

ORIGINAL RESEARCH

Robotic retroauricular thyroidectomy with additional axillary port: Early personal experiences

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Abstract

Objective: This study aimed to analyze the usefulness of an additional axillary port in robotic retroauricular thyroidectomy by comparing the perioperative data and postoperative function between the operations with and without an additional axillary port.

Materials and methods: A retrospective review of the medical records of 11 patients who underwent robotic thyroid operations using a unilateral retroauricular approach with or without an additional axillary port between 2016 and 2021 was conducted. Patient demographics, operation time, drainage amount, hospital stay, complication, postoperative cosmetic satisfaction, and postoperative neck and shoulder pain were analyzed.

Results: Among the 11 patients who underwent robotic retroauricular thyroidectomy, an additional axillary port was used in 6 patients and not used in 5 patients. The total operation time was significantly shorter in the axillary port group (174.5 ± 23 minutes) compared to the without the axillary port group (207.6 ± 20.1 minutes) ($P = .033$). The intraoperative estimated blood loss ($P = .525$), total amount of drainage ($P = .172$), and postoperative hospital stays ($P = .092$) were not different between the 2 groups. There was no postoperative recurrent laryngeal nerve palsy, hypoparathyroidism, hematoma, seroma in the two groups. There was no significant difference for either group in the pain score and cosmetic satisfaction at 2 weeks ($P = .378$, $P = .650$) and 6 weeks ($P = .242$, $P = .546$) postoperatively.

Conclusion: Robotic retroauricular thyroidectomy using an additional axillary port was a novel, safe, and feasible procedure. Dissection was easy due to the availability of the fourth robotic arm to retract the thyroid gland.

Level of Evidence: 4.

KEYWORDS

da Vinci robot, remote access, retroauricular, robotic ectomy, thyroid

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1 | INTRODUCTION

In 1912, Kocher established an open method for providing good thyroid gland exposure, which became the standard for thyroidectomy.¹ Although open thyroidectomy is a safe and effective method, it has the inevitable disadvantage of leaving scars on the neck. As cosmetic interest in thyroid surgery has increased, various techniques, such as transaxillary, breast-axillary, retro-auricular, and transoral approaches, have been proposed to avoid neck scars.²⁻⁵

The retroauricular approach has the advantage of a shorter distance between the retroauricular incision and the thyroid gland than other approaches; thus, the extents of dissections inducing tissue damage are smaller.⁶

Compared to endoscopic thyroidectomy, robotic thyroidectomy can easily preserve the recurrent laryngeal nerve or parathyroid gland in that it can obtain high-definition three-dimensional images that be viewed at a magnification of 10 times or more.⁷ Robotic thyroidectomy is performed with the da Vinci Xi Surgical System robot (Intuitive Surgical, Inc., Sunnyvale, California), which uses one endoscope and three rigid surgical arms. However, the retroauricular approach implements a total of three robotic arms with a single endoscope and two surgical arms due to a narrow workspace, which may not be sufficient for traction during surgery.⁸⁻¹⁰ In general, Maryland dissectors and Harmonic curved shears are used as two surgical arms. We devised a novel method to facilitate traction by adding an axillary port to utilize Prograsp forceps.

This study aimed to determine the technical feasibility and safety of robotic retroauricular thyroidectomy with additional axillary ports.

2 | MATERIALS AND METHODS

2.1 | Study population

Five patients underwent robotic thyroid lobectomy using a unilateral retroauricular approach without an additional axillary port between May 2016 and December 2017. Similarly, six patients underwent robotic retroauricular thyroid lobectomy using an additional axillary port between November 2019 and January 2021.

Thyroid nodules were diagnosed by ultrasonography, fine-needle aspiration cytology, and computed tomography preoperatively. Robotic thyroid lobectomy was indicated in benign thyroid nodules <5 cm and papillary thyroid carcinoma <2 cm in maximal diameter. Patients with papillary thyroid carcinoma with clinically minimal extrathyroidal extension on preoperative image, definitive cervical lymph node metastasis, or distant metastasis were excluded. Patients with previous surgical history in the neck were also excluded.

All patients gave informed consent regarding the possibility that the surgery could have converted to open thyroid lobectomy. Approval for this study was obtained from the Institutional Review Board of Seoul National University Hospital (approval number: 2102-1234-1198).

2.2 | Surgical outcomes

The clinical features, size of tumor, pathologic type, operation time, drainage amount, hospital stay, complications, postoperative cosmetic satisfaction, and postoperative neck pain and shoulder discomfort were analyzed. We assessed postoperative neck pain, cosmetic satisfaction, paresthesia, shoulder discomfort, and subjective voice outcome through the response to the questionnaires. To evaluate the patients' subjective pain, a visual analog scale (VAS) was used with a score from 0 (no pain) to 10 (most severe pain). The questionnaire for postoperative paresthesia/hyperesthesia has a response scale of 1 (hyperesthesia), 2 (slight hyperesthesia), 3 (normal), 4 (slight paresthesia), and 5 (paresthesia). The subjective discomfort of the shoulder was evaluated with questionnaires. The discomfort was rated on a scale from 1 (never), 2 (rarely), 3 (neutral), 4 (sometimes), to 5 (always). The questionnaire for



FIGURE 1 Robotic retroauricular thyroidectomy with additional axillary port. (A) The retroauricular incision was made posterior to the ear lobe. The incision was extended into post auricular crease and runs inside the hairline. Then, 0.8 cm incision was made in the axillary fossa. (B) Three robotic arms, including 30° endoscope in the center and two robotic arms on either side of the endoscope are inserted via retroauricular incision. The fourth arm with Prograsp was placed through the axillary port for retraction

postoperative cosmetic satisfaction has a response scale from 1 (very satisfied), 2 (satisfied), 3 (average), 4 (dissatisfied), to 5 (very dissatisfied). The subjective voice outcome was evaluated with the voice handicap index (VHI). The VHI consists of 30-item statements that describe the handicapping of voice, including functional, physical, and emotional scales. Each question on the VHI is rated using a 5-point scale (range 0-4). The highest score is 120 points. The higher the total score, the stronger the subjective perception of voice disability. Pain, cosmetic satisfaction, paresthesia, and shoulder discomfort were rated at 2 and

6 weeks after surgery. VHI was evaluated before operation and at 2 weeks postoperatively. The surgical outcomes were compared in patients of two groups between using an additional axillary port or not.

2.3 | Statistical analyses

A Chi-square test and Student's *t*-test were used for statistical analyses. All data were analyzed using the IBM SPSS statistical software,

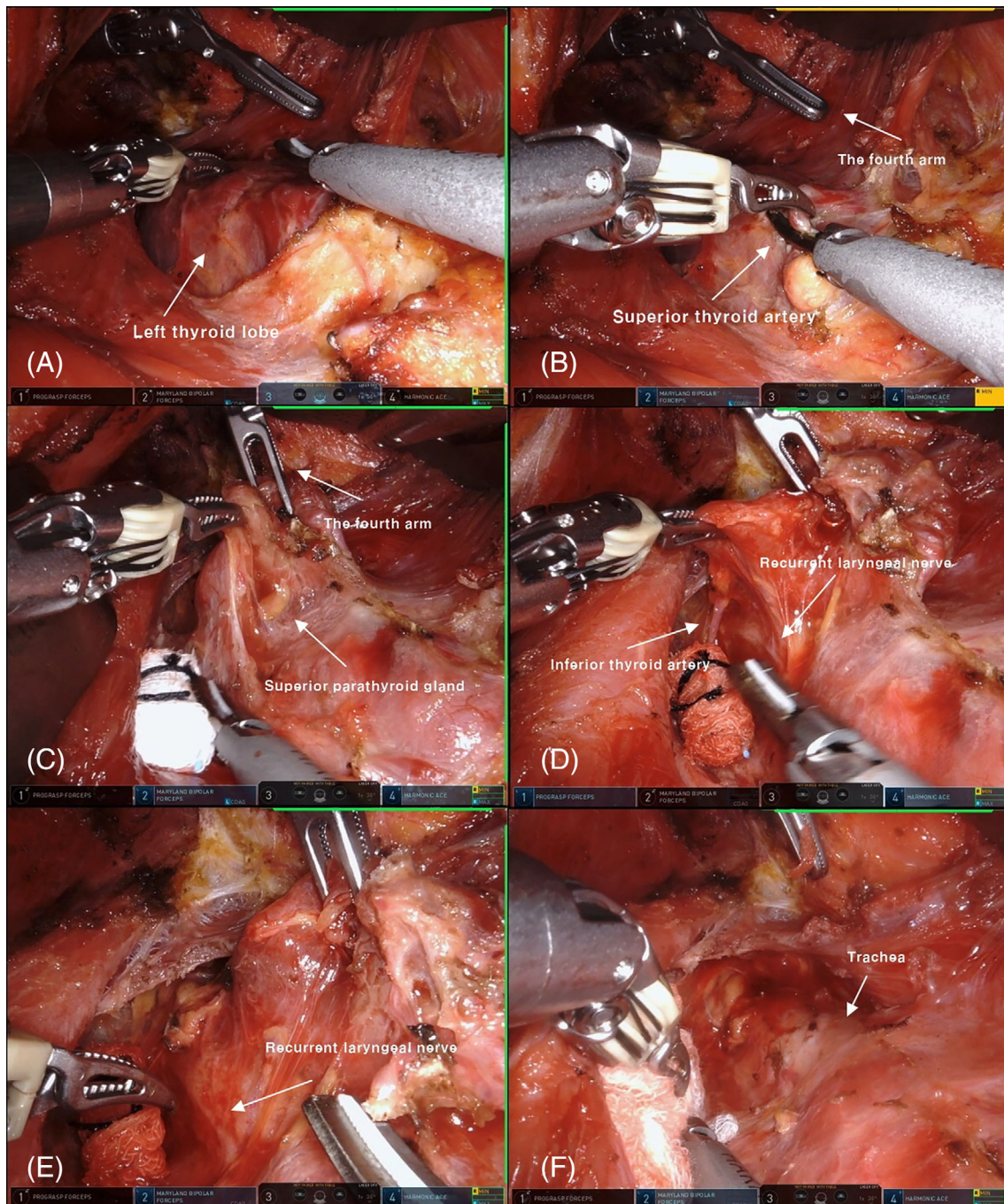


FIGURE 2 Surgical procedure for robotic retroauricular thyroidectomy with additional axillary port. (A) Exposure of the left thyroid lobe. (B) Ligation of superior thyroid vessels using Harmonic curved shears. (C) Preservation of the superior parathyroid gland. (D) Identification of the recurrent laryngeal nerve and ligation of inferior thyroid artery. (E) Further dissection from trachea. (F) The view after left thyroid lobectomy

	Axillary port (+) (n = 6)	Axillary port (-) (n = 5)	P-value
Sex, female, n (%)	6 (100)	3 (60)	.182
Age, years	39.8 ± 14.0	32 ± 7.4	.304
Body mass index, kg/m ²	22.4 ± 2.8	21.9 ± 2.3	.740
Tumor size, cm	1.3 ± 0.8	1.2 ± 0.7	.828
Pathologic type			1.000
Papillary thyroid carcinoma	4	4	
Benign	2	1	

Note: Data are presented as mean ± SD.

	Axillary port (+) (n = 6)	Axillary port (-) (n = 5)	P-value
Total operation time, min	174.5 ± 23	207.6 ± 20.1	.033*
Flap dissection time	59.8 ± 8.4	56.6 ± 8	.531
Docking time	12.2 ± 4.9	19 ± 5	.048
Console time	59 ± 11.2	90.4 ± 5.9	<.001*
Closure time	43.5 ± 3.1	41.6 ± 5.8	.501
Intraoperative bleeding, ml	86.7 ± 38.3	130 ± 156.5	.525
Drain, ml	107.7 ± 50.9	193.2 ± 112.2	.172
Hospital day	3.3 ± 1.4	4.2 ± 1.9	.450
Complications	0	0	

Note: Data are presented as mean ± SD.

*P-value < .05.

	Axillary port (+) (n = 6)	Axillary port (-) (n = 5)	P value
Postoperative pain			
Post op 2 week	1.4 ± 1.1	1.8 ± 1.5	.650
Post op 6 week	0.3 ± 1.2	1.8 ± 1.3	.546
Cosmetic result			
Post op 2 week	1.8 ± 1.0	2.2 ± 0.4	.378
Post op 6 week	1.8 ± 1.1	2.6 ± 0.9	.242
Neck paresthesia			
Post op 2 week	2.5 ± 1.7	2.4 ± 1.1	.920
Post op 6 week	3 ± 1.4	3.6 ± 1.1	.481
Postauricular paresthesia			
Post op 2 week	3.3 ± 2.1	3.4 ± 1.5	.903
Post op 6 week	3.4 ± 1.3	3.6 ± 0.9	.789
Shoulder discomfort			
Post op 2 week	4.3 ± 0.5	2.8 ± 1.6	.122
Post op 6 week	4.4 ± 0.5	3.2 ± 1.3	.094
VHI			
Pre op	3.2 ± 5	0.8 ± 1.1	.326
Post op 2 week	7.2 ± 4.5	6.6 ± 5.5	.855

Note: Data are presented as mean ± SD.

Abbreviations: pre op, preoperative; post op, postoperative; VHI, voice handicap index.

TABLE 1 Demographic data

TABLE 2 Comparison of surgical outcomes in axillary port group and without axillary port group

TABLE 3 Comparison of pain score and cosmetic satisfaction in axillary port group and without axillary port group

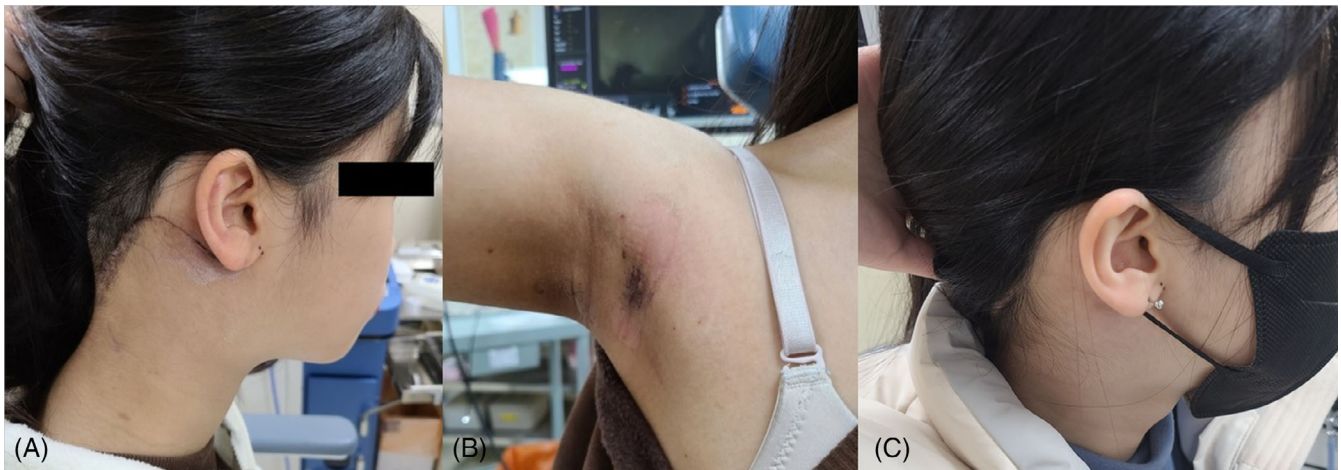


FIGURE 3 (A,B) Postoperative photographs of 2 weeks after robotic retroauricular thyroidectomy with additional axillary port. (C) Postoperative photograph of 6 months after robotic retroauricular thyroidectomy with additional axillary port. The retroauricular incision line and the axillary port installation incision line are well concealed behind the ear and in a neutral position

version 19.0 (IBM Corp., Armonk, New York). Continuous data are presented as mean \pm standard deviation (SD). In all cases, P -value $<.05$ was considered statistically significant.

2.4 | Operative procedure

All robotic thyroid lobectomies were performed by a single surgeon (E-J. C). The retroauricular incision was made posterior to the ear lobe. The incision extended into post auricular crease and along the inside of the hairline. (Figure 1A) The skin flap was created under the plane of the platysma, the superficial muscular aponeurotic system superiorly. After identification of the greater auricular nerve, the plane of dissection remained superficial to the nerve. Until identifying the anterior border of the sternocleidomastoid muscle, dissection was continued. The omohyoid muscle was retracted ventrally, and the strap muscle was dissected from the thyroid gland until the contralateral thyroid lobe is visible; then, the external retractor (Meditech Inframed, Seoul, Korea) was placed. An additional axillary 8 mm port was inserted after the flap was elevated using a tunneler. (Figure 1B) A Maryland dissector was placed in the nondominant hand, and a harmonic curved shear was placed in the dominant hand with a 30° dual-channel down viewing scope in the center. A fourth robotic arm with Prograsp forceps was inserted via the axillary port. When the robot arm was docked completely, the console work began. (Figure 2A and Video S1) The upper thyroid pole was divided from the inferior constrictor muscle, and the superior thyroid vessels were ligated using the harmonic. (Figure 2B) The superior parathyroid gland was visible and preserved. (Figure 2C) After retraction of the thyroid gland medially, the recurrent laryngeal nerve was identified in the tracheoesophageal groove. The nerve was dissected until entering the larynx; a safe space was created between the nerve and thyroid gland. The inferior parathyroid glands were dissected and preserved, and the inferior thyroid vessels were divided. (Figure 2D) The ligament

of Berry was dissected from the trachea, and the isthmus was then divided safely using the harmonic. (Figure 2E) Then, the thyroid was retrieved through the incision. (Figure 2F).

3 | RESULTS

The entire procedure of robotic retroauricular thyroidectomy was performed successfully in all patients. There were no cases converted to open thyroidectomy. All 11 patients underwent ipsilateral lobectomy, and no additional neck dissection was performed. The retroauricular approach with an axillary port was used in 6 patients, whereas the retroauricular approach without the axillary port was performed in 5 patients.

The clinical characteristics of robotic retroauricular thyroidectomy are shown in Table 1. All patients in the axillary port group were female; meanwhile, the without axillary port group comprised three females and two males. The mean age was 39.8 ± 14 years (range = 15-52 years) in the axillary port group. The postoperative pathology of the axillary port group had four patients with papillary thyroid carcinoma, 1 with follicular adenoma, and 1 with nodular hyperplasia. The mean tumor size was 1.3 ± 0.8 cm (range = 0.4-2.3 cm). There were no significant differences in sex, age, postoperative pathology, or tumor size between the two groups.

In the axillary port group, the mean operation time was 174.5 ± 23 minutes (range = 153-215 minutes). The total operation time was significantly shorter in the axillary port group compared to the without the axillary port group (207.6 ± 20.1 minutes) ($P = .033$). Specifically, the time taken for console work was significantly shorter in the axillary port group (59 ± 11.2 minutes) compared to the without axillary port group (90.4 ± 5.9 minutes; $P <.001$). The time taken for skin flap elevation wound closure did not differ between the two groups. (Table 2). The intraoperative estimated blood loss, total amount of postoperative drainage, and hospital stay were not significantly

different between the two groups (Table 2). There was no postoperative recurrent laryngeal nerve palsy, hypoparathyroidism, hematoma, or seroma in the two groups.

The postoperative pain score and cosmetic satisfaction score as rated by the questionnaires are shown in Table 3. There were no differences in the pain scores at 2 and 6 weeks postoperatively. There was also no significant difference in cosmetic satisfaction at 2 and 6 weeks after the operation. The scar in the axilla can be concealed in a natural position (Figure 3). The average paresthesia/hyperesthesia scores at 2 and 6 weeks after surgery were not significantly different between the two groups. Furthermore, there was no significant difference in the mean VHI scores at 2 weeks postoperatively.

4 | DISCUSSION

Thyroid cancer is more common in young women, making postoperative neck scars a major concern in thyroid surgery. These interests focused on the cosmetic aspect and the noninvasiveness of the operation, leading to the development of minimally invasive surgical techniques. Various approaches for endoscopic thyroidectomy have been developed and introduced depending on the site where the surgical instrument is inserted.²⁻⁵ These various approaches have their advantages and disadvantages, and it is still difficult to conclude which approach is superior. With the introduction of the da Vinci Surgical Robot System, the angle and manipulation of surgical instruments, which were uncomfortable during endoscopic thyroidectomy, became much easier. Robot thyroid surgery offers a 10 to 12-fold magnified view with a three-dimensional surgical image, sophisticated movement with wristed instrumentation, tremor filtration, and excellent surgical ergonomics. It helps to identify and preserve important structures, such as the recurrent laryngeal nerve and parathyroid gland during surgery.^{7,11}

The retroauricular approach using a surgical robot was initially reported by Terris et al⁴ and has been popularized. The approach employs facelift incision, which is more familiar to head and neck surgeons, as it is utilized in parotid surgery to resect the submandibular gland. The retroauricular approach allows a shorter distance between the incision and thyroid gland and a lesser dissection area than the transaxillary approach.⁶ The postoperative scar can be concealed behind the auricle. The drawbacks of this approach are that working space is narrow, and contralateral incision is sometimes required to approach the contralateral thyroid lobe when the exposure is not sufficient due to prominent thyroid cartilage and trachea.¹² The greater auricular and marginal mandibular nerves can be injured in the retroauricular approach.

Usually, all 4 robotic arms (30° endoscope, Maryland dissectors, Harmonic curved shears, and ProGrasp fenestrated forceps) are used in the transaxillary approach.^{7,13} However, in the retroauricular approach, if the working space is limited, three robotic arms, including the 30° endoscope, Maryland dissectors, and Harmonic curved shears, are inserted via the retroauricular incision, and only two robotic arms are used for an active procedure without the ProGrasp due to instrumental collision. Dissection with two instrument arms instead of three is difficult and time-consuming. For this reason, the authors proposed

a new surgical method using an additional axillary port with ProGrasp forceps. ProGrasp forceps could be used via a small axillary incision without any instrumental collision. Dissection could be done easily with the aid of traction by the ProGrasp forceps. This method could help to identify and preserve important structures, such as the recurrent laryngeal nerve and parathyroid gland, reduce operative time, and make the procedure safer.

There have been reports of using four robotic arms through the retroauricular approach, but in our experience, positioning the four robotic arms to prevent collision with each other when docking in the existing system is a difficult and time-consuming task, and in some cases, it fails. In our new method, the process of docking four robotic arms is easy and more consistent than the method using four robotic arms only through the retroauricular approach, and it can also reduce robot arm collisions during surgery.

There were no significant differences in cosmetic satisfaction and pain in the additional axillary port group compared with the without axillary port group. The reasons are that the incision scar in the axilla can be obscured in the neutral position, and the blunt dissection with the surgical tunneler for the additional axillary port seems to have been less invasive.

The current study has several limitations. Small number of subjects were analyzed, and the study was a retrospective design, which could have resulted in selection bias. There was a time difference between the groups with and without additional axillary ports; therefore, it is possible that the operating time was shortened by the operator's learning curve. However, after devising a new method, we clearly observed that the surgery was much easier and safer using a third robotic arm, rather than using the learning curve. Despite these limitations, the current study suggested an alternative operative method. Long-term follow-up with large number of cases are required to determine the feasibility of using additional axillary port.

5 | CONCLUSION

In this study, we present a method for robotic retroauricular thyroidectomy using an additional axillary port and the results of our technique. Robotic retroauricular thyroidectomy with an additional axillary port is a safe, feasible method that is easily reproducible.

CONFLICT OF INTEREST

The authors declare no potential conflict of interest.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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