

Use of Implantable Venous Flow Coupler in Head and Neck Free Flap Reconstruction

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ABSTRACT

Objectives:

To describe the use of flow couplers in the postoperative monitoring of free flaps in head and neck reconstruction.

Study Design:

Retrospective review of flow couplers implanted between July 2014 and July 2015.

Methods:

Rates of flap revision, salvage, and failure were compared between patients receiving flow couplers and those who did not. The false positive rate (FPR), true positive rate (TPR), and false negative rate (FNR) of signal loss were determined for the flow coupler group.

Results:

Of 142 flaps performed during the study period, 72 patients received flow couplers, while 70 patients were monitored by Cook-Schwartz doppler. The rate of take-back was 14% (10/72) in the flow coupler group and 10% (7/70) in the non-flow coupler group (P= 0.6066). In 1 patient, complete loss of flow-coupler signal identified venous kinking during initial surgery. Complete loss of signal correctly indicated venous thrombosis upon take-back of 10 patients. Venous signal was transiently lost postoperatively in 2 patients whose flaps were ultimately viable. The FNR was 0%, the FPR 3.3%, and the TPR 100%. Rate of flap salvage was 43% (3/7) in the non-flow group, and 80% (8/10) in the flow-coupler group (P= 0.1618). Flap failure rates were 5.7% (4/70) in the non-flow group and 2.8% (2/72) in the flow-coupler group (P= 0.4381).

Conclusion:

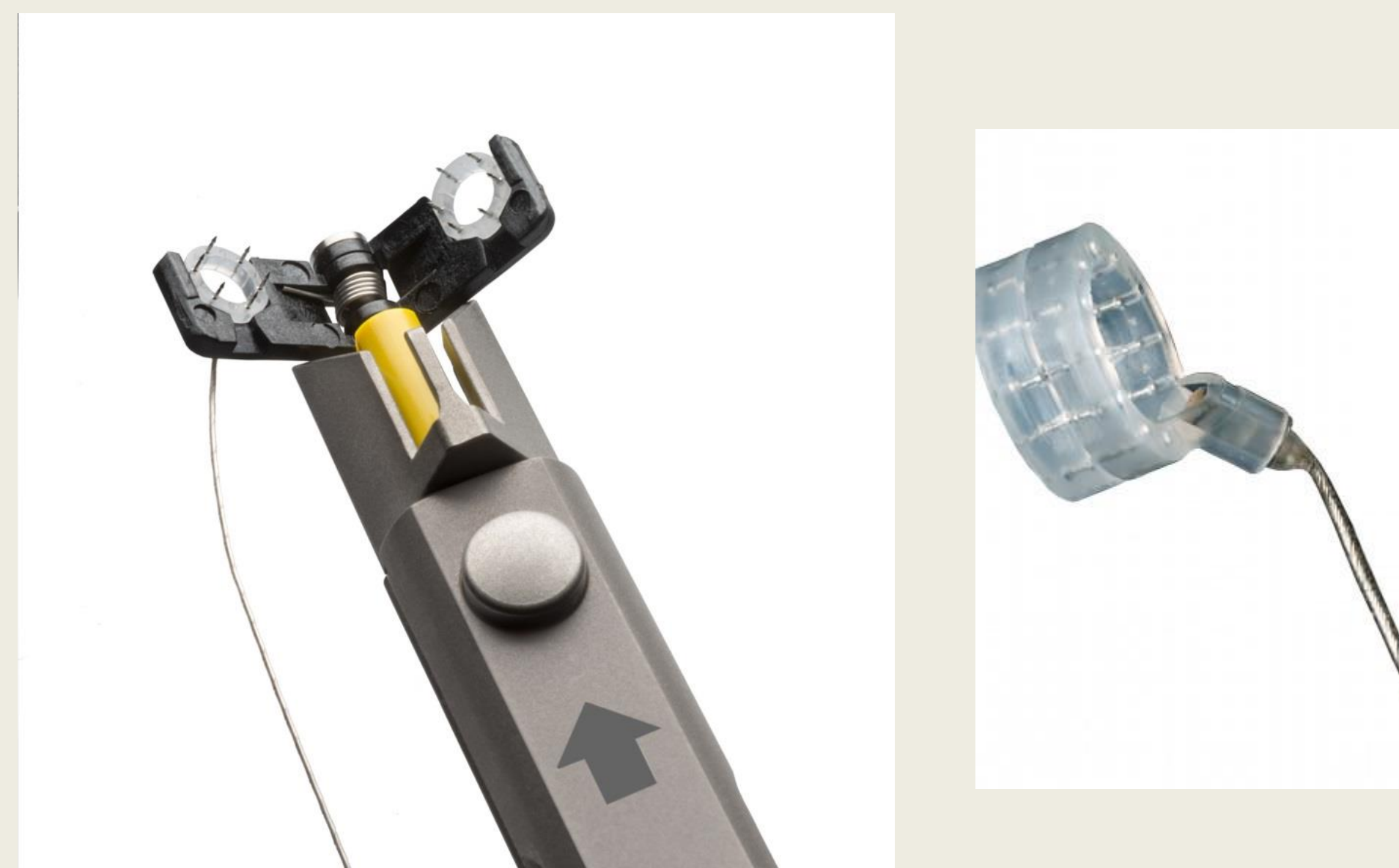
Complete loss of venous flow coupler signal correlated with venous thrombosis. The flow coupler is a viable option for the postoperative monitoring of free flaps and is associated with a high salvage rate.

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INTRODUCTION

- The flow coupler is an anastomotic coupler with an imbedded ultrasonic microdoppler probe that allows for monitoring of venous flow in free flaps.
- Loss of the venous doppler signal may correlate with poor venous flow and allow for early detection of impending flap compromise prior to changes in an arterial doppler signal or clinical appearance of the flap.
- Here, we describe the application of the flow coupler in the monitoring of free flaps in the head and neck.



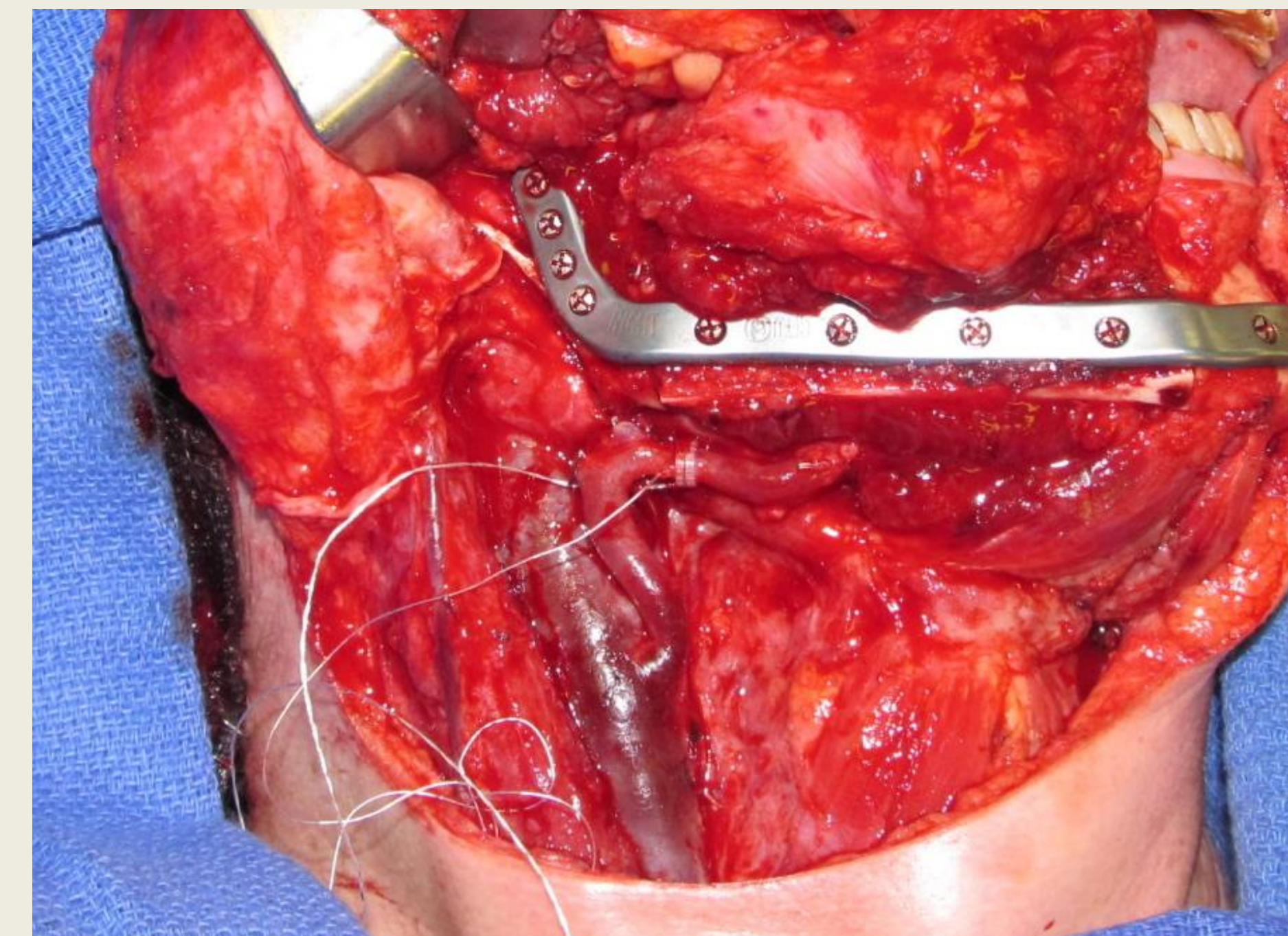
A) Venous anastomotic coupler with imbedded ultrasonic microdoppler probe. Intima of two opposing veins are everted and pulled over the prongs prior to closing the device. 20MHz probe monitors venous outflow.



B) Ultrasonic microdoppler probe wire is inserted into monitoring box which is kept at patient's bedside. A and B channel allow for monitoring of two separate venous signals if necessary.

METHODS AND MATERIALS

- Prospective data were collected from two groups of patients receiving free flaps between July 2014 and November 2015.
- Group 1:** venous anastomosis performed with the flow coupler
 - Group 1 monitored by Cook-Schwartz arterial Doppler, flow coupler, and clinical exam
- Group 2:** traditional venous coupler without an imbedded doppler (non-flow) used as a result of one of the following conditions:
 - anastomosis performed in an end-to-side to the internal jugular vein
 - end-to-end anastomosis proximal to the internal jugular where significant back flow was present
 - Appropriate size flow coupler was not available
- Group 2 monitored by arterial doppler and alone
- Rates of flap take-back, salvage, and failure were compared between the groups.
- The false positive rate (FPR), true positive rate (TPR), and false negative rate (FNR) of venous signal loss were determined for the flow coupler group for the entire five day postoperative monitoring period.



C) Demonstration of flow coupler following venous anastomosis. Segmental mandibulectomy defect reconstructed with fibular free flap.

RESULTS

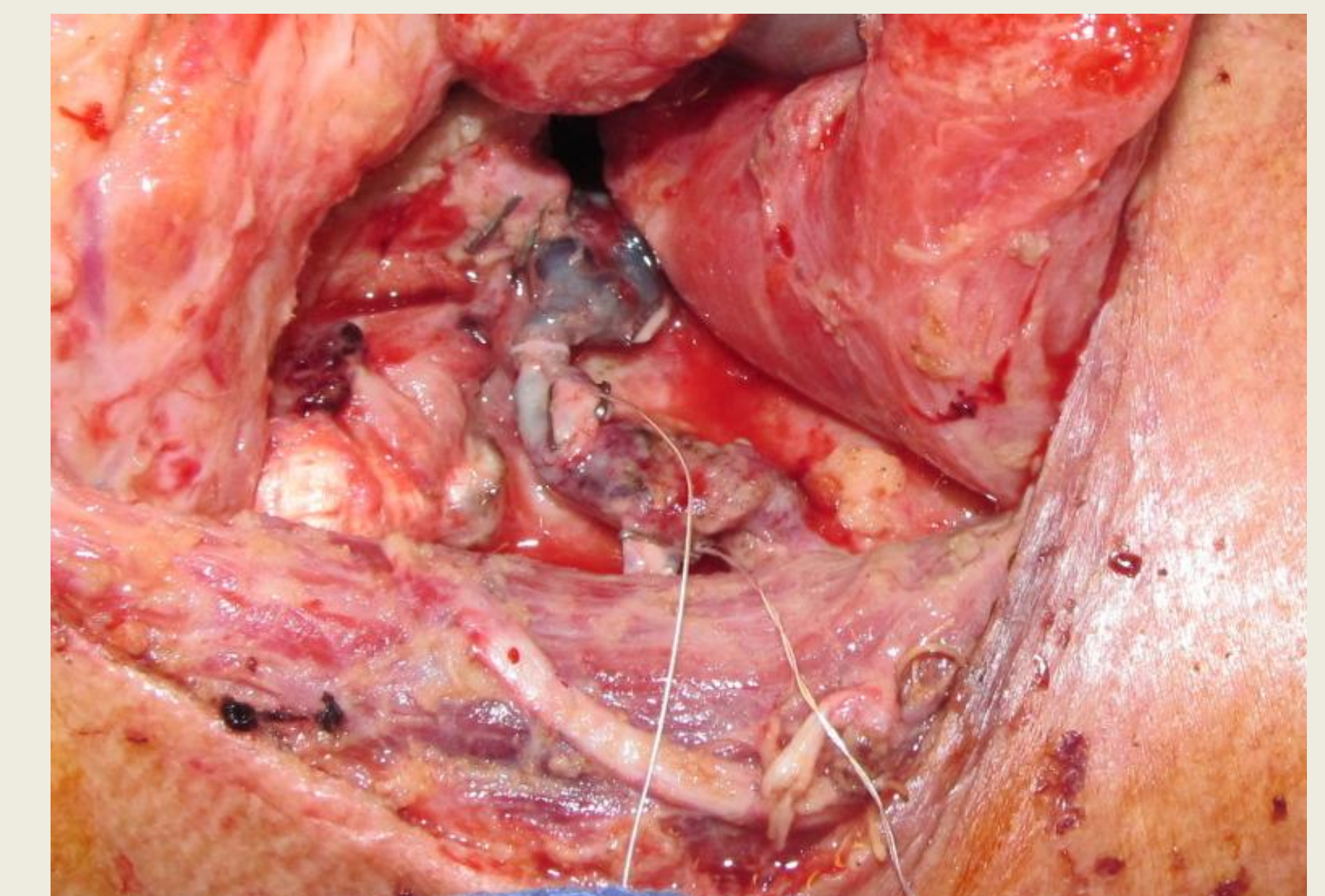
- 142 flaps performed during the study period
 - 72 patients received venous flow couplers
 - 70 patients were anastomosed with traditional non-flow couplers
- The rate of take-back was 14% (10/72) in the flow coupler group and 10% (7/70) in the non-flow coupler group (P= 0.61).
- In 1 patient, complete loss of flow-coupler signal identified venous kinking during initial surgery.
- Complete loss of signal correctly indicated venous thrombosis upon take-back of 10 patients.
- False positives occurred in two patients where the venous signal was lost postoperatively but the flaps were ultimately viable.
- The FNR was 0%, the FPR 3.3%, and the TPR 100%.
- Rate of flap salvage was 43% (3/7) in the non-flow group, and 80% (8/10) in the flow-coupler group (P= 0.16).
- Flap failure rates were 5.7% (4/70) in the non-flow group and 2.8% (2/72) in the flow-coupler group (P= 0.4381).



C) Venous Doppler probe is secured to the skin along side the Cook arterial Doppler. Flaps are monitored by arterial and venous signal and clinical appearance of flap. Doppler wires are pulled out postoperative day 5.

DISCUSSION

- Intraoperative loss the venous signal indicates venous kinking or thrombosis, and can alert the surgeon to situations requiring flap repositioning or re-insetting.
- Flow couplers should not be placed in close proximity to the internal jugular vein, as significant back-flow may be present, and theoretically increase the risk of a false negative event.
- Loss of the venous signal may correctly indicate a thrombotic event, but may also represent a technical device malfunction such as:
 - Inadvertent removal of the Doppler wire
 - Kinking of the pedicle at the site of the coupler resulting from memory / stiffness of the wire
- When venous signal is lost, the arterial signal and clinical exam should also be considered to prevent unnecessary re-exploration of the anastomosis.
- The flow coupler provides addition information in buried flaps where direct clinical inspection is not possible



D) Loss of the venous Doppler signal correctly identified venous thrombosis

CONCLUSIONS

- Complete loss of venous flow coupler signal correlated with venous thrombosis.
- The flow coupler is an adjunctive tool in the postoperative monitoring of free flaps and is associated with a high salvage rate.

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