

ROBOTIC SINGLE-PORT INTERCOSTAL THORACIC SURGERY: TECHNIQUE, WORKFLOW OPTIMIZATION AND KEY INSIGHTS

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Introduction: Single-port (SP) robotic platforms represent a major evolution in minimally invasive thoracic surgery. Current thoracic applications predominantly rely on a subcostal approach, which may limit exposure of apical segments and posterior hilar structures and often requires diaphragmatic manipulation. We developed a purely intercostal uniportal robotic technique using the da Vinci SP system (Intuitive Surgical, Sunnyvale, CA, USA) to overcome these limitations. This study describes the standardized workflow and technical refinements in an early clinical experience.

Methods: A standardized intercostal uniportal approach was implemented across two centers using the da Vinci SP system. Surgery was performed through a 4-5 cm anterior axillary incision in the sixth intercostal space for upper/middle lobes and the seventh for lower lobes. Patients were positioned in lateral decubitus with table flexion to optimize intercostal spacing. Optional low-pressure CO₂ insufflation (8-10mmHg) was used to enhance exposure. A fixed instrument configuration (fenestrated bipolar grasper, Maryland bipolar forceps, Cadiere forceps) and a structured communication protocol with predefined arm nomenclature were systematically applied (Fig.1). Curved-tip manual staplers were introduced through the service channel using loop-guided traction and temporary withdrawal of one robotic arm (Fig. 2). The technique was applied to all lobectomies and selected complex segmentectomies, including right upper lobectomy, S2 segmentectomy, and S8+S9 bisegmentectomy (Table 1).

Case n°	Age (yrs)	Sex	Procedure	Operative time (min)	Postoperative complication grade (Clavien-Dindo)	LOS (days)	Pathology	Pathologic stage
1	69	F	RUL	207	II	4	Adenocarcinoma G2	IA2
2	68	M	RUL	168	II	10	Adenocarcinoma G3	IB
3	70	M	S2	139	II	9	Adenocarcinoma G3	IA1
4	67	F	S8+S9	159	None	2	Adenosquamous carcinoma	IA2
5	68	M	RUL	258	None	5	Adenocarcinoma G3	IA3

Table 1: Initial clinical experience with intercostal single-port robotic anatomical pulmonary resection.

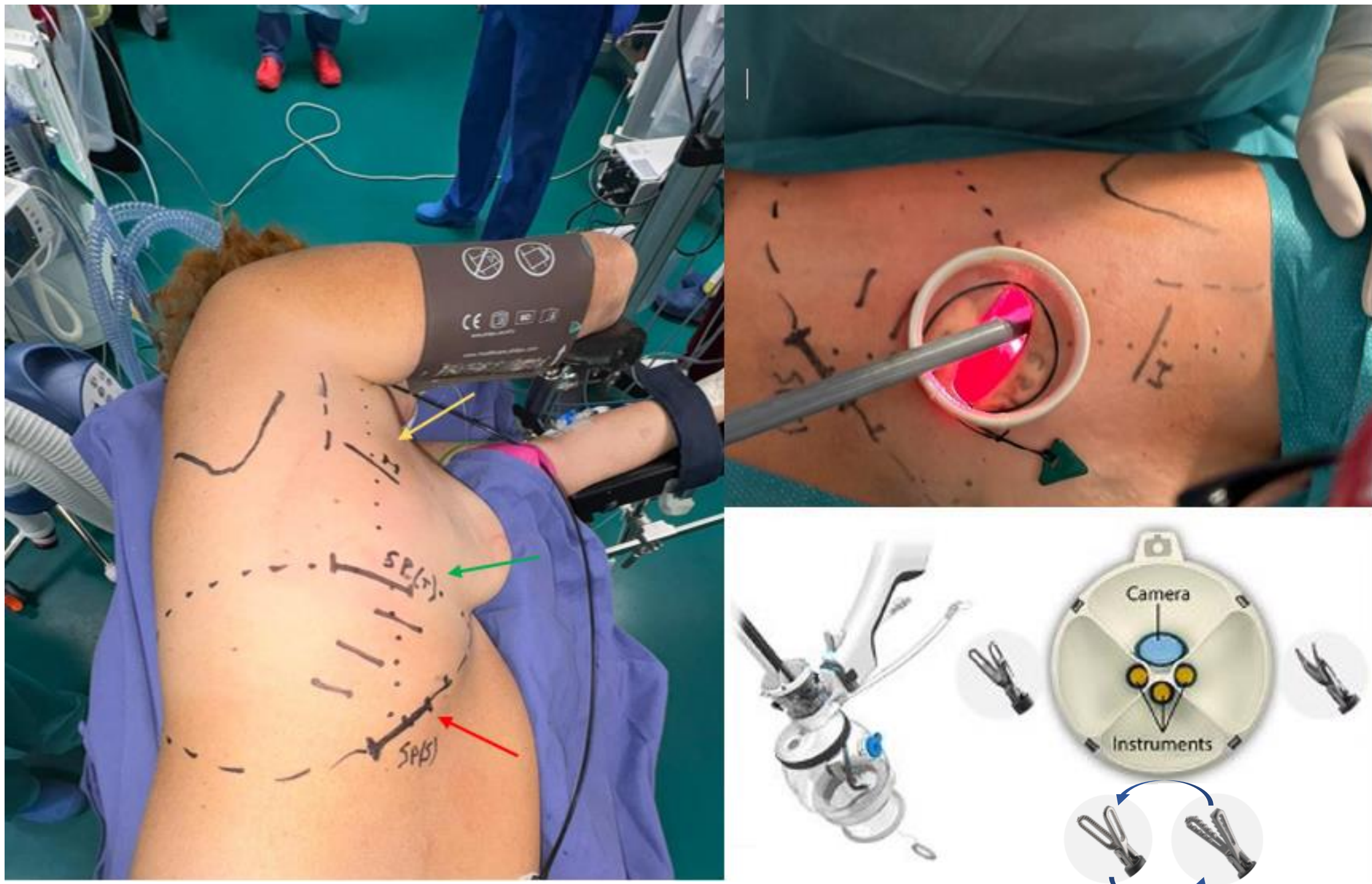


Fig. 1: Patient positioning, incisions and instrument setup. (A) Standard multiport access for the utility incision (yellow arrow); standard subcostal intrathoracic access (red arrow); and uniportal intercostal access (green arrow). (B) Insertion of the robotic SP camera through the intercostal incision before docking. (C) Standard instrument configuration: camera in the upper port, left arm with fenestrated bipolar grasper, right arm with Maryland bipolar forceps, and middle channel with Cadiere forceps.



Fig. 2: The da Vinci SP platform fully docked through the intercostal access with the robotic camera and instruments in working position. The inset demonstrates introduction of a manual stapler through the service channel.

Results: The intercostal approach provided a direct trajectory to hilar structures and apical segments bilaterally, improving exposure in anatomically challenging areas compared with subcostal access. Docking time and total operative duration were comparable to our established multiport robotic approach. Rib-arc constraints were the main technical limitation but were effectively mitigated through table flexion, intercostal level selection, and coordinated instrument handling. Stapling through the service channel was feasible in all cases, although it required specific strategies including loop-guided alignment and temporary arm withdrawal. Standardized communication and arm nomenclature improved intraoperative coordination and reproducibility. CO₂ insufflation enhanced visualization, particularly in lower lobe resections, but was not mandatory. The technique preserved a true uniportal approach without routine need for additional ports or conversion.

Conclusions: The intercostal SP robotic approach is a feasible and reproducible alternative to subcostal access for anatomical lung resections. It offers improved access to apical and posterior hilar structures while avoiding diaphragmatic manipulation. Standardization of setup, instrumentation, and team communication is essential to ensure safety and facilitate adoption. This approach may represent an important step in the evolution of robotic thoracic surgery, particularly for surgeons transitioning from multiport platforms.

References:

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