WELCOME *To the*

2026 SYMPOSIUM

Early Detection of Hemodialysis Access Stenosis Using Contact-Free Optical Monitoring and Predictive Modeling
CMAP-001 prospective multicenter study

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* Henry Ford Health, ^PatenSee Inc

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VASCULAR ACCESS SOCIETY OF THE AMERICAS VASA Access Excellence.

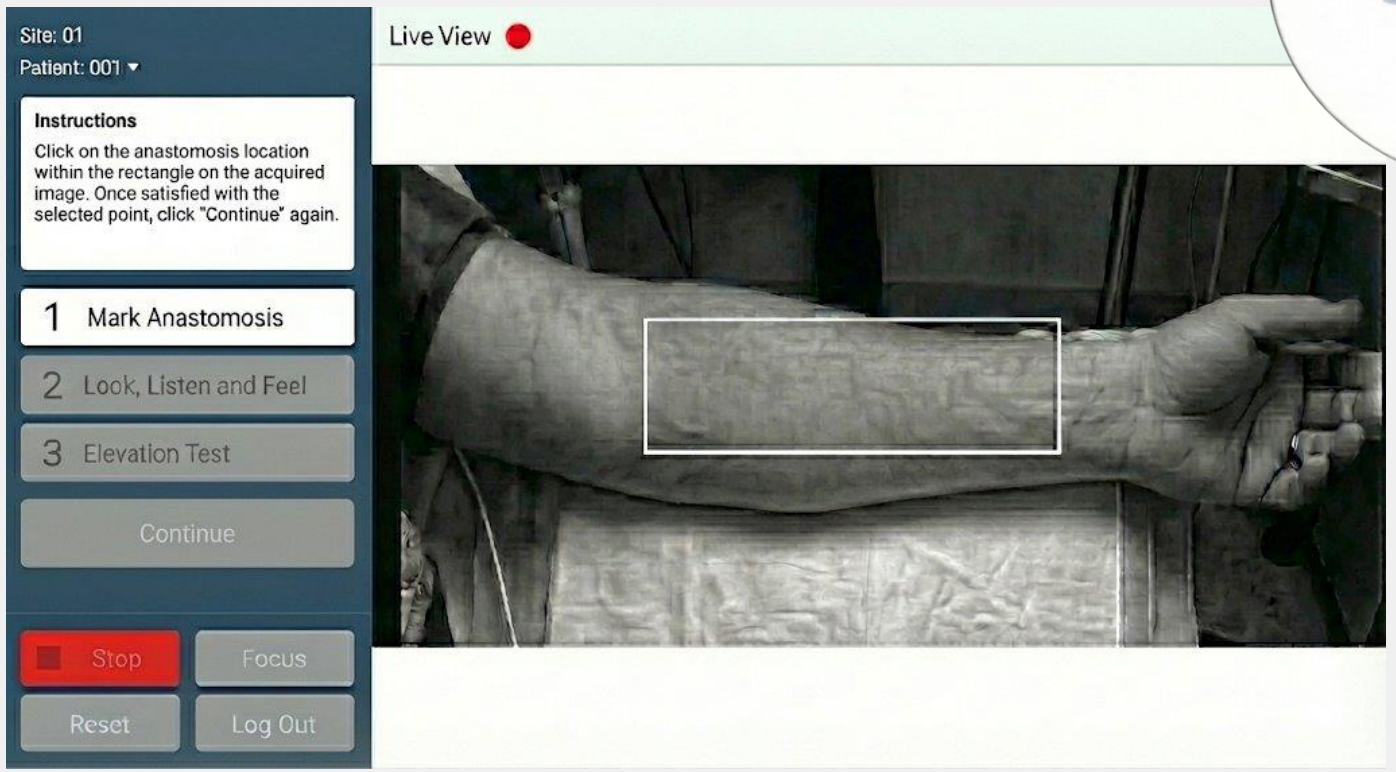
Background

- Hemodialysis vascular access complications remain a major clinical and economic burden.
- Early detection of access stenosis may reduce downstream complications.
- Current “look, listen, and feel” assessments are subjective, operator-dependent, and limited abilityobjective longitudinal trending of vascular access.
- AI-enabled monitoring may identify access dysfunction earlier.

Technology

- PatenSee is a contact-free laser speckle vibrometry system.
- It measures flow-related vibrational signals along the entire access across a broad frequency spectrum of 0.5–800 Hz.
- The system captures frequency components corresponding to the palpable thrill and bruit, converting them into quantitative functional indices.

PatenSee Vascular Access Management System





PatenSee Vascular Access Management System Technical Introduction

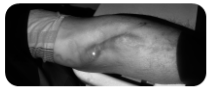
Imaging unit placed at approximately 50 cm from the vascular access:

Projector: Class I laser source providing near-infrared (NIR) and green illumination

Camera for capturing back-reflected light patterns

"Look"

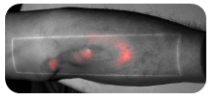
Near IR: Subdermal collaterals



Structured Light: 3D modeling of the arm surface to quantify objects dimensions

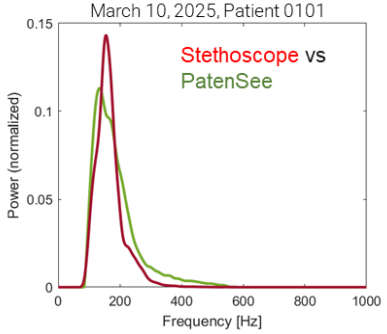


Vibration mapping: spatial-temporal mapping of vibrations data from 200 spots



"Listen"

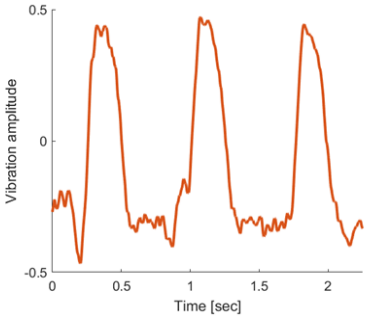
Laser Vibrometry – High Frequency
March 10, 2025, Patient 0101

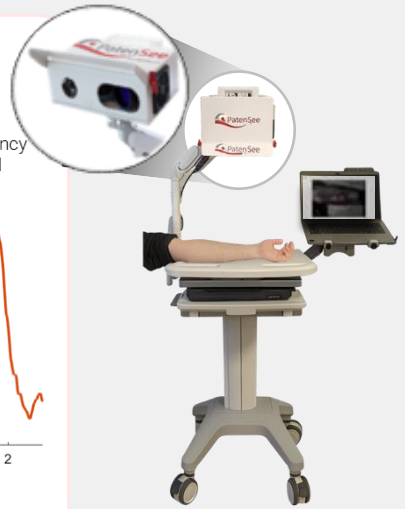


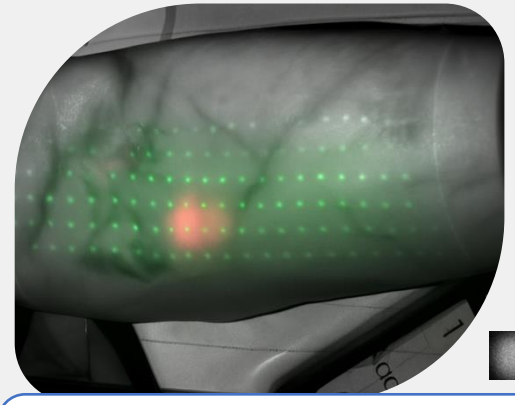
➢ **90% correlation to stethoscope**

"Feel"

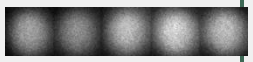
Laser Vibrometry – Low Frequency
March 10, 2025, Patient 0101







Unprocessed Laser Speckle Video:

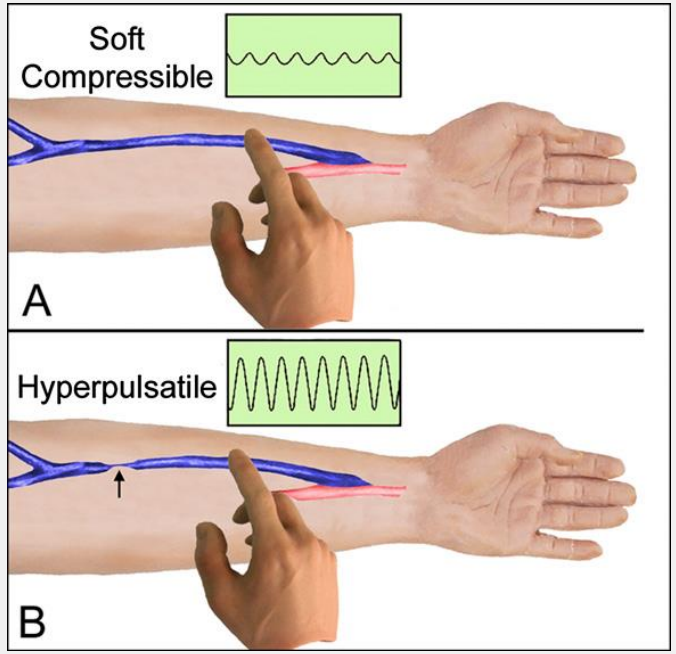


- ❑ 200 spots: Enable localized detection of vibration patterns
- ❑ High frequency – "Listen"
- ❑ Low frequency – "Feel"

PatenSee Vascular Access Management System Mimicking Look, Listen, Feel

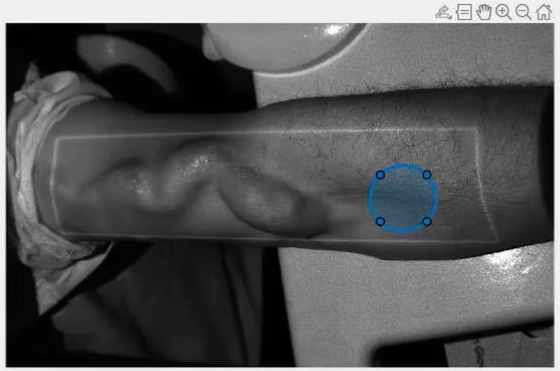


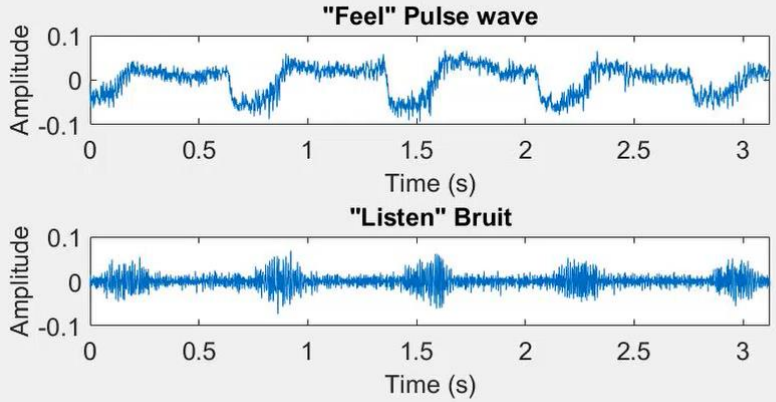
Theory:
Palpation of pulse with fingertips



Salman and Beathard. Physical Examination for Hemodialysis Arteriovenous Access.
Clin J Am Soc Nephrol 8: 1220–1227, 2013. doi: 10.2215/CJN.00740113

PatenSee offline Look, Listen, Feel





Feel

Thrill

Listen

How PatenSee Works
A 2-minute, non-contact scan replaces guesswork

1

Scan
(Optical Vibrometry)

The PatenSee System measures tiny vibrations in the patient's fistula / graft without contact, just a 2-minute scan.

2

Extract

Our software extracts vibrometry features (correlated to hemodynamic features) from the vibration signal.

3

Track Changes

ML algorithm tracks vibration features across 30-day intervals

4

Risk Score

A clear risk flag is generated; giving clinicians time to intervene before access failure.

The result: weeks of advance warning - turning a crisis into a scheduled procedure.

Study Objective

CMAP-001 is an ongoing multicenter study designed to train an artificial intelligence-enabled vibrometry platform for early prediction of clinically significant AV (arterio-venous) access stenosis.

Methods

Adult hemodialysis patients with **AV fistulas or grafts**.

Vibrometry scans **prior to** needle cannulation for dialysis.

Six weekly scans followed by **bi-monthly scans** over a one-year study period.

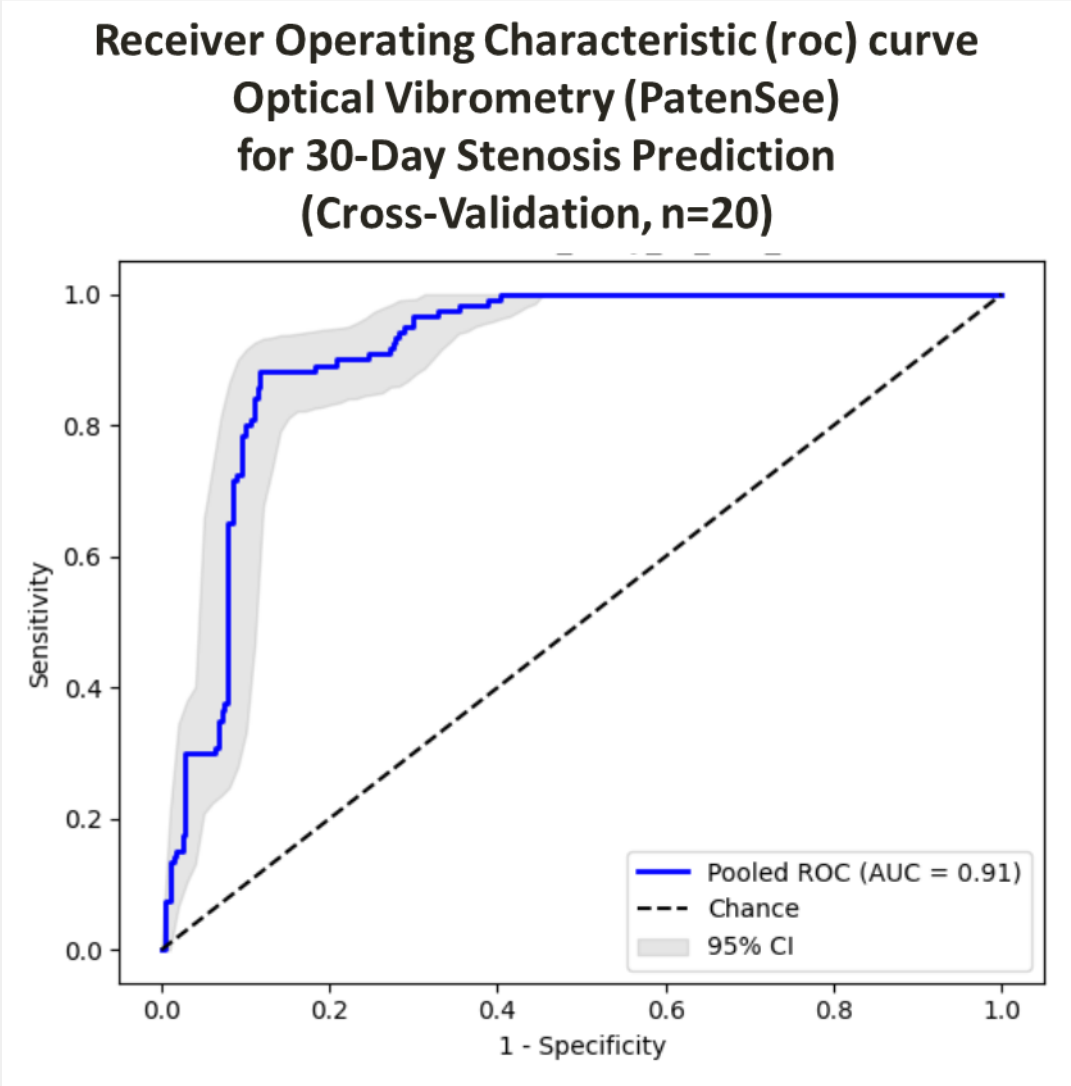
Feature changes were quantified by comparing 60–90-day and 30–60-day pre-PTA windows using absolute log2 fold change.

Model: logistic regression with balanced class weights.

Validation: patient-level cross-validation.

Results

- **20** patients were enrolled.
- Mean follow-up: **174 days**.
- **Stenosis**: 6 patients; **No stenosis**: 14 patients
- Groups were **similar** in age (63.5 vs 63.6 years) and sex (50% vs 57% male).
- Classifier detected **vibration changes ~30 days** before PTA.
- **AUC of 0.91:** strong discrimination.



AUC = 0.91; strong discriminative ability.

Conclusions

- Optical vibrometry + ML may detect access stenosis.
- Earlier detection may reduce thrombosis, catheter use, and morbidity.
- Larger studies are needed to validate and measure clinical impact.

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Thank You!