UNIVERSITÀ DELLA CALABRIA

CHIRURGIA DIGITALE

nuove Frontiere e Prospettive

Cerimonia Inaugurale Anno Accademico 2024/25

World Health Organization

La tecnologia in medicina ***è l'applicazione della conoscenza e delle abilità sotto forma di dispositivi****, farmaci, vaccini e* ***procedure per risolvere problemi di salute e migliorare la qualità della vita***

NUOVE FRONTIERE

CHIRURGIA DIGITALE 4.0

convergenza

AI

CLOUD COMPUTING

3D *VIRTUAL* ***IMAGES***

ROBOTS

PARADIGMA DIGITALE IN CHIRURGIA

OPEN- MIS –ROBOTICA

REMAKEBLE
JOURNEY OF PROGRESS

Robotica ....ORGINI ANTICHE

1495

3DF
+
4DF

L'**Automa Cavaliere** di **Leonardo Da Vinci** fu progettato e costruito nel 1495

Poteva stare in piedi, sedere, alzare la visiera e muovere le braccia indipendentemente. Aveva anche una mandibola mobile.

*Moran, Michael E. (December 2006). "The da Vinci robot". Journal of Endourology. **20** (12): 986–90.*

*"**Results:** It is now known that da Vinci's robot would have had the outer appearance of a Germanic knight. It had a complex core of mechanical devices that probably was human powered. The robot had two independent operating systems. The first had three degree-of-freedom legs, ankles, knees, and hips. The second had four degrees of freedom in the arms with articulated shoulders, elbows, wrists, and hands. ...*

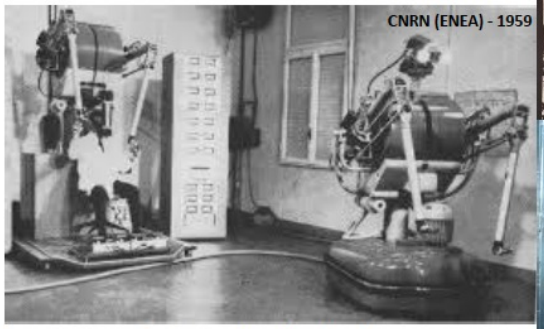
*Moran, Michael E. (December 2006). "The da Vinci robot". Journal of Endourology. **20** (12): 986–90.*

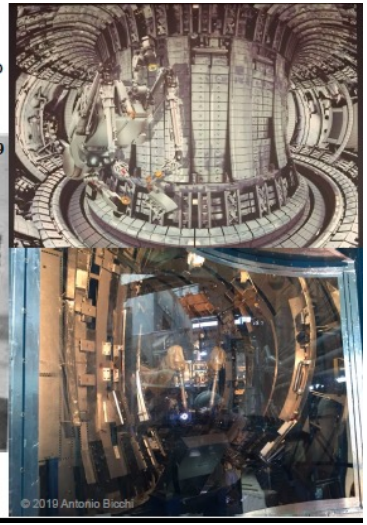
Robotica in Italia

da dove veniamo e chi siamo

Primati della Tecnologia RIM Italiana

MASCOT - MAnipolatore Servo COntrollato Transistorizzato
Carlo Mancini (CNRN-ENEA), Italia, 1959





Due bracci con 6+1 giunti; force feedback
Tuttora in uso al Joint European Thorus, Culham, UK (!)

- ✓Primo Manipolatore Telecontrollato per applicazioni nucleari (CNRN/ENEA)
- ✓Primo robot di misura (DEA)
- ✓Primo robot per assemblaggio (OLIVETTI)
- ✓Primo robot per il taglio laser (PRIMA INDUSTRIE)

Robotica Industriale

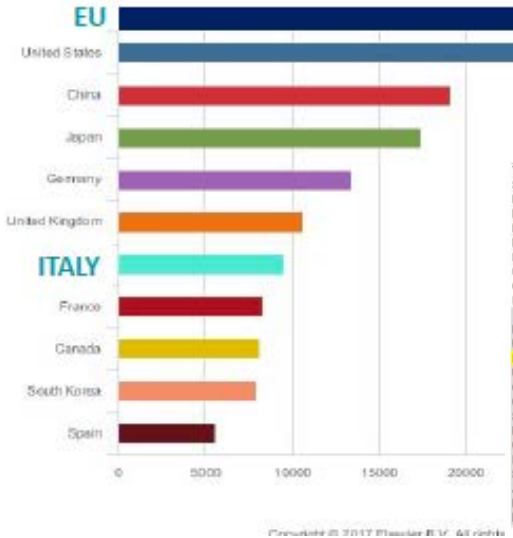
Robotica Riabilitativa

Robotica Chirurgica

RICERCA in ROBOTICA :
ITALIA ed EUROPA ALL'AVANGUARDIA

Pubblicazioni Scientifiche

Source: Scopus



SciVal Metrics – Robotics

Year range	2014 to 2018
Subject classification	ASJC
Filtered by	no subject area filter selected
Data source	Scopus
Date last updated	27 May 2020
Date exported	4 June 2020
Metric name	Self-citations
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	Metric name
Entity	Field-Weighted Citation Impact (excl. self-citations)
United States (ROBOTICS)	1,78
Italy (ROBOTICS)	1,66
United Kingdom (ROBOTICS)	1,54
Germany (ROBOTICS)	1,53
Canada (ROBOTICS)	1,41
Spain (ROBOTICS)	1,37
France (ROBOTICS)	1,36
China (ROBOTICS)	0,9
India (ROBOTICS)	0,89
South Korea (ROBOTICS)	0,86
Japan (ROBOTICS)	0,85
EU (ROBOTICS)	1,38
EU no UK (ROBOTICS)	1,37

Year range	2014 to 2018
Subject classification	ASJC
Filtered by	no subject area filter selected
Data source	Scopus
Date last updated	27 May 2020
Date exported	4 June 2020
Metric name	Self-citations
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	Metric name
Entity	Output in Top 10% Citation Percentiles (excl. self
Italy (ROBOTICS)	12,3
United Kingdom (ROBOTICS)	11,8
United States (ROBOTICS)	11,8
Canada (ROBOTICS)	10,4
France (ROBOTICS)	8,9
Germany (ROBOTICS)	8,5
Spain (ROBOTICS)	8,1
China (ROBOTICS)	7,2
South Korea (ROBOTICS)	6,8
India (ROBOTICS)	4,4
Japan (ROBOTICS)	3,6
EU (ROBOTICS)	8,4
EU no UK (ROBOTICS)	8,1

Year range	2014 to 2018
Subject classification	ASJC
Filtered by	no subject area filter selected
Data source	Scopus
Date last updated	27 May 2020
Date exported	4 June 2020
Metric name	Self-citations
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	Metric name
Entity	Citations per Publication (excl. self-citations)
	Overall
United States (ROBOTICS)	9,3
Italy (ROBOTICS)	9
United Kingdom (ROBOTICS)	8,5
Canada (ROBOTICS)	8,3
Spain (ROBOTICS)	7,7
Germany (ROBOTICS)	7,4
France (ROBOTICS)	7,2
South Korea (ROBOTICS)	5,6
China (ROBOTICS)	5,4
Japan (ROBOTICS)	4,1
India (ROBOTICS)	3,8
EU (ROBOTICS)	7
EU no UK (ROBOTICS)	6,9

Italia prima al mondo per qualità dei prodotti scientifici in Robotica!

PRATICA CLINICA

ROBOT IN CHIRURGIA

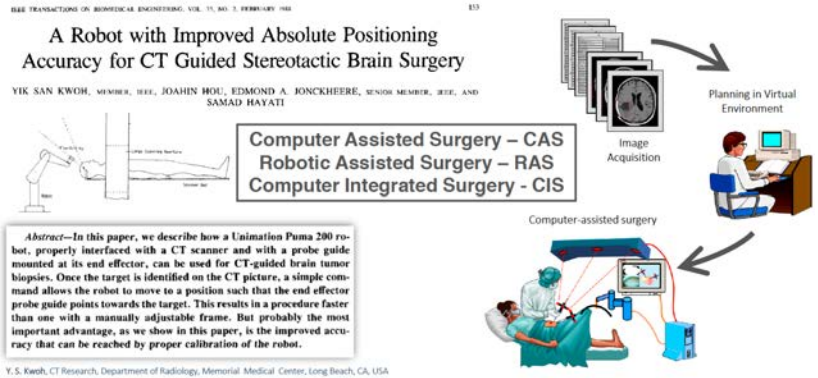
I PRIMI TENTATIVI DI CHIRURGIA ROBOTIZZATA ANNI ‘80

1983 ARTHROBOT the world's first surgical robot ,for orthopedic procedures developed and used for the first time in Vancouver

1985 PUMA 560 used for a brain biopsy by CT-guidance.

1988 PROBOT developed at Imperial College (London) used to perform prostatic surgery.

1992 ROBODOC/ AESOP first surgical robot approved by the FDA

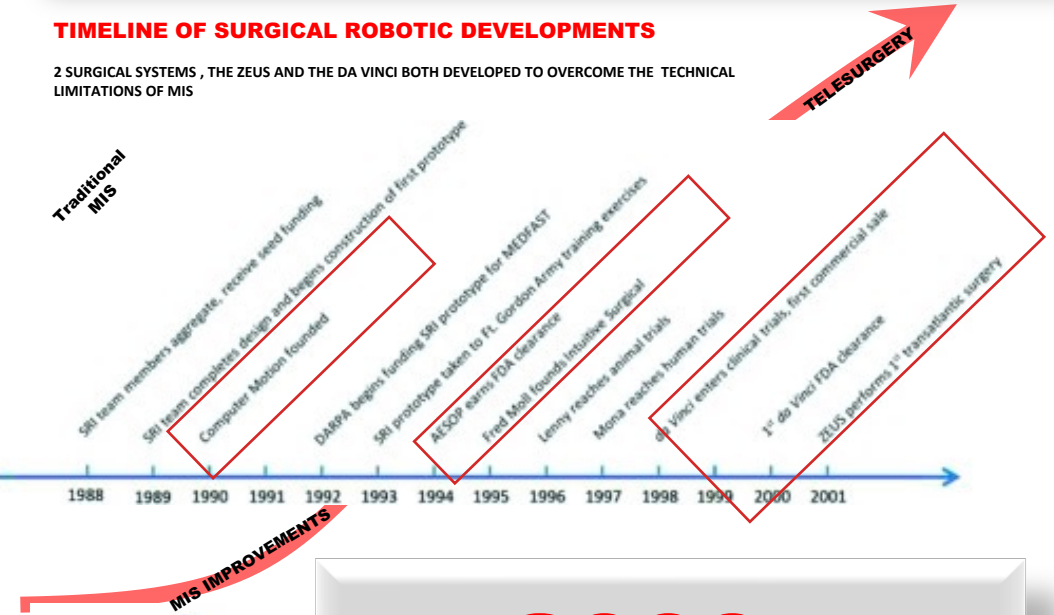


THE MASTER-SLAVE TELEMANIPULATOR "*CONCEPT* "

ANNI 90s

TIMELINE OF SURGICAL ROBOTIC DEVELOPMENTS

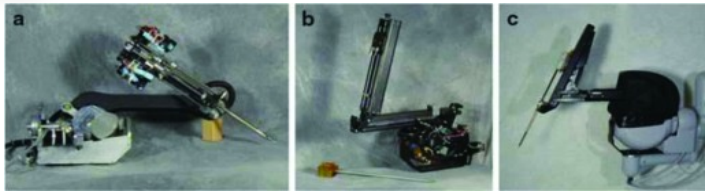
2 SURGICAL SYSTEMS , THE ZEUS AND THE DA VINCI BOTH DEVELOPED TO OVERCOME THE TECHNICAL LIMITATIONS OF MIS



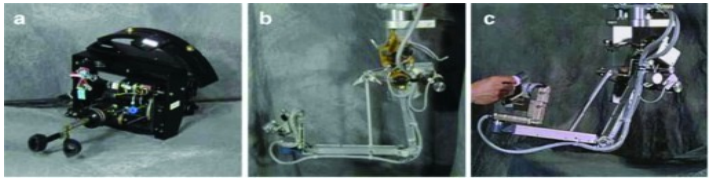
2000

FDA APPROVAL

CARDIOTHORACIC SURGERY/GENERAL SURGERY



Origins of Robotic Surgery: From Skepticism to Standard of Care JSLS. 2018 Oct-Dec; 22(4



***ZEUS* System**
(by computer motion)

***da Vinci* System**
by Intuitive

History of Robotic Surgery

In 1994, ZEUS Robotic Surgical System

Helping Surgeons: The da Vinci and ZEUS System

By FDA

History of Robotic Surgery

In 2000, The da Vinci Surgical System

Robots Helping Surgeons: The da Vinci and ZEUS System

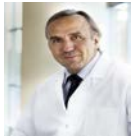
By FDA

First all-robotic-assisted Kidney transplant.

Dr. Stuart Geffner, Santa Barbara Medical Center, New Jersey 2009

Chronological Events

First Robotic Assisted heart bypass using da Vinci surgical System.



F W Mohr Department of Cardiac Surgery,
University of Leipzig, Germany.

I PIONIERI
DELLA CHIRURGIA ROBOTICA

Loulmet D, Aupecle B, et al. Computer assisted open heart surgery. First case operated on with success CR. Acad Sci III. (**1998**) 321:437–42.

Mohr FW, Falk V, Diegeler A, Walther T, Gummert JF, Bucerius J, et al. Computer-enhanced "robotic" cardiac surgery: experience in 148 patients. JThorac Cardiovasc Surg. **(2001)** 121:842–53

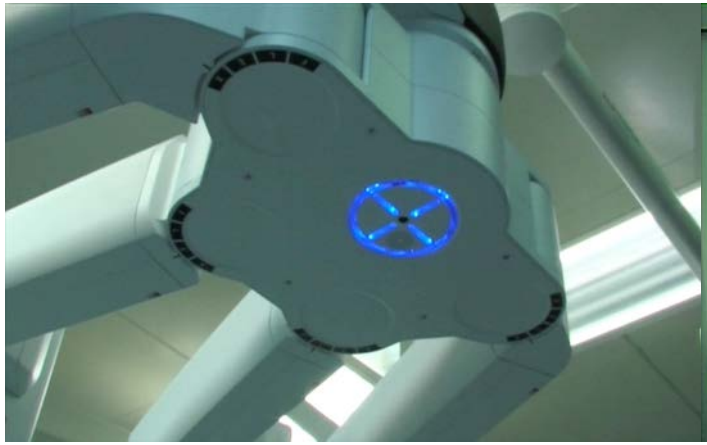
Melfi FMA, et al. Early experience with robotic technology for thoracoscopic surgery. Eur J Cardiothorac Surg **2001**;21:864-8.

Bonatti J, Schachner T, Bonaros N, Laufer G, Kolbitsch C, Margreiter J, et al. Robotic totally endoscopic coronary artery bypass and catheter based coronary intervention in one operative session. Ann Thorac Surg. **(2005)**

Melfi FMA, et Al. Robotically assisted lobectomy: learning curve and complications. Thorac Surg Clin **2008;1**8:289-95, vi-vii.

Park BJ, et al Cost comparison of robotic, video-assisted thoracic surgery and thoracotomy approaches topulmonary lobectomy. Thorac Surg Clin **2008;**18:297-300

EVOLUZIONE TECNOLOGICA



- 3 D
- 7 DOF
- SCALING /TREMOR FILTER
- ERGONOMIC

MAGNIFICAZIONE DELL'IMMAGINE
(10 volte quella normale)

MAGGIORE PRECISIONE

DESTREZZA CHIRURGICA

INDICAZIONI

- **TUMORI LOCALMENTE AVANZATI**
- **PREGRESSI TRATTAMENTI** ***(CT/RT/Immunot/Surgery)***
- **PAZIENTI AD ALTO RISCHIO (ASA III- IV)**

THE AMERICAN COLLEGE OF CHEST PHYSICIANS GUIDELINES
THE NCCN GUIDELINES

RACCOMANDANO UN APPROCCIO MIS E ROBOTICO NEI PAZIENTI AFFETTI DA PATOLOGIA NEOPLASTICA

CHEST Supplement

DIAGNOSIS AND MANAGEMENT OF LUNG CANCER, 3RD ED: ACCP GUIDELINES

Treatment of Stage I and II Non-small Cell Lung Cancer

Diagnosis and Management of Lung Cancer, 3rd ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines

John A. Howington, MD, FCCP; Matthew G. Blum, MD, FCCP; Andrew C. Chang, MD, FCCP; Alex A. Balekian, MD, MSHS; and Sudish C. Murthy, MD, PhD, FCCP

National Comprehensive Cancer Network®

NCCN Guidelines Version 2.2019
Non-Small Cell Lung Cancer

NCCN Guidelines Index
Table of Contents
Discussion

The NCCN Panel believes that surgery may be appropriate for select patients with N2 disease, especially those whose disease responds to induction chemotherapy (see *Principles of Surgical Therapy* in the NCCN Guidelines for NSCLC).[300,306] It is controversial whether pneumonectomy after preoperative chemoradiotherapy is appropriate.[302,306-314] Patients with resectable N2 disease should not be excluded from surgery, because some of them may have long-term survival or may be cured.[306,315]

Thoracoscopic Lobectomy

Video-assisted thoracic surgery (VATS), which is also known as thoracoscopic lobectomy, is a minimally invasive surgical treatment that is currently being investigated in all aspects of lung cancer (see *Principles of Surgical Therapy* in the NCCN Guidelines for NSCLC).[316-318] Published studies suggest that thoracoscopic lobectomy has several advantages over thoracotomy.[319-322] Acute and chronic pain associated with thoracoscopic lobectomy is minimal; thus, this procedure requires a shorter length of hospitalization.[323,324] Thoracoscopic lobectomy is also associated with low postoperative morbidity and mortality, minimal risk of intraoperative bleeding, or minimal locoregional recurrence.[325-329] Thoracoscopic lobectomy is associated with less morbidity, fewer complications, and more rapid return to function than lobectomy by thoracotomy.[316,318]

In patients with stage I NSCLC who had thoracoscopic lobectomy with lymph node dissection, the 5-year survival rate, long-term survival, and local recurrence were comparable to those achieved by routine open lung resection.[334-338] Thoracoscopic lobectomy has also been shown to improve discharge independence in older populations and patients at high risk.[339,340] Data show that thoracoscopic lobectomy improves the ability of patients to complete postoperative chemotherapy regimens.[341,342] Based on its favorable effects on postoperative recovery and morbidity, thoracoscopic lobectomy (including robotic-assisted approaches) is recommended in the NSCLC algorithm as an acceptable approach for patients who are surgically resectable (and have no anatomic or surgical contraindications) as long as principles of thoracic surgery are not compromised (see *Principles of Surgical Therapy* in the NCCN Guidelines for NSCLC).[343-346] Robotic VATS seems to be more expensive with longer operating times than conventional VATS.[347,348]

Radiation Therapy

The *Principles of Radiation Therapy* in the NSCLC algorithm include the following: 1) general principles for early-stage, locally advanced, and advanced NSCLC; 2) target volumes, prescription doses, and normal tissue dose constraints for early-stage, locally advanced, and advanced NSCLC; and 3) RT simulation, planning, and delivery.[349-355] These RT principles are summarized in this section. Whole brain RT and stereotactic radiosurgery (SRS) for brain metastases are also discussed in this section. The abbreviations for RT are defined in the NSCLC algorithm (see Table 1 in *Principles of Radiation Therapy* in the NCCN Guidelines for NSCLC).

General Principles

Treatment recommendations should be made by a multidisciplinary team. Because RT has a potential role in all stages of NSCLC, as either definitive or palliative therapy, input from board-certified radiation oncologists who perform lung cancer RT as a prominent part of their practice should be part of the multidisciplinary evaluation or discussion for all patients with NSCLC. Uses of RT for NSCLC include: 1) definitive therapy for locally advanced NSCLC, generally combined with chemotherapy; 2) definitive therapy for early-stage NSCLC in patients with contraindications for surgery; 3) preoperative or postoperative therapy for selected patients treated with surgery; 4) therapy for limited recurrences and metastases; and/or 5) palliative therapy for patients with incurable NSCLC.[296,355-362] The goals of RT are to maximize tumor control and to minimize treatment toxicity. Advanced technologies such as 4D-conformal

3.2 Recommendation

3.2.1. For patients with clinical stage I NSCLC, a minimally invasive approach such as video-assisted thoracic surgery (thoracoscopy) is preferred over a thoracotomy for anatomic pulmonary resection and is suggested in experienced centers (Grade 2C).

VATS or minimally invasive surgery (including robotic-assisted approaches) should be strongly considered for patients with no anatomic or surgical contraindications, as long as there is no compromise of standard oncologic and dissection principles of thoracic surgery.

L'APPROCCIO ROBOTICO È PIÙ EFFICACE PER TASSO DI CONVERSIONE, ESTENSIONE DELLA LINFOADENECTOMIA, PER RISPOSTA PATOLOGICA COMPLETA

frontiers | Frontiers in Oncology

TYPE Original Research
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EDITED BY
Long Jiang,
First Affiliated Hospital of Guangzhou Medical University, China

REVIEWED BY
Song Xu,
Tianjin Medical University General Hospital, China
Alberto Testori,
Humanitas University, Italy

*CORRESPONDENCE
Yang Gao

Safety and feasibility of robotic-assisted thoracic surgery after neoadjuvant chemoimmunotherapy in non-small cell lung cancer

Jun Zeng[1,2,3,4†], Bin Yi[1,2,3,4†], Ruimin Chang[1,2,3,4], Yufan Chen[1,2,3,4], Zhongjie Yu[1,2,3,4] and Yang Gao[1,2,3,4*]

Index	With IPTW, %		
	VATS	RATS	*P*
Surgery duration, mean (SD), min	190.24 (82.96)	196.87 (72.17)	0.625
Conversion to open, NO. (%)			
Total	33.7%	8.2%	<0.001
Primary tumor invasion	7.1%	1.6%	
Dense adhesion and fibrosis	9.3%	3.2%	
Fibrocalcified lymph nodes	5.2%	0.5%	
Bleeding	12.1%	2.9%	
Transfusion, NO. (%)	19.3%	7.5%	0.054
Bleeding volume, Median (IQR), ML	112.3 (46.7 to 198.8)	121.7 (63.1 to 218.4)	0.184
Transfusion volume Median (IQR), ML	0 (0 to 0)	0 (0 to 0)	0.072

Index	Without IPTW, NO. (%)			With IPTW, %		
	VATS(n=78)	RATS(n=142)	*P*	VATS	RATS	*P*
Lymph node station count, mean (SD)	5.63 (1.75)	8.09 (5.73)	<0.001	5.64 (1.89)	7.98 (5.40)	<0.001
Lymph nodes count, mean (SD)	13.49 (9.32)	20.35 (10.32)	<0.001	13.65 (9.44)	19.92 (10.05)	<0.001
yp-T stage			0.885			0.827
yp-T0	39 (50.0)	73 (51.4)		50.6%	50.9%	
yp-T1	23 (29.5)	42 (29.6)		24.4%	28.8%	
yp-T2	12 (15.4)	20 (14.1)		19.0%	15.2%	
yp-T3	3 (3.8)	3 (2.1)		4.1%	2.0%	
yp-T4	1 (1.3)	4 (2.8)		1.9%	3.2%	
yp-N stage			<0.001			0.015
yp-N0	69 (88.5)	96 (67.6)		86.5%	65.9%	
yp-N1	6 (7.7)	18 (12.7)		7.8%	14.8%	
yp-N2	3 (3.8)	28 (19.7)		5.6%	19.3%	
Pathology response			0.493			0.449
IPR	31 (39.7)	60 (42.3)		38.1%	44.7%	
MPR	9 (11.5)	23 (16.2)		12.1%	15.9%	
PCR	38 (48.7)	59 (41.5)		49.8%	39.4%	

SD, standard deviation; yp-, yield pathological-; IPR, incomplete pathological response; MPR, major pathological response; PCR, pathological complete response; IPTW, inverse probability treatment weight; VATS, video-assisted thoracic surgery; RATS, robotic-assisted thoracic surgery.

GLOBAL DIFFUSION >8.200 ROBOT

13 MIL PTS

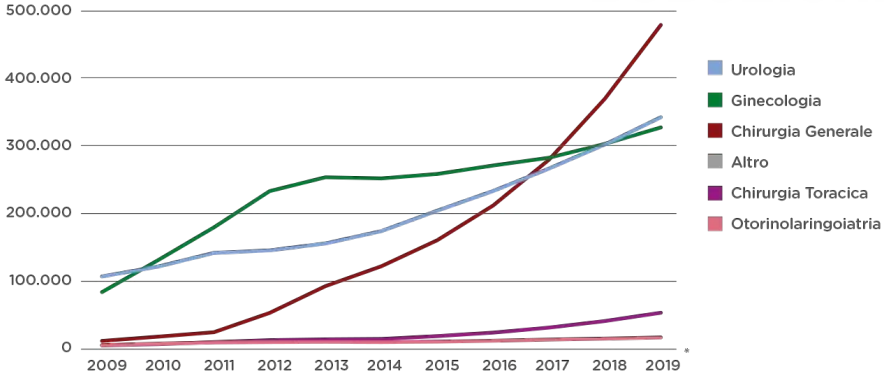
66.000 SURGEONS

34.000 PEER PUBLICATIONS

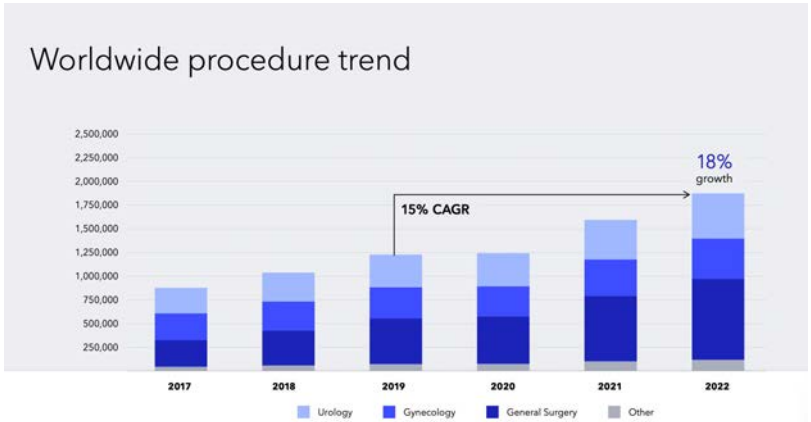
100% TOP H. CANCER

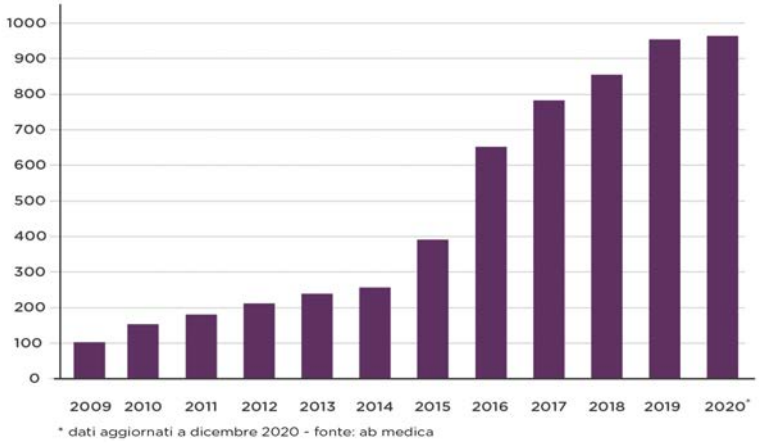
>1500 ROBOT

CRESCITA ESPONENZIALE DELLE PROCEDURE ROBOTICHE IN EUROPA

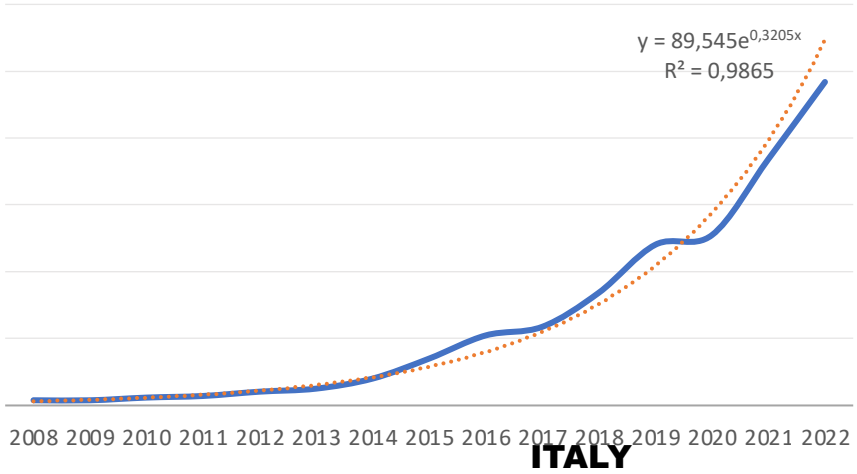


ITALIA



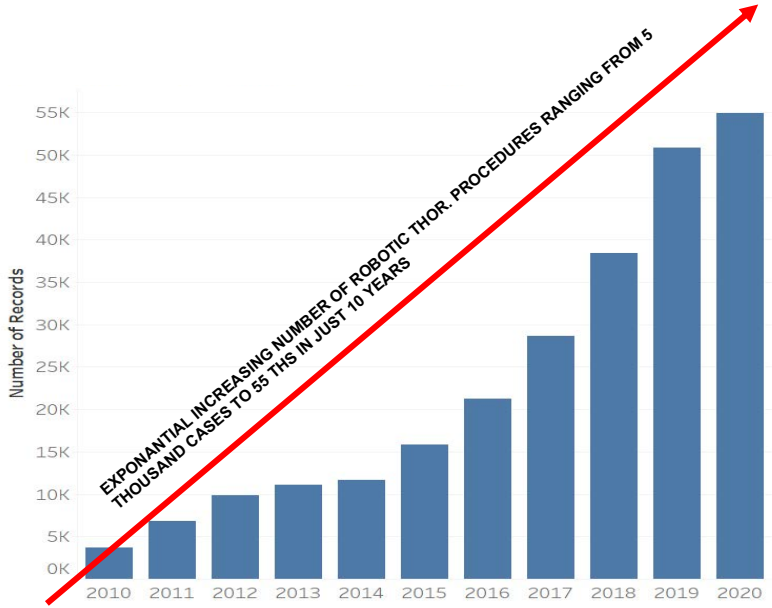


CHIRURGIA ROBOTICA TORACICA IN EUROPA



ITALY

30% /LAST 3 YEARS



KEY POINTS

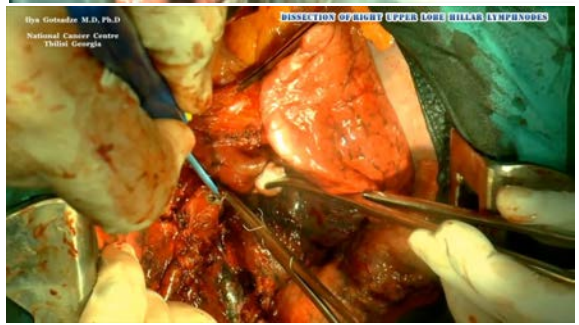
RIPRODUCIBILITA' *anatomical dissection*

PRECISIONE

QUALITA' DELLA CHIRURGIA

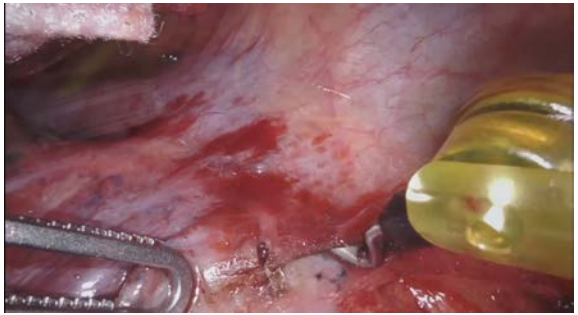
RIPRODUCIBILITA'

OPEN LOBECTOMY

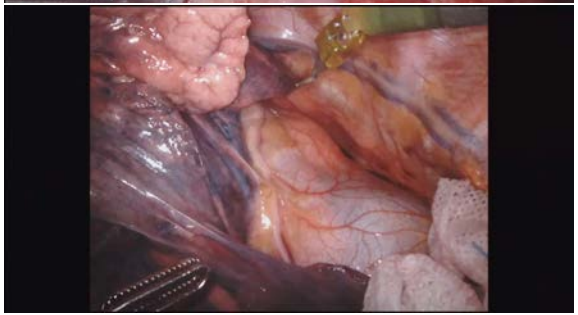


ROBOT LOBECTOMY

ARTERY



VEIN



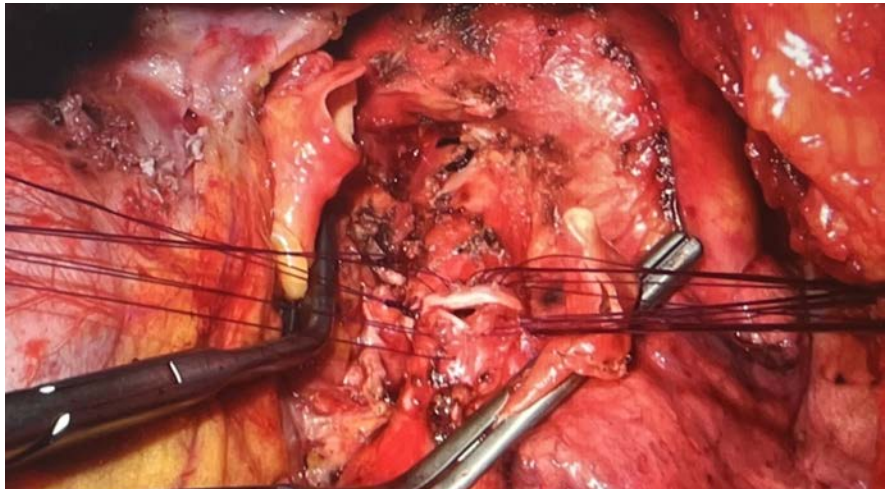
BRONCHUS

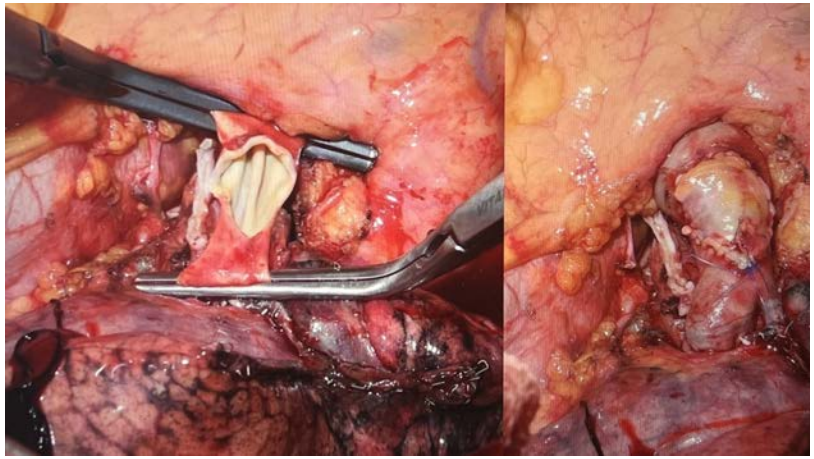
AS SHOWN

Figure 37.3 Anatomical relationship between the airway and the pulmonary artery on the left side.

REPRODUCIBILITA’
PRECISIONE

Bronco-vascular Sleeve





QUALITA' DELLA CHIRURGIA

upstaging

L'upstaging e' una misura della qualità dell'intervento chirurgico.

Tassi elevati di upstaging implicano una maggiore capacita' di valutare più linfonodi fornendo un forte strumento prognostico.

Published Studies	RATS (own centre data)	VATS (NCCN/NSLC database)	Open surgery (NCCN/NSLC) database
Assessment of mediastinal nodal stations			
Mean number of N2 LN stations dissected	3.7 +0.1	3.1 / 2.5	2.9 / 3.7
>3N2 LN dissected	98%	66%	58%
Individual N2 LNs retrieved	7.2 ± 0.3	2.5*	3.7*
Nodal upstaging rate			
cN0-to-pN2	8.2%	2.1-4.9%	1.9-5%
cN0-to-pN1	16.4%	8.8-15.9%	14.3-14.5%

*Damico TA et al, 2011

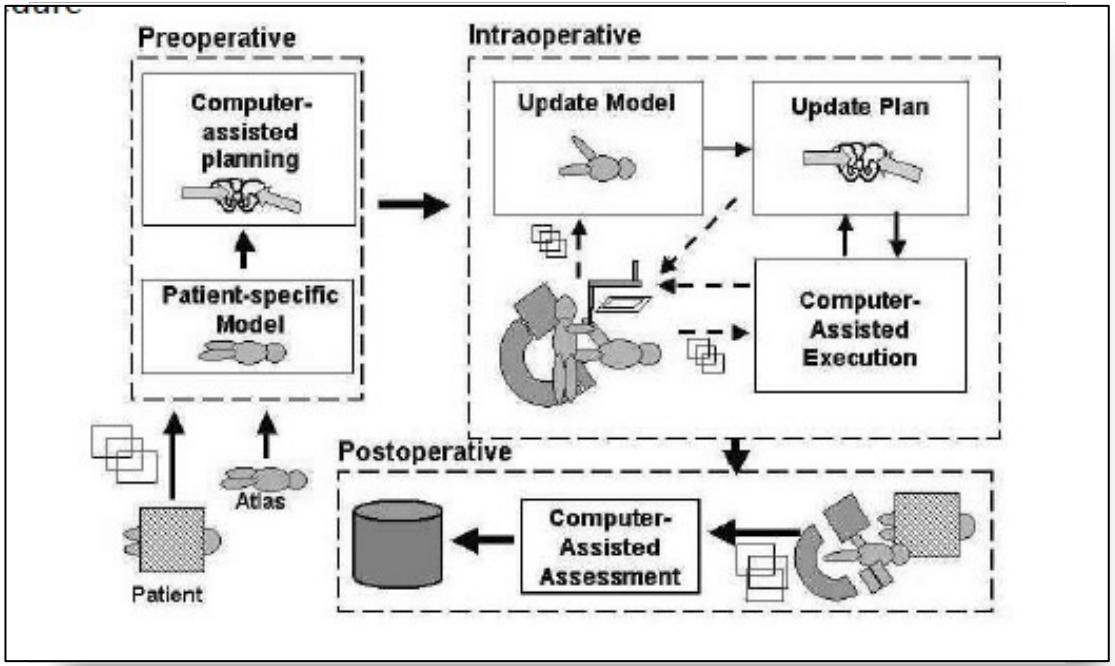
Velez-Cubian et Al, Cancer Control 2015;102(

Nodal upstaging is a surrogate measure of the quality of the surgery.
Higher rates of nodal upstaging are preferred and the ability to assess more nodes provides a strong prognostic tool.

COMPUTER INTEGRATED SURGERY

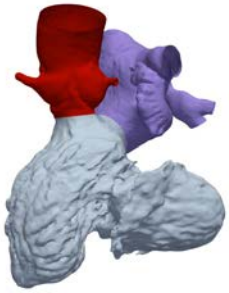
TO PERFORM INCREASINGLY COMPLEX PROCEDURES

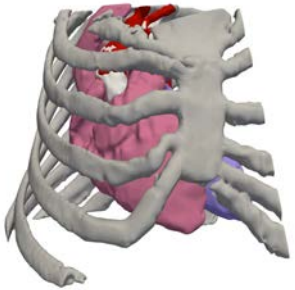
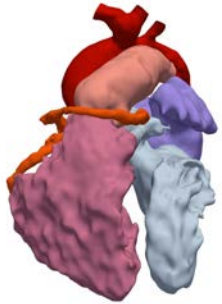
IL ROBOT E' SOLO UNO degli ELEMENTI DI UN VASTO SISTEMA PROGETTATO PER L'ALTA QUALITA' DELLA CHIRURGIA



THIS REFLECTS THE TREMENDOUS TECHNOLOGICAL DEVELOPMENTS EVER MORE INTEGRATED

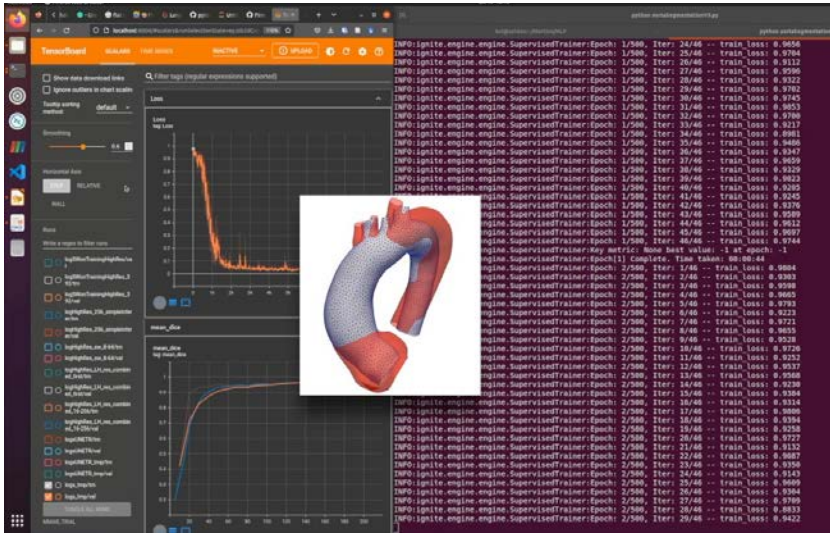
3D VIRTUAL RECONSTRUCTION AI

AI

to identify anatomical AORTA variations starting from real CT*scan* images



GLIMS OF THIS INTEGRATED PLATFORMS SUCH A

PRECISIONE & QUALITA' CHIRURGICA

QUALITY OF VISION

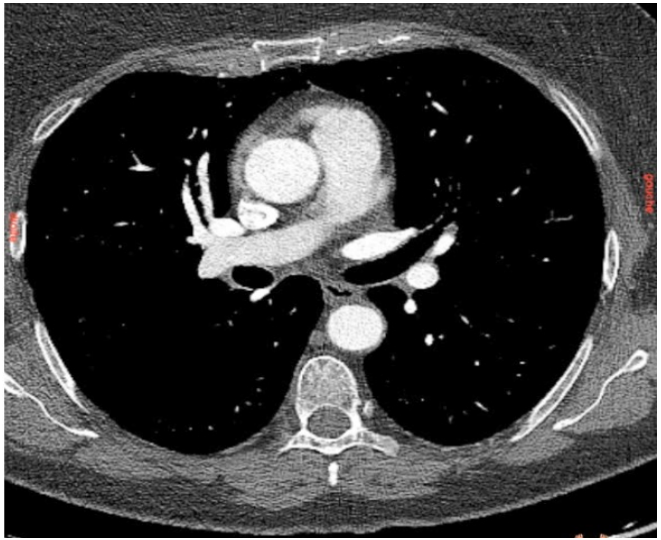
- STABLE,3D, HD, X10
- AUGMENTED (FIREFLY)

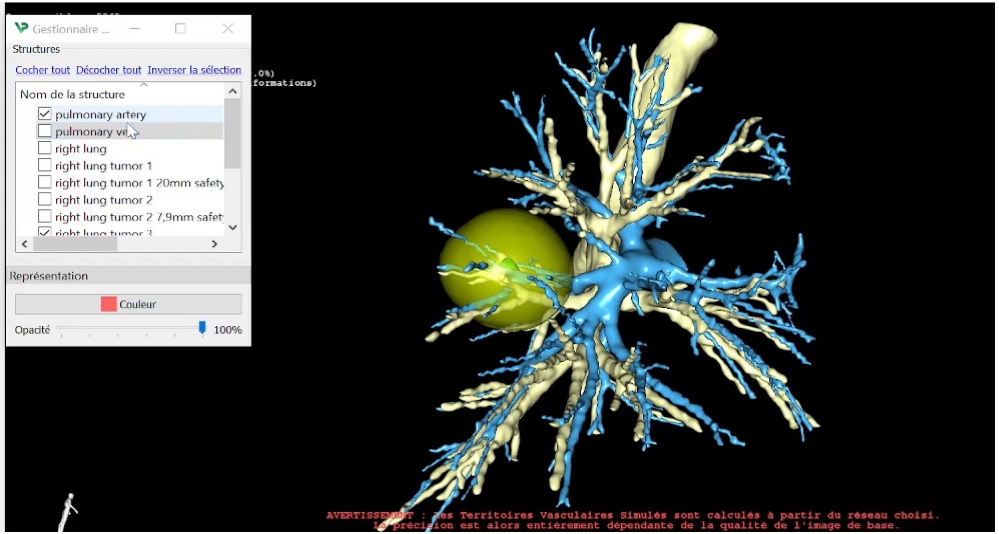
PRECISION

- NO TREMOR
- 7 DEGREES OF FREEDOM

ADVANCED INSTR. STAPLER ENERGY

vascular abnormalities





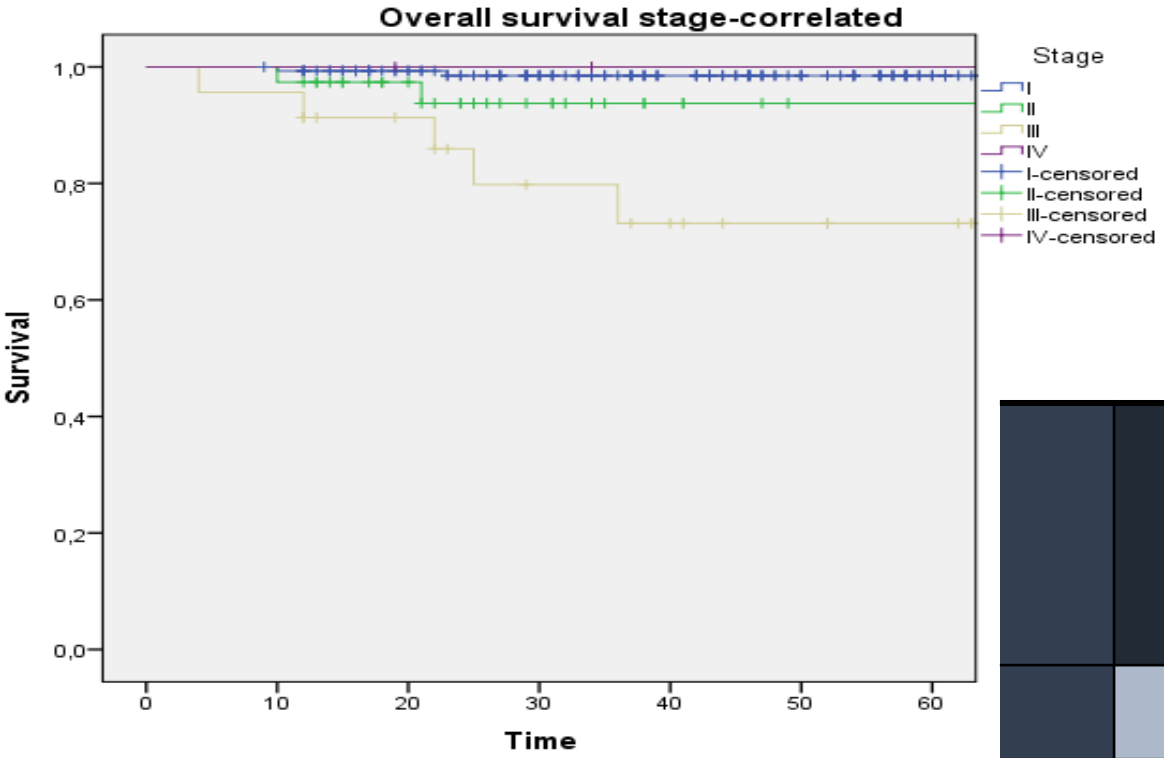
aa 2001(2014)-2023

RESEZIONEPOLMONARI MAGGIORI	**2926**
MEDIASTINO RES	**195**
THYMECTOMY	**267**

3388 pts

(median age 56 y- range 19-81)

RESULTATI
(SOPRAVVIVENZ



*singola metastasi intracranica

Surgical Oncology 28 (2019) 223–227
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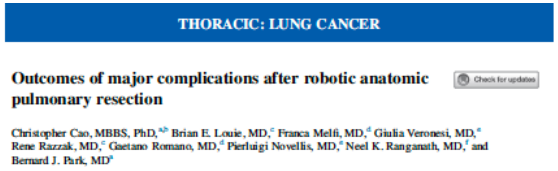
Surgical Oncology
journal homepage: www.elsevier.com/locate/suronc

Long-term oncologic results for robotic major lung resection in non-small cell lung cancer (NSCLC) patients

Carmelina C. Zirafa[a,*,1], Ilenia Cavaliere[b,1], Sara Ricciardi[b], Gaetano Romano[b], Federico Davini[b], Vittorio Aprile[b], Franca Melfi[a]

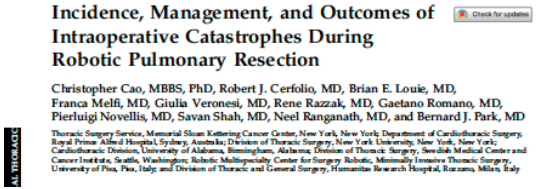
[a] Minimally Invasive and Robotic Thoracic Surgery, Robotic Multispecialty Center of Surgery, University Hospital of Pisa, Pisa, Italy
[b] Division of Thoracic Surgery, Department of Surgical, Medical, Molecular, Pathology and Critical Care, University Hospital of Pisa, Pisa, Italy

	OS 5 YEAR OS > 90% THE STAGE 1 MEAN OS STAGE RANGING FROM 82 MONTHS TO 68 MONTHS FOR STAGE IV			
	1-year	2-year	3-year	5-year
I	99.3%	98.5%	98.5%	98.5%
II	97.4%	93.8%	93.8%	93.7%
III	91.3%	85.1%	73.1%	73.1%
IV	84.7%	66.7%	52.1%	-


THORACIC: LUNG CANCER

Outcomes of major complications after robotic anatomic pulmonary resection

Christopher Cao, MBBS, PhD,[a,b] Brian E. Louie, MD,[c] Franca Melfi, MD,[d] Giulia Veronesi, MD,[e] Rene Razzak, MD,[c] Gaetano Romano, MD,[d] Pierluigi Novellis, MD,[d] Neel K. Ranganath, MD,[f] and Bernard J. Park, MD[a]


Incidence, Management, and Outcomes of Intraoperative Catastrophes During Robotic Pulmonary Resection

Christopher Cao, MBBS, PhD, Robert J. Cerfolio, MD, Brian E. Louie, MD, Franca Melfi, MD, Giulia Veronesi, MD, Rene Razzak, MD, Gaetano Romano, MD, Pierluigi Novellis, MD, Savan Shah, MD, Neel Ranganath, MD, and Bernard J. Park, MD

Thoracic Surgery Service, Memorial Sloan Kettering Cancer Center, New York, New York; Department of Cardiothoracic Surgery, Royal Prince Alfred Hospital, Sydney, Australia; Division of Thoracic Surgery, New York University, New York, New York; Cardiothoracic Division, University of Alabama, Birmingham, Alabama; Division of Thoracic Surgery, Swedish Medical Center and Cancer Institute, Seattle, Washington; Robotic Multispecialty Center for Surgery Robotic, Minimally Invasive Thoracic Surgery, University of Pisa, Pisa, Italy; and Division of Thoracic and General Surgery, Humanitas Research Hospital, Rozzano, Milan, Italy

PERIOD 2001-2015

COMPLICAZIONI INTRAOPERATORIE

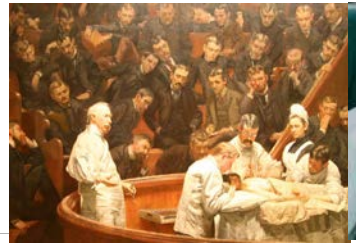
8 (0.6%)

year	procedure	Intaoperative complcation	Conversion	note
2002	Upper right lobecomy	Calcified lymph-node	Yes	
2004	Lower left lobectomy	Instrument Spatula detached	No	
2006	Upper left lobectomy	Bleeding artery Posterior segmental artery g	Yes	Traction of the lobe
2008	Lower right lobectomy	Bleeding apical artery	No	
2011	Left lower lobectomy	Vein laceration Using the hoock	No	
2003	Right Upper Lobectomy	Stapler malfunction	Yes	During proctoring
2014	Lymphadenectomy	Tracheal lesion	No	During proctoring
** 2009	Thymectomy	Mediastinum infiltration	Yes	

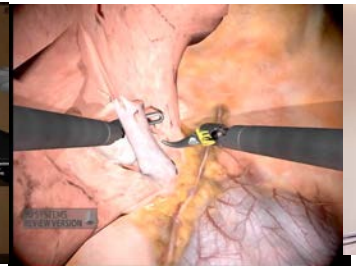
TRAINING CHIRURGICO

.....

LOOKING BACK





DUAL SURGICAL CONSOLE

where the master can teach each surgical step

VIRTUAL AND FISICAL SIMULATION

increasly being incorporated into surgical teaching programme

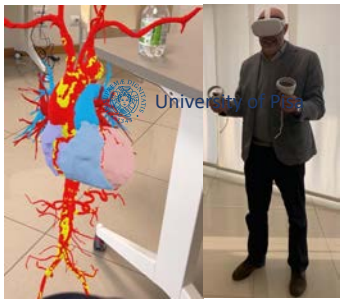
..... ADVANCED EDUCATIONAL PLATFORMS TO DISSEMINATE THE SURGICAL TECHNIQUE NO LONGER IN A "ONE TO ONE WAY " BUT "ONE TO A THOUSAND".

TRAINING Digitale

VIRTUAL GLASSES

VIRTUAL TRAINING

METAVERSE

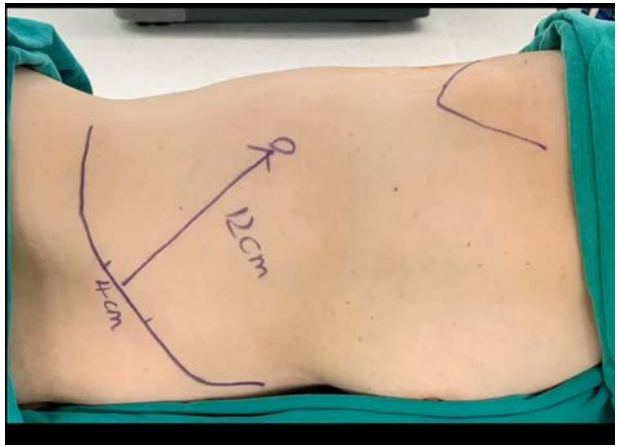


UN RUOLO CRUCIALE NEL RIDURRE IL DIVARIO TRA DOMANDA /OFFERTA DI INTERVENTI CHIRURGICI.

- **143 MILLION SURGERIES/ANNUALLY/NEEDS**
- **2.2 MILLION EXTRA**
  - ***SURGEONS/ANAEST/OBSTETR/*** **NEEDS**

FUTURE PROSPETTIVE

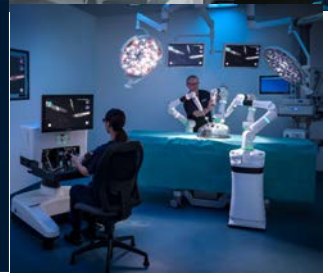
SP SYSTEM



NUOVE PIATTAFORME

to increase precision and reduce invasiveness.

TRANSENTERIX
ION ENDOLUMINAL SYSTEM
AURIS ROBOTIC ENDOSCOPY SYSTEM
PROCEPT
REVO-I
PORT ORIFICE ROBOTIC TECHNOLOGY
MEIDCAROID
VERSIUS
AVRA
SP
HUGO



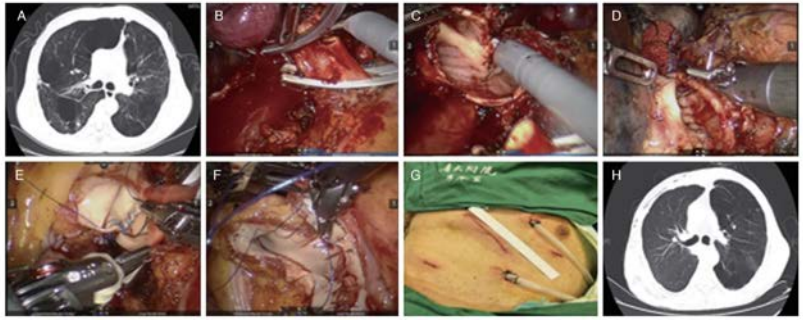
TRAPIANTO POLMONARE ROBOTICO

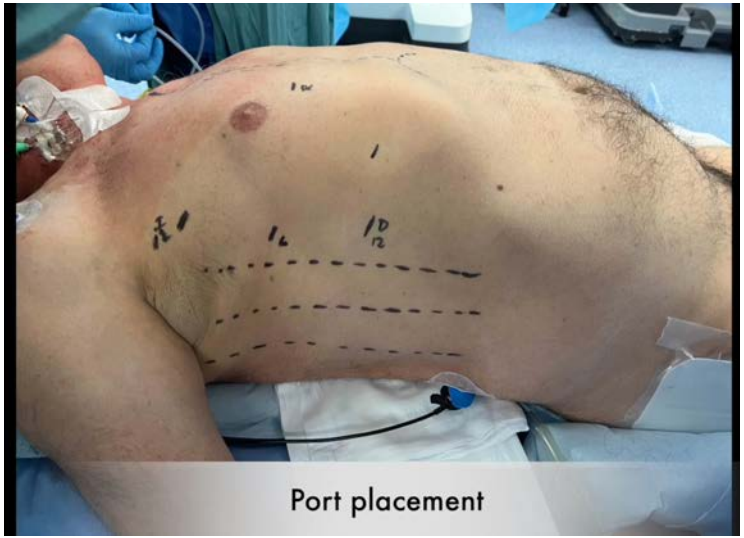
The Journal of Heart and Lung Transplantation
Available online 29 September 2023
In Press, Corrected Proof What's this?

Innovation

Robotic-assisted lung transplantation: First in man

Dominic Emerson MD, Pedro Catarino MD, Reinaldo Rampolla MD, Joanna Chikwe MD, Dominick Megna MD





Robotics becomes Science

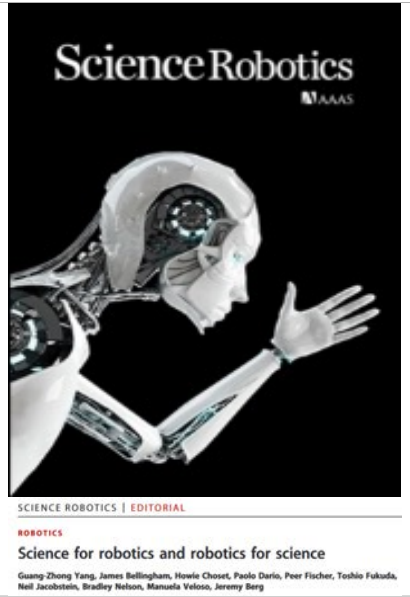
Ongoing Research Activities

New sensing devices

- New sensors for surgical robotic tools to increase information feedback to surgeon
- New class of sensors to acquire chemical, vital information from the field
- **Research issues**
  - FBG (Fiber Bragg Grating) optic sensing
  - Organic conjugated compounds
  - Tactile LED&PT (Light Emitting Diode & Photo Transistor)

Ongoing Research Activities

- New surgical instruments for telerobotic surgery
  - Mechatronic design of tools with integrated sensors and control strategies to improve surgeon's sensorimotor skills
- **Research issues**
  - New tools for needle reorientation reducing regrasping actions during suturing
  - New surgical manipulators with multiple degrees of freefom
  - Continuum robots

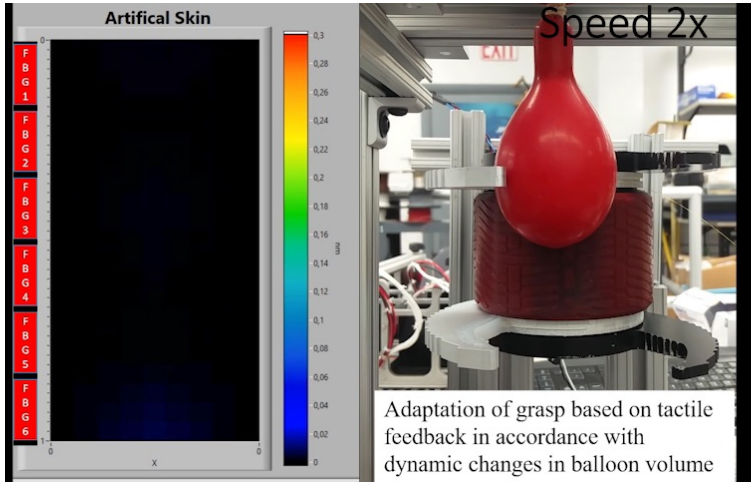


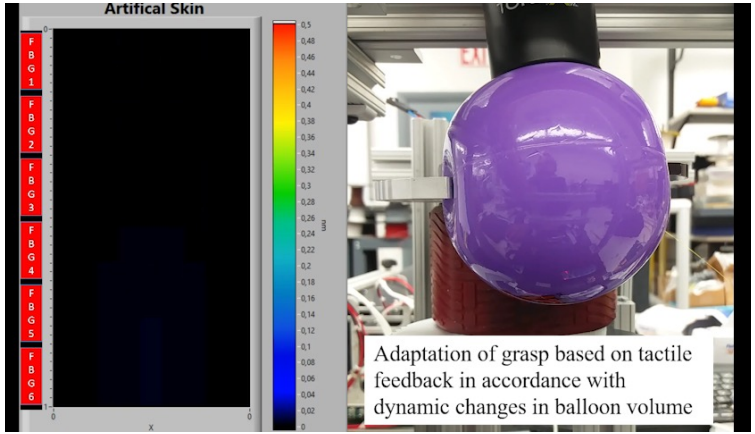
TO INCREASE INFORMATION FEEDBACK TO SURGEON USING AS SENSOR THE FBG (FIBER BRAGG GRATING)

Fiber Bragg Grating
Sensor Principle

TACTILE SENSING TO ENABLE INTERACTION ABILITIES

Jet Propulsion Laboratory (JPL) of NASA for tactile sensorization of the hand of the rescue robot RoboSimian





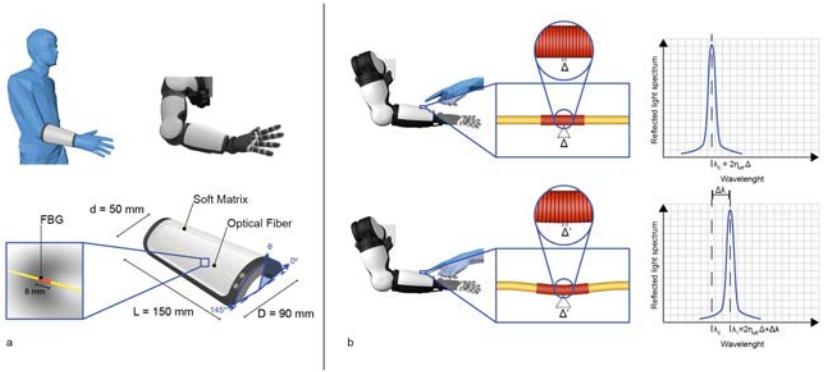
frontiers

Part of this research was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration (NASA) This project received seed funding from the Dubai Future Foundation through Guaana.com open research platform and from the Italian Ministry of Education, Universities and Research within the "Smart Cities and Social Innovation Under 30" program through the PARLOMA Project (SIN_00132)

Tactile Sensing and Control of Robotic Manipulator Integrating Fiber Bragg Grating Strain-Sensor

Luca Massari[1,2], Calogero M. Oddo[1], Edoardo Sinibaldi[3], Renaud Detry[4], Joseph Bowkett[5], Kalind C. Carpenter[4]

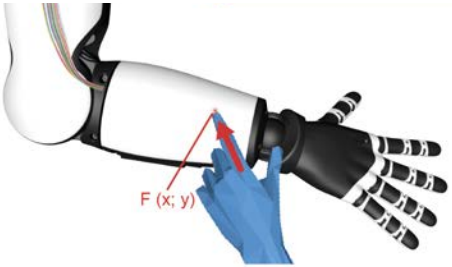
[1]The BioRobotics Institute, Polo Sant'Anna Valdera, Scuola Superiore Sant'Anna, Viale Rinaldo Piaggio 34, 56025 Pontedera, Italy
[2]Department of Linguistics and Comparative Cultural Studies, Ca' Foscari University of Venice, 30123 Venice, Italy
[3]Center for Micro-BioRobotics, Istituto Italiano di Tecnologia, Viale Rinaldo Piaggio 34, 56025 Pontedera, Italy
[4]Jet Propulsion Laboratory, California Institute of Technology, NASA, 4800 Oak Grove Drive, 91109 Pasadena, California, USA
[5]Department of Mechanical & Civil Engineering, California Institute of Technology, 1200 East California Boulevard, 91125 Pasadena, California, USA

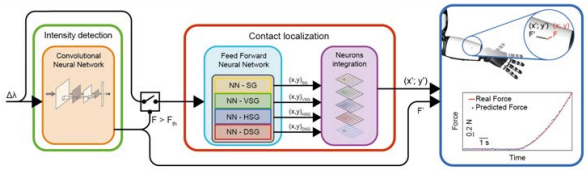


FROM DEEP LEARNING …. TO COLLABORATIVE TASKS

COLLABORATIVE TASKS STARTING FROM DEEP LEARNING IN WHICH THE ROBOT LEARNS FROM THE HUMAN TEACHING EXECUTING THE TRAIECTORY TRAINED BY THE HUMAN EXAMPLE WITH A SAFE INTERACTION WITH THE ROBOT ARM TROUGH TACTILE FEEDBACK

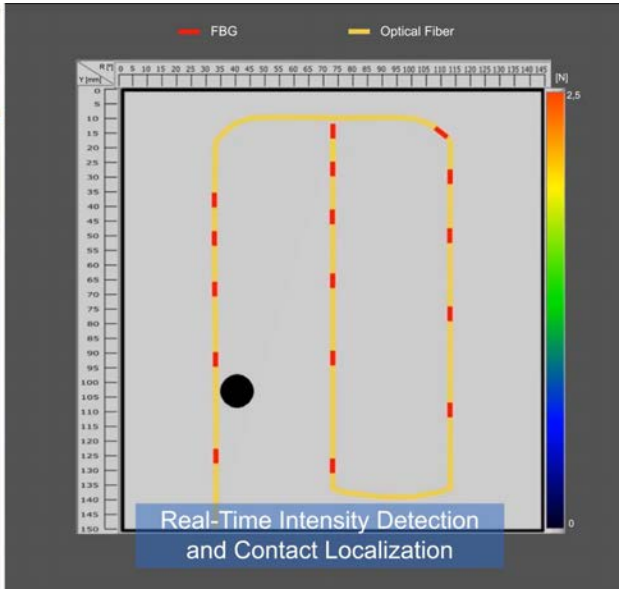
Massari, L., Fransvea, G., D'Abbraccio, J., Filosa, M., Terruso, G., Aliperta, A., ... & Oddo, C. M. (2022). Functional mimicry of Ruffini receptors with Fiber Bragg Gratings and Deep Neural Networks enables a bio-inspired large-area tactile sensitive skin.
Nature Machine Intelligence 2022



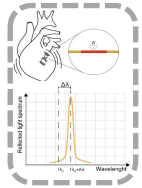


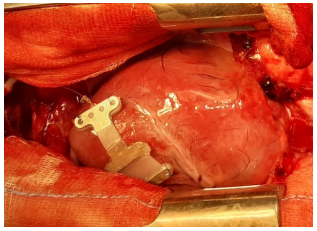
RILEVAMENTO TATTILE
PER IDENTIFICARE
LA FORZA APPLICATA E
LOCALIZZARE IL CONTATTO

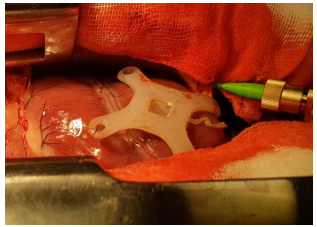
THE ARTIFICIAL SKIN
AI MODEL

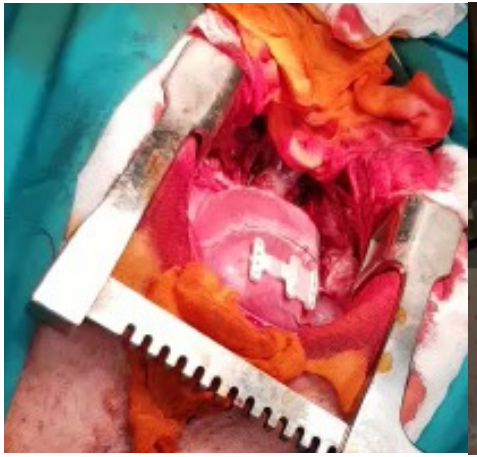


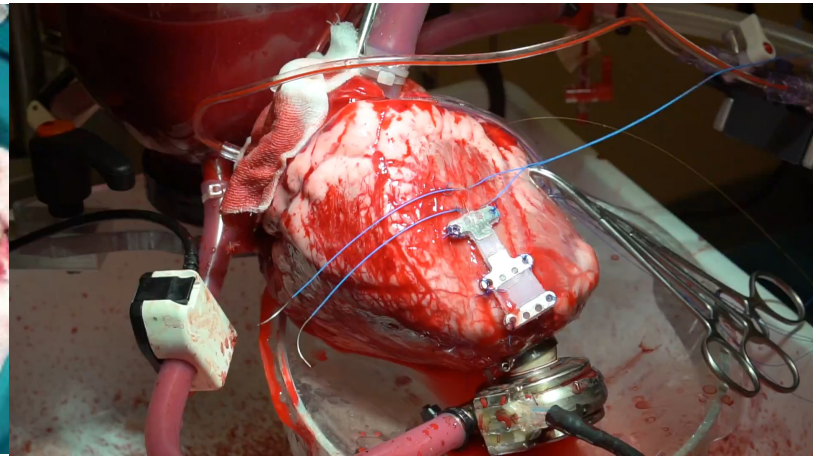
SENSORE FBG IMPIANTABILE PER IL MONITORAGGIO CONTINUO DELL'ATTIVITÀ CARDIACA

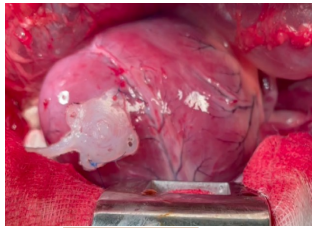


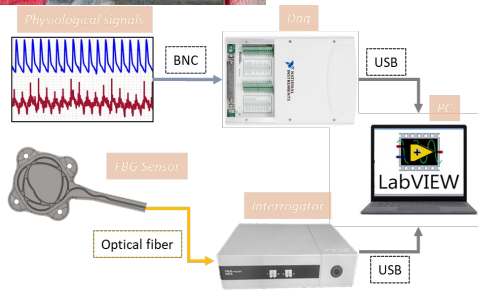


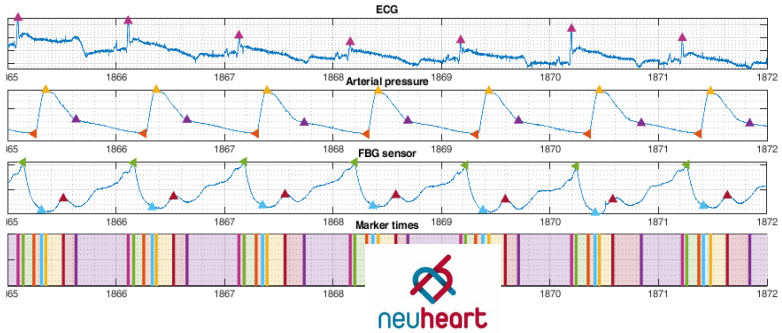












Ferraro, G. D'Alesio et al. (2021), IEEE Sensors Journal

neuheart

CONCLUSION

THE DIGITAL SURGERY
IS A CULTURAL TRANSFORMATION
OF TRADITIONAL SURGICAL CARE.

HOWEVER……
ROBOTS HAVE THE POTENTIAL TO IMPROVE PATIENT CARE by ASSISTING, **BUT NOT REPLACING THE SURGEON**

UNIVERSITÀ DELLA CALABRIA

BUON ANNO ACCADEMICO