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INTERVENTIONAL RADIOLOGY
TECHNICAL NOTE

Looking beyond the gunsight: A potential bailout technique for arterial and venous recanalization

Steven D. Kao
Ravi N. Srinivasa
Tyler Callese
Neema Jamshidi
Adam Plotnik

ABSTRACT
The "gunsight approach" was initially described as the use of overlapping snares and through-and-through puncture of the portal vein and inferior vena cava for the creation of a transcaval portosystemic shunt. This technique can be adapted for the creation of an extra-anatomic channel between any 2 locations where snares can be deployed. We explain the technique, discuss finer technical points, and describe 2 cases where refractory vascular occlusions are crossed using this technique. The first case involves an extensively calcified femoral arterial chronic total occlusion where subintimal tracking past the occlusion is achieved, but luminal re-entry is hampered by dense calcific plaque refractory to multiple re-entry devices. The second case involves a chronic venous occlusion along the femoral vein with loss of in-line flow due to prior stenting. In both cases, the gunsight technique was successfully used as a bailout option after standard recanalization techniques were unsuccessful.

The gunsight technique was originally described as the use of overlapping snares for portocaval shunt creation between the inferior vena cava and the portal vein in a patient without an accessible hepatic vein for placement of a second transjugular intrahepatic portosystemic shunt.[1] Since its inception, this technique has been adapted for recanalization in peripheral arterial disease.[2,3] In these cases, a percutaneous needle stick is performed through 2 snares that are deployed at each end of the occlusion. The image intensifier is positioned orthogonally and parallel to the axis between the snares to guide needle advancement. Once the needle is through both snares, it is exchanged for a wire that is sequentially snared and externalized to establish flossing access.[4] Angioplasty and stent-graft or closed-cell stent placement across the arteriotomy or venotomy is performed to seal the puncture site and maintain patency.

Technique

The applied principle is the same for arterial or venous recanalization; bi-directional snares are deployed, followed by percutaneous needle advancement through both snares to enable subsequent "through-and-through" intraluminal wire access. Equipment choices include a 22-gauge Chiba needle (Cook) and 0.018-inch wire, for example, a Balance Middleweight (Abbott) or V18 (Boston Scientific), with an appropriate length to be externalized at both vascular access sheaths. Any compatible snare may be used, depending on the size of the vessels and sheaths available.

Formal consent was not required for this study. Consent for publication was obtained for every individual person's data included in the study.

Case 1—Arterial

A 63-year-old man with a history of insulin-dependent diabetes mellitus, hypertension, hyperlipidemia, and morbid obesity presented with a 7 cm left heel ulcer complicated by osteomyelitis. The decision was made to pursue optimization of vascular inflow prior to wound closure at the calcanectomy due to soft tissue friability. Arterial duplex and computed tomography angiography (CTA) demonstrated a hemodynamically significant

From the Department of Radiology (S.D.K. ✉ stevenkaomd@gmail.com), Division of Vascular and Interventional Radiology, UCLA Medical Center, Los Angeles, California, USA.

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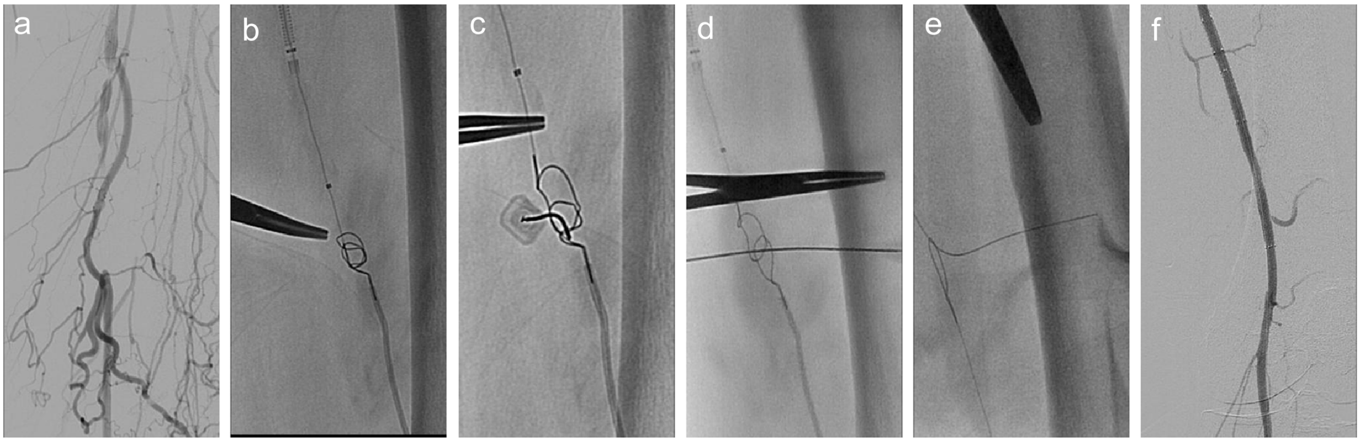

Figure 1. a-f. Gunsight technique for arterial recanalization with trans-intimal flap puncture. **(a)** Pre-intervention angiogram shows chronic total occlusion at the patient's mid superficial femoral artery (SFA) with collateralization. **(b)** Overlapping snares deployed with image intensifier positioned orthogonal to the axis connecting the 2 snares. **(c)** In-plane and **(d)** oblique image of percutaneous access needle which has been placed through both snares. **(e)** Deep snare is closed first and internalized. The wire is withdrawn underneath the skin surface, the superficial snare closed, and the proximal end of the wire is internalized. **(f)** Post-stenting angiogram demonstrates brisk in-line flow with three-vessel runoff.

short segment occlusion at the mid superficial femoral artery (SFA) with recanalization via collaterals and 2 vessel runoff to the foot.

An initial attempt to restore in-line flow was performed via a 6 F 10 cm standard vascular sheath at the contralateral common femoral artery. Arteriograms confirmed a 5 cm length total occlusion at the mid-SFA. Numerous unsuccessful attempts at crossing the occlusion were made using standard techniques with multiple 0.018-inch and 0.035-inch wires, including specialized chronic total occlusion (CTO) crossing wires. Due to the lack of long support sheaths available, the procedure was terminated without successful recanalization. A second attempt via a primary left dorsalis pedal access using a combination of a guidewire and specialized weighted-tip CTO crossing wires and catheters was also unsuccessful due to a severely calcified distal cap.

Main points

- The gunsight technique or approach was originally described as the use of overlapping snares and through-and-through puncture in the portal vein and vena cava for the creation of a portocaval shunt.
- This technique can be adapted for arterial and venous recanalization in cases where standard techniques are not successful.
- The applied principle is the same for arterial or venous recanalization; bi-directional snares are deployed, followed by percutaneous needle advancement through both snares to enable subsequent "through-and-through" intraluminal wire access.

The third attempt was made via a 6 F 90 cm Destination sheath (Terumo) at a contralateral common femoral artery access. Subintimal tracking along the occlusion was achieved using an inflated Armada balloon (Abbott) and stiff guidewire (Terumo). Luminal reentry using recanalization/re-entry devices, including the Enteer (Medtronic) and Outback (Cordis) catheters, was unsuccessful due to calcified plaque.

The gunsight technique was used to cross the intima to establish sub-intimal flossing access.[7] A 10 mm Amplatz Goose Neck snare (Medtronic) was advanced along the subintimal tract. Dorsalis pedis access was obtained and a second snare advanced to the same level (Figure 1a). Direct percutaneous puncture using a 22-gauge 15 cm Chiba needle was performed as described previously (Figure 1b, 1c). Oblique projections were used to confirm "through-and-through" access and to determine that the subintimal snare was deep to the intraluminal snare (Figure 1d). The needle was exchanged for a 300 cm length V18 wire and the deeper snare was closed (Figure 1d). The distal floppy end of the wire was internalized into the lumen of the vessel and then externalized through the femoral sheath (Figure 1e). The wire was then carefully withdrawn from the femoral access until the proximal (sharp) end of the percutaneous wire was retracted just under the skin surface. The superficial snare was subsequently closed over the proximal end of the wire, the wire was doubled over and externalized through the pedal access (Figure 1e). Multistation balloon angioplasty along the subintimal tract was followed by deployment of a 6 mm × 5 cm Viabahn stent (Gore). The final venogram demonstrated brisk in-line flow with 3-vessel runoff (Figure 1f). At 4 months post-recanalization, the wound has been healing well with no need for re-operation.

Case 2—Venous

A 29-year-old man with a 1-year history of bilateral lower extremity deep venous thrombus (DVT) complicated by ulcer development status post balloon venoplasty and stent reconstruction of the left iliofemoral vein and inferior vena cava (IVC) presented with stent occlusion. Recanalization using standard techniques via the right popliteal access was unsuccessful due to extensive collateralization.

Direct puncture of the left common femoral vein stent was performed using a 22-gauge 10 cm Chiba needle. A 15 mm Amplatz Goose Neck snare (Medtronic) was advanced from a left internal jugular vein access and used to capture a V18 wire placed from the femoral access. Subsequent venography demonstrated persistent poor inflow despite multistation venoplasty. Third access was established at the left popliteal vein and venography demonstrated an abrupt cutoff at the level of the iliofemoral stent, suggesting a separate collateral inflow for the stent.

The gunsight technique was used to establish direct in-line flow from the femoral vein to the iliofemoral stent. The snare was advanced to the level of the cutoff (Supplemental Figure 1a) and a

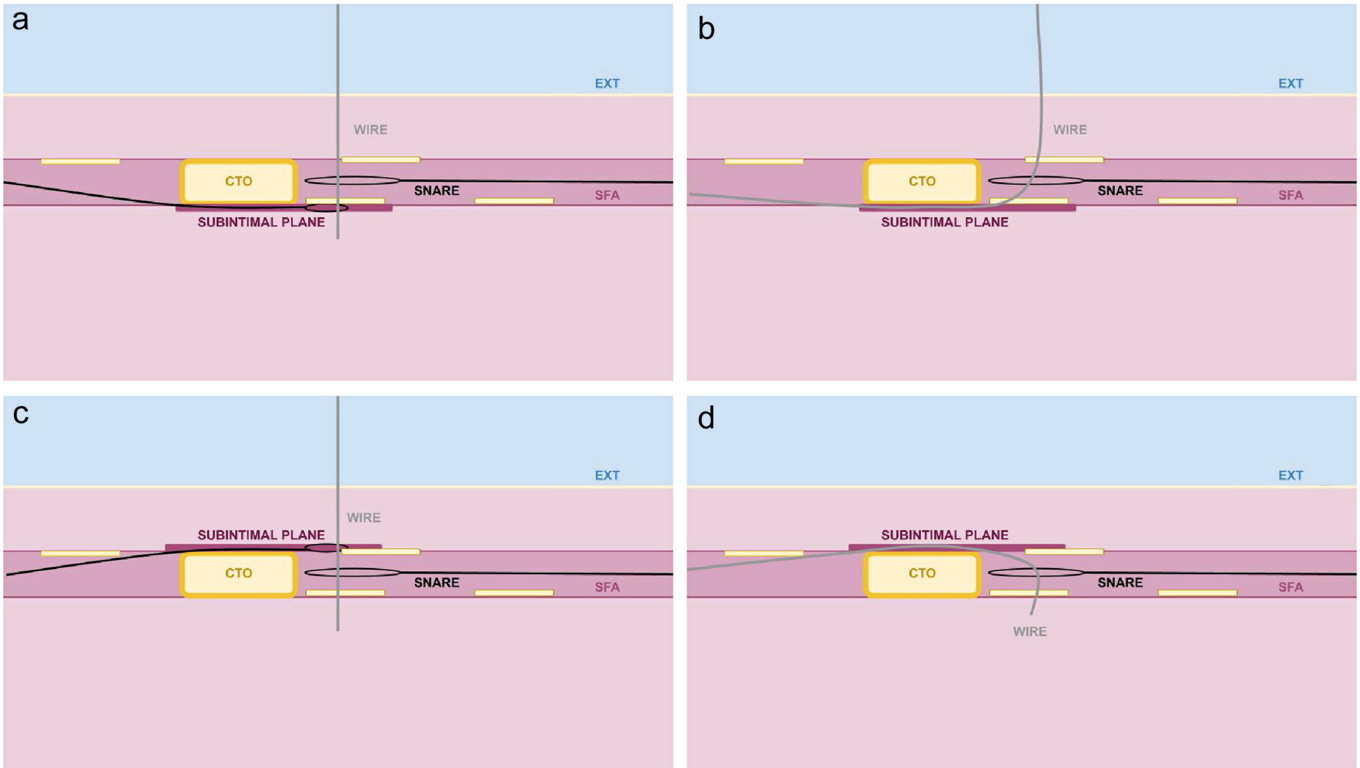

Figure 2. a-d. Schematic diagram of gunsight technique for arterial recanalization demonstrating importance of proper sequence of snare closure. **(a, b)** Deep snare is closed first. This will allow proper internalization of the wire without losing proximal wire control. **(c, d)** Snare closer to the skin entry site is closed first. The operator will lose access to the proximal tip of the wire and repeat puncture will be necessary. CTO, chronic total occlusion; SFA, superficial femoral artery; EXT, external to patient.

second snare was placed from the popliteal vein access to the level of the cutoff (Supplemental Figure 1b). A 22-gauge Chiba needle was then percutaneously passed through the overlapping snares (Supplemental Figure 1c, 1d). The needle was exchanged for a Roadrunner hydrophilic wire (Cook). The distal tip of the wire was first snared and externalized through the left internal jugular access followed by the more superficial proximal tip through the popliteal access (Supplemental Figure 1e-1h and Supplemental Video 1). The tract was dilated with a 10 mm Armada balloon (Abbott) and an 11 mm Viabahn VBX stent graft (Gore) placed. A subsequent venogram demonstrated restoration of brisk in-line flow into the IVC.

Discussion

This technique can be technically challenging, particularly for deeper targets where the size of the snares is limited by the diameter of the native vessels on either end. Depending on the distance between the snares, longer covered stents may be needed to serve as an extra-anatomic bypass conduit. The key to success includes the understanding of the spatial relationship between the snares to ensure the proper sequence of snare closure so that external control of the wire is maintained. The deeper snare should be closed first while wire control is maintained at the skin entry (Figure 2a). Once the distal tip of the wire is externalized through an access sheath, the proximal tip of the wire can then be pulled to the level of the more superficial snare which is closed and used to internalize the wire into the vessel and then send out the other sheath for flossing access (Figure 2b). If the snares are retracted in the incorrect sequence, external wire access would be lost during the internalization step (Figure 2c, 2d) and repeat puncture would be necessary.

An alternative method involving the creation of an extra-anatomic channel using a subcutaneous tunneler may be considered in the event if a long (>5 cm) bypass is needed in a superficial location. This technique has been described for the creation of upper extremity central venous extra-anatomic bypasses[5-7] to avoid precarious axillary/subclavian stenting.

In conclusion, the gunsight technique represents a viable backup option for arterial and venous recanalization when conventional techniques have failed.

Conflict of interest disclosure

Steven D. Kao has received consultation fees from Philips Healthcare. Ravi N. Srinivasa is a consultant for Boston Scientific and Teleflex Medical. Neema Jamshidi, Tyler Callese and Adam Plotnik have no conflicts of interest to disclose.

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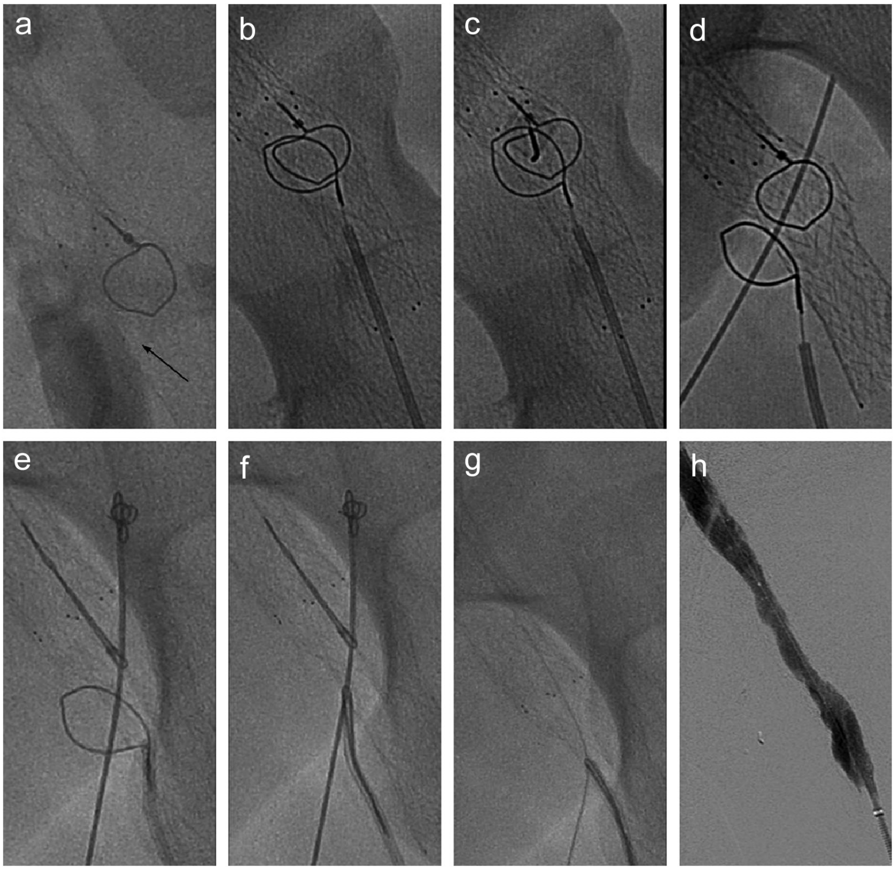
Supplemental Video 1. Supplemental color video demonstrates external view of wire as the distal (stiff) end is internalized into the body and then the vessel.



Supplemental Figure 1. a-h. Gunsight technique for venous recanalization with puncture across stent. **(a)** Initial snare placed from right internal jugular access is brought to the level of the occlusion. Contrast injection via Glidecath (Terumo) placed from distal access showing separate channel *(arrow)*. **(b)** Overlapping snares deployed with image intensifier positioned orthogonal to the axis connecting the two snares. In-plane **(c)** and oblique **(d)** image of percutaneous access needle which has been placed through both snares. **(e, f)** Deep snare is closed first and internalized. **(g)** The remaining snare is closed and the proximal end of the wire internalized. **(h)** Post-stent venogram demonstrates brisk in-line flow to the inferior vena cava.