciousness about appearance, scar evaluation, and self-confidence [13, 14].

We found when we considered the scar appearance (second section of the BIQ), RATT seemed not to have any advantages over CT, but when we looked at the first section of the BIQ, the

self-global satisfaction score was significantly better in patients who underwent RATT. The third part of BIQ, addressing self-confidence, did not show any difference between RATT and CT and neither did the total BIQ score.

A major limitation of this study is that we included patients with benign and malignant diseases, and this could have led us to underestimate the psychologic importance of being a cancer patient, which can per se reduce self-esteem. Another limitation is the small number of patients treated. Even though this is one of the largest studies for cosmetic results in RATT vs CT, the small number does not allow for definitive conclusions.

Furthermore, we are aware that a possible bias may be represented by leaving the choice of the surgical procedure to the patients. This excluded the possibility of performing a randomized study and also explains why the mean age of RATT group was significantly younger than the CT group.

We noticed that the total BIQ score was not significantly different between the two groups, probably because of the limited number of patients. The statistical analyses showed a significant difference in the first section of the BIQ, leading us to think that if a large cohort were involved, the BIQ total score could also become significantly different in favor of RATT.

Conclusions

Our experience shows RATT has a significantly better effect on body image than the conventional approach. Even though the BIQ total score did not differ between RATT and CT in this study, we believe that with a large number of patients, RATT would show a significant advantage over CT. Selection bias and the lack of randomization were major confounders in this study. Further studies supported by larger numbers are needed to confirm these preliminary results.

Compliance with ethical standards

Conflict of interest The authors declare they have no conflict of interest.

Research involving human participants and/or animals This article involves human participants. All patients were asked to participate in the study. The adherence to the study was completely voluntary.

Informed consent All patients were asked to sign an informed consent before adhering to the study.

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