Succès et déconvenues du robot

4éme congrès de la SFCO

26/10/2012

L.Bresler

UNIVERSITÉ DE LORRAINE

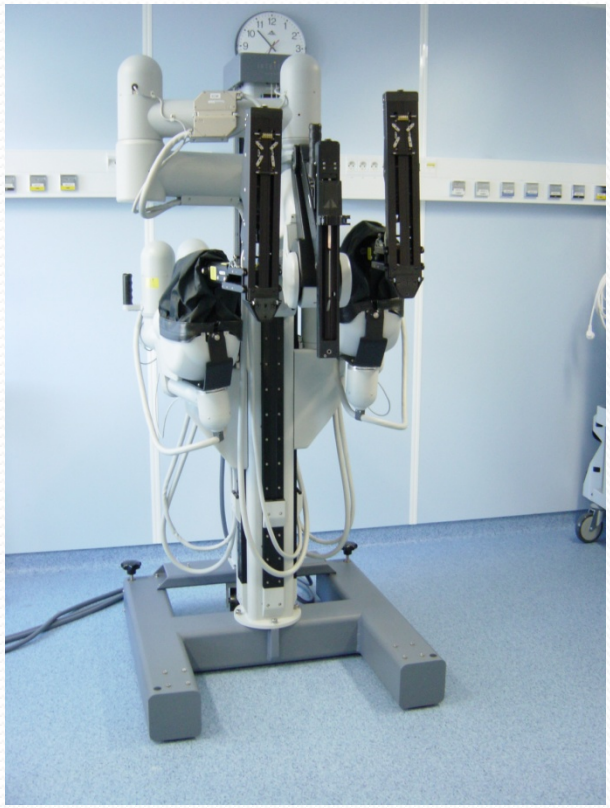
CHU NANCY

ECOLE DE CHIRURGIE NANCY

Le robot da Vinci

LE ROBOT (système Da Vinci standart)

- 1 bras vidéo
- 2013 bras porte-instruments



LA CONSOLE

LES MASTERS

LE DISPOSITIF BINOCULAIRE

LE DISPOSITIF DE COMMANDE

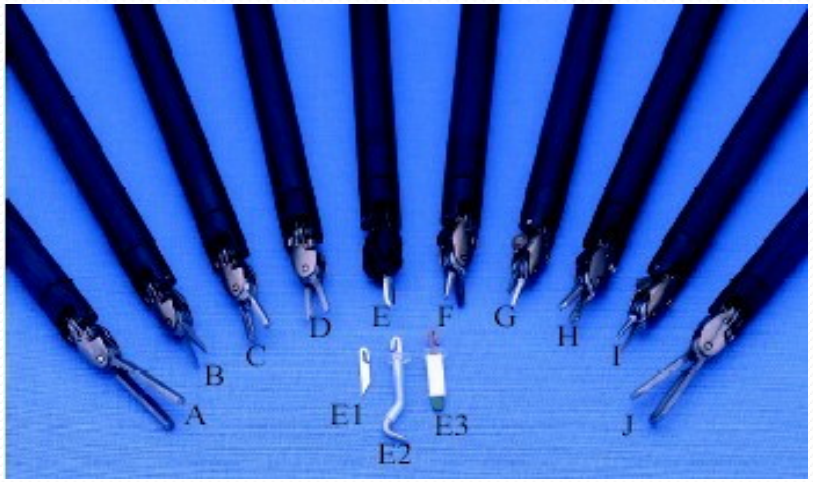
LES PEDALES

La colonne Vidéo

- 1moniteur vidéo
- 1 générateur de BE
- 1 insufflateur de C02
- 2 bouteilles de C02
- 2 sources de lumière froide intuitive
- 2 consoles caméra

Les instruments

- Les instruments habituels de coelioscopie (crochet monopolaire, bipolaire, ciseaux, pinces)
- Bistouri harmonique
- Pince à clip verrouillable



Le système Da Vinci Si avec double console optionnelle

New *da Vinci* Technology for Colorectal Surgery

EndoWrist® One™ Vessel Sealer

- *Seal & cut up to 7mm diameter vessels*
- *Compact snake-wrist architecture*
- *Full control from the surgeon console*

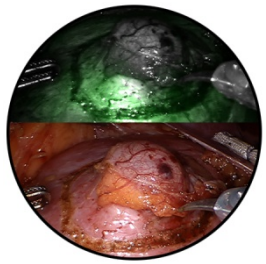
EndoWrist® Stapler*

- *Articulation: 60º pitch, 25ºyaw*
- *45mm jaw (white, green & blue re-loads)*
- *13mm diameter instrument*
- *Full control from the surgeon console*

EndoWrist® Suction Irrigator

- *Multi-purpose instrument:*
  -Suction, Irrigation,
  - Ideal 3rd arm instrument
- *Articulating tip*
- *Full control from the surgeon console or bedside assistant*

Firefly™ Fluorescence Imaging



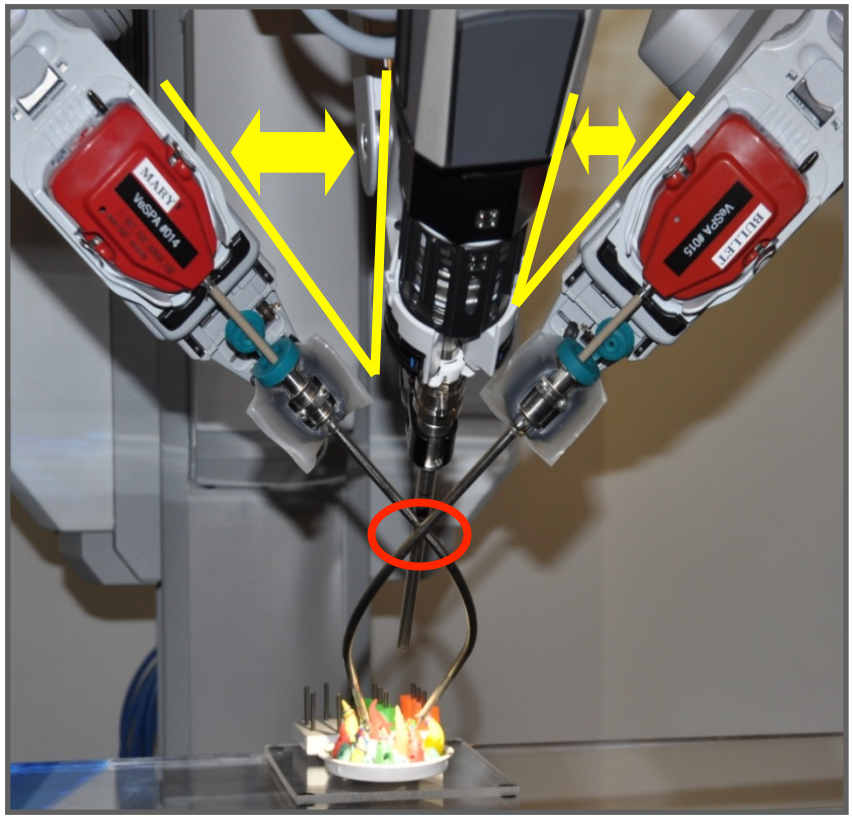
- *Intra-operative fluorescence visualization*
- *Indocyanine green*
- *Vasculature identification and soft tissue perfusion*

**** 510K application is pending***

PN 872486 Rev C 06/12

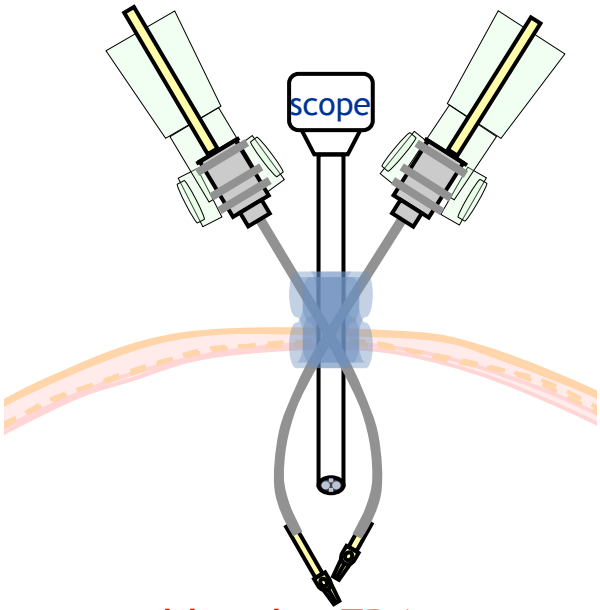
da Vinci Si HD SURGICAL SYSTEM

Chirurgie da Vinci® Single Site™



(*da Vinci* Single Site prototype)

- Utilisation du System *da Vinci Si* avec un endoscope 3D HD 8.5mm
- Chemises de trocarts courbes
- Instruments 5mm, non-articulés, semi-rigides

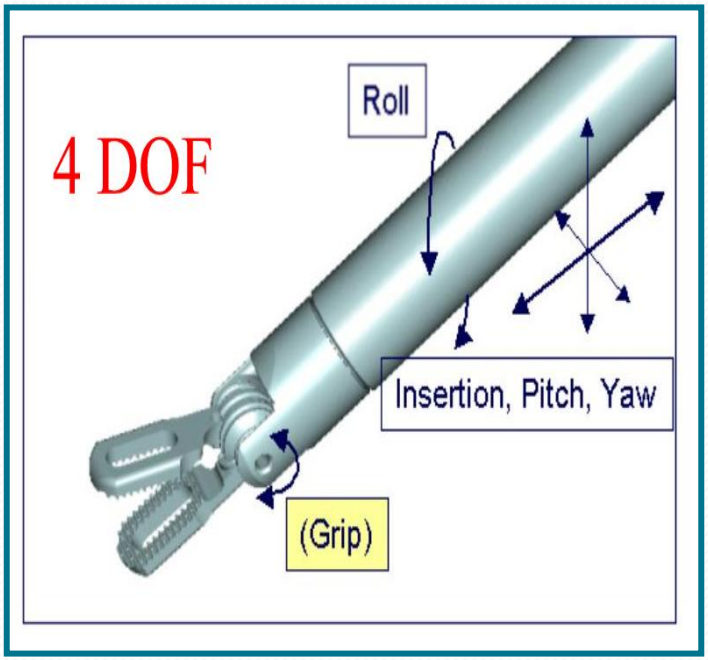


Instruments and accessories shown have not been approved by the FDA

da Vinci Si HD SURGICAL SYSTEM

Les améliorations technologiques par rapport à la laparoscopie traditionnelle

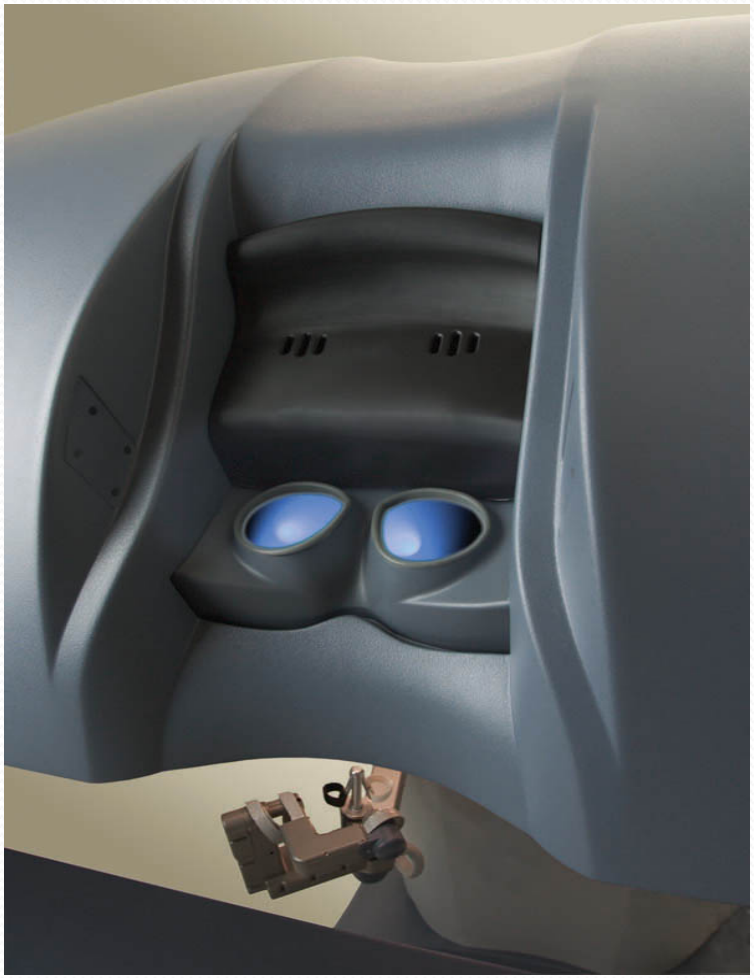
Des degrés de liberté supplémentaires



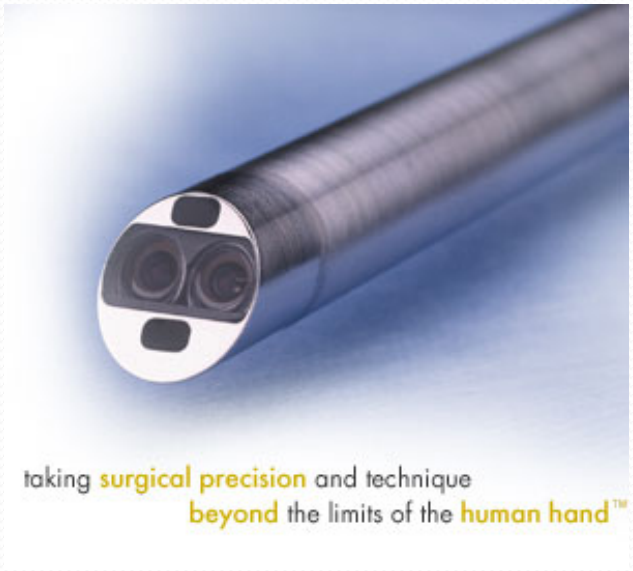
Laparoscopie traditionnelle

Endowrist® Instrument

La vision en relief



Deux lentilles, fusionnées pour donner une image 3-D



L’ergonomie

D’après A . Mottrie

Sans oublier

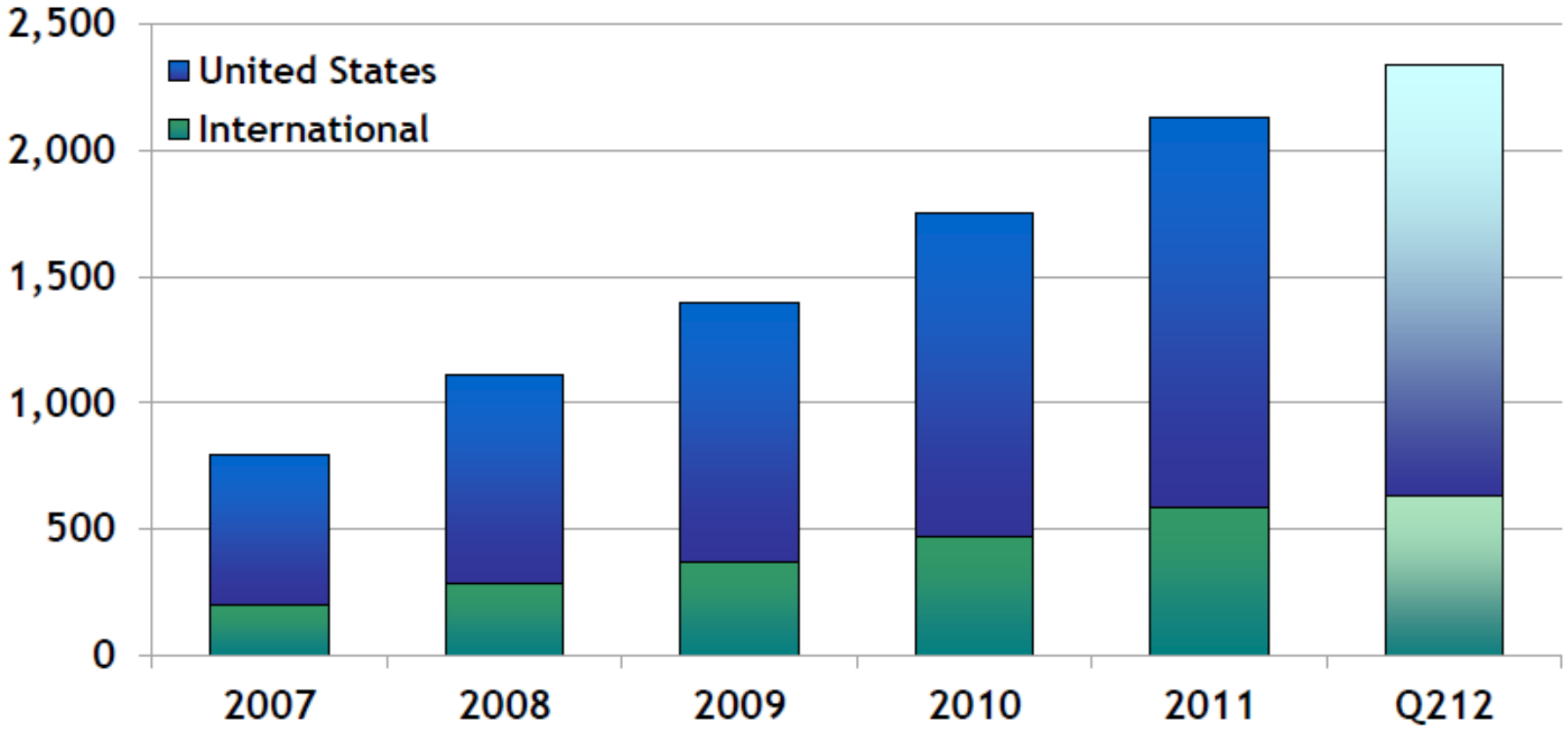
- La filtration des tremblements
- La démultiplication : 1:1, 1:2, 1:5

Les succès

- Les succès pour Intuitive Surgical
- Les succès pour les patients
- Les succès pour les chirurgiens

Les succès pour Intuitive Surgical

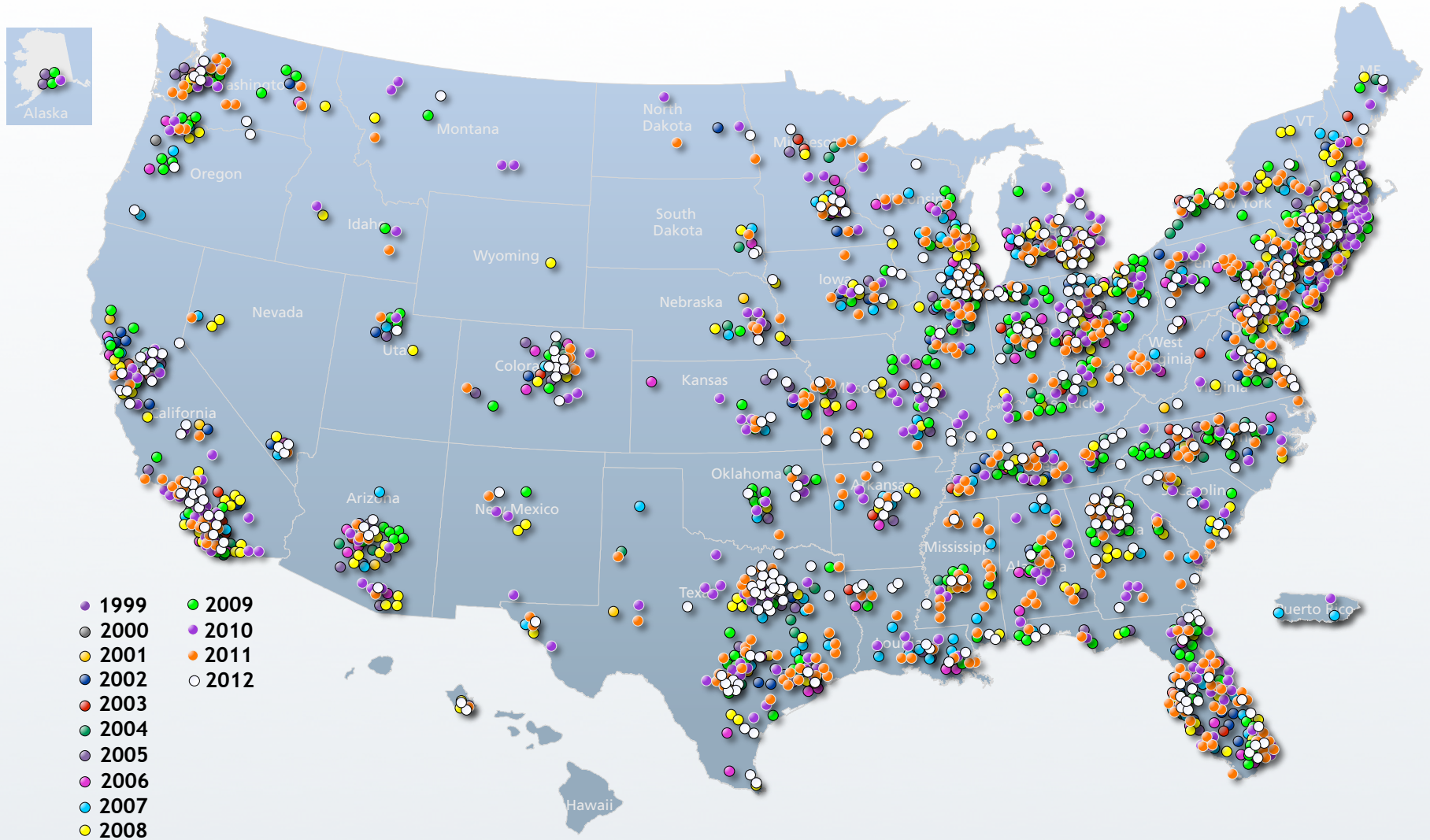
da Vinci® System Installed Base



INTUITIVE SURGICAL®

da Vinci® Surgical System U.S. Cumulative Installs

1999 – 2012

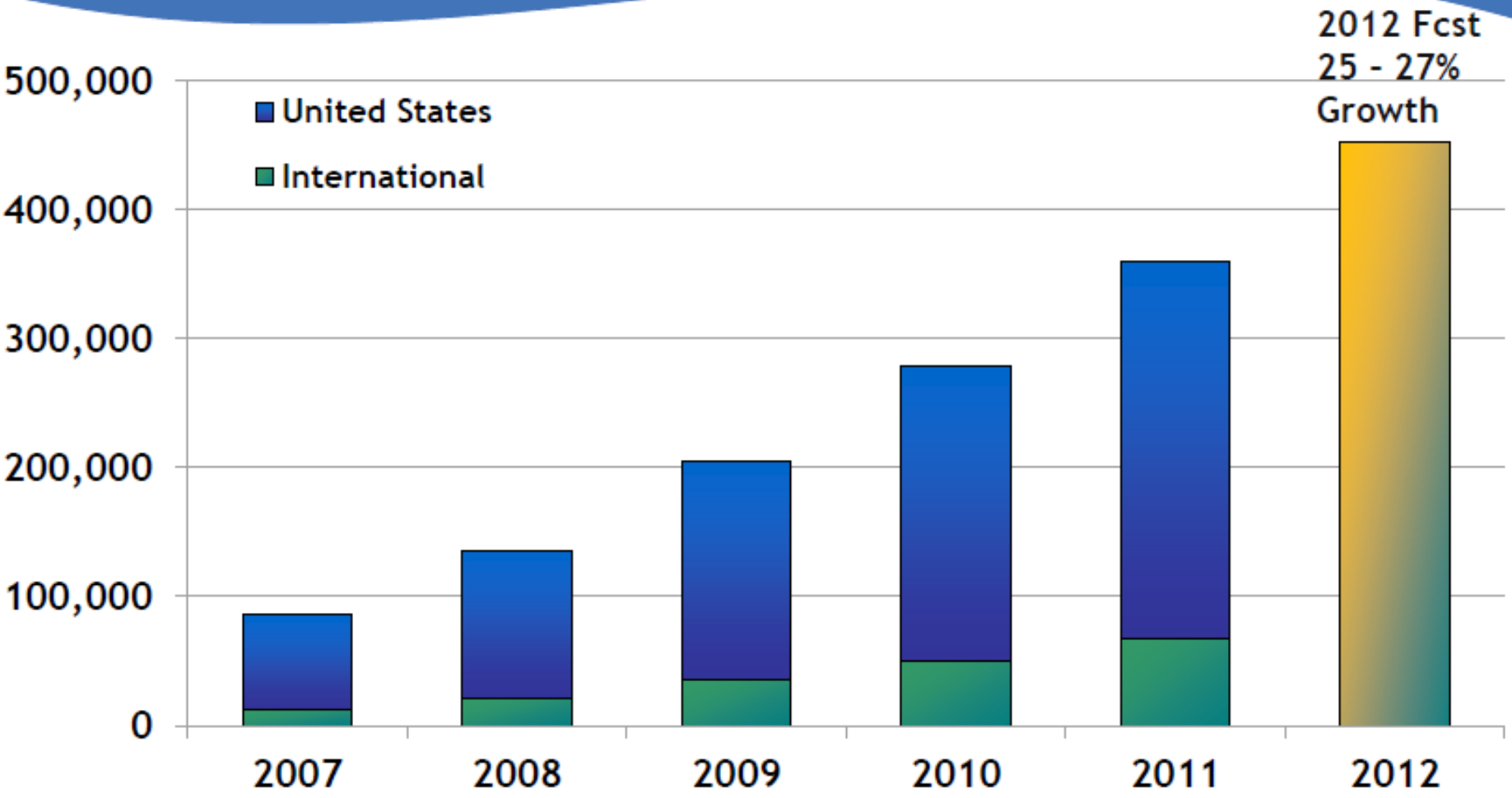


PN 87120 Rev. AE Updated 10/16/12

Implantations in France

2008	2009	2010	Q1-2011
Clinique Saint Augustin	Clinique Saint Augustin	Clinique Saint Augustin	Clinique Saint Augustin
Clinique Belledonne	Clinique Belledonne	L'institut Mutualiste Montsouris	CHU Henri Mondor
CHU Brabois Adultes	CHU Henri Mondor	CHU Henri Mondor	L'institut Mutualiste Montsouris
L'institut Mutualiste Montsouris	CHU Brabois Adultes	Clinique Belledonne	Clinique Belledonne
CHU Henri Mondor	L'institut Mutualiste Montsouris	CHU Brabois Adultes	Clinique du Tonkin
Clinique Generale Beaulieu Genève	Polyclinique de Courlancy	Hopital La Pitie - Salpetriere	Hôpital Foch
Clinique Ambroise Pare	Hopitaux Universitaires de Geneve	Hôpital St. Joseph	Hopital La Pitie - Salpetriere
Polyclinique de Courlancy	Hopital La Pitie - Salpetriere	Institut Paoli-Calmettes	CHU de Rennes
Hopital La Pitie - Salpetriere	Hôpital St. Joseph	Hôpital Foch	Polyclinique Kenval-sarl (Kennedy)
Hopitaux Universitaires de Geneve	Clinique Ambroise Pare	Centre Hospitalier Universitaire de Toulouse	Polyclinique de Courlancy
Hôpital St. Joseph	CHRU de Lille	CHU Tours Bretonneau	Centre Hospitalier Universitaire de Toulouse
Institut Paoli-Calmettes	Clinique Generale Beaulieu Genève	Polyclinique de Courlancy	CHRU de Lille
CHU Tours Bretonneau	Hôpitaux Universitaires de Strasbourg	CHU Nimes	CHU BORDEAUX
Centre Hospitalier Universitaire de Nice	CHU Tours Bretonneau	CHRU de Lille	CHU Brabois Adultes
Hospices Civils de Lyon	Institut Paoli-Calmettes	Polyclinique Kenval-sarl (Kennedy)	CHU Tours Bretonneau
CHU - Nantes	CHU - Nantes	Hopitaux Universitaires de Geneve	Hôpital St. Joseph
Hôpitaux Universitaires de Strasbourg	Polyclinique Kenval-sarl (Kennedy)	CHU Limoges	CHU Nimes
CHRU de Lille	Clinique les Grangettes	Clinique Ambroise Pare	Institut Paoli-Calmettes
CHU Limoges	CHU Nimes	Hôpitaux Universitaires de Strasbourg	Hopitaux Universitaires de Geneve
Clinique St George, Nice	CHU Limoges	CHU BORDEAUX	CHU de Brest-Hôpital de la Cavale Blanche
Clinique les Grangettes	Polyclinique Bordeaux Nord Aquitaine	CHU - Nantes	Hopital Privé la Louviére
Hopital la Tour	Centre Hospitalier Universitaire de Nice	Clinique Generale Beaulieu Genève	Clinique Ambroise Pare
Pompidou Hospital (HEGP)	CHU Dijon	American Hospital of Paris'	Hospices Civils de Lyon
CHU Dijon	Hospices Civils de Lyon	Clinique Victor Pauchet	Clinique SAINT VINCENT
	Clinique St George, Nice	Clinique les Grangettes	CHU - Nantes
	Hopital la Tour	Centre Hospitalier Universitaire de Nice	Clinique de l'Océane
	Pompidou Hospital (HEGP)	CHU Dijon	Clinique Victor Pauchet
	American Hospital of Paris'	CHU de Rennes	Clinique St George, Nice
	Clinique des Cèdres	Hospices Civils de Lyon	Polyclinique Bordeaux Nord Aquitaine
	Centre Hospitalier Universitaire de Toulouse	Clinique des Cèdres	CHU Limoges
	Clinique Victor Pauchet	Clinique St George, Nice	American Hospital of Paris'
		Clinique du Tonkin	Hôpitaux Universitaires de Strasbourg
		Clinique de l'Océane	Clinique Generale Beaulieu Genève
		Polyclinique Bordeaux Nord Aquitaine	Clinique des Cèdres
		Pompidou Hospital (HEGP)	Hopital Val de Grace
		Hopital la Tour	Centre Hospitalier Universitaire de Nice
		GIE CHIRURGIE ASSISTEE ROBOT LIGERIEN (GIE CAROL)	Pompidou Hospital (HEGP)
		CHU de Brest-Hôpital de la Cavale Blanche	GIE CHIRURGIE ASSISTEE ROBOT LIGERIEN (GIE CAROL)
		Clinique Saint Jean Languedoc	Clinique les Grangettes
		Maison de chirurgie Clinique de Turin	Maison de chirurgie Clinique de Turin
		Hopital Privé la Louviére	CHU Dijon
		Hopital Val de Grace	Clinique Saint Jean Languedoc
			Hopital la Tour

Annual Worldwide Procedures



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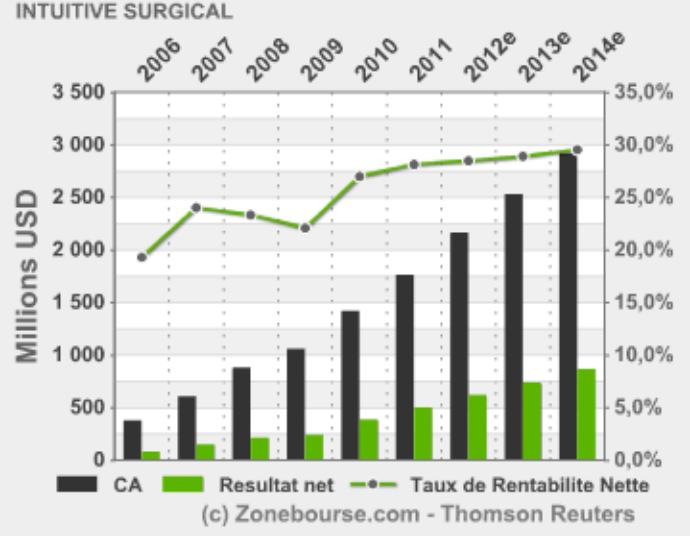
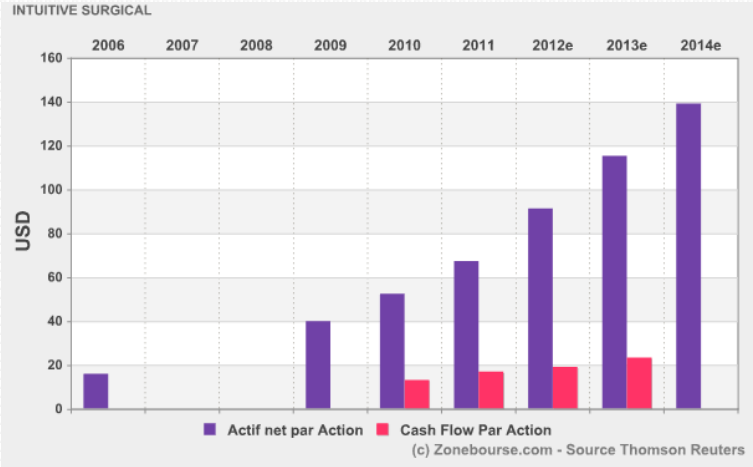
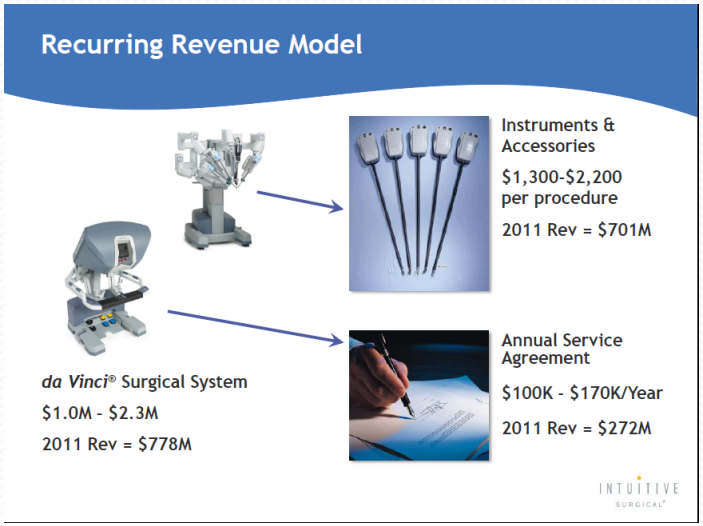
Les données financières







Les succès attendus pour les patients

- The potential advantages of the DVSS over conventionnal laparoscopy are :
  - Greater precision
  - Lower error rates
  - Reduced bleeding
  - Shorter hospital stay
  - Reduced pain
  - More rapid patient recovery
- L' EBM

Annals of Surgery • Volume 252, Number 2, August 2010

Efficacy of the Da Vinci Surgical System in Abdominal Surgery Compared With That of Laparoscopy

A Systematic Review and Meta-Analysis

Sergio Maeso, MD, MPH, Mercedes Reza, PharmD,* Julio A. Mayol, MD,† Juan A. Blasco, MD, MPH,* Mercedes Guerra, Lic,* Elena Andradas, MD, MPH,* and María N. Plana, MD, MPH‡*

TABLE 2. Meta-Analyses Results for Each Surgical Indication and Outcome Included

Outcome	Studies	Patients	I^2 %	Method	Effect 95% CI
Nissen fundoplication					
Surgery time (min)	4 (4)	160	88	MD (IV, rand)	20.67 (−9.69, 51.02)
Incision-closure time (min)	2 (2)	90	48	MD (IV, rand)	−8.40 (−35.91, 19.10)
LOS (d)	4 (4)	160	2	MD (IV, fix)	−0.08 (−0.41, 0.25)
Complications	9 (4)	398	64	RD (M-H, rand)	−0.02 (−0.12, 0.08)
Open conversions	9 (4)	398	0	RD (M-H, fix)	−0.01 (−0.05, 0.03)
Total conversions	9 (4)	398	0	RD (M-H, fix)	0.00 (−0.04, 0.04)
Costs ($)	2	60	96	MD (IV, rand)	1596 (−181, 3374)
Heller myotomy					
Perforations	3	252	0	OR (M-H, fix)	0.11 (0.02, 0.56)*
Surgery time (min)	2	182	72	MD (IV, rand)	38.01 (−8.79, 84.81)
Roux-en-Y gastric bypass					
Total conversions	3 (1)	160	0	OR (M-H, fix)	9.46 (1.72, 52.15)†
Surgery time (min)	3 (1)	160	98	MD (IV, rand)	10.12 (−69.86, 90.11)
Complications	3 (1)	160	0	OR (M-H, fix)	0.58 (0.21, 1.64)
Open conversions	3 (1)	160	55	RD (M-H, rand)	0.06 (−0.04, 0.16)
Gastrectomy					
LOS (d)	2	87	0	MD (IV, fix)	−1.38 (−1.84, −0.93)*
Bowel function recovery (d)	2	87	0	MD (IV, fix)	−0.21 (−0.42, −0.01)*
Surgery time (min)	2	87	64	MD (IV, rand)	37.60 (1.28, 73.92)†
EBL (mL)	2	67	81	MD (IV, rand)	15.88 (−51.84, 83.59)
Lymph nodes (number)	2	87	4	MD (IV, fix)	0.58 (−4.66, 5.81)
Complications	2	87	0	OR (M-H, fix)	0.44 (0.07, 2.94)
Cholecystectomy					
LOS (d)	2	467	66	MD (IV, rand)	−0.73 (−1.43, −0.03)*
Surgery time (min)	4 (1)	511	43	MD (IV, fix)	16.96 (7.95, 25.96)†
Costs ($)	2	124	0	MD (IV, fix)	1,692 (1,139, 2245)†
Complications	3	491	15	OR (M-H, fix)	2.15 (0.64, 7.25)
Total conversions	3 (1)	487	0	RD (M-H, fix)	−0.01 (−0.04, 0.02)
Incision-closure time (min)	2 (1)	120	0	MD (IV, fix)	4.14 (−6.62, 14.89)
Colorectal resection					
Open conversions	6	520	17	RD (M-H, fix)	−0.04 (−0.08, 0.00)*
Surgery time (min)	7	532	85	MD (IV, rand)	39.42 (14.99, 63.84)†
Costs ($)	2	69	0	MD (IV, fix)	792 (42, 1543)†
LOS (d)	6	505	67	MD (IV, rand)	−0.26 (−1.55, 1.02)
EBL (mL)	5	214	0	MD (IV, fix)	−7.04 (−22.73, 8.66)
Total conversions	6	520	35	RD (M-H, fix)	−0.01 (−0.05, 0.04)
Complications	6	526	0	OR (M-H, fix)	0.99 (0.59, 1.65)
Lymph nodes (number)	4	442	0	MD (IV, fix)	−0.20 (−2.40, 2.00)
Distal resection margin (cm)	3	336	0	MD (IV, fix)	0.38 (−0.18, 0.95)
Bowel function recovery (d)	3	424	0	MD (IV, fix)	−0.11 (−0.46, 0.23)
Time to oral diet (d)	3	424	76	MD (IV, rand)	−0.26 (−0.74, 0.22)

*Statistically significative differences favoring da Vinci surgical system.
†Statistically significative differences favoring conventional laparoscopic surgery.
CI indicates confidence interval; LOS, length of stay; EBL, estimated blood loss; $, American dollars; MD, median difference; RD, risk difference; OR, odds ratio; IV, inverse variance; M-H, Mantel–Haenszel; Fix, fixed effects; Rand, random effects; (n), number of randomized controlled trials.

Deux indications qui intéressent les chirurgiens digestifs en 2012

- Les tumeurs du rectum
- Les tumeurs de la tête du pancréas

Current state of rectal cancer robotic surgery in the light of EBM

Laparoscopic approach of colo-rectal cancer

- Feasability, safety, and oncologic value demonstrated for colon cancer with Level I Studies : CLASSIC trial , COST trial (1,2)
- Less clear for Rectal Cancer
  - High conversion rate (34% vs 25%)
  - Higher morbidity and mortality for converted cases
  - Longer learning curve
  - Higher rate of circumferential margin (CRM) involvement :12.4% vs 6.3% in case of anterior resection
  - No difference in local recurrence rate at 5 years follow-up

1) Guillou et al, Lancet 2005
2) COST, N Engl J Med 2004

Studies comparing laparoscopic and robot-assisted proctectomy for rectal cancer

- 4 meta-analysis from Spain, China ,Australia and Italy(486,661, 754 and 854 patients)
- 1 systematic review
- 9 comparative studies
  - Only one randomized study of 18 patients in each group
  - 8 case-control studies
- 5 studies were from Korea, 2 from Italy, 1 from USA, 1 from Romania
- On going multicentre randomized controlled trials :
  - ROLARR
    ACOSOG-Z6051

Conversion rates

Study or subgroup	Robot Events	Robot Total	Laparoscopic Events	Laparoscopic Total	Weight	Risk difference M-H random, 95% CI
Baek	3	41	9	41	8.9%	−0.15 [−0.30, 0.00]
Balk	0	56	6	57	14.5%	−0.11 [−0.19, −0.02]
Bianchi	0	25	1	25	12.6%	−0.04 [−0.14, 0.06]
Kim NK	2	100	3	100	18.6%	−0.01 [−0.05, 0.03]
Kwak	0	59	2	59	17.4%	−0.03 [−0.09, 0.02]
Park	0	41	0	82	19.1%	0.00 [−0.04, 0.04]
Patriti	0	29	10	37	8.9%	−0.27 [−0.42, −0.12]
Total (95% CI)		**351**		**401**	**100%**	**−0.07 [−0.12, −0.01]**
Total events	**5**		**31**			

Heterogeneity: Tau² = 0.00; Chi² = 30.07, df = 6 (P < 0.0001); I² = 80%
Test for overall effect: Z = 2.16 (P = 0.03)

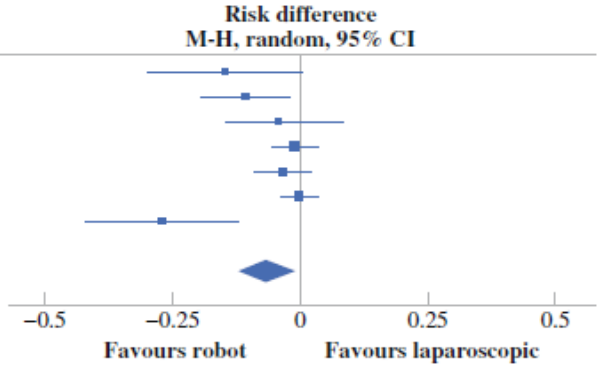


FIG. 2 Forest plot showing a meta-analysis of conversion rates for rectal RALS versus CLS. Risk differences are shown with 95% CIs

The conversion rate is between 0 and 7.3% in the comparative studies
The conversion rate was higher for laparoscopic surgery vs robotic with a significant risk difference of 7%
The conversion rate was 4.3% in the non comparative study of Pigazzi et al (1) including 143 patients with 61.5% having pre-op chemoradiotherapy

1) Pigazzi et al , Ann Surg Oncol 2010

Operation Time

Study or subgroup	Robot Mean	Robot SD	Robot Total	Laparoscopic Mean	Laparoscopic SD	Laparoscopic Total	Weight	Mean difference IV, fixed, 95% CI
Baek	296.0	84.68	41	315.0	100.55	41	1.2%	−19.00 [−59.24, 21.24]
Balk	190.1	45.00	56	191.1	63.50	57	4.8%	−1.00 [−21.26, −19.26]
Bianchi	258.2	76.00	25	245.8	72.50	25	1.2%	12.40 [−28.77, 53.57]
Kim NK	385.3	102.60	100	297.3	83.70	100	2.9%	88.00 [62.05, 113.95]
Kwak	286.0	66.00	59	219.0	55.00	59	4.1%	67.00 [45.08, 88.92]
Park	231.9	61.40	41	168.6	49.30	82	4.2%	63.00 [41.69, 84.91]
Patriti	202.0	12.00	29	208.0	7.00	37	81.6%	−6.00 [−10.92, −1.08]
Total (95% CI)			**351**				**100%**	**2.96 [−0.12, −0.01]**

Heterogeneity: Chi² = 118.23; df = 6 (P < 0.0001); I² = 95%
Test for overall effect: Z = 1.31 (P = 0.19)

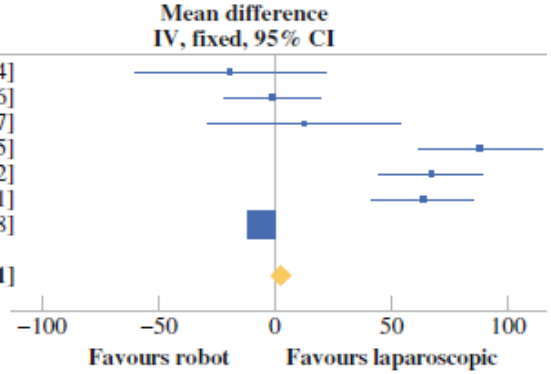


FIG. 3 Forest plot showing a meta-analysis of operation times for rectal RALS versus CLS. Mean differences are shown with 95% CIs

Mean differences in operation time varied widely among the studies
In the Forest plot can be seen 2 clusters, one reporting shorter operation time for laparoscopy, the other reporting no difference
For Park et al (1) a plateau was reached after 22 cases when the laparoscopic approach needed 90 cases

1) Park et al, Ann Surg Oncol 2010

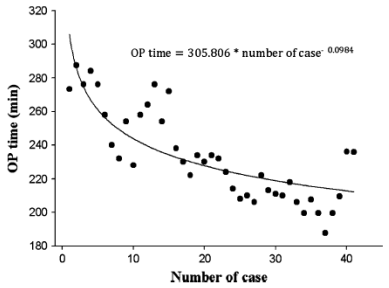


FIG. 2 Changes in operating time for robotic resection in low rectal cancer. The first plateau was observed after 22 patients had undergone the operation

Other early post-operative outcomes

- Blood loss
  - Only 2 studies reported estimated blood loss data and none of them reported difference between the 2 methods (1,2)
- Bowel function recovery
  - The results of the Spanish mata-analysis shows no difference between the 2 methods (p=0,57)
- Hospital stay
  - The results of the Australian meta-analysis shows no difference between the 2 methods (p=0.38)
  - In 2 studies (3,4)there was a significant shorter stay in the robotic group

1)Patriti et al,JLS 2009
2)Baek et al Surg Endosc 2011
3)Baik et al Ann Surg Oncol 2009
4)Kim et al J Korean Soc Coloproctol 2010

Complications

- No mortality and no complications related to the use of the robot were reported
- Australian meta-analysis shows no evidence of a difference in the number of complications between the 2 methods : risk ratio = 0.93 (95% CI 0.67-1.29) p=0.67
- Only the study of Baik et al(1) shows a significant difference favoring the robotic approach concerning the serious con

1)Baik et al Ann Surg Oncol 2009

TABLE 3 Comparison of postoperative complications between groups

Complications	R-LAR ($n = 56$)	L-LAR ($n = 57$)	P
Serious complications			
Intraluminal bleeding	1	0	
Intra-abdominal bleeding	0	1	
Bladder injury	0	1	
Anastomotic leakage	1	4	
Myocardial infarction	0	1	
Pleural effusion	0	1	
Ileus	1	3	
Complication rate (%)	5.4	19.3	0.025
Light complications			
Back pain	2	0	
Scrotal swelling	1	0	
Overall complication rate (%)	10.7	19.3	0.202

R-LAR Robotic low anterior resection, *L-LAR* laparoscopic low anterior resection

Oncologic outcomes

- CRM Status: The results of the Australian Meta-analysis shows no risk difference of CRM involvment between the 2 methods (p=0.77)
- Lymph nodes collected : The results of the Australian Meta-analysis shows no difference between the 2 methods in the mean number of lymph nodes collected (p=0.94)
- DRM : The results of the Australian Meta-analysis shows no difference in mean DRM between the 2 methods (p=0.84)

Mesorectal grade

TABLE 4 Comparison of pathologic results between groups

	R-LAR ($n = 56$) [mean ± SD, median (range)]	L-LAR ($n = 57$) [mean ± SD, median (range)]	*P*
Lymph node harvested (no.)	18.4 ± 9.2, 17.5 (4.0–43.0)	18.7 ± 12, 17.0 (4.0–53.0)	0.831
Proximal resection margin (cm)	10.9 ± 4.0, 10.0 (6.0–25.0)	10.8 ± 4.3, 9.8 (6.0–23.0)	0.971
Distal resection margin (cm)	4.0 ± 1.6, 4.0 (1.0–7.0)	3.6 ± 1.7, 3.0 (1.0–9.0)	0.497
Macroscopic judgment of the specimen			
Complete	52	43 (2)[a]	0.033
Nearly complete	4	12 (3)[a]	
Incomplete	0	2 (1)[a]	
Circumferential resection margin			0.749
Noninvolved (>1 mm)	52	52(6)[a]	
Involved (≤1 mm)	4	5	

R-LAR robotic low anterior resection, *L-LAR* laparoscopic low anterior resection

[a] Conversion cases

The authors attributed this outcome to better quality of dissection in the robotic group

Baik et al Ann Surg Oncol 2009

Long term oncologic outcomes

- Only one comparative study reported long-term outcome with a mean follow-up of 12 months (1)
- Overall survival and disease-free survival was comparable between the 2 groups
- No local recurrence was observed in the robotic group
- In one multicentric case-series (2) with a mean follow-up of 17.4 months
  - The 3-year overall survival rate was 97%,
  - The 3-year disease-free survival rate was 77.6%
  - No isolated local recurrence was observed

1)Patriti et al JSLS 2009
2)Pigazzi et al Ann Surg Oncol 2010

Post-operative bladder and sexual function and quality of life

- There are no data available in the littérature concerning these items
- These data will be secondary endpoints in the ROLARR study

Les pancréatectomies robot-assistées

Chirurgie pancréatique et laparoscopie

- La première DPC laparoscopique a été publiée par Gagner et Pomp en 1994 (1)
- Depuis plusieurs séries d'exérèses laparoscopiques ont été publiées
- Du fait des difficultés rencontrées pour réaliser les gestes les plus complexes par cette voie d'abord et de la longueur de la courbe d'apprentissage, il n'y a pas eu de grand développement dans ce domaine .

1)Gagner et Pomp Surg Endosc 1994

DPC et laparoscopie

Laparoscopic Whipple procedure: review of the literature

Michel Gagner · Mariano Palermo J Hepatobiliary Pancreat Surg (2009) 16:726–730

Table 1 Publications of laparoscopic Whipple reviewed

Author	Year of publication	Number of procedures
Gagner	1994	1
Gagner	1997	10
Gentileschi/Gagner	2001	12
Masson	2003	1
Milone/Gagner	2004	14
Amori	2004	1
Dulucq	2005	10
Staudacher	2005	4
Dulucq	2006	25
Lu	2006	5
Zheng	2006	1
Palanivelu	2007	42
Pugliese	2008	19
Sa Cunha	2008	1
Total		146

Principales données opératoires

Table 2 Blood loss, operation time and hospital stay

References	Blood loss (mL)	Operating time (min)	Hospital stay (days)
Dulucq et al. [1]	162	284	13.6
Assalia and Gagner [25]		510	22.3
Dulucq et al. [11]	107 ± 48	287 ± 39	16.2 ± 2.7
Staudacher et al. [14]	325 ± 50	416 ± 77	12 ± 2
Lu et al. [15]	770	528	39
Zheng et al. [16]	50	390	30
Ammori [19]		660	9
Range	50–770	284–660	9–39

Complications

- Taux de conversion : 46% (12-100%)
- Mortalité: 2 (1,3%)
- Morbidité : 23 (16%)
  - Hemorragies : 2 (1,3%)
  - Occlusion intestinale: 4 (2,6%)
  - Pleuro-pneumopathies : 4 (2,6%)
  - Gastroparésie: 1 (1,3%)
  - Ulcère gastrique: 1 (1,3%)
  - Fistules pancréatiques: 11 (7,5%)

L'étude récente de la Mayo Clinic

Total Laparoscopic Pancreaticoduodenectomy

Feasibility and Outcome in an Early Experience

Michael L. Kendrick, MD; Daniel Cusati, MD Arch Surg. 2010;145(1):19-23

Table 1. Patient Demographics and Operative Data

Characteristic	Median (Range)
Patients, No.	62
Age, mean (SD), y	66 (12)
Body mass index[a]	26 (17-40)
American Society of Anesthesiologists score	3 (2-3)
Sex, female/male, No.	30/32
Disease status, No. (%)	
Benign	17 (27)
Malignant	45 (73)
Type of procedure, No (%)	
Pylorus-preserving	59 (95)
Robotic-assisted	8 (13)
Operative time, mm	368 (258-608)
Estimated blood loss, mL	240 (30-1200)
No. of lymph nodes retrieved	15 (6-31)

[a]Calculated as weight in kilograms divided by height in meters squared.

Table 2. Final Diagnosis and Histologic Findings

Diagnosis	No. of Cases
Pancreatic ductal adenocarcinoma	31
Intraductal papillary mucinous neoplasm	12
Ampullary adenocarcinoma	8
Neuroendocrine carcinoma	4
Chronic pancreatitis	3
Cholangiocarcinoma	1
Metastatic renal cell carcinoma	1
Cystadenoma	1
Duodenal adenoma	1
Specimen characteristics	
Tumor size, median (range), cm	3 (0.9-10.0)
Margin-negative, R0, resection, No. (%)	40 (89)[a]
Regional lymph node metastases, No. (%)	27 (60)[a]

[a]Calculations include only patients with malignancy (n = 45).

Les résultats

- Conversions : 3/65 (4,6%)
  - 1 pour faire la reconstruction en début d'expérience
  - 2 pour envahissement de la VMS découvert en perop
- Mortalité : 1/62 (1,6%)
- Complications : 26 (42%)
  - Fistules pancréatiques : 11 (18%)
  - Gastroparésies : 9 (15%)
  - Réinterventions : 3 (5%°
- Durée moyenne de séjour : 7j (4-69)

Guilianotti's series in Surg Endosc 2010

Table 2 Procedures

	Italy	USA	Total
PD Whipple's	30	20	50
Longmire	6	4	10
DSP	14	9	23
DP (spleen preserving)	13	10	23
MP	3	0	3
TP	0	1	1

Les résultats des DPC

Conversions : 11 (18,3%)

Table 6 Perioperative outcomes (pancreaticoduodenectomy)

Parameters	Italy	USA	Total
OR time, mean (range), (min)	400.5 (240–660)	452 (300–547)	421 (240–660)
EBL mean (range), (ml)	250 (100–600)	433 (80–1,500)	394 (80–1,500)
BT number of patients	1	5	6
Length of stay, mean (range), (days)	28.7 (10–85)	12.5 (5–30)	22 (5–85)
Reoperation	2	2	4
Fistula rate			
Anastomosis done	8	11	19
Fistula	2 (25%)	2 (18%)	4 (21%)
Sclerosis done	28	13	41
Fistula	11 (39.2%)	4 (30.7%)	15 (36.5%)
Total	36	24	60

OR operating room, *EBL* estimated blood loss, *BT* blood transfusion

La série de Pittsburgh :

50 patients opérés entre octobre 2008 et décembre 2010

TABLE 1 Characteristics of the RAPD cohort

Characteristic	Value
Age, year, mean ± SD (range)	68 ± 16 (27–85)
Female sex, *n* (%)	26 (52%)
Prior surgery, *n* (%)	29 (58%)
Body mass index, mean ± SD (range)	27 ± 5 (19–37)
Medical comorbidities, *n* (%)	
Multiple major	11 (22%)
Major	17 (34%)
Minor	2 (4%)
None	20 (40%)
ASA score, *n* (%)	
II	21 (42%)
III	28 (56%)
IV	1 (2%)

ASA American Society of Anesthesiologists

Zeh H.J Ann Surg Oncol 2012

Indications

TABLE 2 Pathologic indications for RAPD

Final histology	*n* (%)
Malignant	37 (74%)
Pancreatic ductal adenocarcinoma	14 (28%)
Neuroendocrine tumor	10 (20%)
Ampullary adenocarcinoma	9 (18%)
Cholangiocarcinoma	2 (4%)
Pseudopapillary neoplasm	2 (4%)
Premalignant	12 (23%)
Intraductal papillary mucinous neoplasm	10 (19%)
Mucinous cystic neoplasm	1 (2%)
Duodenal adenoma	1 (2%)
Benign	1 (3%)
Oligocystic serous cystadenoma	1 (2%)

Données périopératoires

TABLE 3 Perioperative outcomes of the RAPD cohort

Characteristic	Value
Procedure duration (min), median (IQR)	568 (536–629)
Converted to open, *n* (%)	8 (16%)
Blood loss (ml), median (IQR)	350 (150–625)
Blood transfusion, *n* (%)	11 (22%)
Pancreatic duct (mm), median (IQR)	3.0 (3.0–5.0)
Soft pancreatic remnant, *n* (%)	36 (72%)
Length of stay (d), median (IQR)	10.0 (8.0–13.0)

Complications post-op

TABLE 5 Postoperative complications after RAPD

Characteristic	Value
Pancreatic fistula	11 (22%)
Grade A	5 (10%)
Grade B	2 (4%)
Grade C	4 (8%)
30-day morbidity	
Minor (Clavien I/II)	13 (26%)
Major (Clavien III/IV)	15 (30%)
Reoperation	3 (6%)
90-day readmission	15 (30%)
90-day mortality	1 (2%)

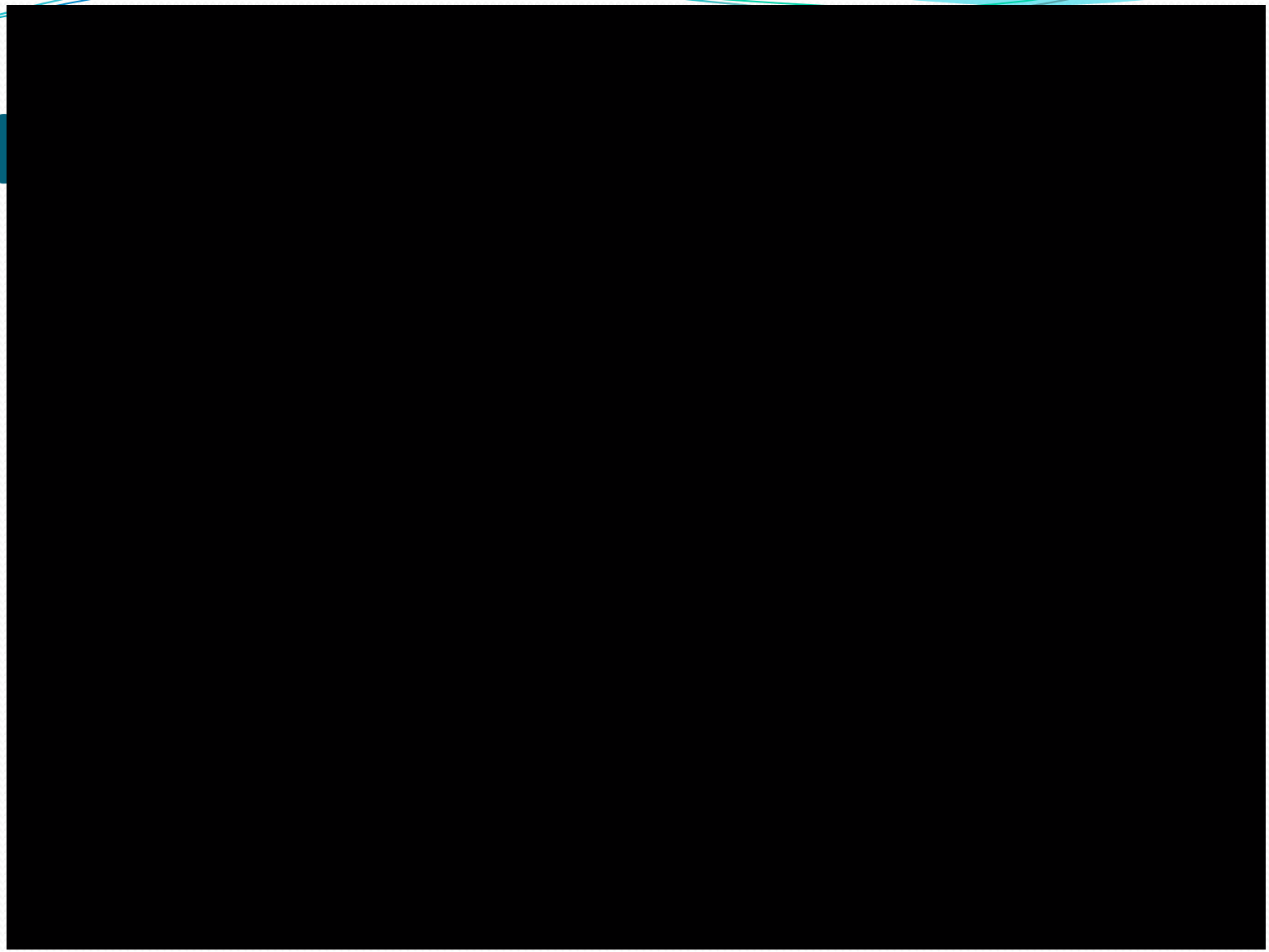
Critères oncologiques

TABLE 4 Pathologic outcomes after RAPD for invasive periampullary adenocarcinoma for PDA, AMP, and CCA only

Characteristic	Value
Total PDA, AMP, and CCA	25 (50%)
TNM ($n = 25$)	
T1N0	2 (8%)
T2N0	4 (16%)
T2N1	1 (4%)
T3N0	6 (24%)
T3N1	10 (40%)
T4N1	2 (8%)
AJCC stage	
IA	2 (8%)
IB	4 (16%)
IIA	6 (24%)
IIB	13 (52%)
Tumor size, cm, median (IQR)	2.7 (0.7)
Lymph nodes collected, median (IQR)	18 (5)
R0 margin	33 (89%)
R1 margin	4 (11%)
Adjuvant therapy indicated ($n = 15$)	11 (73.3)
Duration of adjuvant therapy, week, median (IQR)	11.5 (8.8–12.5)

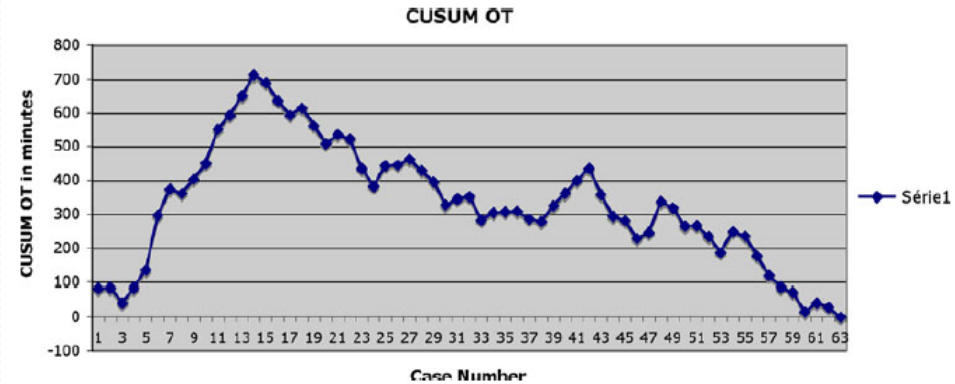
TNM tumor, node, metastasis system, *AJCC* American Joint Committee on Cancer, *PDA* pancreatic ductal adenocarcinoma, *AMP* ampullary carcinoma, *CCA* cholangiocarcinoma

VI



Les succès pour le chirurgien

- Raccourcissement des courbes d'apprentissage
  - By-pass (1)
  - Cancer colo-rectal (2)
- Amélioration incontestable de la dextérité
- Amélioration de l'ergonomie



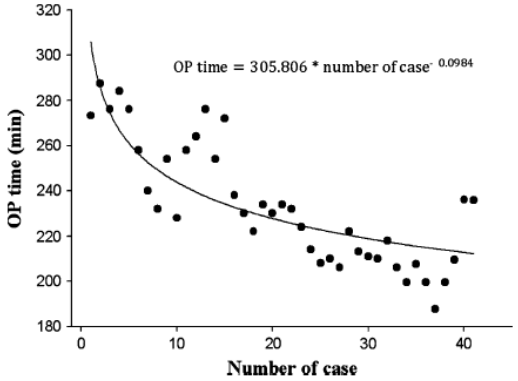


FIG. 2 Changes in operating time for robotic resection in low rectal cancer. The first plateau was observed after 22 patients had undergone the operation

1)Buchs Surg Endosc 2011
2)Park Ann Surg Oncol 2010

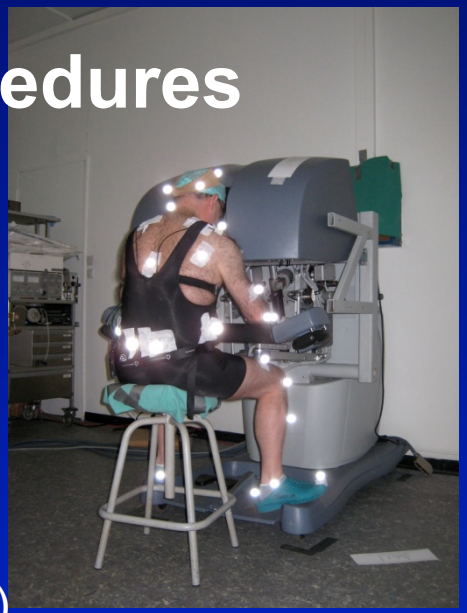
PHRC Nancy-Strasbourg 2008 Ergonomic study comparing laparoscopy vs robotic approach

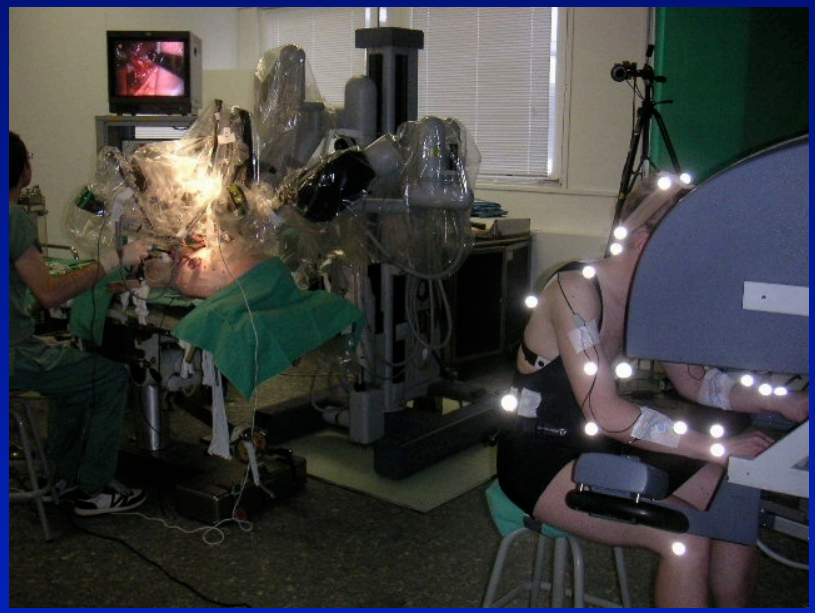
- Subjective study
  - NASA-TLX et Borg Scale
- Cinematic study
  - Motion capture
- Electromyography

4 different procedures

23 surgeons
all right-handed
Mean age 41.6 years

3 sessions of 2 weeks
(january to june 2008)
40 pigs (3 months / 25 kg)
75 minutes procedures





robotic (surgeon seated)

pelvis

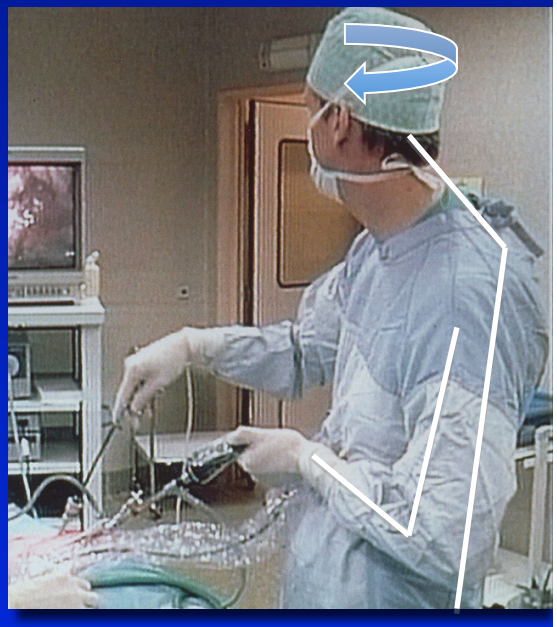
high abdomen

retroperitoneal

Results

Comparing robotic to conventional laparoscopy,

- Our study shows clearly an improvement in subjective assesment of the work burden
- Electromyography analysis shows a reduced muscle activity . Neck and back are particularily spared.
- Preliminary results of "motion capture" shows a more comfortable operating position



Robotic approach reduces surgical discomfort and fatigue and could improve surgical efficiency

Les déconvenues

- Le coût
  - Achat : 2 à 2,5 millions d'Euros
  - Maintenance : 200 000 Euros
  - Instruments : 2000 Euros pour 10 utilisations avec une utilisation de 3,5 instruments par intervention
  - Le drapage : 300 Euros
- L'encombrement
- L'espace de travail limité
- L'aide opératoire doit être très efficace +++

CONCLUSIONS

- Le robot est un formidable facilitateur de la laparoscopie
- Il permet de réaliser des gestes très complexes à la limite de la faisabilité pour le chirurgien « normal »
- On pourrait imaginer dans l'avenir des robots plus petits, moins chers qui pourraient aider tous les gestes laparoscopiques
- Ainsi dans quelques centaines d'années les chirurgiens rappelleront avec effroi que dans le passé, on mettait encore les mains dans le ventre des gens pour les opérer