

Background

- Stereotactic vacuum-assisted biopsy (ST VAB) is a minimally invasive diagnostic tool in the workup of findings suspicious for breast cancer identified on mammography¹
- Clip markers are deployed in the areas where the suspicious findings are biopsied, as many malignancies may no longer be visible on mammography after biopsy²
- Accurate clip placement is crucial as it marks the site of breast cancer and may act as the only localization for the area that should be resected during surgery
- Therefore, clip migration can negatively affect clinical outcomes as it can lead to inaccurate or incomplete resection of breast cancer during surgery
- This study aimed to investigate factors contributing to clip migration in ST VAB

Methods

- A retrospective review of ST VAB performed within an integrated healthcare system from 2022 to 2025 was conducted
- Prebiopsy, intra-procedural, and post-biopsy mammograms were assessed for clip migration
- Patient characteristics were compared according to migration status using bivariate analysis
- Generalized Estimating Equations (GEE) models identified factors associated with clip migration status and distance while accounting for clustering by radiologist-technician teams

References

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Results

Table 1. Descriptive analysis of selected characteristics

| Characteristic | N = 769 | Characteristic | N = 769 |
|------------------------------------|--------------------------------|-------------------------|--------------------------------|
| Age | 58.2 (12.5) ¹ | Clip Type | |
| Mammography Finding | | SecurMark | 112 (15%) |
| Microcalcifications | 740 (96%) | Tumark | 582 (76%) |
| Asymmetry/architectural distortion | 31 (4.0%) | TriMark | 65 (8.5%) |
| Lesion Depth | | HydroMark | 10 (1.3%) |
| Anterior | 121 (16%) | Clip Migration | |
| Middle | 357 (46%) | No | 568 (74%) |
| Posterior | 291 (38%) | Yes | 203 (26%) |
| Proximity to Skin | 4.40 (3.20, 6.10) ² | Clip Migration Distance | 1.50 (1.00, 2.40) ² |

¹ Mean (SD); ² Median (Q1, Q3)

Table 2. Adjusted odds ratio of clip migration using GEE logistic regression model (n = 769)

| Characteristic | Odds Ratio (95% CI) |
|---------------------|----------------------|
| Mammography Finding | |
| Microcalcifications | Ref |
| Asymmetry | 0.40 (0.153, 0.846)* |
| Lesion Depth | |
| Anterior | Ref |
| Middle | 1.36 (0.81, 2.30) |
| Posterior | 1.92 (1.29, 2.85)** |
| Quadrant | |
| Upper Outer | Ref |
| Lower Central | 0.361 (0.14, 0.96)* |
| All Others | — |
| Proximity to skin | 1.10 (1.01, 1.20)* |

Note. Both models included the patient's age, mammogram findings, breast side, pathology results, breast density, biopsy approach, number of cores taken, core thickness, paddle compression force, lesion depth, quadrants, and proximity to skin. The quadrant variable included upper outer, lower central, lower outer, and 6 additional levels labeled as "All Others". * <.05, ** <.01, *** <.001

Table 3. Adjusted mean ratios of clip migration distance using GEE linear regression model (n = 202)

| Characteristic | Exp(Beta) (95% CI) |
|---------------------|----------------------|
| Mammography Finding | |
| Microcalcifications | Ref |
| Asymmetry | 1.55 (1.06, 2.28)* |
| Clip Type | |
| SecurMark | Ref |
| Tumark | 1.11 (0.88, 1.39) |
| TriMark | 0.95 (0.74, 1.22) |
| HydroMark | 1.62 (1.13, 2.31)** |
| Quadrant | |
| Upper Outer | Ref |
| Lower Outer | 0.61 (0.45, 0.82)*** |
| All Others | — |

Acknowledgments

The project described was supported by the JABSOM Office of the Dean. MM was partially supported by the U54MD007601 (Ola HAWAII) and U54GM138062 (PKO) from the National Institute of Health (NIH). The content is solely the responsibility of the authors and does not necessarily represent the official views of NIH.

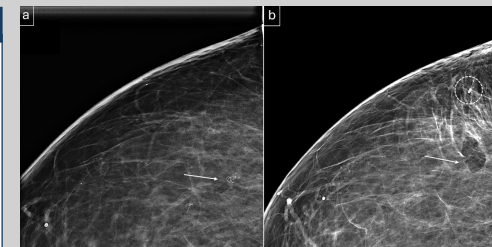


Figure 1. (a) CC spot magnification mammographic view of the right breast demonstrates grouped calcifications in the outer breast at a posterior depth (arrow). (b) CC post biopsy mammographic views of the same breast demonstrate biopsy localization clip (dotted circle) migrated lateral to the area biopsied (arrow). A lateral biopsy approach was used. Note air at biopsy site with no residual calcifications. CC = craniocaudal

Discussion

- Clip migration occurred in over a quarter of biopsies, highlighting that it can commonly occur
- Risk was driven by lesion characteristics rather than patient or procedural factors, with higher odds seen in microcalcifications, posterior lesions, superficial depth, and those in the upper outer quadrant
- HydroMark clips are embedded in an expanding hydrogel that lacks an anchoring structure, possibly contributing to greater migration distance when compared to SecurMark clips that are stabilized by a suture netting³
- Future work will include the addition of further data to strengthen these findings and identify previously unrecognized associations related to clip migration

Conclusion

- Clip marker migration can negatively impact patient care through misidentification of the area of breast cancer, resulting in inadequate surgical resection and treatment
- Our study suggest that the biopsied lesion characteristics, location, and clip type influence the likelihood and magnitude of clip migration following ST VAB
- Understanding the interaction of these modifiable factors may help reduce clip migration and improve surgical outcomes