

LEAD EXTRACTION

Lead's Extraction: Tecniche a confronto

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GIOVEDI 25 GIUGNO 2026 - SALA VULCANO

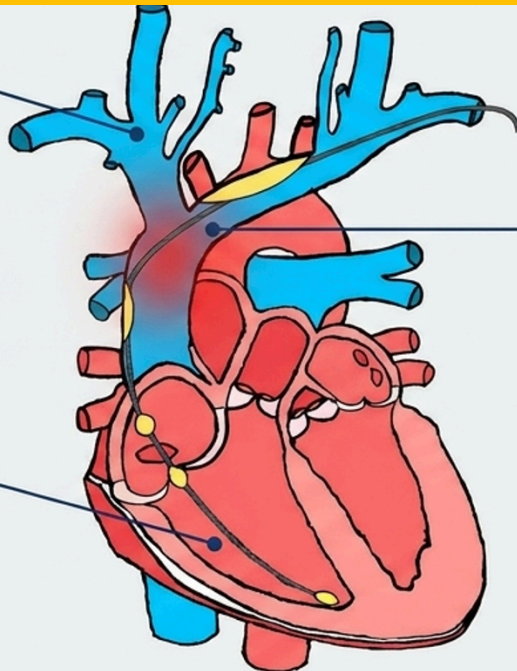
La Sfida Anatomica: Aderenze e Calcificazioni

Key Concept: Il tempo di permanenza in sede (Dwell Time) trasforma i cateteri da corpi estranei liberi a strutture inglobate nella prapete vascolare e nel cuore

1 Vena Succlavia / Anonima
Spazio ristretto tra clavicola e prima costa. Frequente tenace fibrosi.

2 Vena Cava Superiore (SVC)
Il sito più critico. Il tessuto cicatriziale si solidifica e calcifica, legando i cateteri alla parete sottile della SVC. Rischio primario di lacerazione (vascular tear).

3 Endocardio / Miocardio
Aderenze a livello della valvola tricuspidale e dell'apice del ventricolo destro.



Vascular Timeline

Cronistoria dell'Estrazione Transvenosa



The European Lead Extraction ConTrolled (ELECTRa) study: a European Heart Rhythm Association (EHRA) Registry of Transvenous Lead Extraction Outcomes

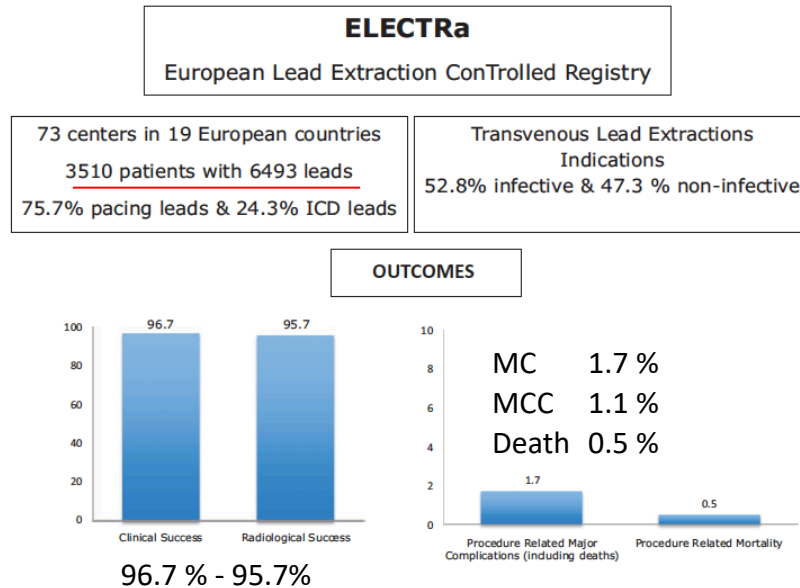


Figure 4 Summary of ELECTRa Registry.

Table 2 Outcomes: patients, procedure, and leads

Patients outcomes	All patients (N = 3510)	
TLE techniques		
Lead removed with traction alone	1741/6376 (27.3) [26.2–28.4]	27.3
Locking stylets	3975/5589 (71.1) [69.9–72.3]	
Sheaths used	4127/6492 (63.6) [62.4–64.7]	63.6
Mechanical not powered sheaths	2359/6492 (36.3) [35.2–37.5]	36.3
Powered sheaths (any)	1757/6492 (27.1) [26.0–28.2]	
Laser sheaths	1250/6492 (19.3) [18.3–20.2]	19.3
Evolution [®] mechanical dilator sheaths ^d	500/6492 (7.7) [7.1–8.4]	7.7
Electrosurgical dissection sheaths (EDS)	7/6492 (0.1) [0.04–0.2]	
Other	11/6492 (0.2) [0.08–0.3]	

Le Tre Filosofie dell'Estrazione

Powered



Powered Laser (e.g., GlideLight)

- **Mechanism:** Photoablation. High speed, high energy.



Powered Rotational (e.g., Evolution RL)

- **Mechanism:** Mechanical cutting via bidirectional rotating blades.



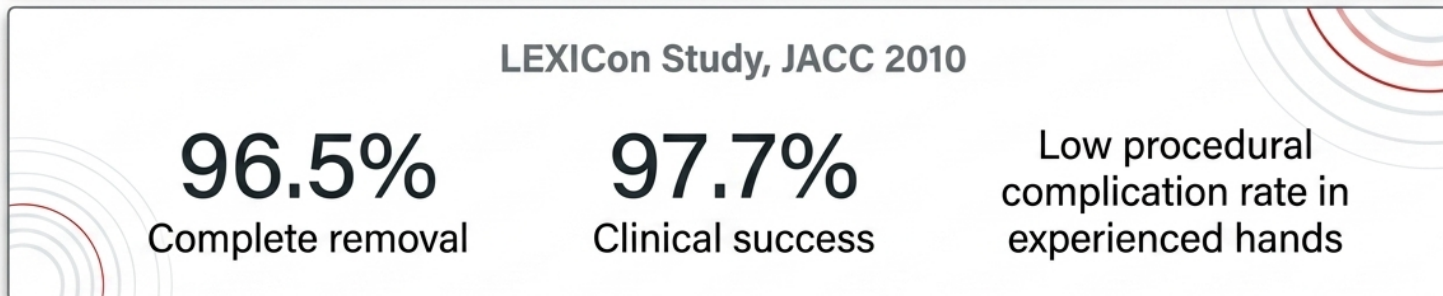
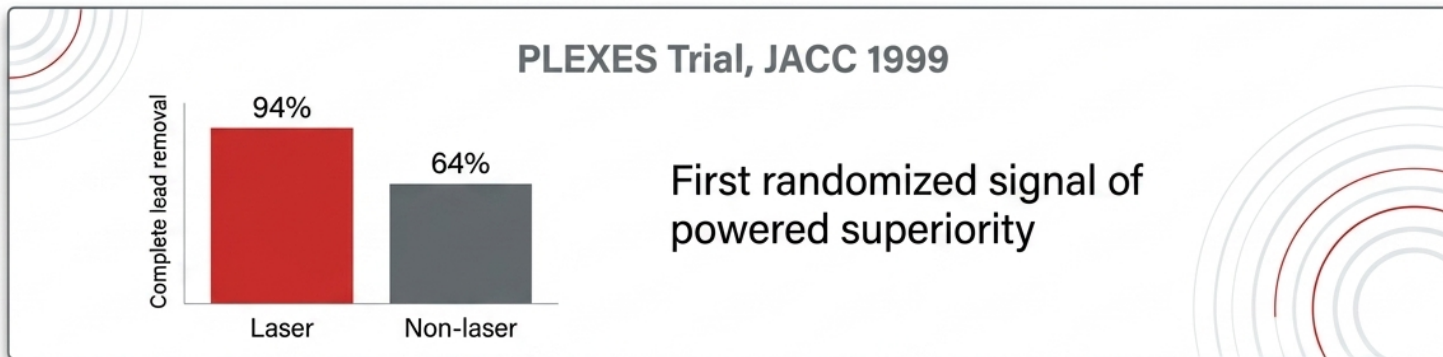
Non powered

Non-Powered Mechanical (Single Sheath)

- **Mechanism:** Polypropylene dissection. Finesse, tactile feedback, and strategic venous routing.



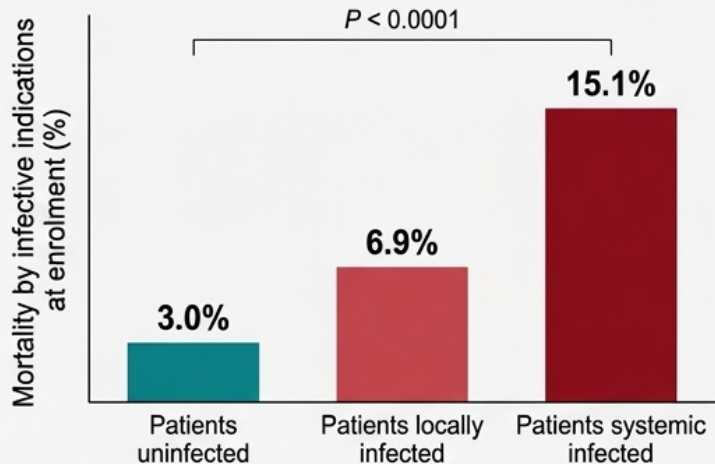
Contender 1: Laser



Caveat Callout: Mortality is heavily influenced by patient infection risk, not just the extraction tool. Laser remains a premier option in highly trained centers.



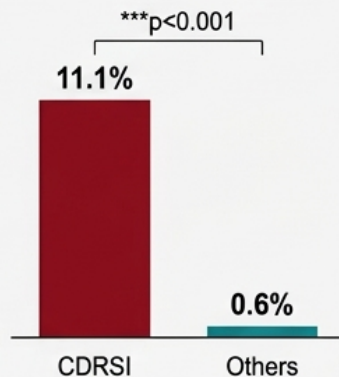
ELECTRa



L'infezione sistemica è il predittore primario di mortalità per tutte le cause (OR 4.93, $p < 0.0001$).

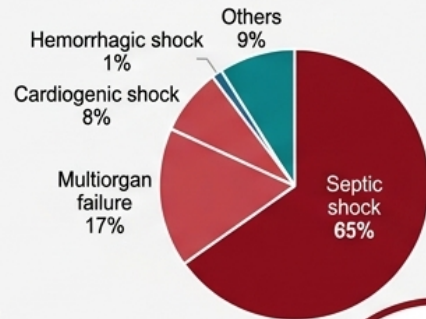
GALLERY Study 2023

All-cause mortality



In pazienti con infezione sistemica severa (CDRSI), la mortalità intra-ospedaliera raggiunge l'11,1% (vs 0,6% negli altri pazienti), nonostante un tasso di successo procedurale identico.

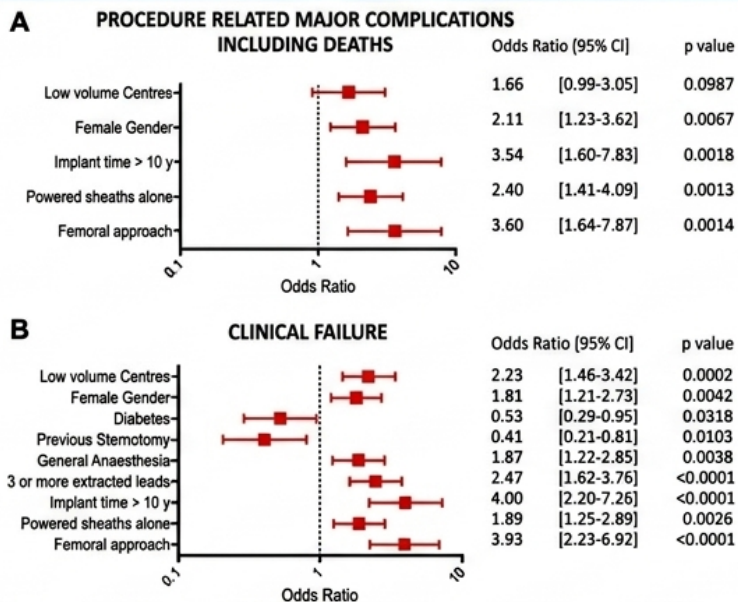
Causes of death in CDRSI after TLE



Il 65% dei decessi post-TLE in pazienti CDRSI è causato da **shock settico**.

La mortalità non riflette un limite tecnico dell'estrazione meccanica, ma la gravità biologica della malattia sottostante. L'estrazione precoce è vitale.

Insight: Il rischio procedurale non dipende solo dallo strumento, ma dal profilo anatomico-clinico del paziente e del catetere.



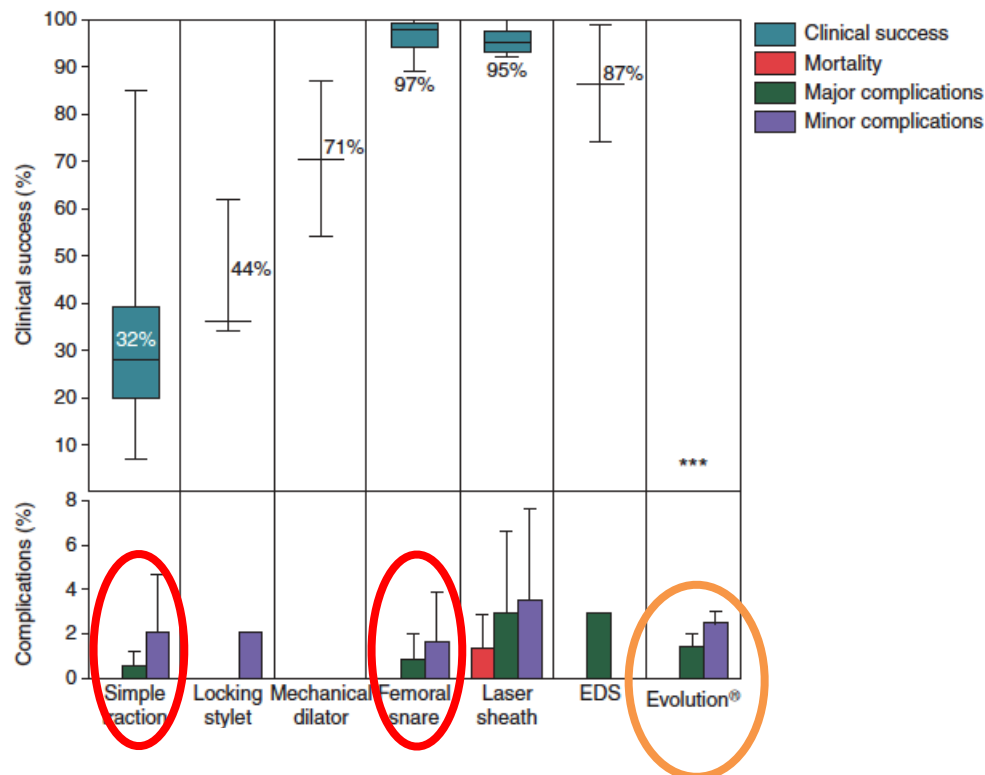
Predittori di Complicanze Maggiori (Dati ELECTRa & Lexicon)

- **Dwell Time > 10 anni:** Rischio aumentato (OR 3.54, P=0.0018). È il singolo fattore di rischio più critico legato all'impianto.
- **Sesso Femminile:** Rischio aumentato (OR 2.11, P=0.0067) (vene di calibro inferiore).
- **Approccio Femorale:** Associato a complicanze maggiori (OR 3.60, P=0.0014) (spesso indice di procedure di bailout estreme).
- **BMI < 25 kg/m²:** Indipendentemente predittivo di eventi avversi maggiori legati alla procedura (dati Lexicon).
- **Estrazione di ≥3 Cateteri:** Aumenta significativamente il rischio di fallimento clinico (OR 2.47).

How adequate are the current methods of lead extraction? A review of the efficiency and safety of transvenous lead extraction methods

Clinical performance of a new bidirectional rotational mechanical lead extraction sheath

Christoph T. Starck^{1*}, Jan Steffel², Etem Caliskan³, Tomas Holubec³, Felix Schoenrath¹, Francesco Maisano³, and Volkmar Falk¹



M.S. Buiten et al. Europace 2015

What's new

- First clinical data on a new bidirectional rotational mechanical lead extraction device.
- Its use is safe and efficient, even in long implanted leads.
- The lead wrapping phenomenon of unidirectional rotational lead extraction sheaths is overcome.

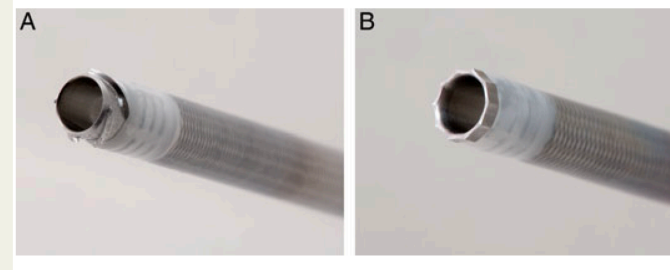
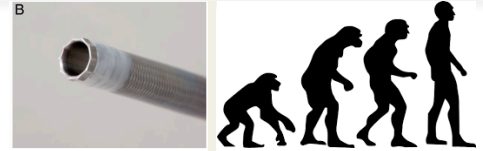


Figure 1 Comparison of the tips of the first (A) and second (B) generation Evolution rotational lead extraction sheath.

An «Evolution» in Extraction?



- Mazzone et al. reported prospective data on 124 consecutive patients in Italy
 - 91.6% extraction success with no major complications.

Mazzone P. et al. Europace 2018
- The PROMET study was a retrospective, multicenter European study including over 2000 patients.
 - 96.5% extraction success with a 1% rate of major complications.

Starck C.T. et al. Europace 2020
- The RELEASE study was a prospective, international, monitored study involving 230 patients and 460 leads.
 - 96.3% extraction success, 2.6 % major complications (no SVC injuries, no deaths), median extraction time: 10 minutes

Sharma S. et al. Heart Rhythm O2 2021

Contender 2: Sheaths Rotazionali

Evidence Card: Mazzone et al., Europace 2018

Prospective multicentre validation of hand-powered bidirectional rotational sheaths. Designed to advance through fibrotic bindings while drastically reducing lead wrapping during extraction.

Evidence Card: PROMET Study, Starck et al., Europace 2020

2,205

procedures

97.0%

clinical success

1.0%

major complications

0.18%

procedure-related
mortality

Core Insight: Mechanical rotational extraction has transitioned into a highly reproducible, 'mechanical-first' strategy for many global programs.

Contender 1 vs Contender 2: Evidenze Disponibili

Mechanical Leans
(Lee 2023, Akhtar 2023) -
Non-laser/Rotating sheaths
favored for superior safety
profiles, lower SVC injury
risk, and higher complete
removal in pooled data.

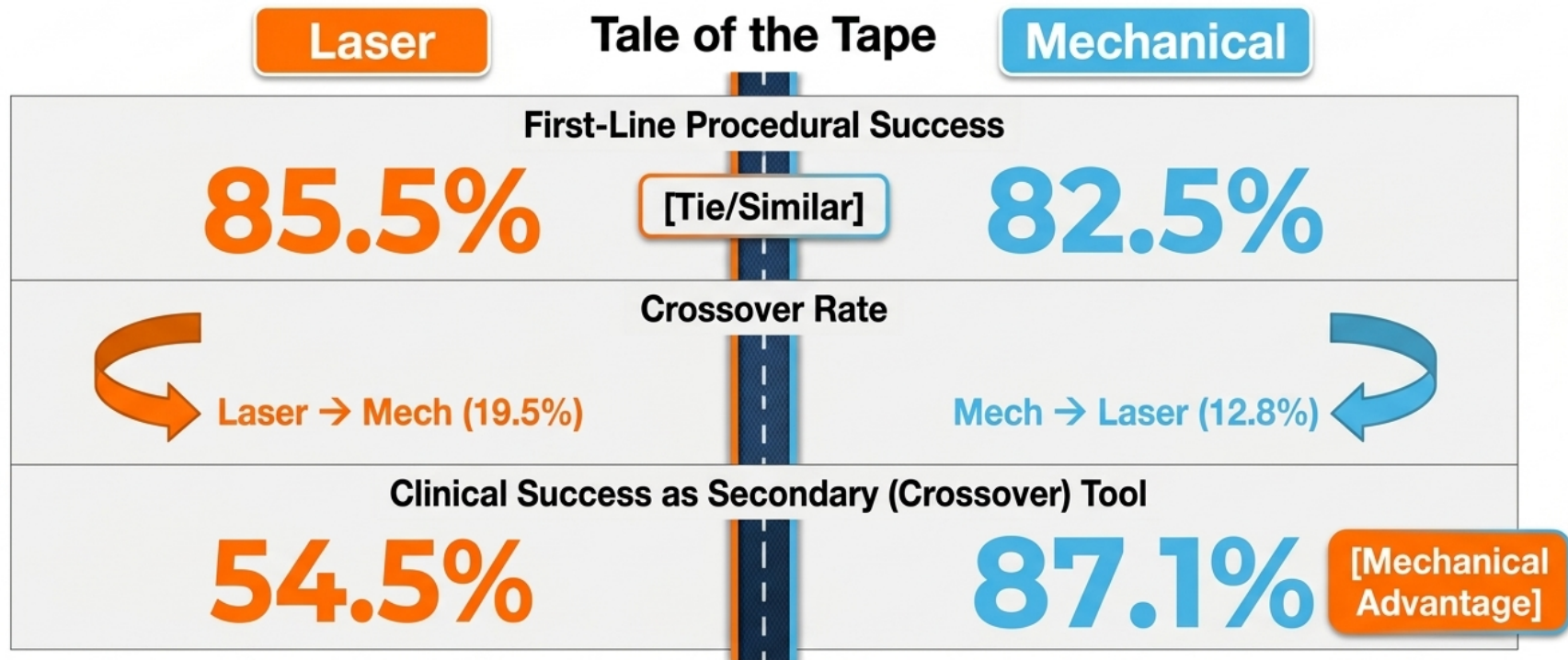


The Tie (Zsigmond 2023) -
Overall efficacy and safety are
statistically similar between the
two platforms in routine cases.

Laser Leans
(Rinaldi 2023) -
High clinical/procedural
success in contemporary
series, defending Laser
as a highly valid primary
platform.

Interpret pooled historical data cautiously: patient mix, centre effect, and era biases heavily influence outcomes.





Device Diversity: having multiple tools improves outcome in the most complex cases. Stepwise analysis reached 91.8% success



Contexta:

Akhtar et al. (2023) hanno sintetizzato i dati di 68 studi (1991–2021) su oltre 25.000 procedure per risolvere il dibattito sulla sicurezza.

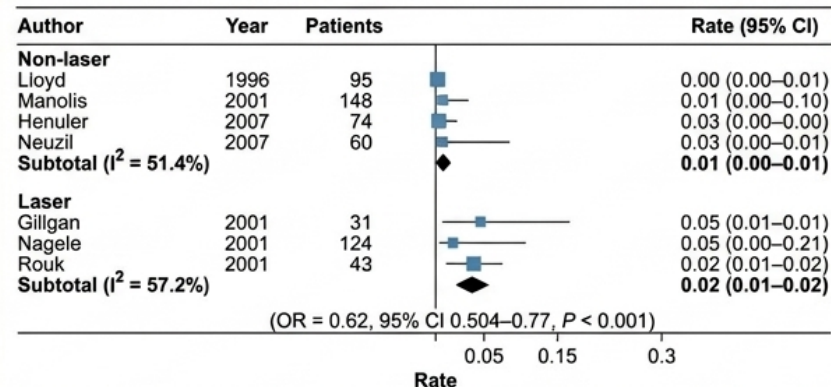
Meccanico (Non-Laser) vs Laser

- Mortalità Procedurale: 0% vs 0.1% ($P < 0.01$).
- Complicanze Maggiori Totali: 0.7% vs 1.7% ($P < 0.01$).



- **Lesione della Vena Cava Superiore (SVC): 0% vs 0.5% ($P < 0.001$).**

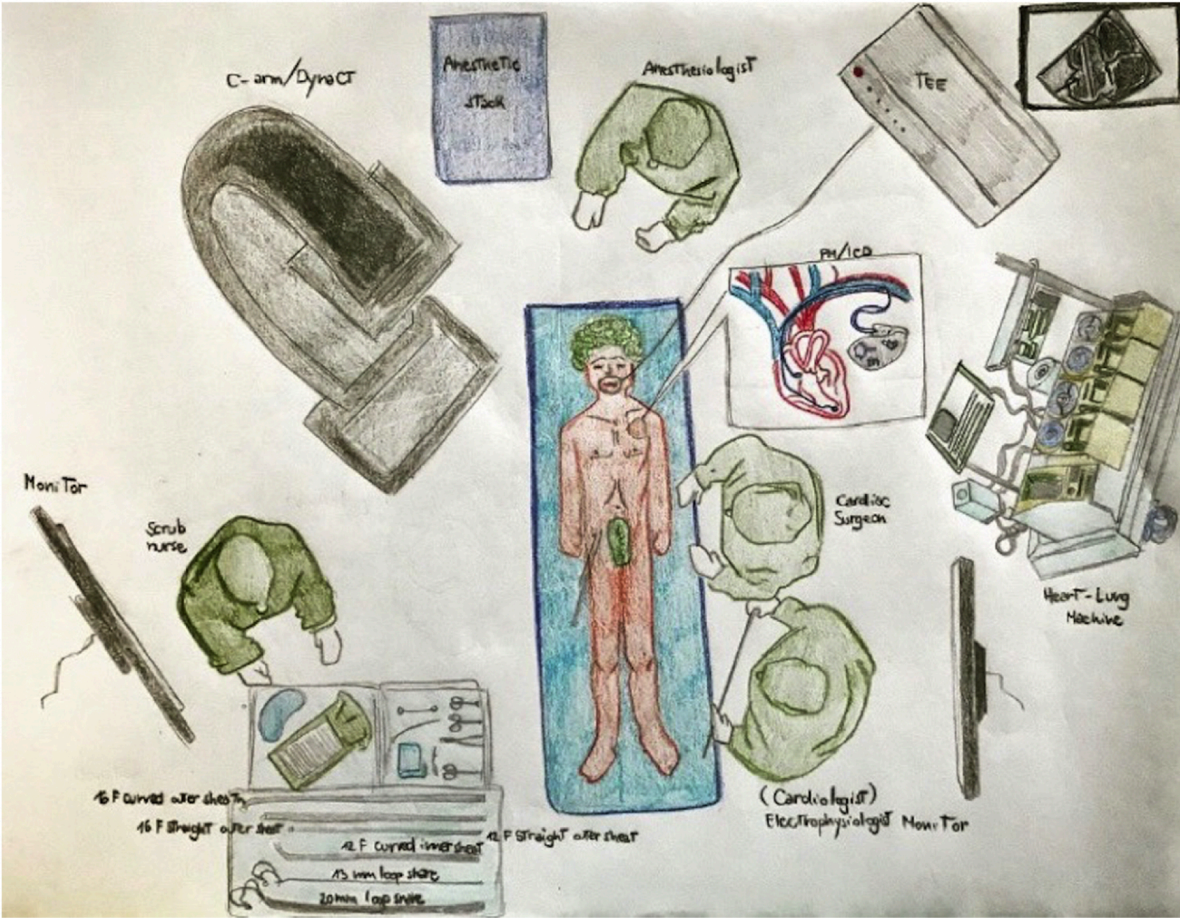
Rate of Major Complications: Mechanical vs Laser Techniques (Meta-analysis)



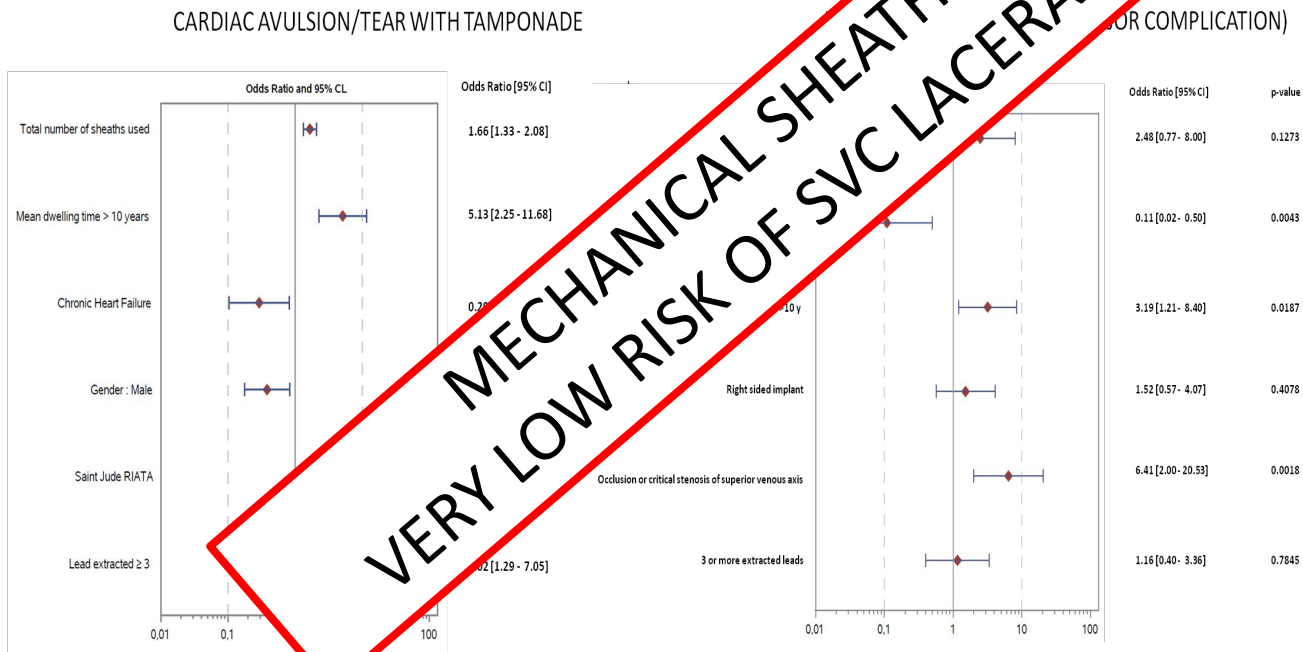
L'Enigma Eziologico della SVC

Il laser vaporizza il tessuto, ma a livello della giunzione succlavia-SVC, la flessione della guaina può dirigere la punta verso la sottile parete cavale, aumentando il rischio di lacerazione rispetto agli strumenti meccanici coassiali.

Cardiac surgeon and electrophysiologist shoulder-to-shoulder approach: Hybrid room, a kingdom for two. A zero mortality transvenous lead extraction single center experience.

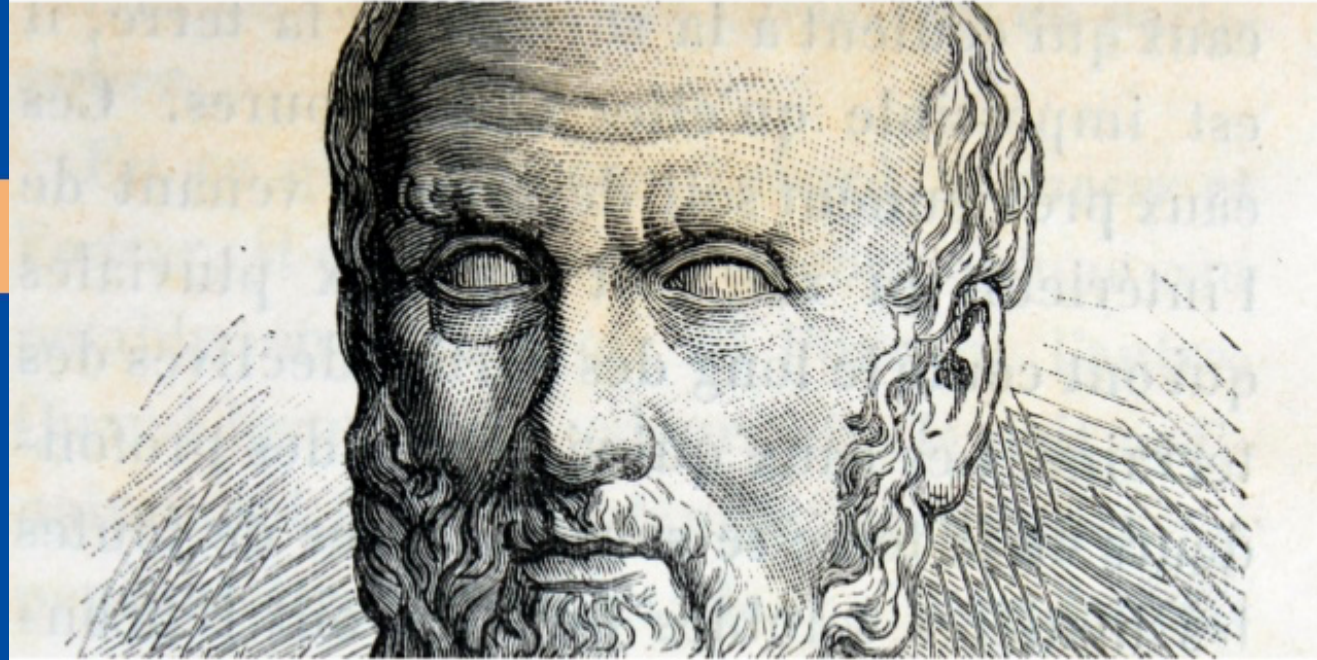


Risk of cardiac tamponade in ELFC study



“Primum non nocere”

(First, do not harm)



Hippocrate (460-370 a.C.)

Maria Grazia Bongiorno
Editor

Transvenous Lead Extraction



From Simple Traction to Internal
Transjugular Approach

Foreword by
Bruce L. Wilkoff

 Springer



Editor: M.G. Bongiorno - Springer 2011

Division of Cardiovascular Diseases - University Hospital of Pisa (Italy)

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Transvenous Lead Extraction



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**BACK
TO THE FUTURE**



European Heart Journal (2008) 29, 2886–2893
doi:10.1093/eurheartj/ehn461

CLINICAL RESEARCH
Arrhythmia/electrophysiology

Transvenous removal of pacing and implantable cardiac defibrillating leads using single sheath mechanical dilatation and multiple venous approaches: high success rate and safety in more than 2000 leads

Maria Grazia Bongiorni*, Ezio Soldati, Giulio Zucchelli, Andrea Di Cori, Luca Segreti, Raffaele De Lucia, Gianluca Solarino, Alberto Balbarini, Mario Marzilli, and Mario Mariani

Arrhythmology Unit of CardioVascular Division, CardioThoracic Department, University Hospital, Via Paradisa 2, 56100 Pisa, Italy

Received 19 November 2007; revised 19 September 2008; accepted 29 September 2008; online publish-ahead-of-print 23 October 2008

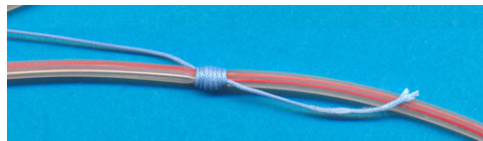
M.G. Bongiorni et al. Eur Heart J 2008 29, 2886–2893

Editor: M.G. Bongiorni - Springer 2011

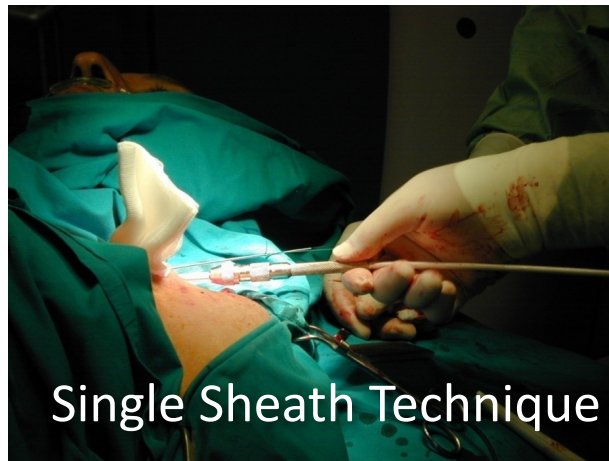
Division of Cardiovascular Diseases - University Hospital of Pisa (Italy)



Personal Experience on Lead Extraction

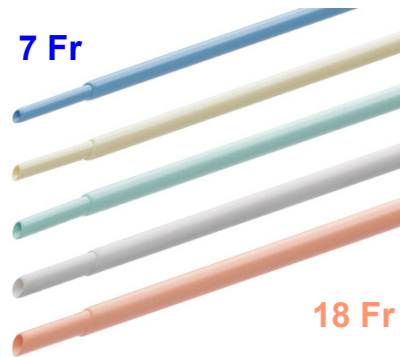


low-profile knot



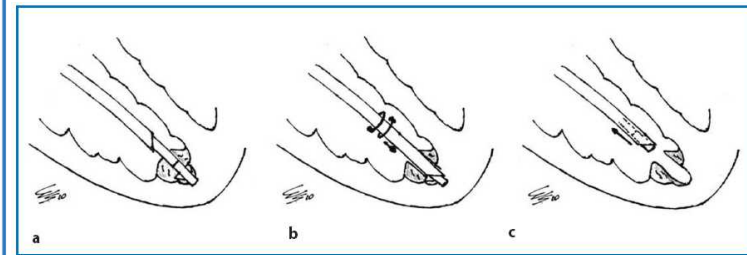
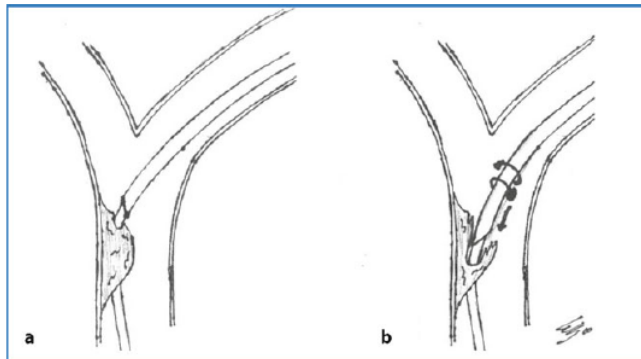
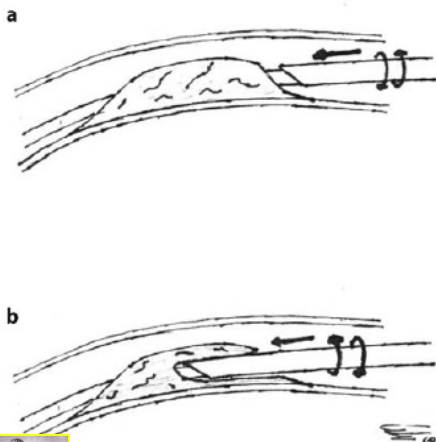
Single Sheath Technique

7 Fr



18 Fr

Mechanical Polypropylene Sheaths



TECHNIQUE

Lead Preparation

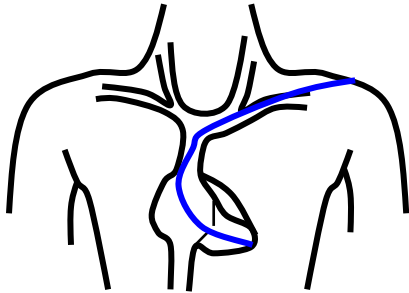
standard stylet, low profile knot

1

gentle Manual Traction attempt

Mechanical dilatation using single progressive sheaths
(rotation, Polypropylene sheaths, Cook Vascular Inc.)

2

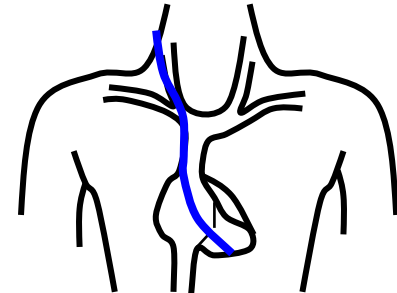


Superior Approach

using the implant vein when it's possible



3



Internal Jugular Approach

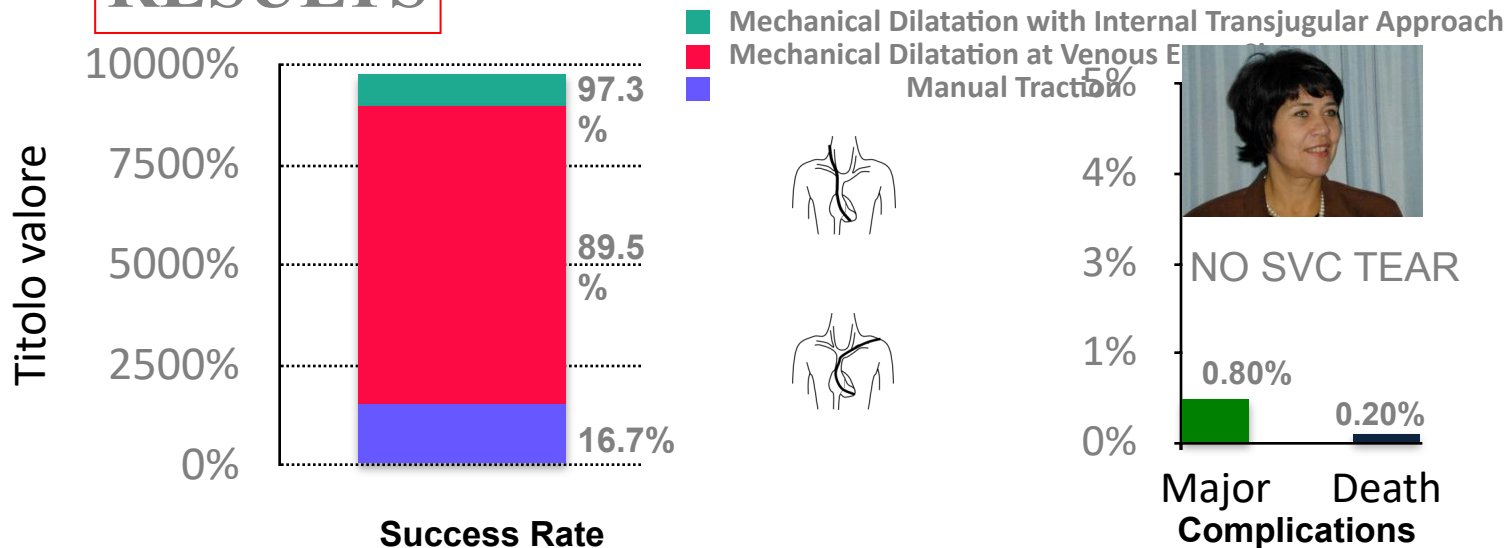
in case of difficult leads

When dilatation was stopped at any binding site for 5 min, or when dilatation was judged too risky, the Internal Jugular Approach was considered.



GLOBAL RESULTS

Lead Extraction: Outcome and Approaches 1997-2022 (5515 leads – 3051 patients)

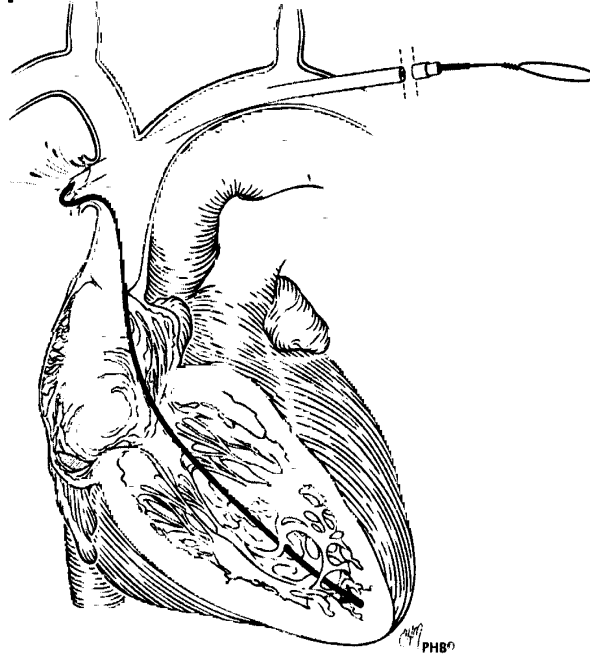
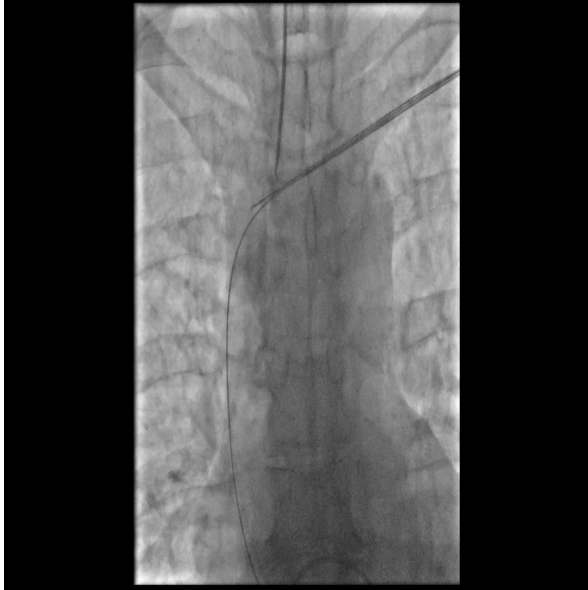


	Leads	Total Extr.	Partial Extr.	Failure	Compl.	Pacing Period	Manual Traction	JA%	Extr. Time
A&V PM	3780	96.7%	1.3%	2.0%	1.0%	82.4	11%	7%	18.3
CS	535	98.2%	0.4%	1.4%	0.2%	48.4	46%	0%	6.4
ICD	1200	98.0%	0.1%	1.9%	0.4%	60.6	6%	12%	21.5

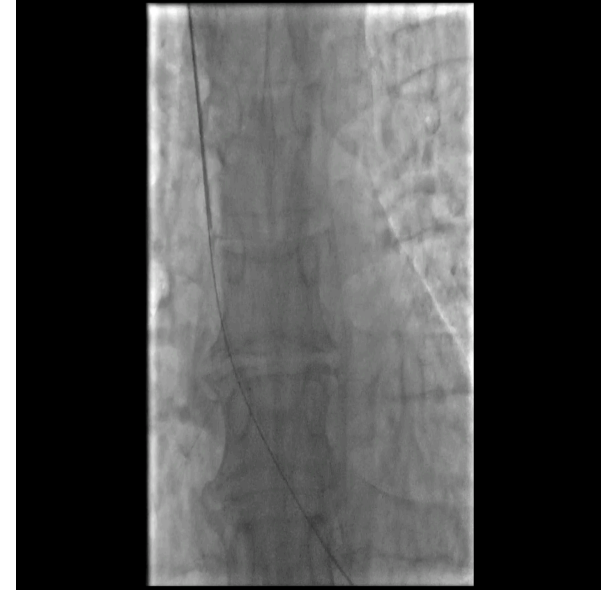


Importance of coaxial orientation to prevent vascular injury

Subclavian Approach



Jugular Approach



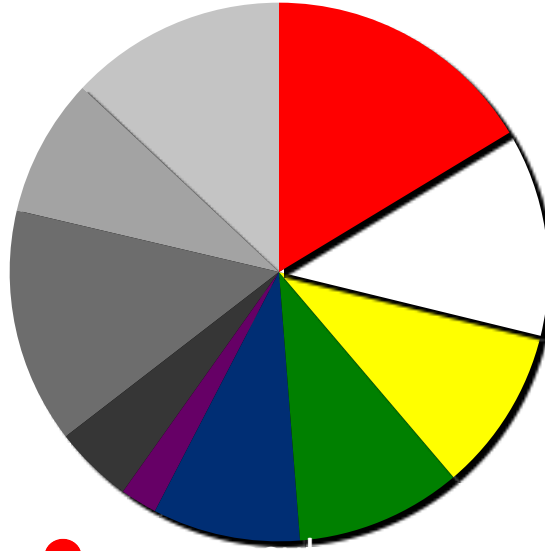
Coaxial sheath orientation is crucial to avoid vascular injury

- Jugular approach ensures a straighter lead path → reduces risk of SVC tear
- Minimizes traction → prevents lead damage and failure



Internal Transjugular Approach: Indications

Tight Binding Sites



Take-Home Algorithm



The Best Extraction Technique is the one selected before the first incision, with the second tool already on stand-by



Grazie per l'Attenzione

“The golden rule is to never send a patient treated for one complication home with another”.



Byrd CL

