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Recent advances in single-port robotic thyroidectomy: evolution, techniques, and clinical outcomes

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Robotic thyroidectomy has progressed from multiport to single-port (SP) platforms to minimize invasiveness and improve cosmesis. The da Vinci SP system (Intuitive Surgical) combines a flexible 3-dimensional endoscope with 3 wristed instruments in a single 2.5-cm cannula-enabled concealed remote access route and mitigates external arm collisions. This review synthesized PubMed-indexed reports (2020–2025) on SP robotic thyroidectomy using the following approaches: transaxillary variants, SP areolar, retroauricular/facelift (SP-hairline variants), and transoral approach. We focused on technical refinement, learning curves, and clinical outcomes. We highlight technical refinements and clinical outcomes across access routes. Contemporary series indicate that SP thyroidectomy is feasible and safe in well-selected patients, with high cosmetic satisfaction and operative metrics comparable to those of multiport cohorts. Among the SP routes, transaxillary variants have the most mature peer-reviewed reporting and are therefore discussed in greater detail. Early applications of SP-assisted lateral neck dissection have also been described. The limitations of current SP platforms include constrained counter-traction, reduced internal workspace, and incomplete integration of advanced energy devices. Nonetheless, ongoing device innovations and the growing global experience suggest that SP systems will increasingly shape endocrine neck surgeries.
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Key Words: Minimally invasive surgical; Neck dissection; Robotic surgical procedures; Thyroidectomy

INTRODUCTION

Robotic thyroid surgery has achieved unprecedented technical progress over the past 2 decades, reshaping the management of thyroid and parathyroid diseases. Early adoption of the da Vinci system (Intuitive Surgical) by endocrine surgeons led to the development of several remote-access approaches, including the transaxillary [1], bilateral axillobreast (BABA) [2], retroauricular [3]/facelift [4], and transoral [5] techniques, predominantly developed in East Asia, especially South Korea. These approaches seek to overcome the cosmetic and functional limitations of conventional open thyroidectomies such as visible cervical scarring and suboptimal visualization of the recurrent laryngeal nerve (RLN) and parathyroid glands.

A single-center series reporting more than 10,000 remote-access robotic thyroidectomies, including early multiport and more recent single-port (SP) experiences, was recently published in South Korea, with subsequent reports expanding the evidence base to other settings [6]. This milestone highlights the procedural maturity and clinical safety of robotic thyroidectomy as a mainstream surgical option. While this represents a major advance in the field, early multiport systems carried approach-specific tradeoffs; for example, some routes require broader subplatysmal elevation, while others rely on

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multiple skin incisions, prompting efforts to refine cosmesis and ergonomics [1-3,7-12]. These constraints, together with ergonomic challenges related to external arm collisions, have catalyzed the development of more compact and less invasive robotic platforms.

The advent of the SP robotic system represents a pivotal step in this evolution. The da Vinci SP platform integrates a flexible, fully wristed 3-dimensional (3D) endoscope and 3 multi-jointed instruments within a single 2.5-cm cannula to minimize external arm collisions, reduce surgical trauma, and improve cosmetic outcomes by enabling minimized, strategically concealed incisions across eligible approaches [13,14]. This configuration is particularly advantageous in anatomically confined cervical regions where conventional multiport systems may encounter restricted maneuverability [13]. Despite these benefits, the clinical adoption of SP thyroidectomy remains concentrated in high-volume expert centers and is hampered by a lack of compatible advanced energy devices, limited countertraction, and a steep learning curve [15-17].

This review summarizes the evolution, technical innovations, clinical outcomes, and future perspectives of SP robotic thyroidectomy based on contemporary literature and representative institutional experience.

From a geographic standpoint, remote-access robotic thyroidectomy originated in South Korea in transaxillary and BABA forms, while the transoral endoscopic vestibular approach originated in Thailand; its transoral robotic adaptation (TORT) has since been developed and widely reported, particularly by Korean centers. In this review, we use SP-TORT for the SP platform cases. The retroauricular/facelift approach was first described in the United States and has since been vigorously adopted and refined in Korea. In the SP era, a substantial proportion of early peer-reviewed clinical reports came from Korea, with additional contributions from Thailand, China, the United States, and Europe. Accordingly, we synthesized all approaches and their outcomes while providing greater procedural granularity for transaxillary techniques, for which the literature is the most mature.

Finally, this review focuses on SP approaches with peer-reviewed clinical series in living patients, namely transaxillary variants, SP robotic areolar (SPRA), retroauricular/facelift (SP-hairline), and transoral entries. The emerging presternal and submental routes using the da Vinci SP system are not covered because they have been described only in cadaveric feasibility studies and lack clinical series suitable for evidence synthesis [18].

We reviewed all SP access routes (transaxillary, SPRA, SP-hairline, and transoral) with an emphasis on transaxillary variants because, as of November 2025, they have the densest peer-reviewed reporting and clearest technical standardization in the SP era. This emphasis does not imply clinical superiority; rather, it reflects the current distribution of evidence.

MAIN BODY

Historical background and rationale

Robot-assisted thyroid and parathyroid surgeries originated in the early 2000s and are catalyzed by the drive to avoid prominent cervical scarring. The Yonsei University group described the "gasless transaxillary robotic thyroidectomy (TART)" in 2007, followed by the BABA, retroauricular/facelift, and TORT approaches [1-5]. Conventional multiport systems (S, Si, X/i, and Xi) enable radical improvements in visibility and precision; however, their geometric rigidity necessitates multiple external arms, leading to a higher risk of arm collision, extended flap dissection, and increased perioperative morbidity compared to open or endoscopic techniques.

SP robotic systems, particularly the da Vinci SP (approved by the U.S. Food and Drug Administration in 2018 for urology and 2020 for selected transoral cases), represent a technological response to these limitations [14]. By combining a flexible endoscope and 3 instruments within a single 2.5-cm cannula, arm collisions are virtually eliminated and the internal workspace requirement is reduced [13]. Importantly, a single incision was made in a concealed location (axilla, areola, oral vestibule, or postauricular crease) to optimize patient satisfaction and broaden the pool of surgical candidates. From an oncological standpoint, SP approaches appear comparable to multiport and open surgery in appropriately selected patients [19-22].

Despite these significant advances, the learning curve and initial capital investments of SP platforms are steep. Early institutional case series underscored the need for carefully structured training and extended proctorship, as well as ongoing device integration (energy devices and vessel sealers) to optimize procedural safety [13,19,22,23].

Transaxillary variants and other surgical approaches in single-port thyroidectomy

Given the current distribution of evidence, transaxillary variants have been described in greater detail without implying clinical superiority.

Common patient positioning and incision principles across single-port approaches

Across the SP thyroidectomy routes, patients are positioned supine with mild neck extension on a thin shoulder roll or backrest, pressure points are padded, and neuromonitoring is confirmed. This shared foundation minimizes airway/venous compromise and standardizes the camera-to-target depth ratio. Approach-specific differences include transaxillary variants (arm position and draping to balance exposure with invasiveness), retroauricular/facelift (typically 20°–30° contralateral head rotation for a lateral-to-medial view), and

transoral variants (oral-vestibule preparation with tooth protection and mental-nerve-sparing drape). For transoral cases, the working space is maintained with low-pressure CO_2 insufflation or, in select reports, a gasless retraction technique [21,24]. Incisions follow concealed lines: axillary crease (transaxillary), periareolar (SPRA), retroauricular/facelift, or midline oral vestibule (SP-TORT). Camera orientation generally differs by route (below-view for transaxillary; typically above-view for areolar, hairline, and transoral entries). The approach schematics with flap extent and key landmarks are shown in Fig. 1.

Transaxillary access (SP-TART, START, GOSTA)

The transaxillary approach is the most extensively reported SP route and provides a familiar workspace for surgeons transitioning from multi-arm systems. With the introduction of the da Vinci SP platform, early adopters began predominantly with SP-TART, a direct SP adaptation of the conventional 4-arm transaxillary workflow [25]. To further limit flap dissection between the axilla and the sternocleidomastoid (SCM), the SP transaxillary thyroidectomy with a 2-step retraction method (START) was developed [19]. Independently, the gas insufflation one-step SP transaxillary approach (GOSTA) was introduced into the streamline setup and enabled reduced bedside assistance [23]. In practice, many surgeons have trialed SP-TART first, incorporated START to minimize dissection, or selected GOSTA for workflow simplicity. All 3 variants have been reported as safe and feasible. The choice among SP-TART,

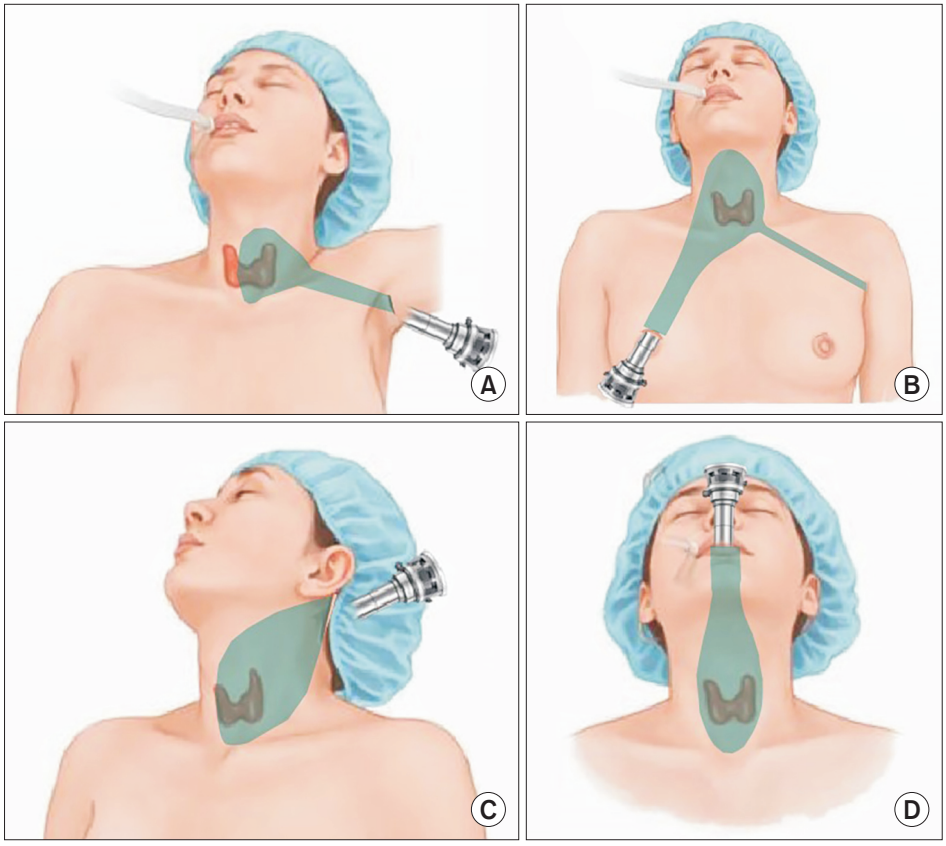

Fig. 1. Single-port (SP) robotic thyroidectomy approaches (shaded areas indicate skin flap.) All schematics are illustrated using a left-sided thyroid lobectomy as the reference orientation. (A) Transaxillary variants. SP-TART (gasless transaxillary robotic thyroidectomy) uses a wider manual flap with conventional docking; START (SP transaxillary thyroidectomy with a 2-step retraction) uses 2-step retraction with robotic completion of the central flap, developing the working space toward the sternocleidomastoid muscle (SCM) and accessing the thyroid beneath the strap muscles. GOSTA (gas insufflation one-step SP transaxillary approach) represents a one-step transaxillary workflow with fixed retraction. The shaded flap area in is depicted based on START as the reference. (B) SP areolar approach. A periareolar SP entry is consistently placed at the right areola regardless of laterality, with direct subcutaneous tunneling to the central neck; the flap extends from the areola to the upper level/border of the thyroid cartilage. An auxiliary small port is placed either via the contralateral circumareola (early series) or the contralateral axilla (recent modifications) (C) Retroauricular/facelift (hairline) approach. A postauricular/facelift crease incision with pproximately 20°–30° contralateral head rotation; a subplatysmal flap is elevated along the SCM anterior border (toward the clavicle) to create the working space. (D) Retroauricular/facelift (hairline) approach. A postauricular/facelift crease incision with approximately 20°–30° contralateral head rotation; a subplatysmal flap is elevated along the SCM anterior border (toward the clavicle) to create the working space.

START, and GOSTA typically reflects surgeon experience, case complexity, and institutional resources; for example, some teams value the familiarity of SP-TART, whereas others adopt START to limit the flap extent or GOSTA to reduce bedside assistance. These options allow tailoring of exposure, assistant dependence, and workspace creation to case complexity while preserving a hidden axillary incision and a below-view camera trajectory that affords a caudo-cranial perspective of the central compartment and RLN.

SP-TART

In an early Korean experience (circa 2018), the SP system was applied by directly adapting the conventional 4-arm TART; the thyroid was exposed under direct vision via an axillary incision, followed by robotic docking for resection [1,7-12]. This approach proved feasible and oncologically safe but trade-offs that may offset some minimally invasive advantages depending on team familiarity and case selection [25]. For example, although the flap is smaller than in classic 4-arm TART, the manual dissection is generally more extensive than in START or GOSTA, and a bedside assistant is typically required.

START with 2-step retraction method

To reduce dissection, the flap was initially created only up to the SCM under direct visualization. A narrow version of Chung's retractor gently maintains the working space, and after SP docking, the central neck flap is robotically completed. This minimizes invasiveness while maintaining operative time and oncologic safety and enhances cosmesis by using the natural axillary skin crease. Skilled assistants and precise docking are required [19].

GOSTA

This is a single-stage, gas-insufflating transaxillary technique that utilizes CO_2 pressure to create working space, eliminating the need for fixed retractors and reducing assistant requirements for a streamlined thyroidectomy [23].

Patient position and incision (transaxillary-specific details-specific details)

Building on the common setup described earlier, a 3–3.5-cm incision is made along the axillary natural crease with mild neck extension. The arm position differs by variant: in SP-TART, the lesion-side arm is raised and fixed (maximal axillary exposure); in START, the arm is abducted but draped to allow controlled intraoperative repositioning for 2-step retraction; and in GOSTA, the arm is typically kept lowered and draped to maintain a compact field for the single-stage (gasless) approach.

Robot setup and camera

The SP cannula is inserted through the axilla with a below-view camera orientation, yielding a caudo-cranial perspective toward the thyroid and tracheoesophageal groove, which facilitates RLN identification and reduces external arm collisions. In a published SP series, a common baseline configuration used mounted bilateral Maryland bipolars in working channels with a superior Cadiere for retraction. In practice, the instrument mix and channel indexing are adapted to the task; for example, monopolar curved scissors or hooks are used for precise dissection and re-indexing camera/instrument positions within the cannula to maintain triangulation during contralateral lobe work or central node dissection.

Advantages and limitations

All 3 variants avoid cervical scarring and offer stable ergonomics with high-definition visualization of the RLN and parathyroids. SP-TART is broadly reproducible but flap-intensive, START minimizes flap size with higher assistant demands, and GOSTA enables a single-surgeon operation but may restrict counter-traction in narrow fields. An early series reported a mean operative time of 90–150 minutes, mean blood loss of <50 mL, and transient RLN palsy rate of <3%.

Taken together, the 3 SP transaxillary variants differ primarily in flap extent, assistant dependency, and docking timing: SP-TART favors wide manual exposure with conventional docking, START minimizes dissection via 2-step retraction and internal completion of the central flap, and GOSTA streamlines a single-surgeon, gasless workflow at the expense of reduced counter-traction. These contrasts are summarized in Table 1 for rapid comparison.

Bilateral axillobreast and areolar access (BABA/SPRA)

Classic BABA uses bilateral areolar and axillary incisions to enable symmetric total thyroidectomy with excellent exposure but extended dissection and multiple ports. With SP adoption, SPRA emerged as a periareolar hybrid that reduces the flap area by >50% compared with BABA while preserving bilateral access [20,22,26].

Patient position/incision

Supine with neck extension; SP docking is performed via a approximately 3-cm right circumareolar incision with subcutaneous tunneling/flap elevation to the central neck, and an auxiliary small port is placed either in the contralateral circumareola (early series) or the medial axilla (recent modifications) [20,22,26].

Robot setup and camera

The SP cannula is introduced through the right areolar incision; internal triangulation enables thyroid lobectomy with central neck dissection, while the auxiliary port (contralateral circumareola or medial axilla) is used as needed for flap work

Table 1. Comparison of SP transaxillary techniques (SP-TART, START, GOSTA)

Feature	SP-TART	START	GOSTA
Flap/working-space creation	Conventional gasless transaxillary working space with an external retractor; flap to SCM/strap region before console work	Two-step retraction method: up to SCM, then robotic central flap dissection	Single-step, CO_2 insufflation–assisted dissection without an external retractor
Docking	After full flap exposure	After partial flap creation	One-step workflow (continuous single-port procedure with insufflation)
Advantages	Reported feasible/safe outcomes in clinical series; gasless TA familiarity	Reduced flap extent with two-step method; feasibility demonstrated in a large clinical series	One-step insufflation workflow without a retractor; feasibility and safety reported with reduced assistant workload

SP, single port; TART, gasless transaxillary robotic thyroidectomy; START, single-port transaxillary thyroidectomy with a 2-step retraction; GOSTA, gas insufflation one-step single-port transaxillary approach; SCM, sternocleidomastoid.

Table 2. Comparison between BABA and SPRA approaches

Feature	BABA	SPRA
Incision	Four small incisions (bilateral axilla and areola)	Primarily a single right areolar access incision for SP docking; an auxiliary trocar may be used in some modifications (technique-dependent)
Working space	Bilateral, multi-site subcutaneous flap elevation to the central neck (axilla + areola)	Reduced flap dissection (smaller working space creation *vs.* BABA)
Docking	Four-arm robotic system	Single SP cannula
Advantages	Symmetric "bottom-up" view; familiar workflow with established experience	Avoids bilateral axillary dissection with a smaller flap; preserves a BABA-like breast-to-neck view

BABA, bilateral axillobreast; SPRA, single-port robotic areolar; SP, single-port.

and suction/irrigation and may serve as a drain site [20,22,26].

The endoscope is commonly configured in an above-view orientation to provide a caudo-cranial view toward the central neck, with channel indexing adjusted intraoperatively for exposure during flap dissection and central compartment work [20,22,26].

Advantages and limitations

An early series reported shorter operating/hospital times and lower drainage rates than those of BABA, with equivalent complication rates and very high cosmetic satisfaction. As with other SP routes, feasibility in reoperative or extensive lateral neck disease is highly operator- and center-dependent, and early SPRA reports emphasized careful selection and stepwise adoption [20,22,26].

Compared with multiport BABA, SPRA reduces the number/length of skin incisions and limits subcutaneous dissection while preserving bilateral access for total thyroidectomy and central compartment work; setup is simplified through a single SP cannula, though reach and learning-curve considerations remain. The key technical and perioperative distinctions are outlined in Table 2.

Single-port retroauricular/facelift (hairline) approach

A 2.5–3.0-cm postauricular skin-crease incision enables subplatysmal tunneling to the neck and is used primarily for unilateral lobectomy or selected central compartment dissection [27,28].

Setup

Given the lateral entry, an above-view camera configuration is typical; approximately 20°–30° contralateral head rotation is often added to optimize the lateral-to-medial view [27,28].

Advantages and disadvantages

This approach offers excellent scar concealment and a direct trajectory to the lateral neck. An early series reported visualization of the RLN and parathyroids comparable to SP transaxillary cases when appropriately selected. However, the narrow corridor and longer instrument path can challenge maneuverability, limiting the indications for large goiters or extensive bilateral/lateral-neck procedures. The evidence volume remains small relative to the transaxillary series, and current indications are intentionally narrow, pending broader experience. The core features and their practical implications are summarized in Table 3.

Transoral approach (single-port transoral robotic adaptation)

Through a single approximately 2.5-cm midline oral-vestibular incision, a subplatysmal pocket is created and, in most series, maintained with low-pressure CO_2; the SP system is then docked to establish a stable midline workspace with the incision concealed within the oral vestibule. Gasless SP-TORT adaptations have also been reported, demonstrating their feasibility in selected settings [21,24].

Setup

The above-view camera configuration is typical and the 3 wristed instruments enable precise dissection within the confined central neck.

Outcomes

Excellent cosmesis, typical operative times of 120–160 minutes; transient RLN palsy <3% in a recent series.

Caveats

Technical demands are substantial, with potential risks, including CO_2-related events and mental nerve injury. Standardized low-pressure protocols and mental nerve-sparing vestibular dissection are recommended with careful patient selection (e.g., benign nodules or papillary thyroid microcarcinoma ≤2 cm without gross extrathyroidal extension [ETE]) [21,24].

Table 3. SP retroauricular/facelift (SP-hairline) approach

Feature	Description
Incision	Postauricular crease incision with extension toward the occipital hairline (facelift-type incision)
Flap extent	Subplatysmal flap with identification of the SCM; dissection proceeds along the SCM toward the lower neck to access the thyroid compartment
Docking	SP cannula introduced through the retroauricular/hairline incision
Advantages	No anterior cervical skin scar (postauricular/hairline scar is typically concealed); feasibility and safety have been reported in appropriately selected patients

SP, single port; SCM, sternocleidomastoid.

Comparison with multiport transoral robotic adaptation

The SP configuration centralizes docking through a single midline vestibular incision, typically permits lower insufflation pressures and improves depth perception via a coaxial flexible 3D endoscope, simplifying triangulation and potentially reducing tissue trauma. These contrasts and their clinical implications are summarized in Table 4.

Clinical outcomes and comparisons

Operative outcomes (platform-specific)

Single-port transaxillary

Most series (SP-TART, START, and GOSTA) reported a mean operative time of 90–150 minutes for lobectomy, blood loss of <50 mL, and sharp improvement in console efficiency after 15–20 cases [15-17]. START shortens flap creation by approximately 20% compared to SP-TART [19], whereas GOSTA reduces bedside assistance at the cost of limited counter-traction [23].

Single-port robotic areolar

Operative time approximately 120 minutes; flap area reduced >50% *vs.* BABA [20,22,26]. Symmetric exposure allows for efficient total thyroidectomy through a single periareolar incision. The drain output and hospital stay were consistently shorter than those in the multiport BABA [20,22,26].

Single-port retroauricular/facelift (hairline)

Lobectomy is typically 100–140 minutes [27,28]. A longer instrument path increases setup complexity, but docking is rapid. Exposure of the RLN and parathyroids was comparable to transaxillary routes in a small-volume series [27,28].

Single-port transoral robotic adaptation

The reported mean time is 120–160 minutes [21,24]. Setup through a single midline vestibular incision minimizes tissue trauma; a CO_2 pressure of 4–6 mmHg reduces the risk of

Table 4. Comparison between multi-port TORT and SP-TORT

Feature	Multi-port TORT	SP-TORT
Incision	Three vestibular incisions; an additional axillary port may be used depending on technique	Central vestibular incision extended to 2.5–3 cm Lateral 5-mm vestibular incisions may be created initially and then closed (technique-dependent)
Docking	Multiple arms	SP through the central vestibular incision
Assistant	Generally required	Generally required; bedside arm-management needs may be reduced (setting-dependent)
Cosmetic result	No cervical skin scar; a small axillary scar may present if an axillary port is used	No cervical/axillary scar; an additional axillary incision is typically not required

SP, single port; TORT, transoral robotic thyroidectomy.

subcutaneous emphysema [21,24]. The console time decreased markedly after approximately 10 cases in experienced robotics teams [21,24].

Safety and complications

The incidence rates of transient RLN palsy, permanent RLN palsy, temporary hypocalcemia, and major bleeding/infection are approximately 1–3%, <1%, approximately 5–8% with resolution in weeks, and <1% (aggregate across routes), respectively. Gasless transaxillary and hairline entry prevents CO_2-related events, whereas SP-TORT requires strict pressure control [21,24]. No mortality or life-threatening events were reported in the contemporary series.

Patient-reported and cosmetic outcomes

Across SP platforms, patients report lower pain and higher cosmetic satisfaction than those in the multiport or endoscopic cohorts. Hidden incisions (axilla, areolar, hairline, and oral vestibule) yield excellent cosmesis; a return to daily life in approximately 3–5 days is common [15-17,19-23,27,28].

Oncologic feasibility

SP thyroidectomy achieves complete resection for tumors ≤3 cm without gross ETE in appropriately selected patients. Central lymph nodes yield an average of 5–9 nodes, comparable to multiport or open cohorts, with acceptable margin status and early biochemical [19-22].

Early recurrence rates remain low (<2% at 1–2 years in the available series), although long-term multicenter data are limited. Taken together, SP thyroidectomy demonstrates oncologic adequacy comparable to that of conventional approaches and provides proper case selection and adherence to standardized techniques.

Single-port robotic neck dissection

Using the SP transaxillary route, an early single-center series demonstrated the feasibility of comprehensive lateral neck dissection (levels II–V) through a single axillary incision [29-31]. Flexible instruments and a 3D endoscope facilitate meticulous dissection while preserving the major neurovascular structures. Compared with multiport or open modified radical neck dissection (RND), SP-RND offers superior cosmetic outcomes, reduced flap morbidity, and improved ergonomics. Early series (sample size of approximately 20–30) report lymph-node yields of approximately 25–30 and operative times of 180–220 minutes, without major vascular or neural injury. Technical constraints include restricted counter-traction and limited access to level IIb; future articulating SP systems may mitigate these issues.

According to a recent multi-institutional review [25], the evolution of SP-RND mirrors that of SP thyroidectomy itself. The initial SP-RND reproduced the traditional multi-arm transaxillary robotic modified RND workflow under the SP platform, confirming its oncological safety and technical feasibility. Subsequently, the SP transaxillary robotic RND (STAR-RND) technique was developed to minimize flap dissection using a 2-step retraction method [29], while the GOSTA-RND technique aimed to streamline the procedure and enable near-solo surgery [30]. Both approaches maintained adequate nodal yield and avoided major complications, highlighting the procedural versatility of the SP system for lateral neck dissection.

To date, peer-reviewed SP-assisted RND has been reported predominantly via transaxillary variants, including STAR-RND [29] and GOSTA-RND [30], and in a smaller series via the SPRA-RND) [31]. Across these reports, feasibility has been demonstrated with lymph node yields of 25–30 and operative times of 180–220 minutes without major vascular or neurological complications in carefully selected patients [29-31]. In contrast, as of November 2025, large-scale patient cohort studies using SP hairline or transoral routes for lateral neck dissection have not been published [32,33].

Technical insights and learning curve considerations

Learning curve and proficiency acquisition

Across contemporary series, the learning curve for SP thyroidectomy generally spans approximately 15–30 cases, trending toward approximately 15–20 with substantial prior robotic/endoscopic experience and a trained bedside assistant (docking time and collisions stabilized; lobectomy ≤120 minutes) [15-17]. Early lobectomy times (approximately 150–180 minutes) typically decline to approximately 90–120 minutes with console familiarity, flap creation, and retraction control standardization. The simulation, dual-console mentoring, and wet-lab rehearsal shortened the curve by approximately 30%. Safety remained stable across learning phases, with transient RLN palsy <3% and hypocalcemia <8% under structured proctoring [15-17].

Practical recommendations for novice surgeons

Plan curricula around a 15–30-case learning window, targeting the lower end when prior multiport/endoscopic experience and a trained bedside assistant are present [15-17].

How to start

For the first several cases, train on-site at a high-volume SP center together with a bedside assistant, and standardize traction angles, instrument handoffs, and verbal cues. When proctoring is unavailable, consider self-retaining narrow retractors (e.g., START) and favor low-force short-lever maneuvers.

Case selection

Start with unilateral, low-risk nodules (≤1 cm) in non-obese patients without prior neck surgery.

Docking discipline

Maintain approximately 25–30 cm cannula-to-target distance. This standardizes instrument sequence and team roles.

Camera/view

A below-view orientation for transaxillary cases is preferred because the superior Cadiere channel can then provide efficient traction on the specimen or adjacent structures, while the bilateral working channels perform dissection.

Video review

Record every case and conduct brief team debriefs; tag key clips (docking, flap creation, and RLN/parathyroid identification) to accelerate proficiency and reduce avoidable errors.

CONCLUSION

SP robotic thyroidectomy has matured across transaxillary, areolar, hairline, and transoral routes, delivering comparable perioperative safety and excellent cosmesis in properly selected patients. Transaxillary variants remain the most granularly described, reflecting reporting density rather than inherent superiority. Current limitations, such as counter-traction constraints, incomplete energy-device integration, and contacts, are likely to ease with next-generation SP instruments, standardized training, and imaging/artificial intelligence adjuncts. Long-term multicenter outcomes, particularly oncologic durability and lateral neck applications, are key evidence gaps to close next.

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