



THREADING THE LINE: A REVIEW OF PINCH-OFF SYNDROME FROM CENTRAL VENOUS CATHETER PLACEMENT IN SUBCLAVIAN AND INTERNAL JUGULAR APPROACHES



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INTRODUCTION

Annually in the United States, more than 5 million patients undergo placement of long-term central venous catheters (CVCs) for treatments such as dialysis, chemotherapy, and parenteral nutrition. The subclavian vein, located beneath the clavicle, is frequently used due to its direct route into central circulation. This placement site is favored for its comfort and discreet location, yet it carries an increased risk of pinch-Off Syndrome (POS). POS occurs when the catheter is compressed between the clavicle and first rib, potentially leading to catheter failure, fracture, and other severe complications. The internal jugular (IJ) vein offers an alternative route that avoids this anatomical compression site, yet comparative data on long-term safety, efficacy, and complication rates between the two approaches remain limited.

METHODS

A comprehensive search was conducted using Google Scholar and PubMed for peer-reviewed clinical studies, retrospective reviews, and case studies published between 2002 and 2025. Search terms included “pinch-off syndrome,” “subclavian vein,” “internal jugular vein,” “central venous catheter,” and “catheter fracture.” Selected studies focused on relevance to adult and pediatric populations that received long-term central venous catheters and compared subclavian and IJ approaches. Studies consisted of those conducted in the last 15 years and written in English. The incidence of POS and catheter related complications associated with each access site was generally recorded, analyzed, and compared.

RESULTS

Subclavian Vein (SCV) Access

Across reviewed studies, long-term central venous catheters placed via the SCV demonstrated an incidence of POS ranging from 1.1% to 5%,¹ with various mechanical complications including catheter fracture, embolism, and device malfunction². Notably, multiple case series and retrospective analyses confirmed that these mechanical issues, including all documented POS cases, were exclusive to SCV placements²⁻³. Ultrasound-guided lateral insertion techniques were shown to help better avoid the costoclavicular space, hence reducing—but not fully eliminating—the risk of POS⁴⁻⁵.

Internal Jugular (IJ) Access

The IJ vein route consistently demonstrated a lower overall mechanical complication rate in comparative studies³, with no recorded incidents of POS². Arterial puncture incidence was notably higher at 3% with the IJ approach, as opposed to 0.5% with the SCV approach⁶. However, the use of ultrasound guidance significantly reduced this risk while also improving first-pass success rates⁶. The IJ approach was associated with up to a 4% lower catheter misposition rates compared to subclavian access⁶.

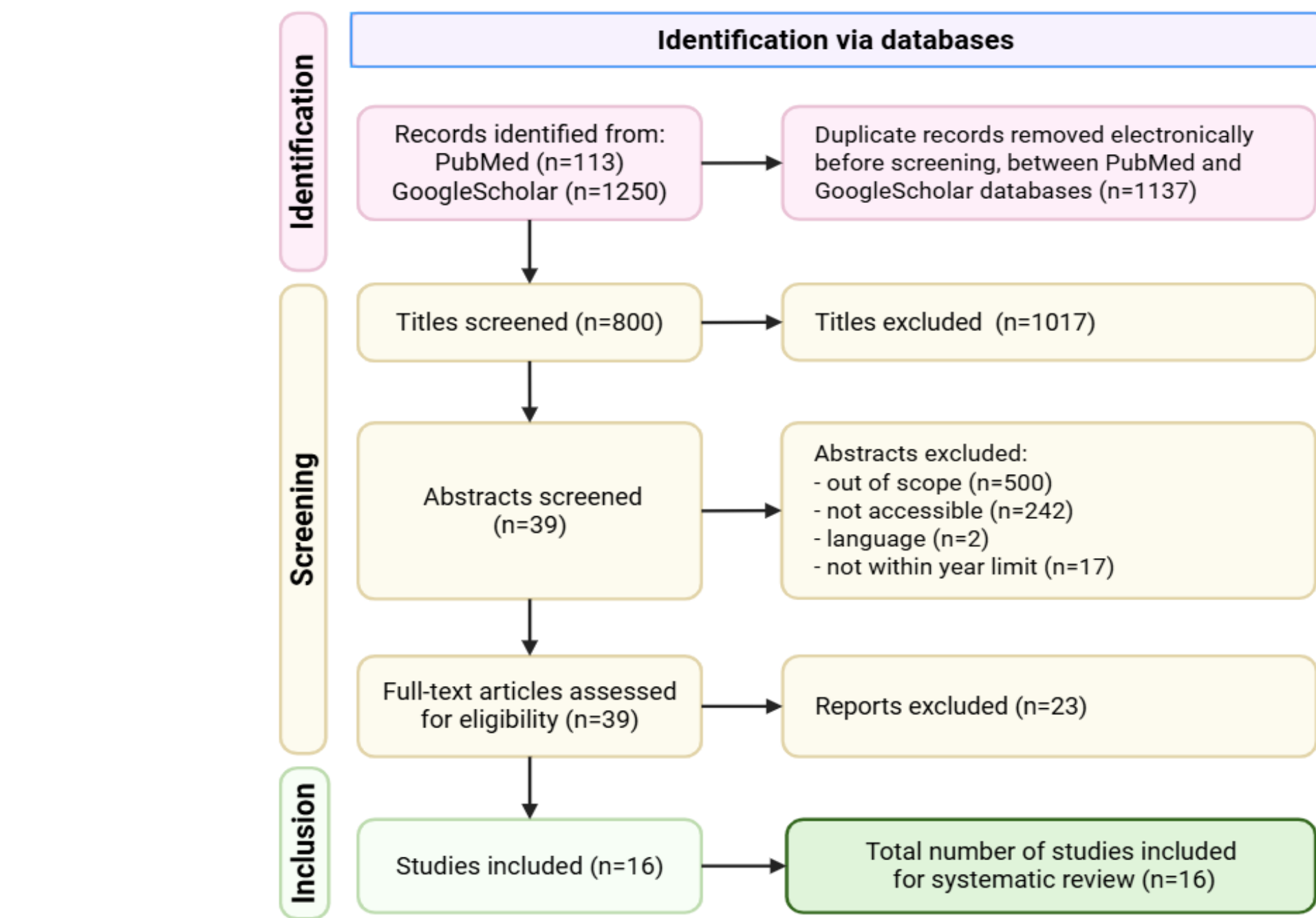


Figure 1. Flowchart depicting methodology followed for literature review of sources.

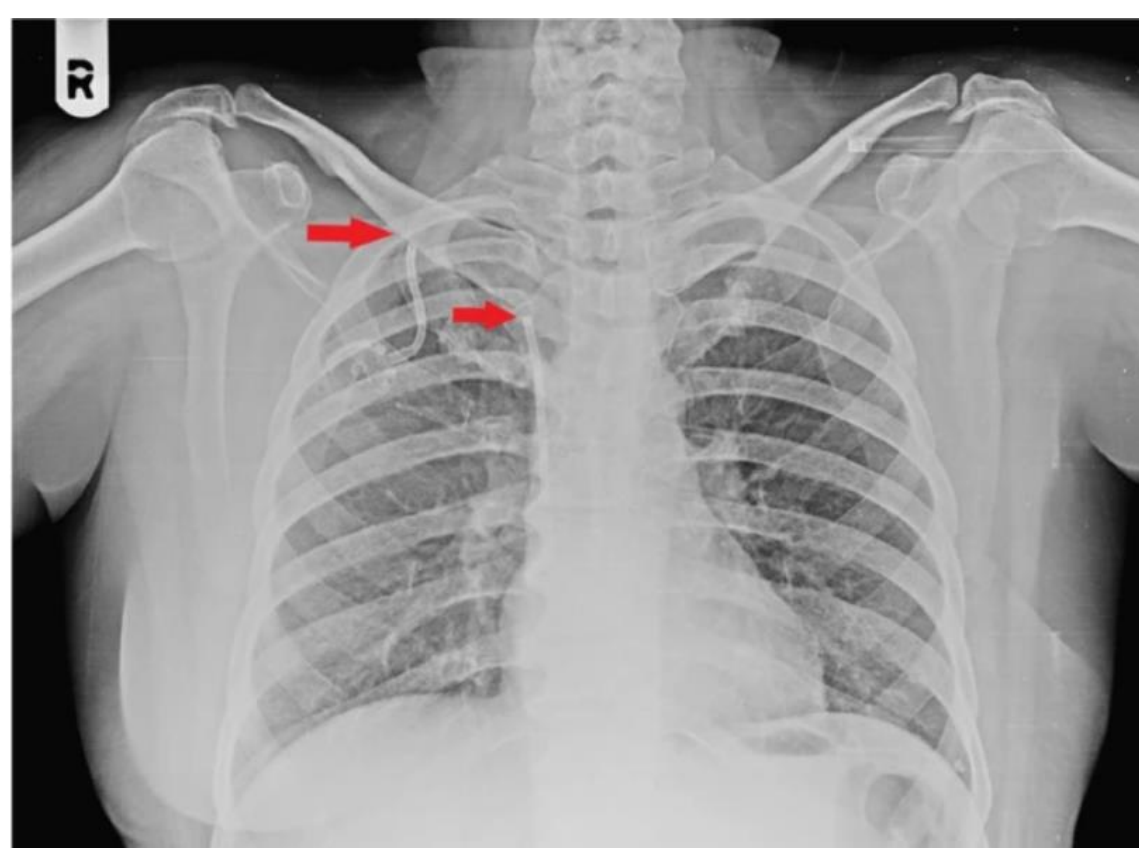


Figure 2. X-ray image of Pinch-Off Syndrome of patient with CVC inserted using subclavian approach. Arrows indicate two ends of fractured catheter⁷.

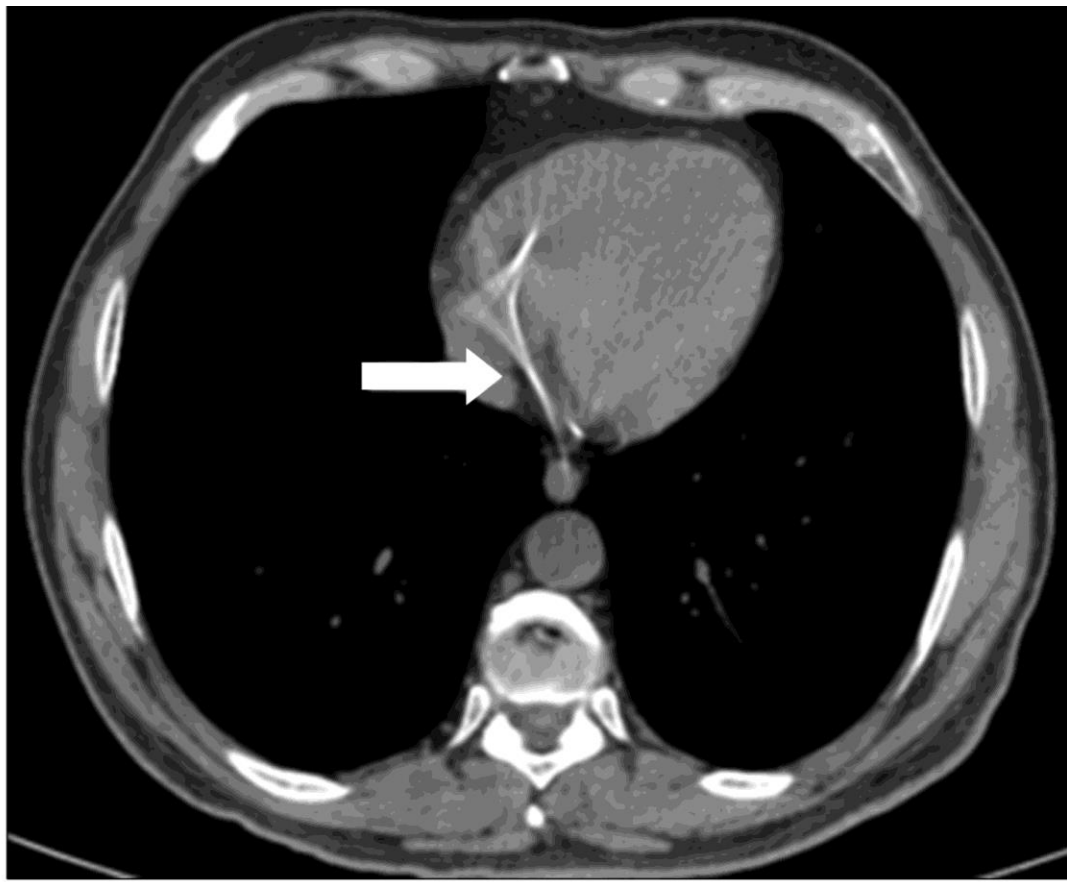


Figure 3. CT image of patient showing fractured catheter embedded into heart⁸.

Table 1. Percentage of port-related complications in patients with CVC insertion through the internal jugular approach (Group 1) and subclavian approach (Group 2). Group 1 had 92 patients and Group 2 had 79 patients⁹.

	Group 1	Group 2	p-value
Mechanical complications, No. (%)	2 (2.2)	9 (11.4)	0.033
Pneumothorax	0 (0.0)	1 (1.3)	0.462
Hemothorax	0 (0.0)	0 (0.0)	-
Migration/malposition	1 (1.1)	3 (3.8)	0.336
Pinch off syndrome	0 (0.0)	4 (5.1)	0.044
Malfunction	1 (1.1)	1 (1.3)	1.000
Infectious complications, No. (%)	4 (4.3)	4 (5.1)	1.000
Thrombotic complications, No. (%)	2 (2.2)	3 (3.8)	0.663
Total, No. (%)	8 (8.7)	16 (20.3)	0.030

Data are shown as number of patients with percentages in parentheses.

Table 2. Results of Cannulation at the IJ site using a traditional landmark method (LM) vs. Ultrasound guidance (USG). Notably, the USG group experienced a significantly higher first-pass success rate and a lower rate of overall mechanical complications¹⁰.

Results of Cannulation	LM Group (n = 40)	USG Group (n = 40)	P
First-pass success rate without complication	28 (70%)	37 (92.5%)	<0.001*
Cannulation site			
Right	34 (85%)	36 (90%)	0.915
Left	6 (15%)	4 (10%)	
Cannulation failure	1 (2.5%)	0	0.161
Average number of attempts	1.27 ± 0.52	1.07 ± 0.26	0.034*
First attempt	28 (70%)	37 (92.5%)	<0.001*
Second attempt	10 (25%)	3 (7.5%)	0.034*
Third attempt	1 (2.5%)	0	0.323
Fourth attempt	1 (2.5%)	0	0.323
Average time for the procedure	7.45 ± 1.10	8 ± 0.93	0.018*
Overall mechanical complication	5 (12.5%)	2 (5%)	0.251
Mechanical complication			
Pneumothorax	1 (2.5%)	0	0.323
Arterial puncture	2 (5%)	0	0.159
Difficult to pass	2 (5%)	2 (5%)	>0.999

Data are means±SD or n(%).

*Significant P value.

LM, landmark method; USG, ultrasonography.

DISCUSSION

Evidence from the literature confirms that while subclavian access offers certain patient comfort and cosmetic advantages, it poses an elevated risk for mechanical complications, particularly POS, due to catheter entrapment between the clavicle and first rib. Complications include catheter fracture, embolization, and the need for interventional retrieval procedures. Lateralizing the puncture method and adopting ultrasound guidance at the subclavian site can mitigate, but not eliminate, these risks.

In contrast, the internal jugular approach circumvents the anatomical costoclavicular space implicated in POS and shows consistently lower mechanical complication rates across retrospective and comparative studies published thus far. Although arterial puncture occurs more frequently with IJ access, the difference is marginal, and literature indicates a significant mitigation in this risk with ultrasound guidance.

Despite the appealing promise of the IJ route, robust comparative long-term outcome data remains sparse, and heterogeneity in study designs limits the ability to develop broad generalizations of the IJ approach's efficacy or safety. Nonetheless, existing literature supports its consideration for adoption in long-term venous access.

CONCLUSIONS

- ✓ Pinch-Off Syndrome is a rare but clinically serious complication predominantly associated with subclavian venous catheterization.
- ✓ The internal jugular vein approach provides a potentially viable alternative with no documented POS cases and fewer overall mechanical complications.
- ✓ Ultrasound guidance and precision in the angle of catheter insertion improve procedural safety and success for both approaches, particularly for IJ access.
- ✓ Future large-scale prospective studies are warranted and encouraged to validate published findings and inform standardized, evidence-based venous access protocols.

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