San Antonio Breast Cancer Symposium® - December 9-12, 2025

Prospective assessment of upper extremity range of motion changes following mastectomy and breast reconstruction using a novel smartphone app

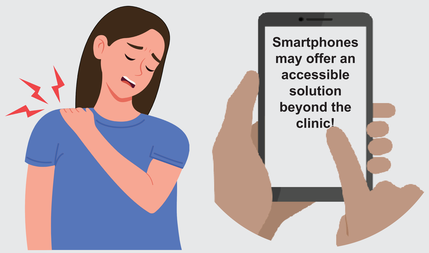
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Introduction

30% of breast cancer patients experience deficits in shoulder range of motion following a mastectomy[1].

Earlier detection following surgery ensures patients receive rehabilitation sooner[2], improving long-term function[3].

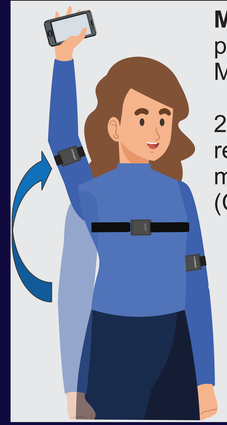


Key Question and Hypothesis

Key Question: Can a mobile phone application accurately identify shoulder range of motion after mastectomy and breast reconstruction?

Hypothesis: Mastectomy and immediate breast reconstruction will reduce shoulder range of motion, with similar deficits measured with wearable inertial measurement units (IMUs) and an iPhone app (MotionDetect).

Methods



MotionDetect is an iPhone app developed to measure peak shoulder **abduction** and **flexion** angles within the MyDataHelps clinical trial platform (CareEvolution).

20 patients undergoing bilateral breast cancer surgery recorded their range of motion from home using their mobile device while concurrently wearing wearable IMUs (Clario Opal) (**Table 1**).

Wearable IMUs
MotionDetect

PRE - SURGERY
2 - 4 Weeks Pre

↓

Mastectomy + Breast Reconstruction Surgery

Wearable IMUs
MotionDetect

POST - SURGERY
8 - 12 Weeks Post

Table 1: Summary of patient demographics

Variable	Value
N	20
Age (years)	45.4 (9.24)
Height (m)	1.7 (0.07)
Weight (kg)	88.2 (22.14)
BMI (kg/m²)	32.0 (7.29)
Dominant side treated	8 (40%)
Prophylactic (Yes / No)	6 (30%)
Surgery (DIEP / PRE)	6 / 14
Weeks post-surgery	10.1 (2.5)

Results

Patients undergoing mastectomy + immediate breast reconstruction exhibit significantly reduced abduction range of motion using wearable IMUs ($p = 0.004$) and the MotionDetect app ($p = 0.03$) (**Figure 1**).

Flexion range of motion was reduced, but the decrease was not statistically significant ($p = 0.054 – 0.11$) (**Figure 1**).

Thirty percent of patients experienced clinically meaningful reductions (≥25°) in abduction measured with the MotionDetect app (**Figure 2**).

Post-operative changes in shoulder range of motion were strongly correlated ($r = 0.82 – 0.91$) between wearable IMUs and the MotionDetect app (**Figure 2**).

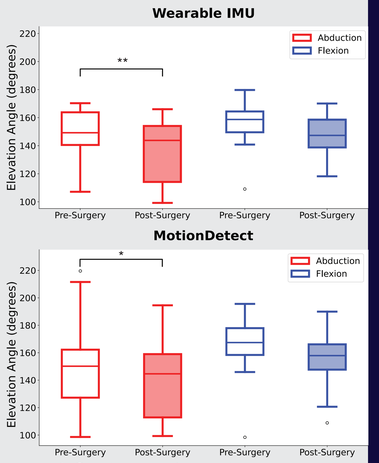


Figure 1: Shoulder elevation angle recorded using wearable IMUs (top) and the MotionDetect iPhone app (bottom) as patients (N=20) completed range of motion assessments in abduction (red — raising arm to the side) or flexion (blue — raising arm forward). Assessments were performed before mastectomy and immediate reconstruction and 8-12 weeks post. Repeated Measures ANOVA Time effect: * $p < 0.05$; ** $p < 0.01$.

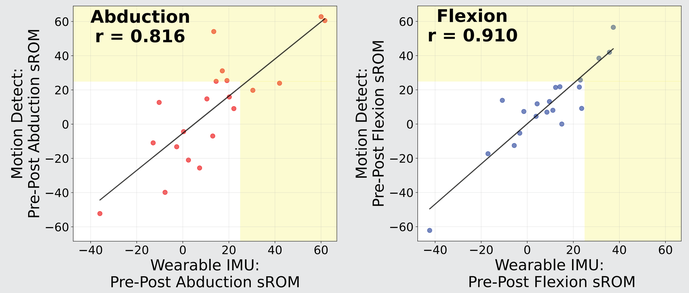


Figure 2: Comparison of the change in (left) abduction and (right) flexion range of motion recorded with wearable IMUs (x-axis) and the MotionDetect iPhone app (y-axis) on the dominant arm. Changes are calculated as pre-op minus post-op, with a larger positive value indicative of a greater decline in range of motion. Yellow shaded regions denote clinically meaningful reductions in shoulder range of motion (≥25°) for flexion or abduction.

Structured Interviews (N = 7)

Enrollment and app downloading
Ease of completing mobile app assessments
Timing and frequency of assessments
Total time required to complete assessments
Preferences for receiving information returned by the app

All participants found the app easy to use and an acceptable assessment for remote monitoring of shoulder range of motion.

Minor challenges included limited cellular service and the lack of an Android option (3/7).

Most (5/7) found the two assessment time points appropriate.

Completion time was acceptable to all patients (5-10 minutes).

Most patients (6/7) wanted data shared back to their physician.

Discussion & Conclusions

MotionDetect identified post-surgical shoulder mobility deficits with accuracy comparable to wearable IMUs, demonstrating that smartphone-based assessment is feasible and clinically meaningful.

~30% of patients showed clinically significant declines in shoulder range of motion, consistent with prior reports and emphasizing the need for routine functional monitoring after breast cancer surgery.

Patients found the mobile assessments easy to complete at home and expressed interest in receiving results as part of their care, supporting the app's potential for scalable, patient-centered tracking.

Limitations: small sample size, lack of Android support, and limited integration with broader symptom-tracking tools.

Future work: longer term follow-up; inclusion in decentralized clinical trials.

Acknowledgments

American Cancer Society grants TLC-22-191-01, RSG-20-016-01-CCE; assistance of Anna Lamport.

References

(1) Nesvold IL et al. Acta Oncol 2008;47:835-42 PMID: 18568481; (2) Lai L et al. Ann Surg Oncol 2016; 23:3379-84 PMID: 27334210; (3) Chrischilles EA, et al. Breast Cancer Res Treat. 2019;175(3):675-689 PMID: 30852760

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