WELCOME *To the*

2026 SYMPOSIUM

AV Fistula Needle Designs

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Disclosures:
Retired Nephrology Nurse
No disclosures related to this talk

AV Fistula Metal Needle

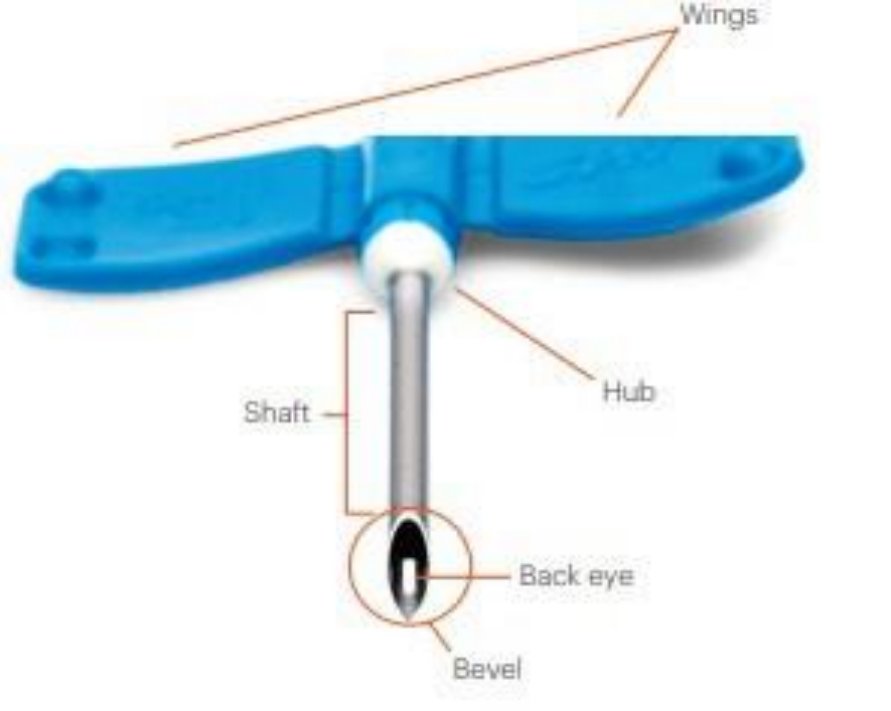
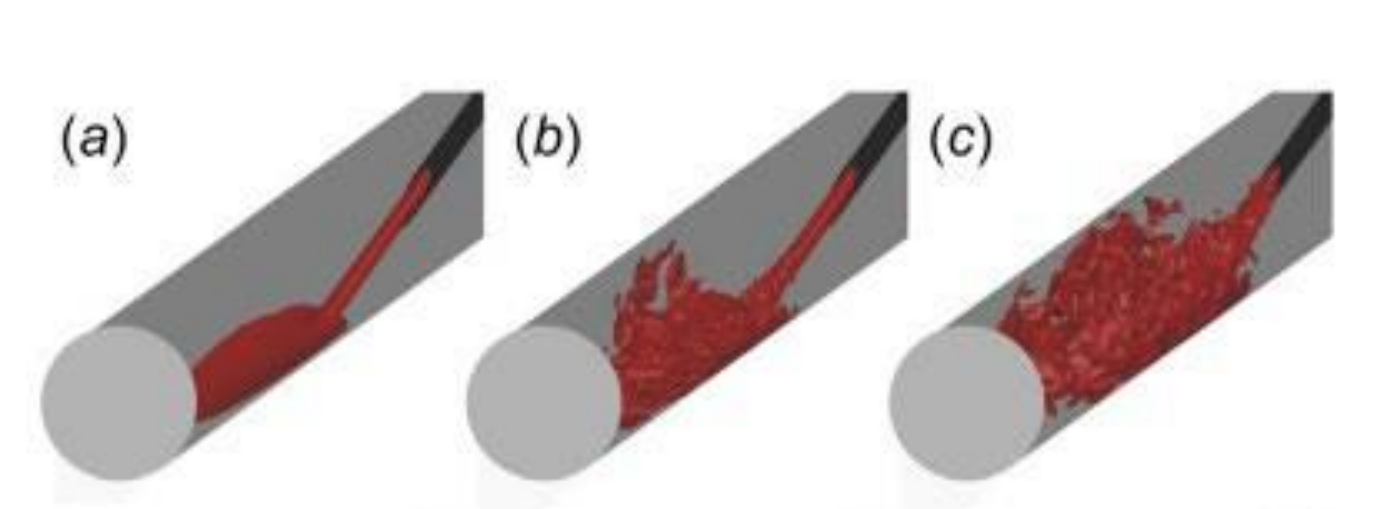


Image source: https://www.kidney.org/sites/default/files/Fistula%20Bulletin.pdf

Damage From Flow Patterns

Jetting of Blood from the Venous Needle by Blood Flow Rate

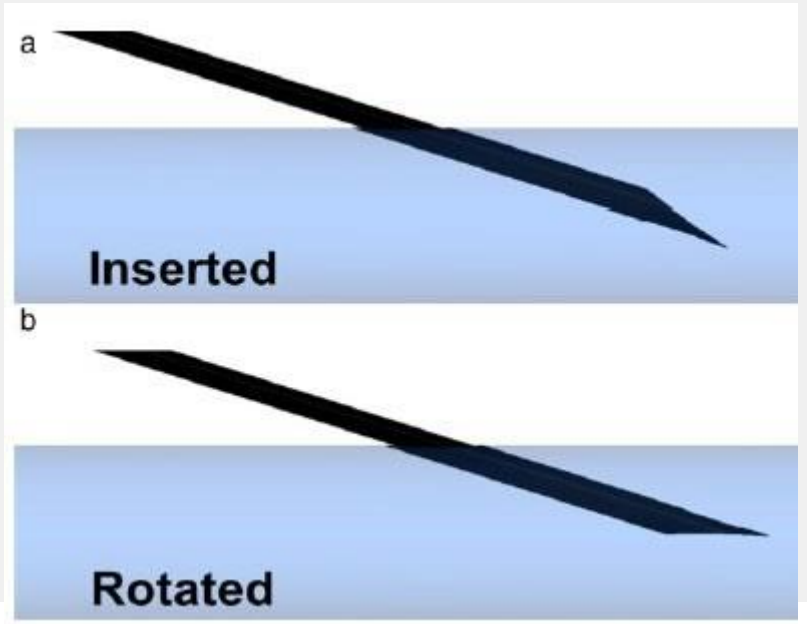
a) 200 mL/min b) 300 mL/min c) 400 mL/min

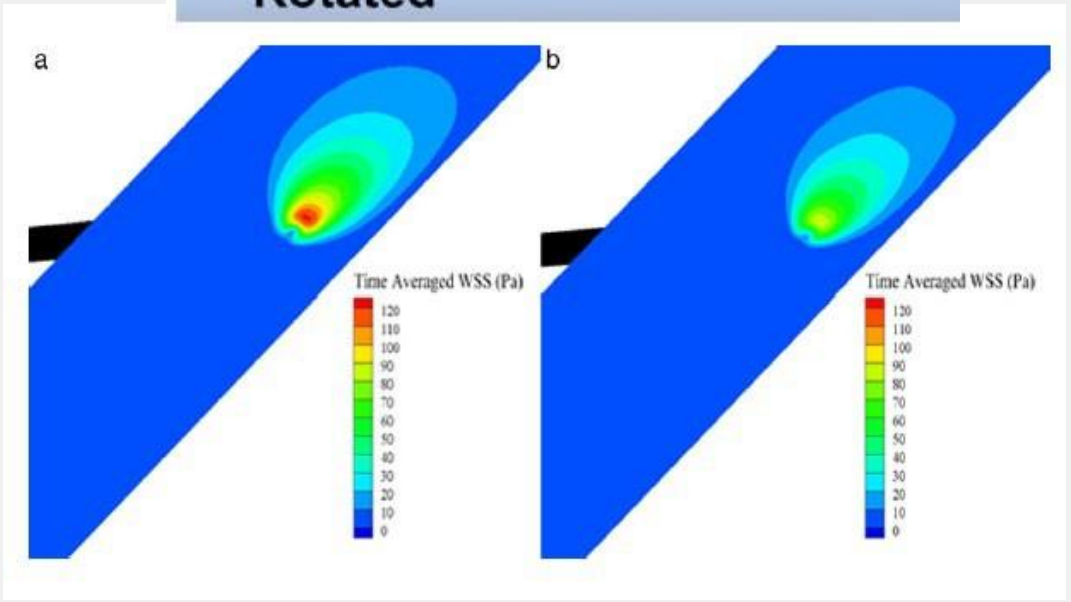


Fulker D, Simmons A, Barber T. Computational Model of the Arterial and Venous Needle During Hemodialysis. J Biomech Eng. 2017 Jan 1;139(1). doi: 10.1115/1.4034429. PMID: 27537240.

Damage From Flow Patterns

- Wall Shear Stress due to the constant needle jet.
- Reaching maximum values of 122 Pa and 85 Pa for the inserted and rotated positions, respectively.
- The crucial finding was that rotating the needle can reduce the maximum WSS on the vein floor by 30%
- Needles typically rotated after insertion



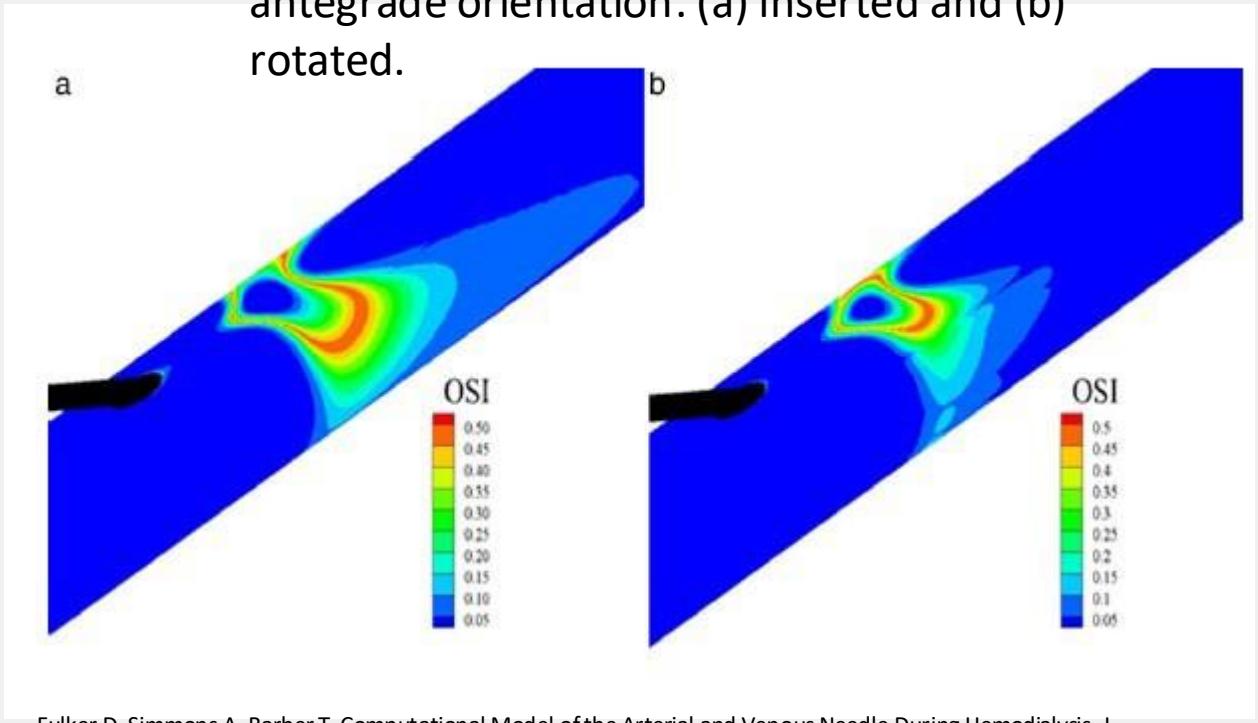


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Damage From Flow Patterns

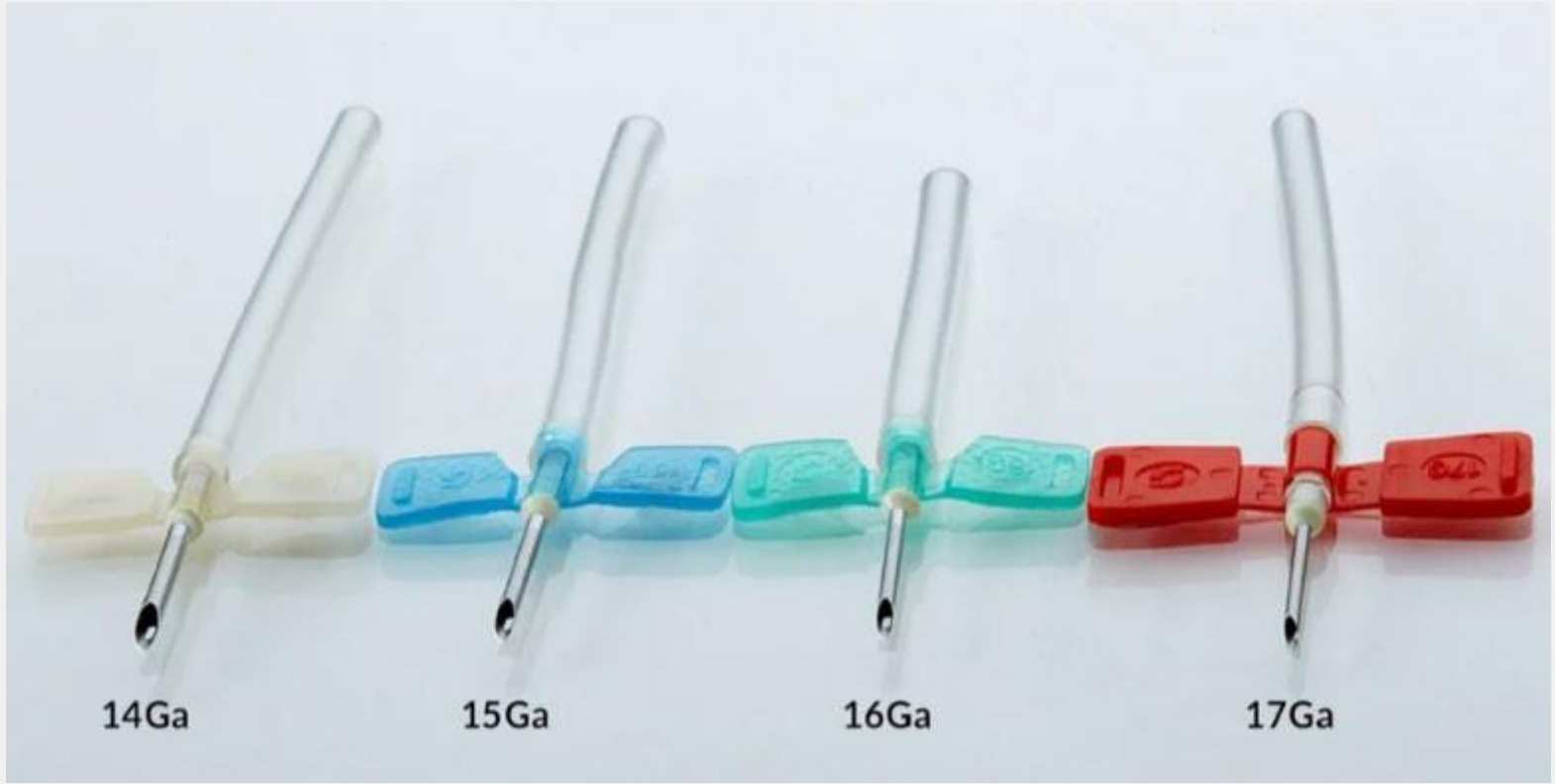
- Oscillatory shear index (OSI) of the vein roof for the arterial needle
- Pure oscillatory flow with no net forward motion and a high possibility of endothelial dysfunction.
- Flow entering the back eye = 36% to 42% of the total flow through the needle
- Needle rotation has minimal effect on the volume of core flow affected by the needle, with the flow entering smoothly through the central bore.

Oscillatory shear index (OSI) of the vein roof for the arterial needle in the antegrade orientation: (a) inserted and (b) rotated.



Fulker D, Simmons A, Barber T. Computational Model of the Arterial and Venous Needle During Hemodialysis. J Biomech Eng. 2017 Jan 1;139(1). doi: 10.1115/1.4034429. PMID: 27537240.

Standard AV Fistula Needles





https://www.reddit.com/r/mildlyinteresting/comments/tuhx9j/the_size_difference_of_a_dialysis_needle_to_a/

Image source: https://www.indiamart.com/proddetail/a-v-fistula-needle-20893751530.html?srsltid=AfmBOoodEAONdOV8su8VKU3DQIdCefLbnr9pMf_ruBGELSj40AVvTdep

15Ga & 14 Ga due to Blood Flow Rates >400 mL/min

Prescribed blood flow rate Pre-pump Arterial Pressure ≤ −200 to −250 mmHg	Metal needle gauge required to support blood flow rate
200–250 mL/min	17 Gauge
250–350 mL/min	16 Gauge
350–450 mL/min	15 Gauge
>450 mL/min	14 Gauge

Table source: https://link.springer.com/book/10.1007/978-3-031-70514-4

Needle Angle & Length

Based on the skin to vessel depth

Depth in cm	Depth in mm	Angle of the needle insertion
0–0.4 cm	0–4 mm	15–20° angle, 1″ needle or 3/5″ needle
0.5–0.9 cm	5–9 mm	30–45° angle, 1″ needle
1.0–1.5 cm	10–15 mm	45° angle, 1¼″ needle

Table source: https://link.springer.com/book/10.1007/978-3-031-70514-4

Bevel Sharpness

Buttonhole Needle Design Varies in Cutting Surface on the Bevel

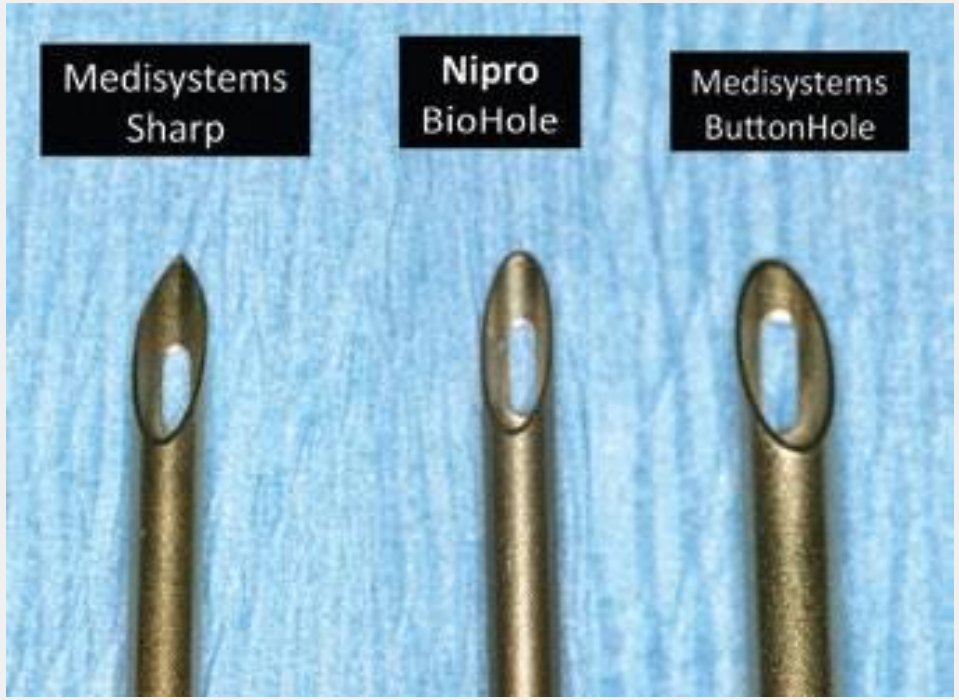


Image source: Twardowski ZJ. Update on Cannulation Techniques. The Journal of Vascular Access. 2015;16(9_suppl):S54-S60. doi:10.5301/jva.5000349

Buttonhole Scab Removers

- Diacan Buttonhole



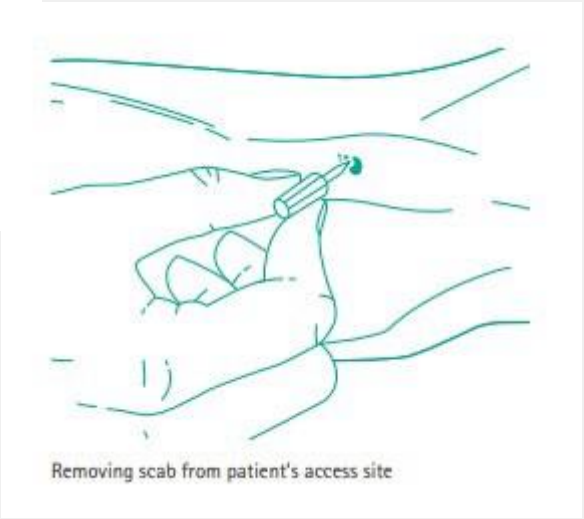


Image source: https://catalogs.bbraun.com/en-01/p/PRID00009851/diacan-buttonhole-fistula-needle-for-hemodialysis?bomUsage=marketingDocuments

- Harmony Buttonhole Needle







https://www.jmsna.net/hubfs/AV%20Needles%20PDFS/Harmony%20PDFS/Harmony%20User's%20Guide%20EN.pdf?hsLang=en

Plastic Cannula

Outside the United States, plastic cannulas are commonly utilized for AV access.

The Argyle™ Fistula Cannula with Anti-Reflux Valve is manufactured by Medtronic Medical Systems, Inc. (South Jordan, UT/not FDA cleared)

Cannula inner diameter size	Cannula outer diameter size
1.53 mm	1.8 mm or 15 Gauge
1.3 mm	1.6 mm or 16 Gauge
1.12 mm	1.4 mm or 17 Gauge







https://mozarcmedical.com/products/emea-en/dialysis-access/chronic-hd/argyle-fistula-cannula/

Flow Patterns with Doppler Velocities

Metal Needle compared to Plastic Cannula

Marticorena RM, Donnelly SM. Impact of needles in vascular access for hemodialysis. J Vasc Access. 2016 Mar;17 Suppl 1:S32-7. doi: 10.5301/jva.5000534. Epub 2016 Mar 6. PMID: 26951901.

TABLE I - Doppler velocities expressed in cm/s taken at 2 cm and 4 cm from the needle tip at baseline and with pump speeds from 200 to 400 mL/min, with metal needle and plastic cannula

Type of needle	Bevel	Qb mL/min	at 2 cm (cm/s) mean ± SD	at 2 cm (cm/s) mean ± SD
Metal needle	Up	0	38 ± 7	
Metal needle	Up	200	50 ± 10	96 ± 4
Metal needle	Up	300	63 ± 11	104 ± 16
Metal needle	Up	400	75 ± 7	172 ± 8
Plastic cannula	N/A	0	46 ± 5	
Plastic cannula	N/A	200	58 ± 16	84 ± 24
Plastic cannula	N/A	300	72 ± 8	126 ± 17
Plastic cannula	N/A	400	87 ± 13	144 ± 12

Qb = blood flow; N/A = not applicable.

Plastic Cannulae Scoping Review

Schoch M, Kerr D, Smith V, Wynne R. Use of plastic cannulae in haemodialysis: A scoping review. Int J Nurs Stud. 2026 Jan;173:105246. doi: 10.1016/j.ijnurstu.2025.105246. Epub 2025 Oct 9. PMID: 41109064.

Conclusion

There is a growing global interest in plastic cannulae for haemodialysis vascular access. Although emerging evidence points to potential clinical and economic advantages, widespread adoption remains limited due to logistical challenges and higher initial costs. Robust, high-quality trials comparing metal needles versus plastic cannulae are required to accurately determine relative effectiveness. Trial design must accommodate an appropriate period of plastic cannulae practice integration.

Effect of the arterial needle bevel position on puncture pain and postremoval bleeding time in hemodialysis patients: A self-controlled, single-blind study

Bevel Down

Abstract

Aim: This study aimed to investigate the effect of the bevel orientation (facing upwards or downwards towards the skin) of the needle inserted into the arterial limb of the arteriovenous fistula (AVF) on puncture pain and postremoval bleeding time.

Methods: This study, using a single-blind crossover design, was conducted on 35 maintenance hemodialysis patients who had been dialyzed for at least 6 months and in whom blood access was via an AVF. AVF cannulation was performed with the needle bevel pointing upward in the first six sessions and the needle bevel pointing downwards (towards the skin) in the subsequent six sessions. Needles were always inserted in the direction of blood flow. At each dialysis session, cannulation pain was measured using a visual analog scale (VAS), and the bleeding time at the end of dialysis after needle removal was recorded.

Findings: The VAS score and postremoval bleeding time were lower when the needle bevel pointed downwards towards the skin during insertion ($P < 0.05$).

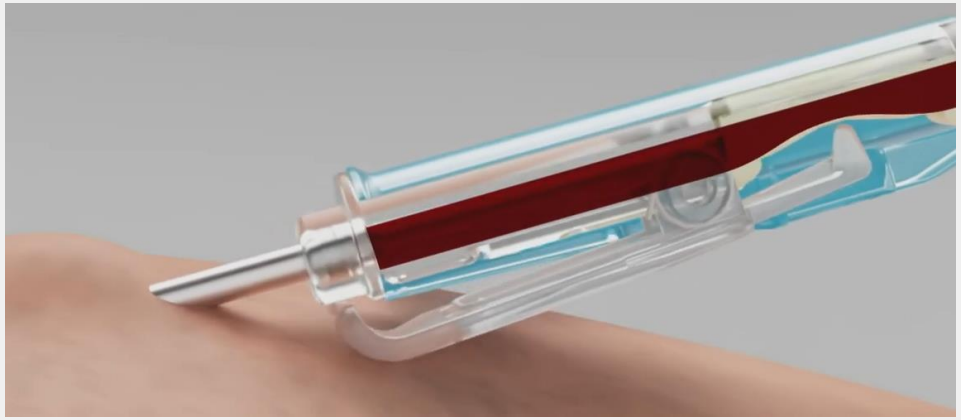
Discussion: Insertion of the needle with the bevel pointed downward decreased puncture pain during cannulation and bleeding time postdialysis on needle removal.

Ozen N, Tosun B, Sayilan AA, Eyileten T, Ozen V, Ecder T, Tosun N. Effect of the arterial needle bevel position on puncture pain and postremoval bleeding time in hemodialysis patients: A self-controlled, single-blind study. Hemodial Int. 2022 Oct;26(4):503-508. doi: 10.1111/hdi.13044. Epub 2022 Sep 6. PMID: 36068183.

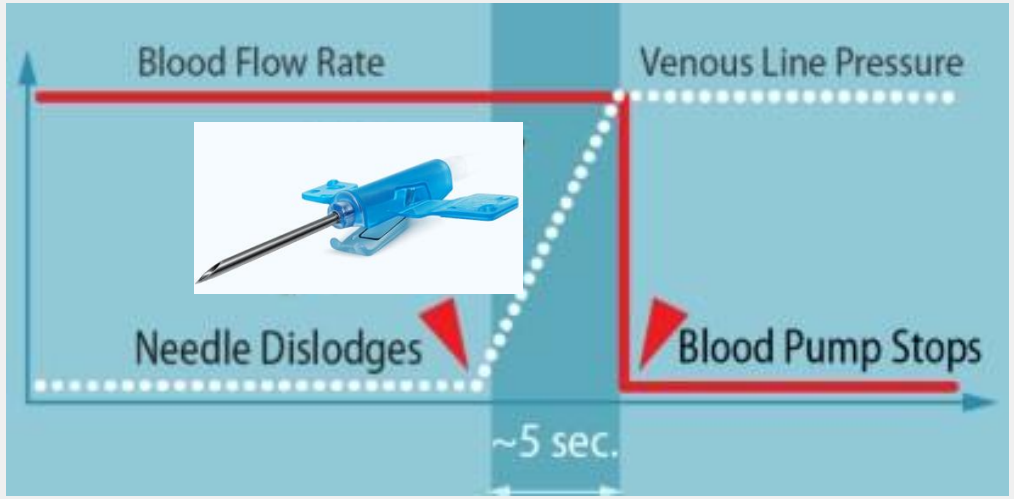
ClinicalTrials.gov List of Studies: Completed Now FDA Cleared

Confirmatory Study to Assess the V Needle in End-Stage Renal Disease Patients During In-Clinic Hemodialysis (Clinic-SAVER) – Status Completed

V Needle is designed to automatically generate a partial occlusion of the internal fluid path and trigger the hemodialysis machine to alarm and shut off if a complete dislodgement of the venous needle from the arm inadvertently occurs.



https://www.jmsna.net/en/caveo



ClinicalTrials.gov List of Studies

Argyle Safety Fistula Cannula With Anti-reflux Valve Clinical Study

Status Completed 11/2025 at 3 DaVita Dialysis Facilities



https://clinicaltrials.gov/study/NCT05927532?intr=anti-reflux%20valve&rank=3&tab=study&a=8

Voice of Patients

- Reduce trauma and fear from a minimum of 312 cannulations a year!!!!
- Reduced or eliminated pain with cannulation
- Rapid indication of the needle inside the vessel correctly
- Reduced infiltration rate with cannulation
- Ability to move their access arm during treatment without fear of infiltration or dislodgement
- Prevent any venous needle dislodgement from leading to exsanguination
- Better enable self-cannulation and single-handed needle removal

Voice of Patients

Health-related quality of life (HRQOL) impacts across different access types are not well established.

SONG-HD group systematic review of clinical trials showed that Patient Reported Outcomes (PROs) were used very infrequently in trials

Only 11% of 168 trials included patient-reported pain measures and only 3% included Quality Of Life (QOL) measures.

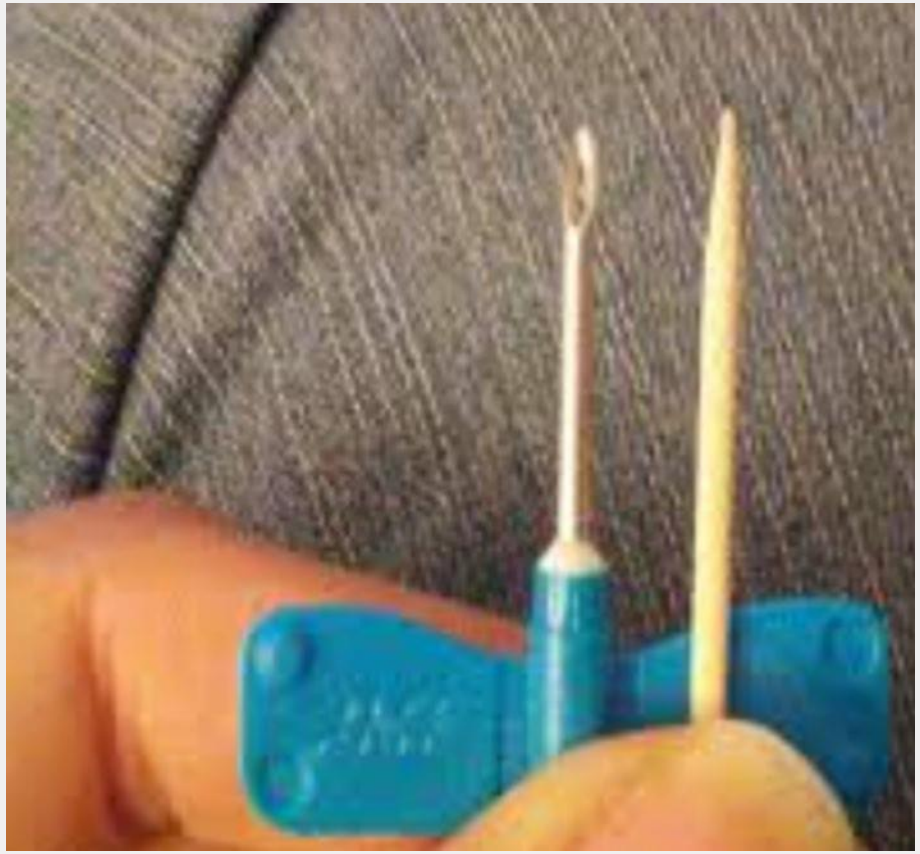
The SONG-HD group has also advocated for comprehensive measurement of patients' quality of life as a function of the "core measure" of access function.

https://khi.asn-online.org/patient-reported-outcomes-for-dialysis-vascular-access/

Voice of Patients

We can do better!!!

We need Innovation!!!



FB image a patient posted of how they see the needles
They are not wrong!