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Comparison of postoperative voice outcomes after postauricular facelift robotic hemithyroidectomy and conventional transcervical hemithyroidectomy

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Abstract

Background: The purpose of this study was to determine whether postauricular robotic and conventional hemithyroidectomy result in significantly different voice outcomes.

Methods: We prospectively compared the voice handicap index (VHI)-10 and acoustic parameters of a postauricular facelift robotic group and a conventional group preoperatively, 1 week, 1 month, and 6 months after surgery.

Results: Forty-two patients in the postauricular group and 68 patients in the conventional group completed the VHI-10 questionnaire and acoustic analysis. The postoperative VHI-10 scores were not significantly different between the two groups. In female patients, the highest frequency was higher and the frequency range was wider in the postauricular group compared to the conventional group postoperatively until 1 month after surgery.

Conclusion: Postauricular facelift robotic thyroidectomy has advantages over conventional thyroidectomy in terms of postoperative voice pitch.

KEYWORDS

postauricular facelift approach, robotic thyroidectomy, thyroid neoplasm, voice

1 | INTRODUCTION

Remote-access thyroidectomy has gained in popularity over the last two decades with the development of robotic and endoscopic surgical instruments.[1] Various incisions involving transaxillary, axillo-breast, postauricular facelift, and transoral approaches have been developed to avoid a visible scar in the anterior part of the neck.[2-5] In our institution, we have performed endoscopic and robotic thyroidectomy using gasless unilateral axillary and axillo-breast approaches, postauricular facelift, and transoral approaches since 2005.[6-11]

The use of robotic thyroidectomy with a remote-access approach is controversial because of its high cost and long operative times.[12] However, it has some advantages over conventional trans-cervical thyroidectomy especially in terms of cosmetic satisfaction and postoperative voice outcomes.[13,14]

The postoperative status of the voice is one of the most important aspects of thyroidectomy. Dysfunction of the voice can interfere with the quality of life of survivors of thyroid cancer.[15] The quality of voice after robotic thyroidectomy using a gasless transaxillary approach is reported to be similar to or better than that after conventional trans-cervical thyroidectomy.[14,16,17] However, to the best of our knowledge, there

has been no thorough evaluation of postoperative voice after robotic thyroidectomy using a facelift approach. The purpose of this study was to determine the difference in self-assessment voice outcome measures following postauricular robotic and conventional transcervical hemithyroidectomy.

2 | MATERIALS AND METHODS

2.1 | Subjects

This prospective study involved a cohort of patients who underwent hemithyroidectomy by a robotic postauricular facelift approach or a conventional trans-cervical approach with or without central neck dissection from January 2015 to December 2016 in a single tertiary hospital. The study was approved by the Institutional Review Board of Hanyang University Hospital. The inclusion criteria were patients who underwent hemithyroidectomy with or without central neck dissection and those who provided informed consent for preoperative and postoperative voice analysis. The voice analysis was continued for 6 months or more in all participants.

The exclusion criteria were: (a) patients with preoperative voice disorders including mucosal lesions in the vocal fold or movement disorders, (b) patients with preoperative or postoperative vocal fold paralysis or apparent injury to the external branch of the superior laryngeal nerve (EBSLN), (c) age <18 and age >70 years, (d) completion thyroidectomy or thyroidectomy of an extent exceeding lobectomy, including total and subtotal thyroidectomy, (e) concurrent lateral or modified radical neck dissection, (f) history of neck surgery or irradiation, and (g) gross extrathyroidal extension.[14,16] We excluded subtotal or total thyroidectomy cases in this study, because they are infrequently performed via a unilateral postauricular facelift approach because of the difficulty in access to the contralateral thyroid lobe and also because of the acoustic results between total thyroidectomy and hemithyroidectomy cases might differ.

2.2 | Surgical procedure

All robotic thyroidectomies were performed by one surgeon (K.T.) using the da Vinci S Surgical system (Intuitive Surgical, Sunnyvale, California). The surgical procedure using a postauricular facelift approach has been described previously.[8] Here, we briefly summarize the procedures for postauricular facelift approach. Skin incision is made in the postauricular sulcus and continued to the occipital hairline. After the subplatysmal skin flap is elevated, the strap muscles are retracted upward to expose the thyroid gland. After thyroid lobectomy, pretracheal and paratracheal lymph nodes are dissected and removed while tracing the recurrent laryngeal nerve (RLN) and preserving the inferior parathyroid gland.

Conventional trans-cervical thyroidectomy started with a transverse incision two finger-breadths above the suprasternal notch. RLN was preserved, and EBSLN was not routinely identified. Randomization for robotic thyroidectomy vs conventional thyroid surgery was not performed. We explained the procedures and costs of postauricular robotic approach and transcervical approach to the patients prior to surgery, and the procedure was chosen according to the patients' preference. We did not explain voice outcomes differently according to the procedures in preoperative counseling. The patients did not undergo postoperative speech therapy routinely.

2.3 | Voice assessment

Self-reported voice evaluation was performed preoperatively and at 1 week and 6 months after surgery. Objective acoustic analysis was performed preoperatively and on postoperative 1 week, 1 month, and 6 months after thyroidectomy. Videostroboscopic and fiberoptic flexible laryngoscopic examinations were performed with an EndoSTROB DX (Xion, Berlin, Germany) the day before surgery and the day after surgery. We evaluated the movement and mucosal lesions of vocal folds, symmetry of arytenoid excursion, closure of both vocal folds, and any signs of injury to the RLN and EBSLN.

Voice handicap index (VHI)-10 questionnaire, which is a modification of the original VHI, was used to evaluate vocal dysfunction in this study. The original VHI is a validated and reliable questionnaire instrument developed to diagnose disability associated with voice disorders.[18] It is composed of 30 items and evaluates functional, physical, and emotional components. However, each evaluation requires a long time and is burdensome for both clinicians and patients when repeated over time in clinics. Hence, Rosen et al. developed VHI-10 by reducing the 30 items of VHI to 10 questions, without loss of validity.[19]

2.4 | Acoustic voice analysis

Objective voice evaluation was performed by an experienced speech-language pathologist using Computerized Speech Lab software (Model 4150B; KayPENTAX, Lincoln Park, New Jersey). To assess voice range profile (VRP), patient was asked to produce the sustained vowel (a) as loudly and as softly as possible from the lowest frequency to the highest.[16] VRP provided measurements of the lowest frequency (F-low, Hz), highest frequency (F-high, Hz), frequency range (Hz and semitones, respectively), and intensity range (dB). For the multidimensional voice program (MDVP), the patient was instructed to produce a sustained vowel (a) at the most comfortable amplitude and pitch for longer than 5 seconds.

The MDVP provided data on fundamental frequency (F0, Hz), noise-to-harmonics ratio (dB), jitter (%), and

shimmer (%).[14] Maximal phonation time (MPT, seconds) was measured as an aerodynamic test, and it was measured by instructing the patient to repeat phonating the vowel (a) for as long as possible three times and selecting the longest measurement.

2.5 | Statistical analysis

Continuous variables were analyzed by the Mann-Whitney *U* test. Categorical variables were evaluated by the chi-square test, or Fisher's exact test in cases with small cell sizes. The preoperative values were set as baseline and were compared with each set of postoperative values by the Wilcoxon signed rank test. Multiple regression analysis was performed including risk factors for voice impairment. SPSS version 21.0 program (SPSS Chicago, Illinois) was used for statistical analysis. The 0.05 level of confidence was set to test the significance of the results.

3 | RESULTS

3.1 | Clinicopathological characteristics

Over the study period, 156 patients who underwent hemithyroidectomy met the inclusion criteria. Of these, 22 were excluded by the exclusion criteria and 1 (1.9%) in the facelift group and 2 (2.5%) in the conventional group, whose laryngoscopic examinations showed postoperative vocal fold paralysis, were also excluded. The rate of vocal fold paralysis in both groups was not significantly different. Of the 131 enrolled patients, 110 completed the VHI-10 questionnaire and acoustic analysis. They comprised 42 cases of robotic facelift thyroidectomy and 68 of transcervical conventional thyroidectomy. The demographic, clinical, and pathological data for the two groups are summarized in Table 1. The robotic postauricular group was significantly younger than the transcervical group, and its total operative time was longer. There were no significant differences in sex, body mass index, vocal risk factors, tumor pathology, central neck dissection, and perioperative complication rate between the two groups.

3.2 | Patient's assessment of voice handicap

Preoperative and serial postoperative VHI-10 scores are listed in Table 2. When the VHI-10 scores of the two groups were compared period by period, the differences did not reach the .05 level of significance. The VHI-10 scores were significantly higher in 1 week postoperatively than the preoperative levels, and they recovered to preoperative levels by 6 months in both groups.

3.3 | Acoustic and aerodynamic analysis in female patients

The acoustic and aerodynamic parameters of the two groups were compared separately in male and female subgroups because the fundamental frequency (F0) and frequency range of male and female are different. The acoustic analysis of the two groups of female patients is shown in Table 3. F-high was significantly higher in the postauricular group than the conventional group from postoperative 1 week to 1 month. In the postauricular group, F-high was significantly below the preoperative value for a week after surgery, whereas in the conventional group, it remained depressed for 1 month. The frequency ranges in terms of Hz and semitones behaved similarly. It was wider in the postauricular group than the conventional group for 1 month when analyzed by Hz and also wider for a month when analyzed in semitones. The frequency range was reduced postoperatively in both Hz and semitones for a week in the postauricular group and for 1 month in the conventional group. There were no significant changes of intensity range, F0, jitter, shimmer, or NHR in either group after surgery, and no differences between the two groups in any period. However, the postoperative MPT was significantly lower than the preoperative value in the conventional group, whereas there was no reduction of MPT in the postauricular group. MPT did not differ significantly between the two groups in any period of evaluation.

We additionally compared the acoustic parameters between 1 week vs 1 month and 1 month vs 6 months in both groups. In the postauricular group, significant differences were observed between 1 week vs 1 month in F-high (Hz; $P = .045$), frequency range (Hz; $P = .018$), and frequency range (semitone; $P = .006$). In the conventional group, significant differences were found between 1 month vs 6 months for F-high (Hz; $P = .025$), frequency range (Hz; $P = .021$), and frequency range (semitones; $P = .040$). There was no other significant difference between time points in other parameters in both groups. In the male patients, acoustic parameters showed a tendency similar to those of female patients, although the differences did not reach statistical significance (data not shown).

4 | DISCUSSION

This study demonstrated some differences in acoustic analysis between postauricular facelift robotic thyroidectomy and conventional transcervical thyroidectomy, although there was no significant difference in VHI-10 scores between the two groups. In female patients, F-high was lower and frequency range (Hz) narrower in the conventional group for 1 month after surgery, and also these two parameters recovered faster in the postauricular group (by 1 month)

TABLE 1 Comparison of the clinicopathologic and surgical characteristics of the robotic postauricular facelift and transcervical conventional thyroidectomy groups

Characteristic	Robotic group (N = 42), number of patients (%)	Conventional group (N = 68), number of patients (%)	*P* value
Age (y), mean	44.7 ± 10.9	54.5 ± 11.5	<.001*
<40	12 (28.6%)	5 (7.4%)	.002*
40-65	28 (66.7%)	53 (77.9%)	
>65	2 (4.8%)	10 (14.7%)	
Sex			.525
Female	31 (73.8%)	45 (66.2%)	
Male	11 (26.2%)	23 (33.8%)	
Body mass index (kg/m^2), mean	24.9 ± 4.3	25.1 ± 4.3	.829
Vocal risk factor			
Smoking	4/42 (10.0%)	9/68 (13.2%)	.764
Alcohol drinking	16/42 (40.0%)	18/68 (26.5%)	.198
LPR	17/42 (40.5%)	33/68 (48.5%)	.437
Tumor			
Nodule size (mm), mean	13.13 ± 12.88	12.67 ± 12.84	.861
Multiplicity	1/42 (2.4%)	9/68 (13.2%)	.086
Pathology type			.675
Benign	12 (28.6%)	23 (33.8%)	
Malignancy	30 (71.4%)	45 (66.2%)	
Extrathyroidal extension (minimal)	14/42 (33.3%)	20/68 (29.4%)	.677
CND, n (%)	27/42 (64.3%)	46/68 (67.6%)	.836
Operative time (min), mean	145.6 ± 24.0	115.7 ± 43.4	<.001*
Total drainage amount (mL), mean	121.8 ± 43.8	106.5 ± 50.1	.104
Hospital day, mean	8.05 ± 1.34	8.18 ± 1.93	.705
Complication			
Hypoparathyroidism	1 (2.4%)	3 (4.4%)	.506
Hematoma	0	0	NA
Seroma	2 (4.8%)	4 (5.9%)	.583
VFP, temporary (excluded)*	1/43 (2.3%)	2/69 (2.9%)	.677
VFP, permanent (excluded)[a]	0/43	0/69	NA

Note. Fischer's exact test and the Mann-Whitney *U* test.
Abbreviations: CND, central neck dissection; LPR, laryngopharyngeal reflux; NA, not applicable; VFP: vocal fold palsy.
[a]Vocal fold palsy was excluded from the analysis.
*$P < .05$.

TABLE 2 Comparison of preoperative and postoperative VHI-10 scores in the robotic postauricular facelift and transcervical conventional thyroidectomy groups

VHI-10	Postauricular thyroidectomy (N = 42, A)	*P* value vs preoperative	Transcervical conventional thyroidectomy (N = 68, B)	*P* value vs preopeartive	*P* value A vs B
Preoperative	1.04 ± 2.06		1.15 ± 3.65		.630
1 wk, postoperative	3.70 ± 6.07	.004*	4.15 ± 7.07	.006*	.786
6 mo, postoperative	2.09 ± 3.99	.188	2.46 ± 3.91	.146	.405

Note. Comparison between A and B: Mann-Whitney U test; comparison with preoperative values: Wilcoxon signed rank test.
Abbreviations: VHI, voice handicap index.
*$P < .05$.

TABLE 3 Comparison of preoperative and postoperative aerodynamic and acoustic parameters in the robotic postauricular and transcervical conventional thyroidectomy groups among female patients

Parameter	Postauricular thyroidectomy (N = 31, A)	*P* value vs preopeartive	Transcervical conventional thyroidectomy (N = 45, B)	*P* value vs preoperative	*P* value A vs B
F-high (Hz)					
Preoperative	391.0 ± 109.7		355.4 ± 117.9		.067
1 wk	364.7 ± 95.3	<.001*	294.9 ± 74.2	<.001*	.001*
1 mo	388.8 ± 103.9	.657	307.2 ± 82.6	.002*	<.001*
6 mo	369.3 ± 106.4	.619	338.5 ± 73.4	.342	.520
F-low (Hz)					
Preopeartive	151.5 ± 22.1		146.9 ± 20.8		.390
1 wk	154.1 ± 20.3	.458	144.4 ± 29.6	.592	.137
1 mo	149.5 ± 24.6	.676	145.0 ± 25.0	.297	.295
6 mo	148.4 ± 19.2	.772	148.0 ± 26.0	.720	.917
Frequency range (Hz)					
Preoperative	239.4 ± 108.3		208.4 ± 120.6		.151
1 wk	210.6 ± 94.7	.025*	150.5 ± 71.4	<.001*	.003*
1 mo	239.3 ± 105.2	.407	162.2 ± 83.1	<.001*	<.001*
6 mo	220.9 ± 102.2	.609	190.6 ± 73.6	.259	.356
Frequency range (St)					
Preoperative	15.90 ± 5.12		14.66 ± 5.63		.295
1 wk	14.34 ± 4.79	.017*	14.46 ± 12.93	.001*	.039
1 mo	16.13 ± 5.41	.466	12.77 ± 4.92	.001*	.005*
6 mo	15.22 ± 4.86	.690	14.16 ± 4.44	.338	.429
Intensity range (dB)					
Preopeartive	18.63 ± 2.93		18.29 ± 4.22		.686
1 wk	17.44 ± 3.31	.123	17.21 ± 3.15	.209	.759
1 mo	17.32 ± 4.33	.117	17.16 ± 4.01	.133	.871
6 mo	16.67 ± 4.36	.247	18.24 ± 4.41	.532	.253
F0 (Hz)					
Preoperative	194.8 ± 25.4		192.0 ± 22.5		.390
1 wk	199.7 ± 23.1	.120	191.6 ± 33.2	.858	.191
1 mo	198.6 ± 22.6	.177	194.2 ± 26.6	.510	.455
6 mo	191.2 ± 25.6	.983	195.7 ± 27.1	.937	.761
Jitter (%)					
Preoperative	1.34 ± 1.56		1.24 ± 0.80		.723
1 wk	1.54 ± 1.67	.646	1.25 ± 1.01	.552	.383
1 mo	1.18 ± 0.97	.375	1.12 ± 0.75	.581	.753
6 mo	1.14 ± 0.51	.180	1.13 ± 1.06	.426	.979
Shimmer (%)					
Preoperative	4.24 ± 3.05		3.62 ± 1.32		.466
1 wk	4.25 ± 2.98	.814	4.45 ± 3.05	.338	.637
1 mo	3.77 ± 1.74	.828	3.78 ± 1.53	.460	.838
6 mo	3.82 ± 1.10	.229	4.04 ± 1.65	.458	.798

(Continues)

TABLE 3 (Continued)

Parameter	Postauricular thyroidectomy (N = 31, A)	*P* value vs preopeartive	Transcervical conventional thyroidectomy (N = 45, B)	*P* value vs preoperative	*P* value A vs B
NHR (dB)					
Preoperative	0.142 ± 0.041		0.135 ± 0.026		.825
1 wk	0.143 ± 0.045	.633	0.135 ± 0.038	.374	.469
1 mo	0.138 ± 0.026	.602	0.131 ± 0.027	.331	.276
6 mo	0.132 ± 0.023	.702	0.138 ± 0.039	.249	.995
MPT (s)					
Preoperative	13.32 ± 5.75		12.26 ± 5.64		.468
1 wk	11.54 ± 4.60	.099	11.16 ± 4.71	.006*	.678
1 mo	11.88 ± 4.48	.152	11.60 ± 4.87	.140	.847
6 mo	11.78 ± 6.56	.495	11.81 ± 3.87	.958	.201

Note. Comparison between A and B: Mann–Whitney U test; Comparison with preoperative values: Wilcoxon signed rank test.
Abbreviations: F0, fundamental frequency; F-high, highest frequency; F-low, lowest frequency; St, semitone; NHR, noise-to-harmonic ratio; MPT, maximum phonation time.
*$p < .05$).

than the conventional group (by 6 months). MPT significantly decreased after conventional surgery for 1 weeks, whereas no change of MPT was observed in the postauricular thyroidectomy group.

To the best of our knowledge, this is the first comprehensive study comparing objective aspects of voice serially after robotic thyroidectomy by a postauricular facelift approach and also comparing these outcomes with those of conventional transcervical thyroidectomy. Previously, we compared voice changes after robotic thyroidectomy using a gasless transaxillary approach and conventional thyroidectomy.[14,16] The results were similar to the current ones in terms of impairment in voice pitch. Transaxillary thyroidectomy was advantageous for recovery of subjective voice impairment and voice pitch. However, whereas MPT was not different between the transaxillary approach and conventional thyroidectomy, there was a short-term impairment of MPT only in the conventional group in this study.

Two studies from the same institution have evaluated voice changes after postauricular thyroidectomy using endoscopy or surgical robots as part of studies comparing the surgical and functional outcomes of endoscopic and robotic procedures with those of conventional transcervical procedure.[20,21] One study by Chung et al. enrolled patients who underwent endoscopic thyroidectomy but not any robotic procedures and compared VHI scores and acoustic parameters following postauricular endoscopic thyroidectomy and conventional thyroidectomy.[20] In that study, endoscopic thyroidectomy via a postauricular approach resulted in longer postoperative impairment of VHI than conventional thyroidectomy. Also the functional, physical, and emotional subscales and total VHI scores of the postauricular group were worse than those of the conventional thyroidectomy groups for 3 months after surgery. The other study, by Lee et al, also evaluated acoustic parameters after postauricular approach thyroidectomy employing a variety of robotic procedures (32%) and endoscopy procedures (68%).[21] They found that VHI recovered in a shorter time in the postauricular group than in the conventional thyroidectomy group and also that the highest voice pitch was higher in the postauricular group than the conventional group, as we observed above. We do not know why the results for VHI were so different in the two studies despite the fact that all the operations were performed by the same surgeon.

The voice parameters of female and male patients are significantly different, especially in terms of voice pitch and fundamental frequency.[22] The above two studies just referred to evaluated voice parameters in female and male patients together, and their results might have changed if they had considered them separately.[20,21] A strength of our study is that we analyzed the acoustic and aerodynamic parameters of a homogenous group of patients including only female patients who have undergone hemithyroidectomy.

The pathophysiology of voice change after thyroidectomy may include laryngotracheal fixation with decrease in vertical movement, cricothyroidal dysfunction, malfunction of the strap muscles, injury to the EBSLN, and localized pain in the neck.[23-26] The causes of the differences in voice outcomes, including subjective outcomes and vocal pitch, between robotic postauricular approach and conventional thyroidectomy may be multifactorial. First, laryngotracheal fixation and strap muscle dysfunction might be lower in the postauricular approach because the fascia between the bilateral strap muscles that lie over larynx and trachea are not divided in the postauricular approach. In the conventional

TABLE 4 Associations of highest frequency (Hz) at postoperative 1 wk and variables by multiple linear regression

Variables	$\beta \pm$ SE	R^2	*P* value
Thyroidectomy groups[a]	−37.004 ± 17.703	0.106	.039*
Age[b]	−54.075 ± 15.741	0.130	.001*
Sex	−89.457 ± 19.689	0.179	<.001*
Smoking	1.618 ± 27.441	0.023	.953
Drinking	9.492 ± 19.193	0.001	.622
LPR	−17.349 ± 15.679	0.002	.271
Operative time (min)	−.120 ± 0.206	0.010	.561

Abbreviation: LPR, laryngopharyngeal reflux.
[a]Thyroidectomy groups indicates robotic postauricular and transcervical conventional thyroidectomy groups.
[b]Age groups (<40, 40-65, >65 y).
*$P < .05$.

approach, adhesion may occur between the strap muscles and neck skin incision and cause tracheolaryngeal fixation. Second, because the incision in the postauricular approach is not in the anterior neck and is made away from the organs that are primarily related to phonation, the pain in the anterior neck area may be reduced, resulting in an improved voice.[27]

This study has several limitations. First, factors affecting voice including age, smoking, alcohol drinking, and laryngopharyngeal reflux were not controlled. We additionally performed a multiple linear regression analysis including multiple factors that may affect voice as shown in Table 4. The type of approach for thyroidectomy (postauricular vs conventional approaches), age, and sex were significantly associated with vocal pitch at postoperative 1 week. Actually, voice risk factors except age did not differ between the robotic and conventional groups in this study. Second, the population sample was small, especially in the case of male patients. Third, randomization for postauricular and conventional thyroidectomy was not performed: after thorough explanation of both procedures, patients chose whether to receive the robotic postauricular facelift approach or conventional transcervical thyroidectomy. Randomized studies with larger numbers of patients are needed to overcome these limitations. Fourth, routine laryngeal electromyography to confirm EBSLN injury was not performed, although injury to the EBSLN was routinely evaluated by postoperative stroboscopic and fiberoptic laryngoscopic examination in cases of subjective voice change after surgery.

5 | CONCLUSION

Postauricular facelift hemithyroidectomy resulted in superior voice pitch than conventional hemithyroidectomy over the first month following surgery. However, there was no significant difference in all acoustic parameters at 6 months after thyroidectomy between the two groups.

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