Robotic-assisted Inguinal Hernioplasty with the Senhance® Robotic Platform: Single Center Experience

輔仁大學附設醫院泌尿科
藍祺昀

Why we used Senhance before adopting da Vinci?

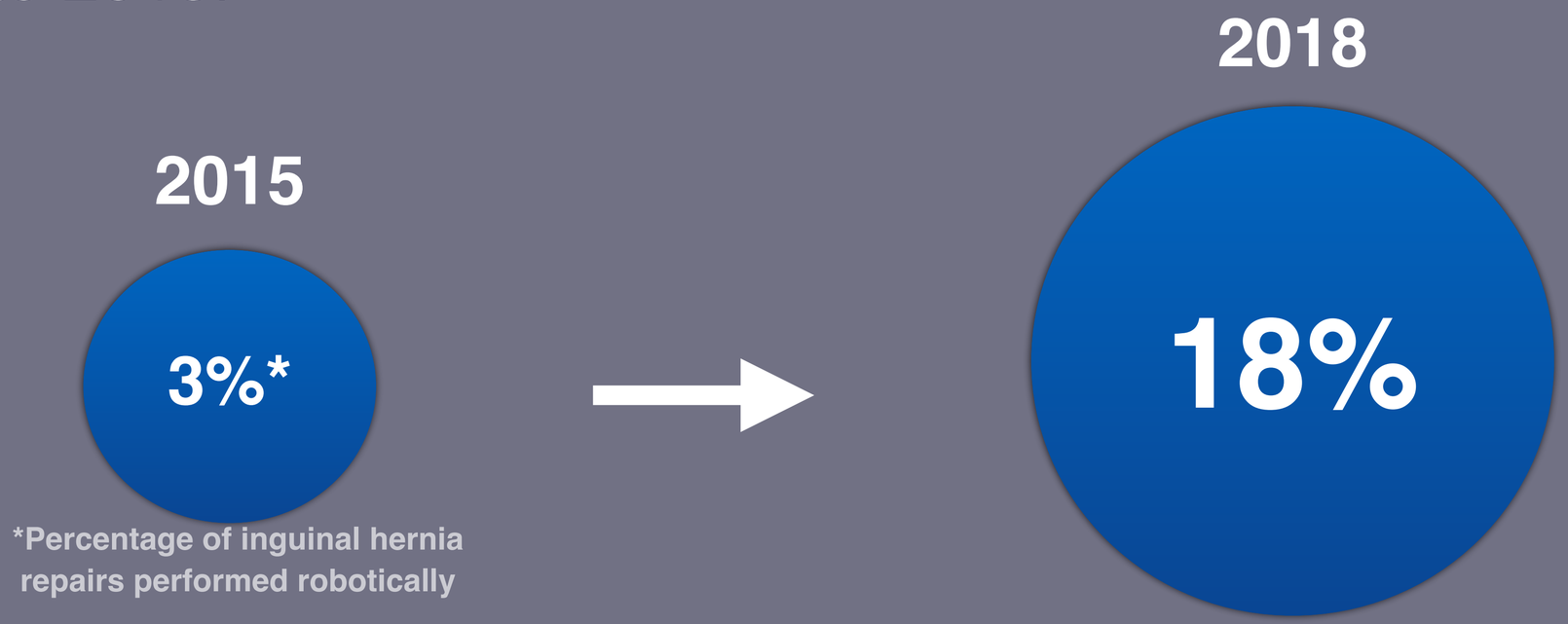
Growing Use of Robotic-assisted Hernia Repair

- Rapid global increase in robotic-assisted inguinal hernia repair (RIHR)
- Multiple studies have demonstrated comparable perioperative outcomes between laparoscopic inguinal hernia repair (LIHR) and RIHR.
- The majority of published RIHR data are based on the da Vinci® robotic surgical system

Maas MC, Alicuben ET, Houghton CC, et al. Safety and efficacy of robotic-assisted groin hernia repair. J Robot Surg. 2021;15(4):547-552.
Aiolfi, A., Cavalli, M., Micheletto, G. et al. Robotic inguinal hernia repair: is technology taking over? Systematic review and meta-analysis. Hernia 23, 2019: 509–519

Rapid Increase in Robotic Inguinal Hernia Repair in the U.S.

- According to MSQC data published in JAMA Surgery 2020, the adoption of robotic inguinal hernia repair had a 6-fold increase from 2015 to 2018.



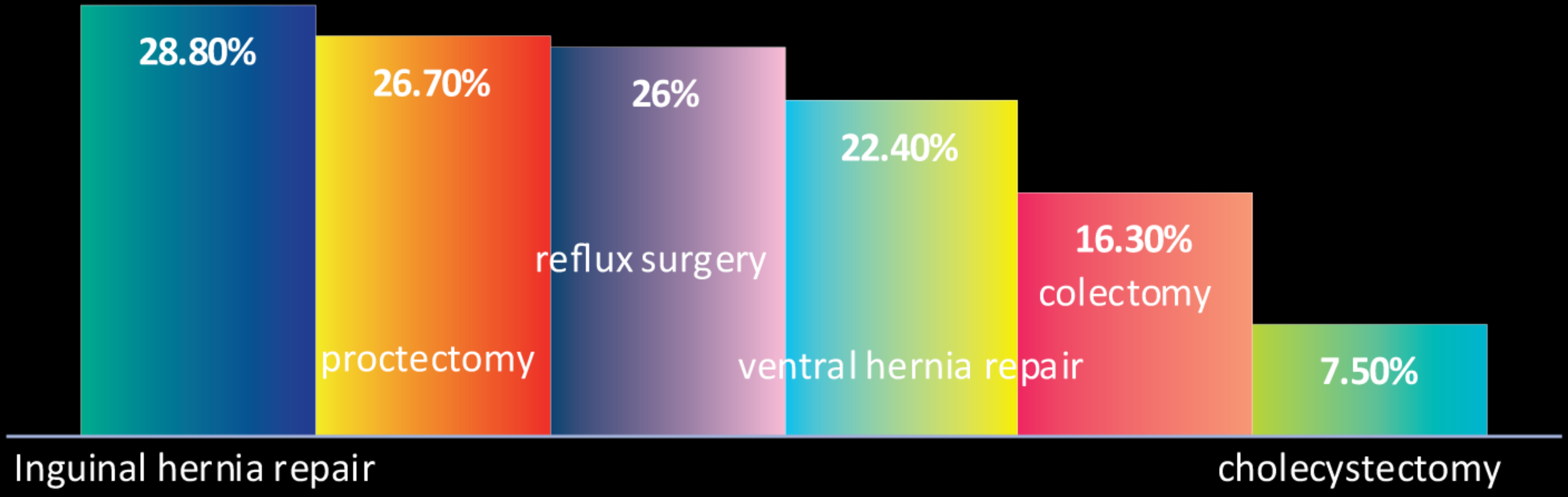
Sheetz KH, Claflin J, Dimick JB. Trends in the Adoption of Robotic Surgery for Common Surgical Procedures. JAMA Surgery. 2020;155(6):500–507

TOP ROBOTIC SURGERY STATISTICS -

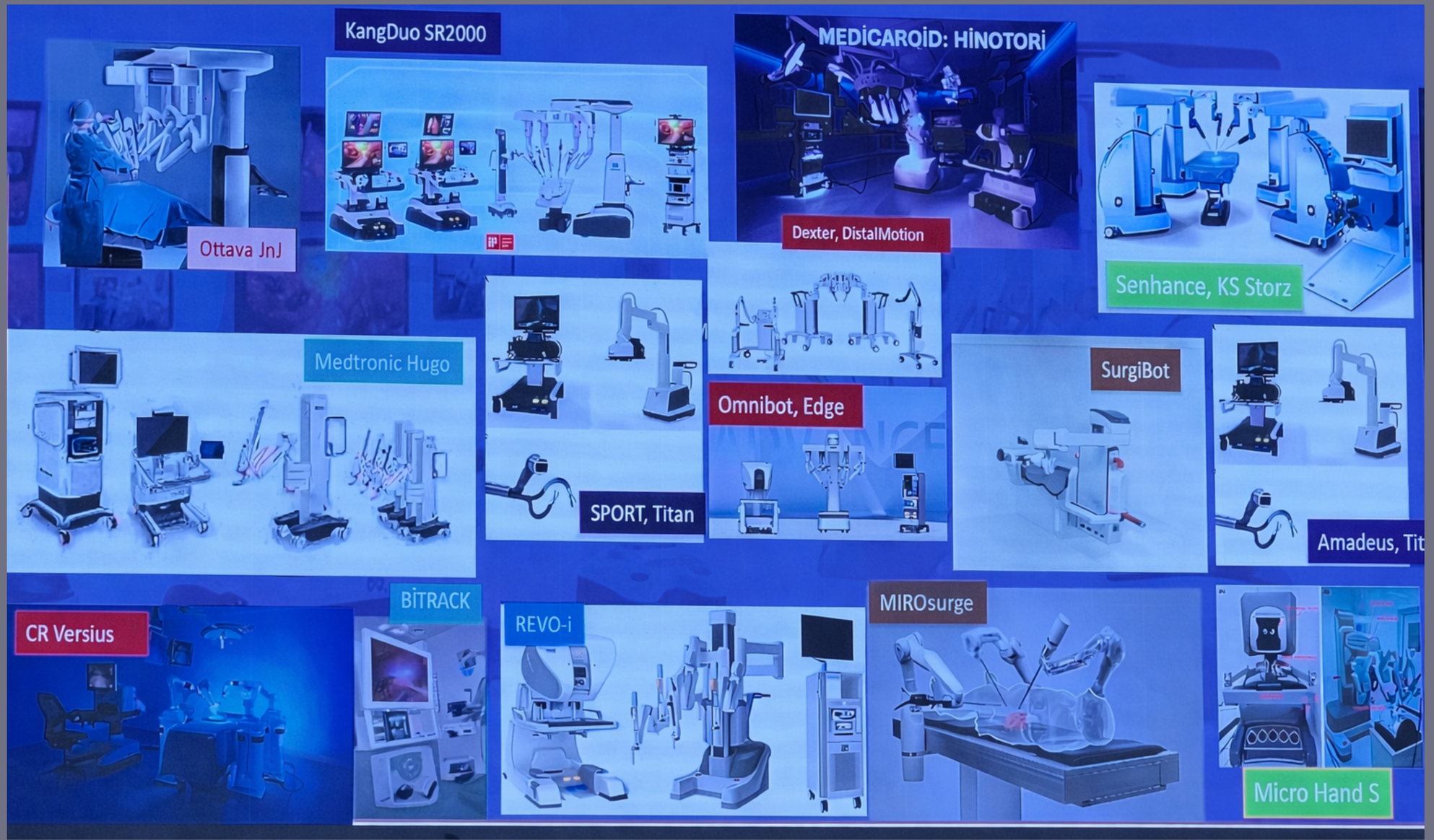
General surgery procedures that use robotic surgery.

STRATEGIC MARKET RESEARCH

Inguinal hernia repair (28.8%), proctectomy (26.7%), reflux surgery (26%), ventral hernia repair (22.4%), colectomy (16.3%), and cholecystectomy (7.5%) are common general surgery procedures that use robotic surgery.



More than 24 Robotic Surgical Platforms Are Available Worldwide

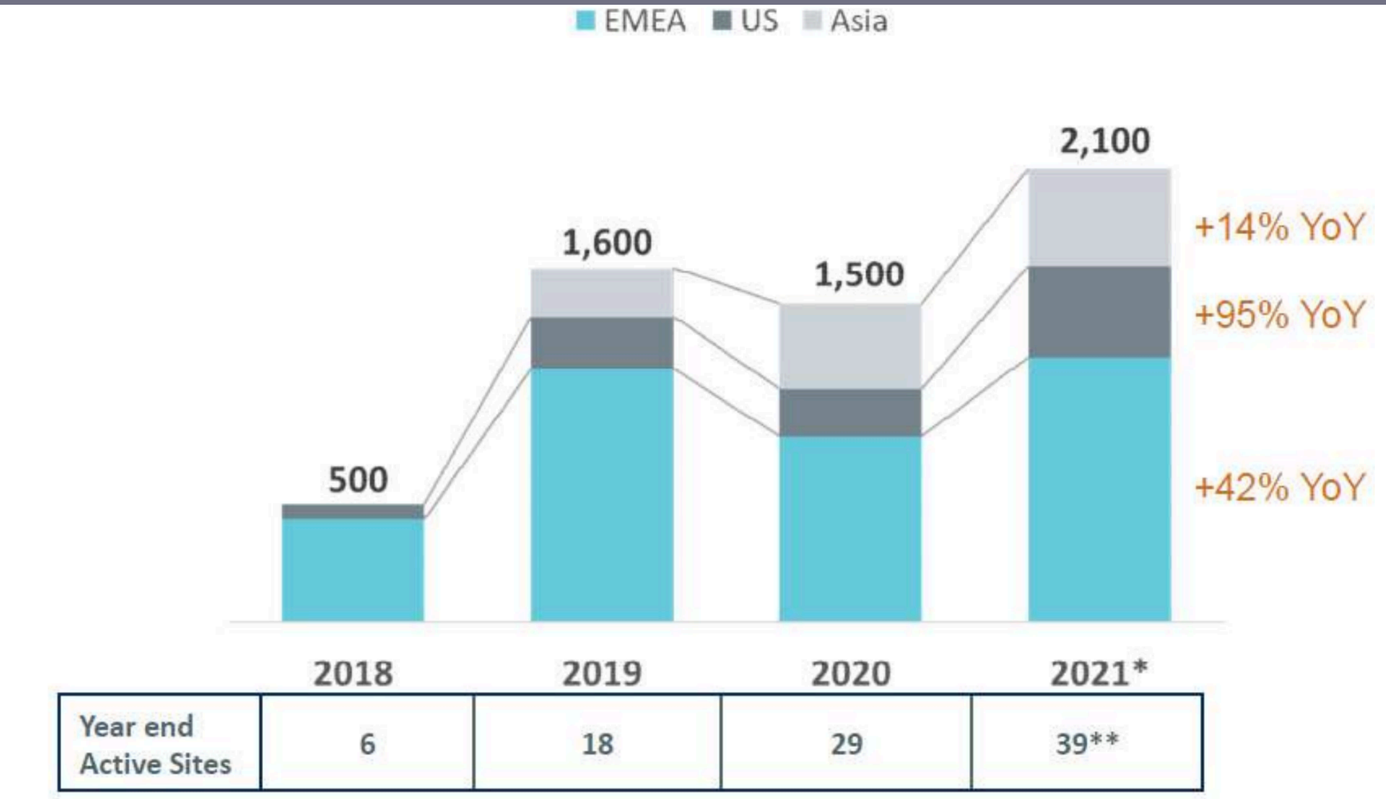


Senhance® Robotic Surgical System

- Launched in 2016 by Asensus Surgical (formerly TransEnterix)
- FDA 510(k) clearance in October 2017
- Available in US, EU, Japan and other total 18 countries
- Global installations: Approximately 30–40 systems worldwide (estimate based on 2021–2022 data)
- In Taiwan: 4 sets, started from 2019
  (da Vinci® >62 sets)

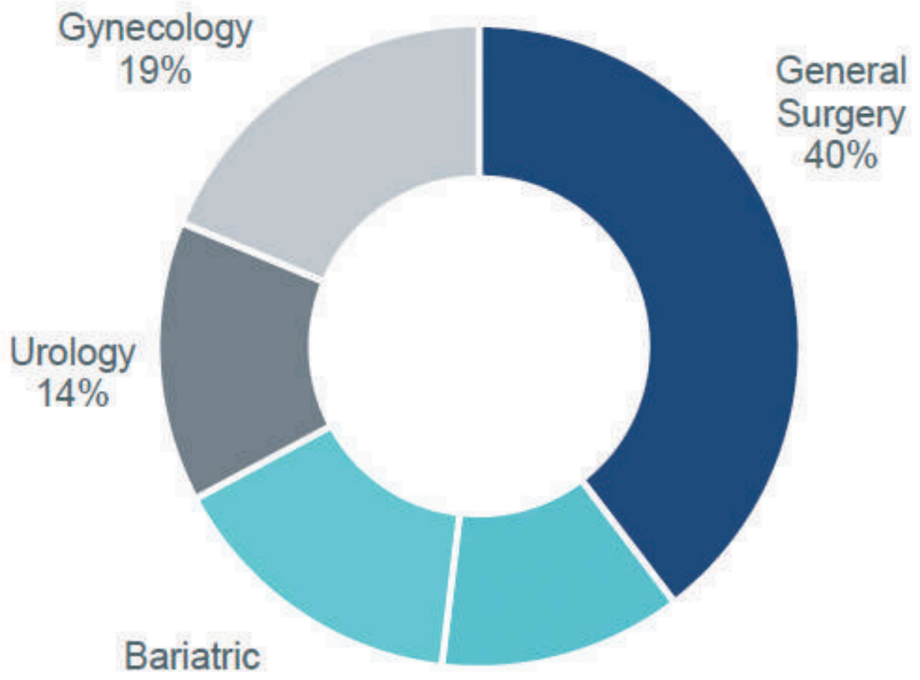
Photo credit: Asensus Surgical

Global Clinical Case Volume Trend



Year end Active Sites	6	18	29	39**

全球Senhance高智感手術系統手術量。EMEA: Europe, Middle East and Africa。US: United States。



全球2021年Senhance高智感手術系統手術分科圖

Features of Senhance® Robotic Surgical System

- Open console
- Laparoscopy-based system
- Higher image resolution
- Eye-tracking camera control
- Haptic feedback
- **Lower cost than da Vinci® system**

Photo credit: Asensus Surgical

Features of Senhance® Robotic Surgical System

Open console: Improved ergonomics and continuous awareness of the sterile field

Features of Senhance® Robotic Surgical System

Laparoscopy-based system

- Familiar instrument design

- Easy and rapid transition from conventional laparoscopic surgery

Features of Senhance® Robotic Surgical System

Laparoscopy-based system

- Familiar instrument design but with inherent mechanical limitations

Senhance®

da Vinci®

Hugo®

Versius®

Features of Senhance® Robotic Surgical System

Laparoscopy-based system

- Most instruments are 5-mm and compatible with standard laparoscopic trocars
- Immediate conversion back to laparoscopy can be performed within seconds

Features of Senhance® Robotic Surgical System

- **High 3D image resolution**
- **Eye-tracking camera control**
- **Haptic feedback**

	da Vinci Xi	da Vinci 5	Senhance
Native resolution	HD(1080p)	4K	HD to 4K

Video: https://www.youtube.com/watch?v=23EagOonbXI

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	da Vinci Xi	da Vinci 5	Senhance
Haptic/Force Feedback	No	Available	Available

Video: https://www.youtube.com/watch?v=23EagOonbXI

Features of Senhance® Robotic Surgical System

Lower Overall System Cost Compared with the da Vinci® Platform

- Lower price of the platform
- Lower annual maintenance fee
- Fully reusable instruments

Lower fixed cost
不管有沒有開刀，醫院一定要付的錢

Lower variable cost
每多做一台手術，才會多花的錢

1.Khoraki, J., Gomez, P.P., Mazzini, G.S. et al. Perioperative outcomes and cost of robotic-assisted versus laparoscopic inguinal hernia repair. Surg Endosc 34, 3496–3507 (2020).
2.Lin, YC., Yuan, LH., Tseng, CS. et al. Comparison of senhance and da vinci robotic radical prostatectomy: short-term outcomes, learning curve, and cost analysis. Prostate Cancer Prostatic Dis (2023).

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Fee for Procedure (USD per case)

	Senhance	da Vinci
Inguinal hernioplasty (Out-of-Pocket Expense/Taiwan)	~950	~3200
Prostatectomy[2]	4169	7750
Hysterectomy[2]	559	1393

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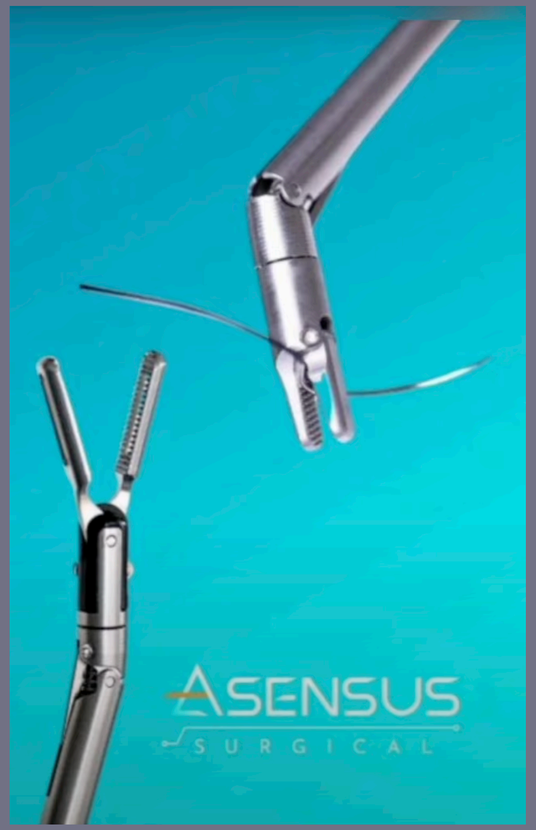
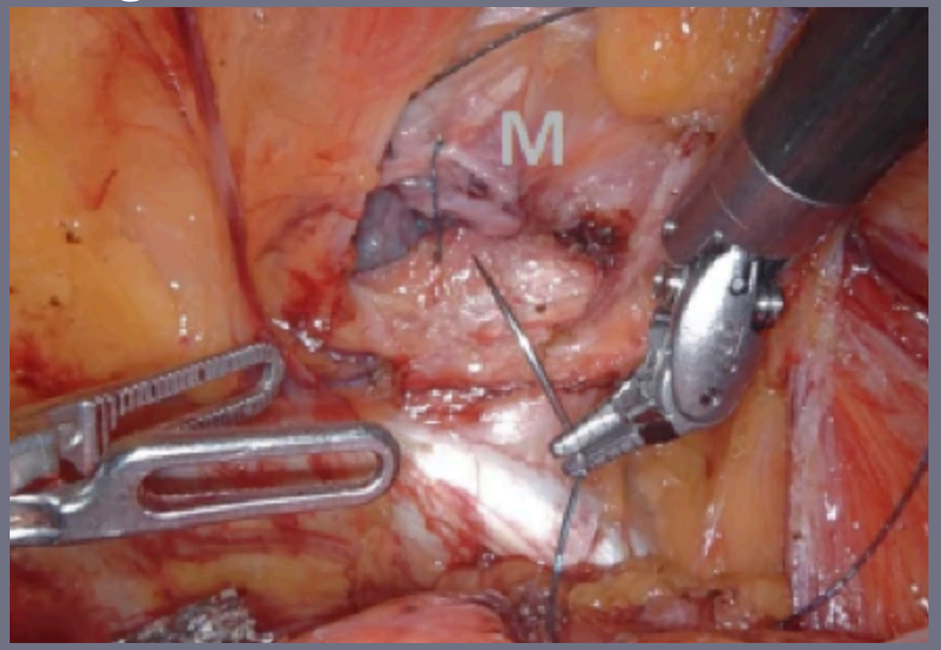
Limitations of Senhance® Robotic Surgical System

- **Lack of articulating instruments** (articulating forceps was available in US/Japan at the end of 2022, with 2 more degree of freedom)



Endowrist of da Vinci® robotic system had better ROM w/ 7 degree of freedom



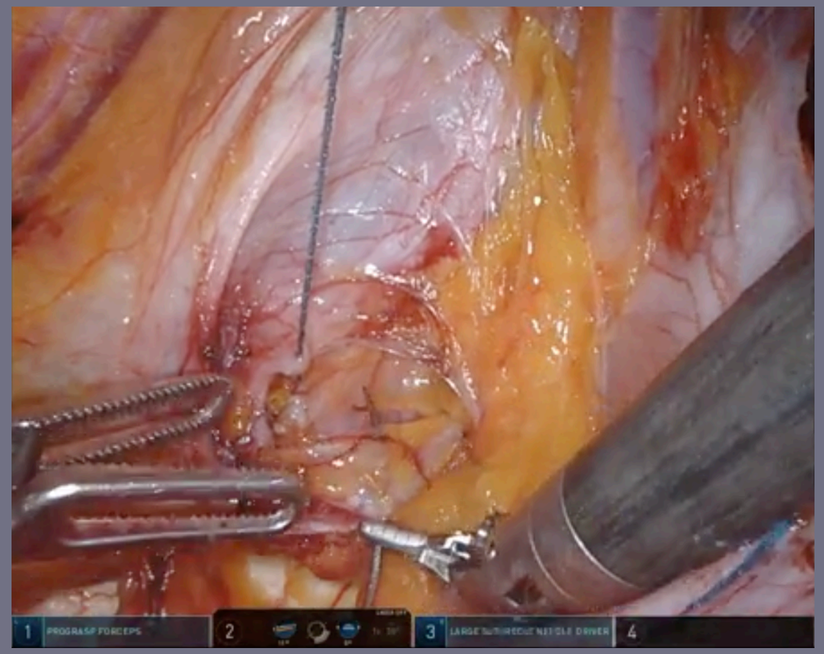


Photo credit: Ramser, M., Baur, J., Keller, N. et al. Robotic hernia surgery I. English version. Chirurg 92 (Suppl 1), 1–13 (2021)

Comparison between Senhance and da Vinci System

Aspect	Senhance	da Vinci
Console	**Open**	Closed
Arm configuration	Independent arms	Integrated cart
Haptic feedback	**Yes**	No
Wristed instruments (EndoWrist)	No	**Yes (7 DoF)**
Camera control	Eye-tracking	Hand control
Instrument size	5 mm / 10 mm	8 mm
Surgical feel	Similar to laparoscopy	Fully robotic
Port placement flexibility	**High**	Moderate
Learning curve (lap surgeon)	**Shorter**	Longer
Cost	**Lower**	Higher

Case Series in FJUH

Senhace TAPP

From 2019 to 2023	
Surgeon	GS 3, GU 3
Number of patients	44
Age (year)	60 ± 13
Sex (male:female)	37:7 (84%:16%)
Hernia type	
Unilateral (%)	36 (82)
Indirect : direct : mixed (%)	18:18:8 (41:41:18)

Case Series in FJUH

	Senhace TAPP
Surgery time, min, median (IQR)	
For unilateral	75 (50-111)
For bilateral	158 (116-185)
Docking time, min, median (IQR)	15 (12-22)
Conversion (%)	0
Seroma (%)	2 (4.5%)
Complications (>Clavien-Dindo grade 2) (%)	0
Visual Analogue Scale	2.63 ± 0.91
Hospital stay, day	2.34 ± 0.88

Case Series in FJUH

	Senhace TAPP (FJUH)	**Senhace TAPP (TRUST)**	**L-TEP (my last 60 cases)**
Surgery time, min, median (IQR)			
For unilateral	75 (50-111)	74 ± 35	47 ± 11
For bilateral	158 (116-185)	104 ± 36	53 ± 13
Docking time, min, median (IQR)	15 (12-22)	7±3	NA

Case Series in FJUH

	Senhace TAPP (FJUH)	**Senhace TAPP (TRUST)**	**L-TEP (my last 63 cases)**
Surgery time, min, median (IQR)			
For unilateral	75 (50-111)	74 ± 35	47 ± 11
For bilateral	158 (116-185)	104 ± 36	59 ± 13
Docking time, min, median (IQR)	15 (12-22)	7±3	NA
Patient’s cost in FJUH (USD)	960	NA	645

Conclusions

- Robotic-assisted inguinal hernia repair is increasingly adopted with comparable short-term outcomes to laparoscopic approaches.
- Unilateral TAPP using the Senhance® system is feasible and safe based on our single-center experience.
- **Senhance offers a distinct profile: laparoscopic-based workflow, shorter learning curve, and lower procedural cost.**
- **Limitations remain, particularly the lack of fully wristed instruments compared with da Vinci®.**
- Robotic surgery should be viewed as a tool, and system selection should be based on procedure complexity, surgeon experience, and healthcare cost considerations.

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Thank You!

Cost Comparison

Cost Domain	Senhance	da Vinci	Evidence from Literature
Capital cost	**Lower**	Higher	Robotic platforms have higher fixed cost than laparoscopy
Maintenance cost	**Lower**	Higher	Annual service contracts contribute significantly
Instrument type	**Reusable**	Disposable / limited-use	Instrument policy affects variable cost
Per-case variable cost	**Lower**	Higher	Reusable instruments reduce per-case expense
OR time (early phase)	Comparable	Comparable	No consistent difference after learning curve
Total procedural cost	Lower than da Vinci	Higher	Robotic IHR > laparoscopic IHR overall
Cost-effectiveness	Context-dependent	Context-dependent	Value not proven for routine IHR