

# Comparison of effects of energy based devices on quality of life after sutureless thyroidectomy

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## Abstract

**Objective:** In current literature, no studies evaluated effect of energy-based vessel-sealing-devices on quality of life after sutureless total thyroidectomies. This study aimed to identify any potential differences between two energy-based vessel-sealing-devices (Harmonic Focus, Ligasure LF1212) in patients with benign thyroid disorders who underwent sutureless total thyroidectomy.

**Materials and methods:** Differences in quality of life of patients were evaluated using data obtained by Thy-PRO-39-Tr questionnaire prior to and four-week after surgery. Total and domain-based alterations in quality of life were compared between groups according to energy-based vessel-sealing-devices type (Group L, Group H). Additionally, data including demographics, height, weight, body mass index, neck circumference, sternomental distance were collected.

**Results:** Of 1032 patients, 200 were eligible for study, at the end 193 were analysed. There were no differences between groups in terms of age, sex, body mass index, tobacco use. Analysis did not reveal any differences in overall quality of life between groups ( $P = .42$ ). However, in “eye symptoms” ( $P < .001$ ) and “cognitive functions” ( $P = .002$ ) domains, Harmonic provided statistically improved quality of life. Effect on cognitive function was greater in patients of advanced age.

**Conclusions:** Especially in elderly patients with worsening eye conditions and cognitive functions, use of Harmonic may enhance patients’ outcome by increasing quality of life in addition to optimizing surgical outcome when compared to Ligasure.

**Abbreviations:** BTM = benign thyroid disorders, EBVSD = energy-based vessel sealing devices, ICS = Information Collection System, NC = neck circumference, QoL = quality of life, SMD = sternomental distance, STT = sutureless total thyroidectomy, ThyPRO = thyroid-related patient-reported outcome.

**Keywords:** medical device, quality of life, surgery, surveys and questionnaires, thyroid diseases

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The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Istanbul University, Cerrahpasa Medical Faculty, Clinical Researches Ethical Committee approved this study with number of 83045809/604.01/02. Informed consent was received from involved patients.

The authors have no conflicts of interest to disclose.

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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## 1. Introduction

Thyroidectomy is one of the most common surgeries in the world. With developing technology, especially energy-based vessel sealing devices (EBVSD) such as Ligasure (Medtronic, Minneapolis, MN) and Harmonic (Ethicon Endo Surgery, Albuquerque, NM), duration of a thyroidectomy has shortened and reliability of EBVSDs has been established.<sup>[1,2]</sup>

Quality of life (QoL) has been defined as a person’s overall happiness and satisfaction from life in early 1900s; however, QoL is more than just that.<sup>[3]</sup> The World Health Organization (WHO) defines QoL as an “individual’s perception of own position in life in context of culture and value systems in which he/she lives and in relation to their goals, expectations, standards, and concerns.”<sup>[4]</sup> Given the multidimensional nature of QoL, its quantification requires assessing several domains, though which domain is the most important remains unknown.<sup>[5]</sup> According to the WHO, main domains are physical, emotional, social, economic, and level of independence.<sup>[4]</sup>

Health-related QoL can be used to obtain information on reliability and efficacy of medical devices in clinical trials. Scales used to evaluate health-related quality of life are classified as generic or disease specific. Generic scales evaluate different QoL domains and can be applied to patients with different diseases and healthy individuals.<sup>[6]</sup> However, generic scales are insufficient to evaluate applied treatment according to disease-specific parameters.<sup>[6]</sup>

Of many disease-specific scales available to assess benign thyroid disorders (BTM), we chose thyroid-related patient-

reported outcome (ThyPRO-39) (©Torquil Watt, Copenhagen University Hospital, Rigshospitalet, Denmark) because it is the most contemporary.<sup>[7]</sup> ThyPRO-39 is a validated, shortened version of ThyPRO questionnaire designed for use in clinical settings.<sup>[7]</sup> Domains covered by ThyPRO-39 include goitre symptoms, hyperthyroidism symptoms, hypothyroidism symptoms, eye symptoms, tiredness, cognitive functions, anxiety, depression, emotional susceptibility, impaired social life, impaired daily life, appearance, and general QoL.

In a condition for which different devices with similar benefits and drawbacks can be used for same procedure, effect on QoL can affect surgeons' and administrators' decision of which device to use and buy, respectively, with patients' well-being as their highest priority. This study investigated difference in terms of QoL between Ligasure LF1212 and Harmonic Focus used during sutureless total thyroidectomy (STT) for BTD.<sup>[8]</sup>

## 2. Material and methods

### 2.1. Patient selection

This study included patients over 18-year-old who underwent STT with EBVSDs for BTD in Istanbul University, Cerrahpasa Medical Faculty, Department of General Surgery, division of Endocrine Surgery.

Vocal cords of patients were examined preoperatively and postoperatively. If any dysfunction was detected pre/postoperatively, the patient was excluded from study. Preoperative free T<sub>3</sub>, free T<sub>4</sub>, and thyroid-stimulating hormone were measured and patients who exceed the normal limits of the laboratory were excluded. Preoperative and immediately postoperative PTH were measured and patients who fell outside of the laboratory's normal range were excluded. Additional exclusion criteria were any malignancy or parathyroid gland (incidentally resected) in pathology report, co-existing parathyroid, psychiatric, or systemic diseases, and current pregnancy.

During discharge, patients received a three-week prescription for 50 mcg levothyroxine QD in morning after fasting in addition to combined effervescent tablet of 1000mg calcium and 880 IU Vitamin D<sub>3</sub> QD for three-week and sustained release tablet form of 75mg diclofenac BID for one week.

### 2.2. Ethical considerations

Istanbul University, Cerrahpasa Medical Faculty, Clinical Researches Ethical Committee approved this study with number of 83045809/604.01/02. Informed consent was received from involved patients.

### 2.3. Survey translation

ThyPRO-39 has only English and Danish versions in literature. ThyPRO-39 was translated into Turkish according to the guidelines provided by the WHO.<sup>[9]</sup> The translated survey was pilot tested with 10 patients, rephrased based on their feedback, and re-tested until all questions were clear. The finalized version was named ThyPRO-39-Tr.

### 2.4. Double-blind data entry

The preoperative and postoperative QoLs of patients who met inclusion criteria for study were assessed using ThyPRO-39-Tr. In addition to ThyPRO-39-Tr, data on age, height, weight, sex,

sternomental distance (SMD), neck circumference, and smoking status were collected. Demographic information and answers to each survey item were recorded on-line into an information collection system (ICS) designed specifically for this study. To obtain an objective, blind analysis, one of the two independent and unfamiliar system users recorded demographic information and EBVSD used, while the other system user (blind to EBVSD used) recorded responses to the survey items into the ICS. After data entry, patients were anonymized and used EBVSD were encoded. None of the patients were aware of used EBVSD, operative nurses were unaware of study, and surgeons did not know if the patient was included in study or not. All surgeons used the same technique, were similarly familiar with each device, and did not prefer one to the other. The EBVSD used was randomly chosen by surgeon in operating room by picking a label from bag. Patients were grouped according to EBVSD used (Group L: Ligasure and Group H: Harmonic) and comparisons were performed between two groups.

Preoperative QoLs of patients were obtained via a printed survey form in the day before or the day of the surgery. The postoperative QoLs were recorded from those who were admitted to hospital for re-assessment (fourth week) using a printed survey form and from who were not, the information was obtained by phone.

In studies investigating effect of the event on QoL, like this study, evaluating pre and postoperative QoL differences provides more accurate comparisons.<sup>[10]</sup> While difference-score was used for each survey item, weighted scores were used for each domain to justify number of included items in each domain. Weighted scores for domains were calculated as sum of scores from each item in each domain divided by number of items in relevant domain.

Body mass index (BMI) was calculated according to formula of Keys et al.<sup>[11]</sup>

### 2.5. Statistical analyses

The study data were recorded into a Microsoft Access 2016 (Microsoft Corporation, Redmond, WA) database using the ICS. Statistical analyses of anonymized and encoded data were performed by an independent biostatistician with IBM SPSS Statistics for Windows, Version 20.0 (IBM Corp, Armonk, NY). A five-point Likert scale in which "0" reflected the best and "4" the worst situation was used for every survey item. Descriptive analyses, Student *t*-test, and Wilcoxon signed-rank test were utilized for assessment. A *P*-value < .05 was considered indicative of statistical significance.

This study can be found on ClinicalTrials.gov under number NCT02683551.

## 3. Results

Patient files, hospital information system records, operation notes, and pathology reports of 1032 patients who underwent STT during study period were examined. Of these patients, 44 received simultaneously parathyroidectomies, four laparoscopic cholecystectomy, one lateral internal sphincterotomy, 51 neck dissections, 95 (BTd:33) completion thyroidectomy. Of 1032 patients, 44 (BTd:14) had a co-existing systemic disease, 14 (BTd:4) vocal cord paralysis, eight (BTd:3) incidental parathyroidectomy, and one pregnancy. These patients were excluded from study. Of 1032 patients, 763 were diagnosed with thyroid malignancies, 10 were unreachable, and five chose not to participate in study (Table 1).

**Table 1**  
**Distribution of excluded patients.**

	Number of patients	Percentage
Total number of investigated patients	1032	100
Malignancy in final histopathology	763	73.9
Benign thyroid disorders in final pathology	269	26.1
Simultaneously performed neck dissection with final benign histopathology	33	3.2
Co-existing systemic disease with final benign histopathology	14	1.4
Unreachable prior to surgery with final benign histopathology	10	1
Rejected enrollment with final benign histopathology	5	0.5
Vocal fold palsy with final benign histopathology	4	0.4
Incidental parathyroidectomy with final benign histopathology	3	0.3

After statistical analyses, patients underwent to STT with Ligasure were designated as Group L (n=100) and those with Harmonic as Group H (n=100). Of these 200 patients, seven patients in Group L could not be reached and thus were dropped from study (Fig. 1).

Average age of patients (n=193) was  $48.8 \pm 12.5$  years old, height  $162 \pm 8$  cm, weight  $74 \pm 14$  kg, BMI  $28.1 \pm 5.4$  kg/m<sup>2</sup>, SMD  $16.7 \pm 6.6$  cm, and NC  $35.6 \pm 6.7$  cm. Among these values, the only difference was shorter SMD in Group L ( $P < .001$ ). Of the 193 patients, 155 (80.3%) were female and 58 (19.7%) were male, 118 (61.1%) were non-smokers and 75 (38.9%) were smokers; there were no differences in these aspects (Table 2).

In evaluation of preoperative QoL, there were no statistical differences between groups in all items except “impaired vision,” “itchy skin,” “slow or unclear thinking” (Table 3). In comparison of domains, there were no differences except “hypothyroidism symptoms,” “eye symptoms,” and “impaired daily life” (Table 4).

### 3.1. Group L

From analysing each item in ThyPRO-39-Tr, postoperative decreases in mean values for “fullness in neck,” “pressure in throat,” “difficulty swallowing,” “trembling hands,” “sweat a lot,” and “palpitation” showed a positive effect of treatment ( $P < .05$ ). In addition, mean values for “swollen hands or feet,” and “been tired,” statistically decreased after surgery ( $P < .05$ ). Additionally, “felt afraid or anxious, tense, uneasy, sad, unhappy,” “not self-confident,” “easily felt stressed,” “mood swings” also statistically decreased ( $P < .05$ ). Additionally, decreases were observed in “difficulty being together with other people,” “difficulty managing daily life,” and “not be able to participate in life around ( $P < .05$ ).” By contrast, mean values of “sensitive to light,” “feel energetic,” “difficulty remembering” increased statistically after surgery. There were no statistically different changes observed in other items (Table 3).

By analysing scores according to domain and combined, significant decreases were found in all domains except “cognitive functions,” “hypothyroidism symptoms,” “eye symptoms,” “tiredness,” “appearance,” and “general.” Contrary, score of cognitive functions domain showed statistical increase ( $P < .001$ ). In addition, combined overall score decreased, indicating an increase in QoL (Table 4).

### 3.2. Group H

From analysing each item in ThyPRO-39-Tr, postoperative statistically decreases in mean values for “fullness in neck,”

“pressure in throat,” “difficulty swallowing,” “trembling hands,” “sweat a lot,” and “palpitation” ( $P < .05$ ) indicates success of treatment, similar to Group L. In addition, mean values for “upset stomach,” “dryness in eyes,” “impaired vision,” “sensitive to light,” “swollen hands or feet,” and “been tired” also decreased statistically after surgery ( $P < .05$ ). Additionally, “slow or unclear thinking,” “difficulty concentrating,” “felt afraid or anxious, tense, uneasy, sad, unhappy” “self-confidence,” and “easily felt stressed” also decreased statistically ( $P < .05$ ). Statistical decreases in mean values for “being burden to other people,” “conflicts with other people,” “difficulty managing daily life,” “not be able to participate in life around,” “everything takes longer to do,” and “been bothered by other people looking at you” were also observed ( $P < .05$ ). In line with these, mean score for “felt energetic” increased statistically after surgery ( $P < .05$ ). There were no statistically significant differences observed in other items (Table 3).

By analysing scores according to domain and combined, significant decreases were found in all domains except “hypothyroidism symptoms,” “cognitive functions,” “tiredness,” “appearance,” and “general” ( $P < .05$ ). Additionally, overall combined score statistically decreased, indicating an increased QoL (Table 4).

Comparison of QoL between the groups L and H, postoperatively according to each item, revealed no significant differences in mean values except for “fullness in neck,” “upset stomach,” “itchy skin,” “difficulty remembering,” “slow or unclear thinking,” “difficulty concentrating,” and “feel as if everything takes longer to do” (Table 3). Whereas, in domain-based comparison, there were no significant differences in mean values except for “cognitive functions” and “impaired daily life” (Table 4).

In assessment of difference-score for each questions, decreases reported in Group H were much greater than Group L. Comparison of difference-scores in terms of individual items, showed statistical significance for “upset stomach ( $P = .016$ ),” “dryness in eyes ( $P = .021$ ),” “impaired vision ( $P < .001$ ),” “light sensitivity ( $P = .043$ ),” “slow or unclear thinking ( $P = .007$ ),” “difficulty concentrating ( $P = .003$ ),” “feel you were a burden to other people ( $P = .031$ ),” “self-confidence ( $P = .03$ ),” and “bothered by other people looking at you ( $P = .039$ )”; in terms of domain, for “eye symptoms ( $P < .001$ )” and “cognitive functions ( $P = .002$ )” (Tables 3 and 4). Thus, Harmonic confers greater enhancement of QoL after STT than Ligasure.

## 4. Discussion

Thyroid disease affects many aspects of individuals’ QoL. In literature, there are studies assessing QoL of patients with thyroid

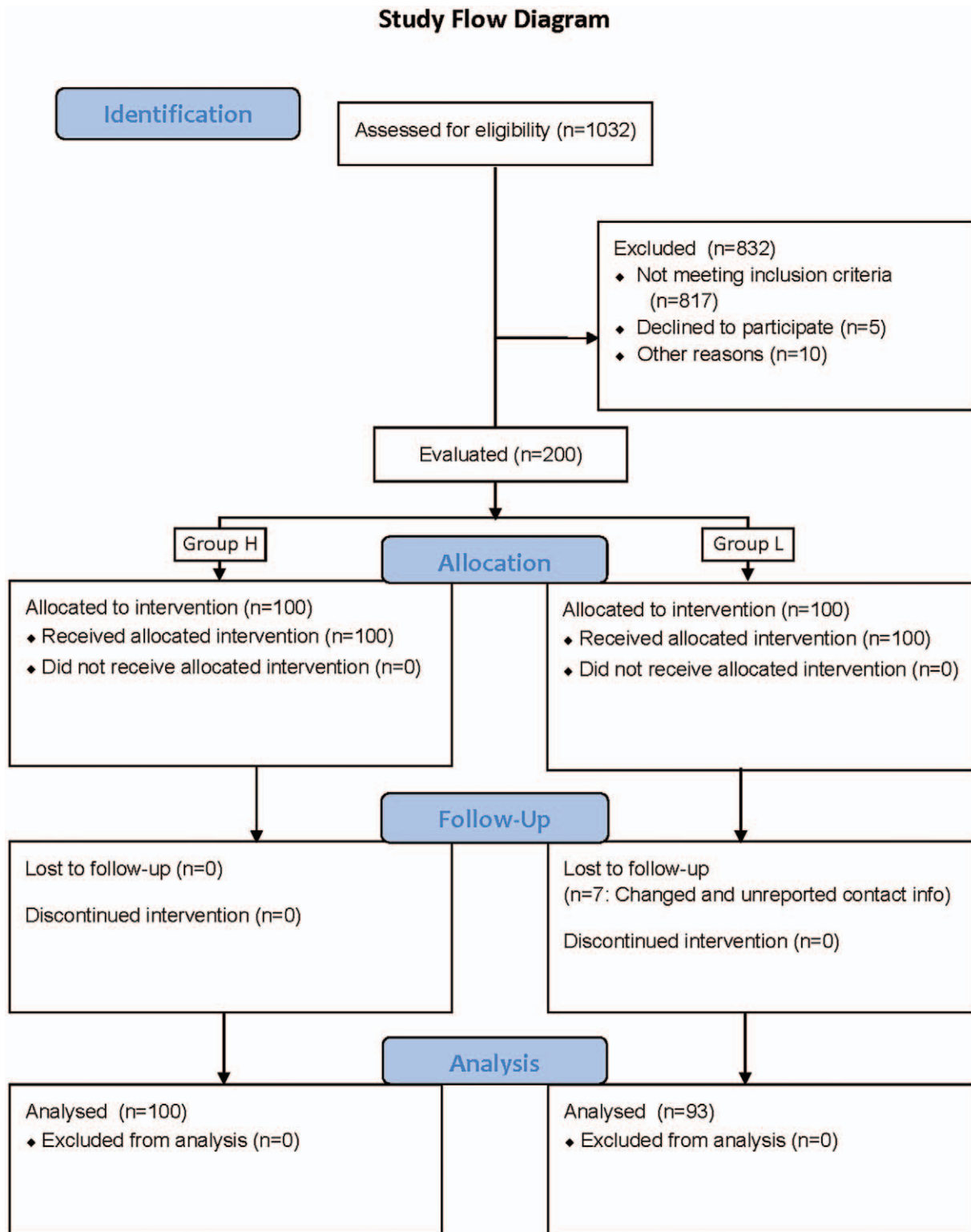


Figure 1. Study flow diagram.

disease according to hormone levels, nevertheless, studies on BTD are limited in number.<sup>[12–15]</sup> Additionally, no study examines effect of EBVSDs used in STT on QoL, thus, anticipation of results was not possible prior to conducting this study. However, generally, there will be no symptoms if

endocrine function of thyroid is preserved and thus it was assumed that there would not be much difference in QoL.

For all patients, the least affected items before surgery were “bothered by other people looking at you,” “your disease influenced which clothes you wear,” “not be able to participate in

**Table 2**  
Demographic information of groups.

	Group L	Group H	P value*
Age (yr) <sup>†</sup>	48.54±12.2	49.1±12.84	.865
Body mass index (kg/m <sup>2</sup> ) <sup>†</sup>	27.86±5.64	28.35±5.27	.531
Sternomental distance (cm) <sup>†</sup>	15.54±7.13	17.73±5.85	<.001
Neck circumference (cm) <sup>†</sup>	34.92±7.42	36.16±5.84	.49
Smokers <sup>‡</sup>	35 (37.6%)	40 (40%)	.769
Non-smokers <sup>‡</sup>	58 (62.4%)	60 (60%)	
Male <sup>‡</sup>	21 (22.6%)	17 (17%)	.368
Female <sup>‡</sup>	72 (77.4%)	83 (83%)	
<b>Diagnosis<sup>‡</sup></b>			<i>Can not be calculated due to insufficient distribution of diagnosis to the groups.</i>
Graves' Disease	2 (2.2%)	6 (6%)	
De Quervain's Thyroiditis	1 (1.1%)	0 (0%)	
Hashimoto's Thyroiditis	7 (7.5%)	0 (0%)	
Hürthle Cell Adenoma	10 (10.8%)	0 (0%)	
Multi Nodular Goiter (MNG)	70 (75.3%)	88 (88%)	
Solitary Nodule	0 (0%)	2 (2%)	
Toxic MNG	0 (0%)	4 (4%)	
Toxic Solitary Nodule	3 (3.2%)	0 (0%)	

\* P-value <.05 is accepted as statistically significant.

<sup>†</sup> Values given as average± standard deviation.

<sup>‡</sup> Values given as number of patients (percentage).

life around you,” “difficulty managing your daily life,” and “feel you were a burden to other people” in ascending order. This list was similar between groups yet, “have difficulty being together with other people” took place of “feel you were a burden to other people” were listed in different orders in two groups.

In analyses of domains according to pre-operative scores weighted to questions, the least affected three domains were “appearance,” “impaired daily life,” and “impaired social life” in all patients and each group with different orders. The most affected three domains were “tiredness,” “emotional susceptibility,” and “anxiety” in all patients and Group L with different orders, however, “anxiety” was replaced by “depression” in Group H.

The least affected five items after surgery were “fullness in neck,” “pressure in throat,” “discomfort swallowing,” “trembling hands,” and “sweat a lot” for all patients and Group L, however, “palpitation” and “sensitive to cold” took place of “trembling hands” and “sweat a lot” in Group H. In analyses of domains by question from postoperative period, the least affected three domains were “goitre symptoms,” “hyperthyroidism symptoms,” and “hypothyroidism symptoms” in all patients and in Group H “goitre symptoms” was replaced by “anxiety” in Group L.

The most affected five items after surgery were “difficulty remembering,” “been tired,” “felt in control of your life,” “felt energetic,” and “difficulty getting motivated to do anything at all” for all patients and each group in an unordered fashion. In analyses of domains by question weighing for the postoperative period, the most affected three were “eye symptoms,” “tiredness,” and “cognitive functions” in all patients and Group H but “general QoL” replaced “cognitive functions” in Group L.

Age, BMI, and neck circumference were not different between groups. Difference observed in SMD (Group L: shorter) might affect interpretation of appearance and goitre symptoms, nevertheless difference-scores were similar between groups ( $P > .05$ ).

Similar to Group H, there were no decreases in “hypothyroidism symptoms,” “tiredness,” “appearance,” and “general QoL” domains in Group L. Additionally, “eye symptoms” domain was decreased in Group L. In assessment of whole cohort overall there were no significant differences in domains of “impaired daily life,” “emotional susceptibility,” “appearance,” and “eye symptoms” in postoperative compared to preoperative period, domains other than “emotional susceptibility” were valued <3. Similarly, these domains were also below three in study published by Bukvic et al<sup>[16]</sup>; however, they showed a significant decrease after surgery, contrary to present study.

In analyses of both overall and group specific QoL, “easily felt stressed” and “felt tense” in preoperative phase were replaced by “felt energetic” and “difficulty remembering” in postoperative period. This stress and anxiety could be related to a fear of surgery, but further interrogation is needed to fully elucidate this aspect of QoL.

In assessing the three most affected QoL domains during preoperative period, “tiredness” and “emotional susceptibility” were observed in two groups and overall cohort with variable order. The most affected domain of QoL was “tiredness” in Group L and overall, while Group H most commonly reported feelings of “emotional susceptibility.” While “anxiety” took place in the most affected three domains of QoL in Group L and overall, “depression” domain was more prominent in Group H. Even though differences were observed between groups for these four domains, there were no statistical differences in preoperative period.

In assessment of QoL during postoperative period, “tiredness” and “emotional susceptibility” remained the most affected three domains for both groups and overall, as in preoperative period. Additionally, “general QoL” domain appeared to be affected in Group H and all patients, however, “cognitive functions” domain was more prominently affected in Group L and this difference was statistically significant. In analysis of questions in “cognitive functions” domain (“difficulty remembering,”

**Table 3**  
Scores obtained for questions and their analyses.

Questioned item	Ligasure LF1212			Harmonic Focus			P values*				
	Preoperative	Postoperative	Difference (Δ)	Preoperative	Postoperative	Difference (Δ)	Pre (H-L) <sup>†</sup>	Post (H-L) <sup>‡</sup>	L (pre-post) <sup>§</sup>	H (pre-post) <sup>  </sup>	Δ (H-L) <sup>¶</sup>
Sensation of fullness in neck	2.91 ± 1.93	1.35 ± 1.01	-1.56 ± 1.99	3.2 ± 1.68	1.74 ± 1.36	-1.46 ± 2.24	.687	<b>.031</b>	<.001	<.001	.716
Pressure in throat	2.81 ± 1.88	1.7 ± 1.38	-1.11 ± 2.17	3.4 ± 1.6	1.86 ± 1.44	-1.54 ± 1.86	.076	.45	<.001	<.001	.124
Discomfort swallowing	2.42 ± 1.78	1.67 ± 1.29	-0.75 ± 2.05	2.87 ± 1.67	1.9 ± 1.41	-0.97 ± 1.81	.1	.314	<b>.001</b>	<.001	.418
Trembling hands	2.11 ± 1.69	1.52 ± 1.17	-0.59 ± 1.81	2.31 ± 1.69	1.61 ± 1.27	-0.7 ± 1.93	.357	.84	<b>.002</b>	<b>.001</b>	.602
Sweat a lot	2.99 ± 1.9	2.28 ± 1.76	-0.71 ± 1.87	3.06 ± 1.73	2.3 ± 1.64	-0.76 ± 1.79	.882	.959	<b>.001</b>	<.001	.641
Palpitations	3.08 ± 1.86	2.11 ± 1.47	-0.97 ± 1.87	3.15 ± 1.7	2.4 ± 1.55	-0.75 ± 2	.931	.277	<.001	<.001	.654
Sensitive to cold	2.67 ± 1.9	2.68 ± 1.83	0.01 ± 1.94	2.9 ± 1.74	2.65 ± 1.83	-0.25 ± 2.18	.313	.801	.89	.317	.239
Upset stomach	2.51 ± 1.79	2.62 ± 1.75	0.12 ± 1.74	2.65 ± 1.68	2.08 ± 1.54	-0.57 ± 1.83	.476	<b>.014</b>	.524	<b>.003</b>	<b>.016</b>
Sensation of dryness in eyes	2.35 ± 1.83	2.45 ± 1.79	0.1 ± 1.89	2.73 ± 1.75	2.25 ± 1.62	-0.48 ± 1.83	.132	.38	.61	<b>.017</b>	<b>.021</b>
Impaired vision	2.02 ± 1.62	2.27 ± 1.71	0.25 ± 1.61	2.76 ± 1.71	1.93 ± 1.45	-0.83 ± 1.8	<b>.002</b>	.122	.12	<.001	<.001
Sensitive to light	2.41 ± 1.86	2.58 ± 1.87	0.17 ± 1.42	2.48 ± 1.63	2.1 ± 1.56	-0.38 ± 1.79	.708	.061	<b>.034</b>	<b>.034</b>	<b>.043</b>
Swollen hands or feet	2.23 ± 1.8	2 ± 1.6	-0.23 ± 1.5	2.56 ± 1.67	2.14 ± 1.59	-0.42 ± 1.79	.119	.714	<b>.023</b>	<b>.023</b>	.363
Dry skin	2.45 ± 1.86	2.46 ± 1.83	0.01 ± 1.89	2.82 ± 1.78	2.51 ± 1.85	-0.31 ± 2.02	.136	.873	.774	.109	.317
Itchy skin	1.89 ± 1.61	1.8 ± 1.46	-0.1 ± 1.57	2.6 ± 1.75	2.48 ± 1.78	-0.12 ± 2.05	<b>.002</b>	<b>.014</b>	.563	.521	.825
Been tired	4.04 ± 1.57	3.53 ± 1.7	-0.52 ± 2.05	4.01 ± 1.42	3.46 ± 1.7	-0.55 ± 2.03	.274	.545	<b>.02</b>	<b>.009</b>	.874
Difficulty getting motivated	3.75 ± 1.74	3.25 ± 1.82	-0.51 ± 2.18	3.42 ± 1.65	3.08 ± 1.79	-0.34 ± 1.84	<b>.028</b>	.431	<b>.03</b>	.068	.484
Felt not energetic	2.8 ± 1.71	3.37 ± 1.65	0.57 ± 2.08	2.7 ± 1.51	3.71 ± 1.39	1.01 ± 1.87	.686	.239	<b>.018</b>	<.001	.148
Difficulty remembering	2.97 ± 1.8	3.62 ± 1.66	0.66 ± 1.99	3.08 ± 1.66	3.02 ± 1.73	-0.06 ± 2.23	.818	<b>.007</b>	<b>.002</b>	.75	.066
Slow or unclear thinking	2.42 ± 1.78	2.8 ± 1.83	0.38 ± 1.89	2.7 ± 1.7	2.28 ± 1.65	-0.42 ± 2.01	.235	<b>.029</b>	.064	<b>.042</b>	<b>.007</b>
Difficulty concentrating	2.52 ± 1.8	2.78 ± 1.88	0.27 ± 1.79	2.74 ± 1.62	2.24 ± 1.62	-0.5 ± 1.98	.25	<b>.019</b>	.163	<b>.015</b>	<b>.003</b>
Anxious	3.05 ± 1.87	2.25 ± 1.74	-0.81 ± 1.85	2.94 ± 1.65	2.07 ± 1.57	-0.87 ± 1.96	.411	.425	<.001	<.001	.315
Felt tense	3.7 ± 1.75	2.87 ± 1.78	-0.83 ± 2.14	3.18 ± 1.64	2.72 ± 1.71	-0.46 ± 2.06	<b>.005</b>	.468	<.001	<b>.028</b>	.332
Felt uneasy	3.23 ± 1.86	2.56 ± 1.78	-0.67 ± 1.85	3.24 ± 1.6	2.6 ± 1.68	-0.64 ± 1.89	.582	.962	<b>.001</b>	<b>.001</b>	.884
Felt sad	3.04 ± 1.91	2.42 ± 1.77	-0.62 ± 1.57	3.1 ± 1.62	2.43 ± 1.68	-0.67 ± 2.05	.591	.972	<.001	<b>.003</b>	.475
Felt unhappy	3.12 ± 1.9	2.57 ± 1.79	-0.55 ± 1.68	3.03 ± 1.64	2.49 ± 1.7	-0.54 ± 2.03	.365	.643	<b>.002</b>	<b>.008</b>	.887
Self-inconfidence	2.84 ± 1.9	2.06 ± 1.61	-0.77 ± 1.68	3.4 ± 1.63	1.97 ± 1.53	-1.43 ± 2.22	.059	.652	<.001	<.001	<b>.03</b>
Easily felt stressed	3.46 ± 1.81	2.98 ± 1.81	-0.48 ± 1.61	3.73 ± 1.52	2.87 ± 1.74	-0.86 ± 1.97	.796	.501	<b>.005</b>	<.001	.056
Mood swings	3.24 ± 1.84	2.58 ± 1.75	-0.66 ± 1.73	3.19 ± 1.61	2.82 ± 1.72	-0.37 ± 2.05	.478	.439	<b>.001</b>	.08	.346
Felt in control of your life	3.25 ± 1.77	3.49 ± 1.77	0.25 ± 1.49	3.44 ± 1.56	3.66 ± 1.66	0.22 ± 2.18	.804	.734	.123	.358	.505
Being together with others	2.22 ± 1.65	1.83 ± 1.4	-0.39 ± 1.47	2.01 ± 1.57	1.86 ± 1.39	-0.15 ± 1.77	.353	.834	<b>.016</b>	.454	.451
Burden to other people	1.68 ± 1.42	1.49 ± 1.19	-0.18 ± 1.27	2.13 ± 1.62	1.62 ± 1.33	-0.51 ± 1.86	<b>.021</b>	.7	.121	<b>.013</b>	<b>.031</b>
Conflicts with other people	1.86 ± 1.49	1.67 ± 1.31	-0.19 ± 1.34	2.11 ± 1.56	1.58 ± 1.19	-0.53 ± 1.63	.19	.809	.189	<b>.003</b>	<b>.122</b>
Difficulty in daily life	1.65 ± 1.39	1.33 ± 0.94	-0.31 ± 1.38	2.04 ± 1.53	1.55 ± 1.18	-0.49 ± 1.69	<b>.033</b>	.196	<b>.03</b>	<b>.008</b>	.208
Difficulty in social life	1.52 ± 1.3	1.18 ± 0.69	-0.33 ± 1.26	2.04 ± 1.53	1.56 ± 1.2	-0.48 ± 1.76	<b>.002</b>	<b>.023</b>	<b>.016</b>	<b>.009</b>	.235
Everything takes longer to do	1.86 ± 1.54	1.58 ± 1.25	-0.28 ± 1.39	2.52 ± 1.64	1.96 ± 1.52	-0.56 ± 2.01	<b>.001</b>	.135	.059	<b>.011</b>	.076
Appearance	2.57 ± 1.77	2.71 ± 1.81	0.14 ± 1.75	2.65 ± 1.78	2.81 ± 1.62	0.16 ± 2.22	.636	.951	.317	.48	.98
Bothered by other people looking at you	1.17 ± 0.73	1.11 ± 0.6	-0.06 ± 0.73	1.55 ± 1.24	1.21 ± 0.77	-0.34 ± 1.43	<b>.009</b>	.292	.577	<b>.027</b>	<b>.039</b>
Clothes you wear	1.66 ± 1.39	1.75 ± 1.44	0.1 ± 1.38	1.84 ± 1.46	1.86 ± 1.44	0.02 ± 2.16	.275	.518	.489	.846	.648
General quality of life	3 ± 1.85	2.99 ± 1.87	-0.01 ± 0.88	2.8 ± 1.79	2.63 ± 1.72	-0.17 ± 2.12	.299	.178	.929	.529	.22

\* P-value <.05 is accepted as statistically significant.

† Statistical analyses of Group H and L for preoperative scores

‡ Statistical analyses of Group H and L for postoperative scores

§ Statistical analyses of preoperative and postoperative scores for Group L

|| Statistical analyses of preoperative and postoperative scores for Group H

¶ Statistical analyses of Group H and L for difference in score from pre-operative to postoperative.

“difficulty concentrating,” and “slow or unclear thinking”), while patients in Group H were more affected than in Group L, though without statistical significance, in preoperative period, patients in Group L showed aggravation contrary to patients in Group H with a statistical difference. This situation occurred due to significant decrease in items “difficulty concentrating” and “slow or unclear thinking” in Group H and increase in item “difficulty remembering” in Group L. Age can affect cognitive function so, we divided patients using a cut-off point of 50 year-old and found, in under 50-year-old patients, there were no differences between groups for difference-scores (H=0.85, L=-0.68, P=.16); however, in group age≥50 year-old, there was a

significant improvement in Group H (H=-1.28, L=1.78, P=.004). Bukvic et al<sup>[16]</sup> showed similar results. In literature there are studies regarding improved cognitive functions with utilization of ultrasound waves.<sup>[17–19]</sup> Suchkova et al.<sup>[20]</sup> showed that, ultrasound waves can trigger nitric oxide synthesis. Additionally, Eguchi et al<sup>[17]</sup> showed that low-intensity pulsed ultrasound can improve cognitive functions. May be ultrasonic vibration of Harmonic scalpel induces nitric oxide synthesis and this can be the reason of improved cognitive function in Group H.

“Eye symptoms” were statistically more frequently reported by Group H than Group L (P=.021). Every type of eye symptom (“impaired vision,” “sensation of dryness in eyes,” and “sensitive

**Table 4**  
Scores obtained for domains and their analyses.

Domains	Ligasure LF1212			Harmonic Focus			P values*				
	Preoperative	Postoperative	Difference (Δ)	Preoperative	Postoperative	Difference (Δ)	Pre-Op (H-L) <sup>†</sup>	Post-Op (H-L) <sup>‡</sup>	L (pre-post) <sup>§</sup>	H (pre-post) <sup>  </sup>	Δ (H-L) <sup>¶</sup>
Goiter symptoms	8.14±4.335	4.72±2.631	-3.42±4.977	9.47±4.09	5.5±3.26	-3.97±4.63	.024	.14	<.001	<.001	.422
Hyperthyroidism symptoms	10.68±4.848	8.53±4.002	-2.15±5.069	11.17±4.41	8.39±3.71	-2.78±4.53	.369	.839	<.001	<.001	.192
Hypothyroidism symptoms	9.24±4.763	8.94±4.664	-0.3±4.462	10.88±5.05	9.78±4.91	-1.1±5.44	.024	.311	.442	.051	.208
Eye symptoms	6.78±4.046	7.3±4.138	0.52±3.537	7.97±3.97	6.28±3.48	-1.69±3.97	.021	.108	.191	<.001	<.001
Tiredness	10.59±2.81	10.14±3.038	-0.45±3.292	10.13±3.29	10.25±2.97	0.12±3.87	.465	.857	.189	.912	.357
Cognitive Functions	7.09±3.807	9.2±4.724	2.12±5.324	7.86±3.98	7.54±4.28	-0.32±5.27	.16	.011	<.001	.518	.002
Anxiety	9.98±5.002	7.68±4.95	-2.3±5.506	9.36±4.21	7.39±4.4	-1.97±5.16	.181	.762	<.001	<.001	.629
Depression	9±5.341	7.05±4.645	-1.95±4.633	9.53±3.9	6.89±4.5	-2.64±5.3	.903	.861	<.001	<.001	.126
Emotional susceptibility	9.95±3.702	9.05±3.754	-0.89±3.038	10.36±3.42	9.35±3.19	-1.01±4.27	.472	.532	.006	.012	.332
Impaired social Life	5.75±3.494	4.99±3.091	-0.76±3.268	6.25±4.18	5.06±3.12	-1.19±4.36	.621	.745	.014	.012	.853
Impaired daily life	5.02±3.68	4.1±2.177	-0.92±3.564	6.6±3.99	5.07±3.12	-1.53±4.41	<.001	.039	.014	.002	.053
Appearance	5.4±3.072	5.57±3.16	0.17±3.035	6.04±3.66	5.88±3.01	-0.16±4.66	.264	.328	.742	.783	.761
General quality of life	3±1.847	2.99±1.868	-0.01±0.878	2.8±1.79	2.63±1.72	-0.17±2.12	.299	.178	.929	.529	.22
Total	100.61±29.268	90.26±26.703	-10.35±27.297	108.42±33.74	90.01±27.13	-18.41±35.76	.081	.875	<.001	<.001	.422

\* P-value <.05 is accepted as statistically significant.

<sup>†</sup> Statistical analyses of Group H and L for preoperative scores

<sup>‡</sup> Statistical analyses of Group H and L for postoperative scores

<sup>§</sup> Statistical analyses of preoperative and postoperative scores for Group L

<sup>||</sup> Statistical analyses of preoperative and postoperative scores for Group H

<sup>¶</sup> Statistical analyses of Group H and L for difference in score from preoperative to postoperative.

to light”) in ThyPRO-39-Tr was statistically increased in Group H and decreased (but not statistically) in Group L in comparison to pre-operative status (Table 3). This difference could result from an imbalanced distribution of patients with Graves’ disease among groups (Group H: n=6, 6%, Group L: n=2, 2.2%). For further analysis, we performed a subgroup analysis for major diagnostic group excluding Graves’ disease (patients diagnosed with multinodular goitre were included only, patient number was 70 for Group L and 88 for Group H) and then reassessed the difference-scores (L=0.17, H=-0.44, P=.002); however, results were similar to initial analysis. Despite low difference-scores for each group, a statistical difference can be due to opposite alteration. Overall assessment of patients’ difference-score was -0.63, P=.027. Similarly, in a study that assessed effect of total thyroidectomy for BTd on QoL with ThyPRO, Bukvic et al<sup>[16]</sup> reported “eye symptoms” as the least altered domain but they did observe statistical improvement upon excluding patients with Graves’ disease.

The least affected three domains were “impaired social life,” “impaired daily life,” and “appearance” in each group and overall in preoperative period. However, in postoperative period, “appearance” showed up on fourth order and replaced by “goitre symptoms.” Reason for this change could be that removal of thyroid gland causes disappearance of items (“pressure in your throat,” “sensation of fullness in neck,” and “discomfort swallowing”) found in “goitre symptoms” domain. Cosmetic concerns related to scar formation on neck likely underlie gained importance in “appearance” domain, yet there were neither statistical nor ordinal differences between groups. “Goitre symptoms” domain was more affected in Group H in preoperative period, nevertheless, there was no statistical difference for NC between groups and SMD was longer in Group H.

In both all patients and each group separately, overall QoL was enhanced after surgery, as described in current literature and there were no differences between two EBVSD examined in this study.

## 5. Conclusions

QoL was assessed with BTd-specific ThyPRO-39-Tr questionnaire in pre and postoperative periods of STT with goal of illuminating differences between Harmonic Focus and Ligasure LF1212. Improvements reported in “eye symptoms” and “cognitive functions” were greater with Harmonic even after exclusion of Graves’ patients. Thus, it may be concluded that, use of the Harmonic may improve the outcome of QoL for patients experiencing eye symptoms and patients over 50-year-old with worsen cognitive functions.

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Ethical statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Istanbul University, Cerrahpasa Medical Faculty, Clinical Researches Ethical Committee approved this study with number of 83045809/604.01/02. Informed consent was received from involved patients.

## Author contributions

Concept or design: All authors. Acquisition of data: All authors. Analysis or interpretation of data: Outsourced. Drafting of the

article: AEA. Critical revision for important intellectual content: All authors. Final approval of manuscript: All authors

## References

- [1] Dionigi G, Boni L, Raused S, et al. The safety of energy-based devices in open thyroidectomy: a prospective, randomised study comparing the LigaSure (LF1212) and the Harmonic(R) FOCUS. *Langenbecks Arch Surg* 2012;397:817–23.
- [2] Kwak HY, Dionigi G, Kim D, et al. Thermal injury of the recurrent laryngeal nerve by THUNDERBEAT during thyroid surgery: findings from continuous intraoperative neuromonitoring in a porcine model. *J Surg Res* 2016;200:177–82.
- [3] Felce D, Perry J. Quality of life: its definition and measurement. *Res Dev Disabil* 1995;16:51–74.
- [4] The WHOQOL Group. The World Health Organization Quality of Life assessment (WHOQOL): position paper from the World Health Organization. *Soc Sci Med* 1995;41:1403–9. doi:10.1016/0277-9536(95)00112-k.
- [5] Sirgy MJ, Michalos AC, Ferriss AL, Easterlin RA, Patrick D, Pavot W. The quality-of-life (QOL) research movement: past, present, and future. *Soc Indic Res* 2006;76:343–466.
- [6] Fayers PM, Machin D. Fayers PM, Machin D. Introduction. *Quality of Life: The assessment analysis and interpretation of patient-reported outcomes* 2nd ed. England: Wiley; 2007;1-30.
- [7] Watt T, Bjorner JB, Groenvold M, et al. Development of a short version of the thyroid-related patient-reported outcome ThyPRO. *Thyroid* 2015;25:1069–79.
- [8] Teksoz S, Bukey Y, Ozcan M, Arikan AE, Ozyegin A. Sutureless thyroidectomy with energy-based devices: Cerrahpasa experience. *Updates Surg* 2013;65:301–7.
- [9] World Health Organization. Process of translation and adaptation of instruments. Available at: [http://www.who.int/substance\\_abuse/research\\_tools/translation/en/](http://www.who.int/substance_abuse/research_tools/translation/en/). Accessed 15 Jan, 2016.
- [10] Zimmerman DW, Williams RH. Gain scores in research can be highly reliable. *J Educ Meas* 1982;19:149–54.
- [11] Keys A, Fidanza F, Karvonen MJ, Kimura N, Taylor HL. Indices of relative weight and obesity. *Int J Epidemiol* 2014;43:655–65.
- [12] Biondi B, Palmieri EA, Fazio S, et al. Endogenous subclinical hyperthyroidism affects quality of life and cardiac morphology and function in young and middle-aged patients. *J Clin Endocrinol Metab* 2000;85:4701–5.
- [13] McMillan C, Bradley C, Razvi S, Weaver J. Evaluation of new measures of the impact of hypothyroidism on quality of life and symptoms: the ThyDQoL and ThySRQ. *Value Health* 2008;11:285–94.
- [14] Bianchi GP, Zaccheroni V, Solaroli E, et al. Health-related quality of life in patients with thyroid disorders. *Qual Life Res* 2004;13:45–54.
- [15] Razvi S, McMillan CV, Weaver JU. Instruments used in measuring symptoms, health status and quality of life in hypothyroidism: a systematic qualitative review. *Clin Endocrinol (Oxf)* 2005;63: 617–24.
- [16] Bukvic BR, Zivaljevic VR, Sipetic SB, Diklic AD, Tausanovic KM, Paunovic IR. Improvement of quality of life in patients with benign goiter after surgical treatment. *Langenbecks Arch Surg* 2014;399: 755–64.
- [17] Eguchi K, Shindo T, Ito K, et al. Whole-brain low-intensity pulsed ultrasound therapy markedly improves cognitive dysfunctions in mouse models of dementia - Crucial roles of endothelial nitric oxide synthase. *Brain Stimul* 2018;11:959–73.
- [18] Huang X, Lin Z, Wang K, et al. Transcranial low-intensity pulsed ultrasound modulates structural and functional synaptic plasticity in rat hippocampus. *IEEE Trans Ultrason Ferroelectr Freq Control* 2019; 66:930–8.
- [19] Folloni D, Verhagen L, Mars RB, et al. Manipulation of subcortical and deep cortical activity in the primate brain using transcranial focused ultrasound stimulation. *Neuron* 2019;101:1109.e.5–16.e.5.
- [20] Suchkova VN, Baggs RB, Sahni SK, Francis CW. Ultrasound improves tissue perfusion in ischemic tissue through a nitric oxide dependent mechanism. *Thromb Haemost* 2002;88:865–70.