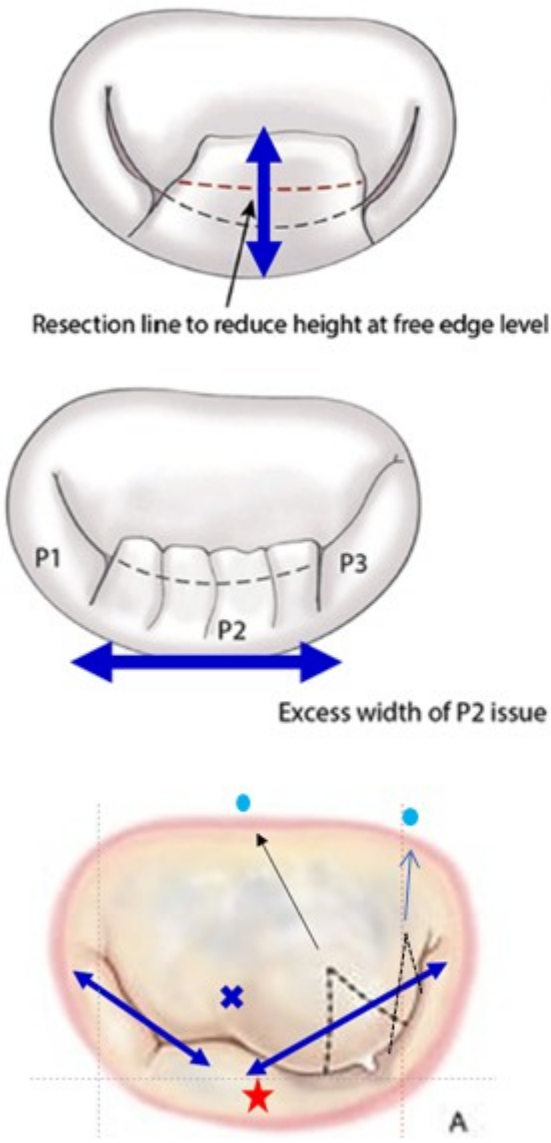


Robot-assisted vs 3D Endoscopic Mitral Valve Repair Using A “Loop + Resect With Respect” Strategy

Tomoki Shimokawa, Naomi Ozawa,
Haruki Mikoshiba, Hiro Uehara Chen Ken.
Teikyo University, Tokyo, Japan.



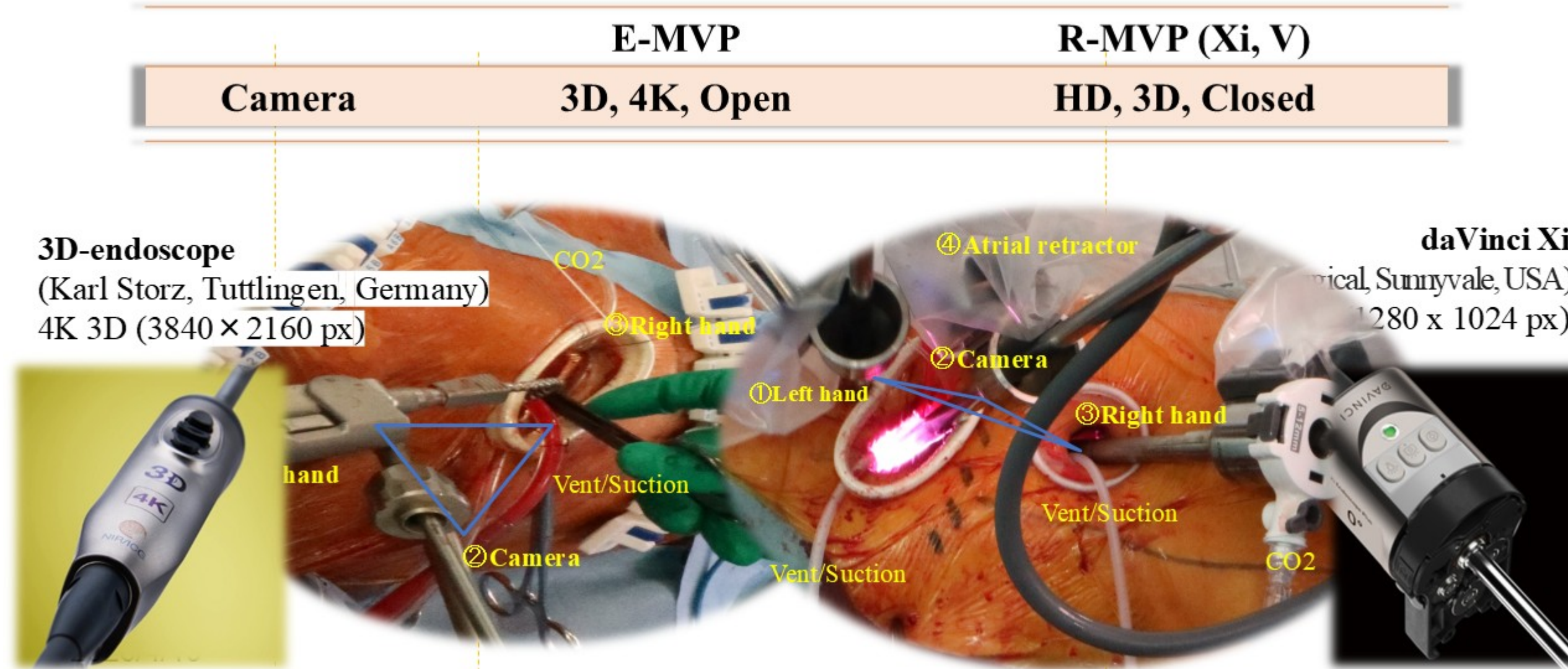
“Loop + Resect with Respect” concept

Prolapsing lesions: All leaflet prolapses are corrected with Loop.
+ Posterior Leaflet Prolapse
Sclerotic lesions
Tall leaflet ($\geq 20\text{mm}$) $\rightarrow$ Haircut: reduce P2 height to 15–18mm
Short leaflet ($\leq 10\text{mm}$) $\rightarrow$ Augmentation
Horizontally Wide leaflet $\rightarrow$ Simple resection / Indentation closure
+ Anterior Leaflet Prolapse
Calcification / Asymmetry ($A2 < A3$) $\rightarrow$ Simple resection
(applicable to symmetric anterior leaflets without calcific deformity)
+ Commissural Prolapse $\rightarrow$ Edge-to-edge repair or Simple resection
Annuloplasty $\rightarrow$ Ring Annuloplasty

Outcomes

Variables	Early results (1 week)			Late results (>1 year)		
	Endo	Robo	<i>p</i>	Endo	Robo	<i>p</i>
Mortality	0	0	<i>N/A</i>	0	0	<i>0.63</i>
LAD	36.0 $\pm$ 5.2	37.0 $\pm$ 5.0	<i>0.57</i>	35.2 $\pm$ 6.4	34.9 $\pm$ 4.4	<i>0.69</i>
LVDd	46.5 $\pm$ 5.5	46.3 $\pm$ 4.6	<i>0.60</i>	45.0 $\pm$ 4.5	44.2 $\pm$ 4.2	<i>0.74</i>
LVDs	33.2 $\pm$ 4.8	33.2 $\pm$ 4.3	<i>0.80</i>	31.0 $\pm$ 4.4	30.6 $\pm$ 4.5	<i>0.92</i>
Ejection fraction	54.2 $\pm$ 5.8	56.2 $\pm$ 5.9	<i>0.72</i>	58.2 $\pm$ 4.6	59.4 $\pm$ 3.7	<i>0.67</i>
MR recurrence $\geq$ moderate	2 (0.6)	2 (1.2)	<i>0.32</i>	14 (4.2)	4 (2.9)	<i>0.84</i>
Mean PG	2.4 $\pm$ 1.5	2.3 $\pm$ 0.8	<i>1.0</i>	2.2 $\pm$ 2.4	2.4 $\pm$ 0.9	<i>1.0</i>
Reoperation	0	0		3 (0.9)	4 (2.5)	
				Recurrence 3	Recurrence 2	
					Hemolysis 2	
				N (%) / mean $\pm$ SD		

High-Resolution Imaging Capability



BACKGROUND

Patient Characteristics

Variables	Endoscopic (n=332)	Robotic (n=157)	<i>P value</i>
Age, years	57.5 $\pm$ 10.3	58.5 $\pm$ 9.0	<i>0.30</i>
Male gender	211 (63.5)	105 (66.2)	<i>0.74</i>
History of cardiac surgery	5 (1.5)	7 (4.4)	<i>0.08</i>
MR grade			
moderate	19 (5.7)	0 (0)	<i>N/A</i>
severe	313 (94.2)	157 (100)	
Prolapse lesion			
Anterior leaflet	31 (9.3)	37 (22.8)	<i>N/A</i>
Bi-leaflet	54 (16.2)	12 (7.4)	
Posterior leaflet	195 (58.7)	105 (66.9)	
Commissural leaflet	55 (16.5)	24 (14.7)	

N (%) / mean $\pm$ SD *Prolapse lesion contains duplicates

To compare outcomes and limitations of robot-assisted (R-MVP) versus 3D endoscopic mitral valve repair (E-MVP) under a standardized repair concept, based on a single surgeon’s experience across two institutions.

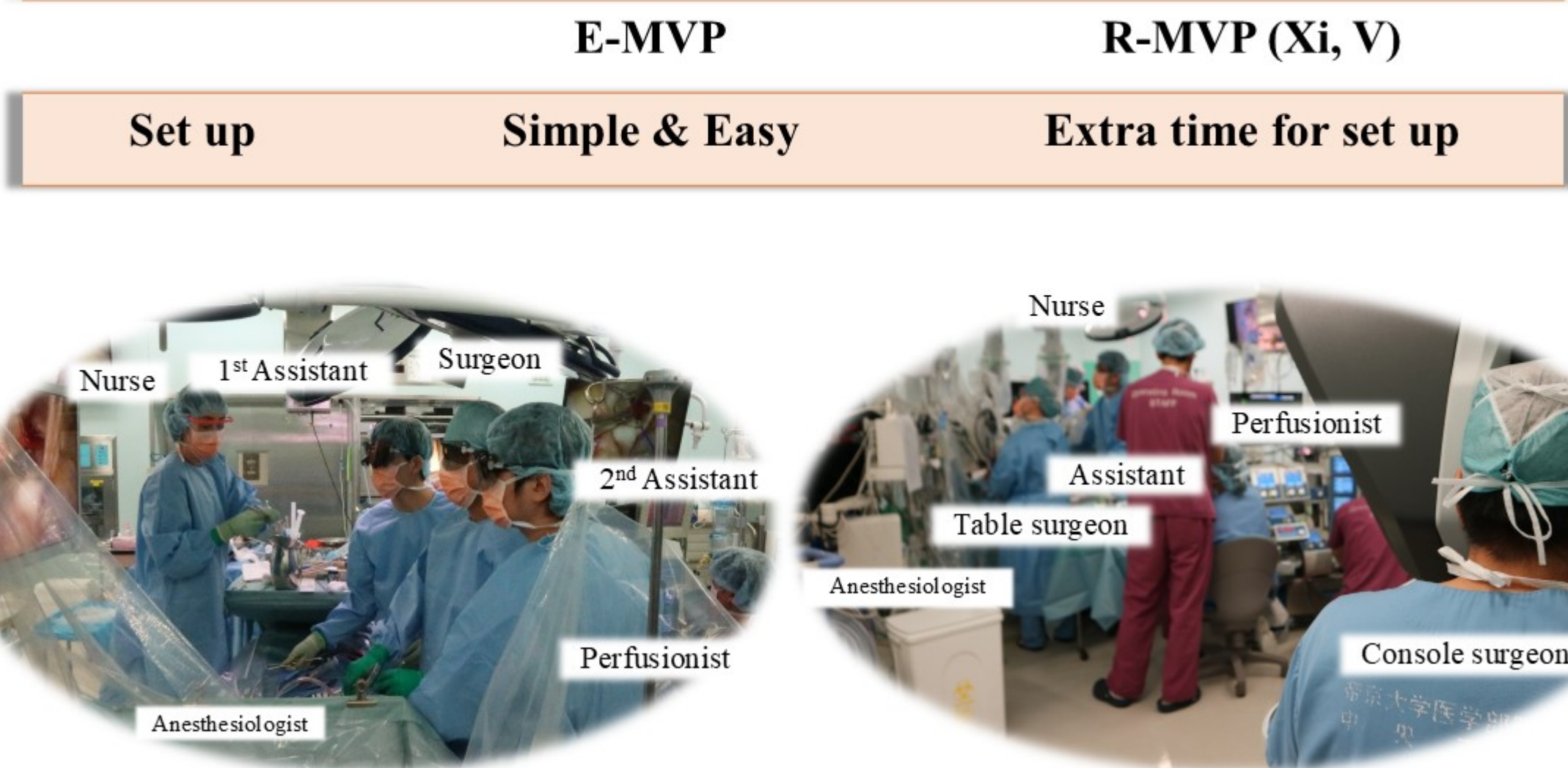
METHODS

We retrospectively analyzed 489 consecutive patients (E-MVP: 332; R-MVP: 157) undergoing minimally invasive MVP for degenerative mitral regurgitation (2019-2025). All cases followed the “Loop + Resect with Respect” strategy: artificial chordae were used for prolapse lesions, combined with selective leaflet height reduction (“Haircut”) when excessive. For horizontally elongated leaflets, simple resection and/or indentation closure was added as needed. Endpoints included mortality, $\geq$ moderate MR recurrence, transmitral gradients, reoperation, and repair-related complications.

The robotic cohort included more anterior leaflet prolapse. Early and late mortality were zero in both groups. Mid-term MR recurrence ($\geq$ moderate) remained low in both approaches (E-MVP: 4.2% vs. R-MVP: 2.9%), with preserved ventricular function and low gradients. Reoperation was uncommon; the robotic cohort included two reoperations for hemolysis. Two posterior leaflet perforations occurred only in the robotic group, consistent with forceps-related leaflet injury.

Results

Discussion



Advantages of Robotic Surgery: Dexterity and Complex Repairs

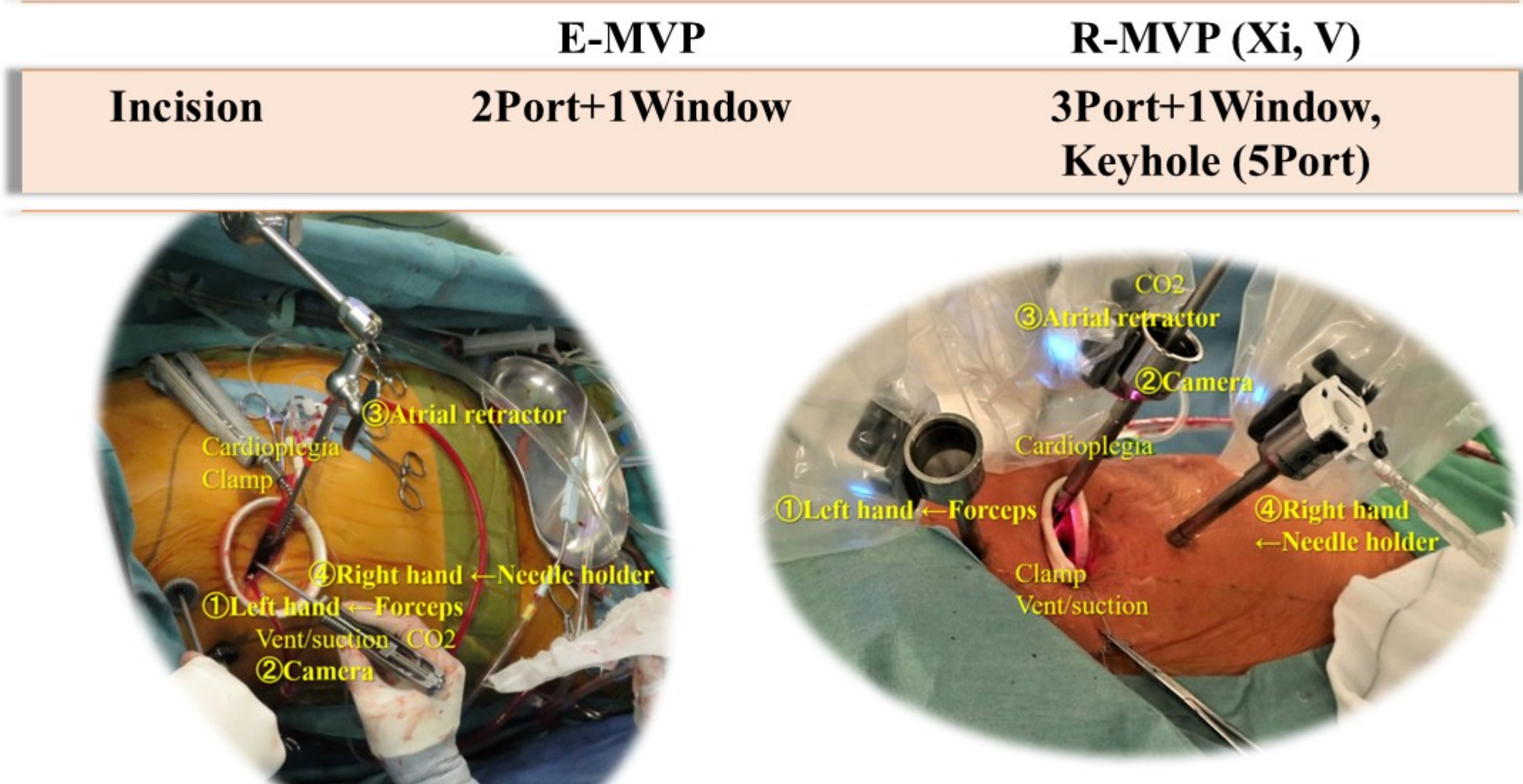
	E-MVP	R-MVP (Xi, V)
Instrument	Small instrument	Small EndoWrist instrument
Hand movement	Limited range of motion Tremor amplified Fulcrum effect	Full 360 degrees, Tremor elimination, Intuitive motion,
Suture ligation	Knot pusher	Knot pusher (assistant), Robotic
Grasp force	Stepless Touch sensation	Two-step Only vision (No sense of touch)

5 Degrees of Freedom in Endoscopic Instruments
① Grasp
② External Yaw
③ External Pitch
④ Rotation
⑤ In-out

7 Degrees of Freedom in the da Vinci System
① Grasp
② Internal Yaw
③ Internal Pitch
④ External Yaw
⑤ External Pitch
⑥ Rotation
⑦ In-out

Stanley Winata. Wireless Teleoperation Control Interface of Articulated Forceps for Minimally Invasive Surgery Thesis. Jul 2018

Small Incision



CONCLUSIONS

Within a standardized framework, both Endoscopic-MVP and Robotic-MVP provide excellent safety and mid-term durability.

Robotic surgery offers stable 3D visualization and wristed instruments, advantageous for complex anterior repairs, but the lack of haptic feedback mandates meticulous leaflet handling to prevent instrument-related injury. Optimal outcomes require disciplined case selection and seamless console-table coordination.