

The temporal and financial benefit of intraoperative breast specimen imaging: A pilot study of the Kubtec MOZART

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Capital purchases for the operating room (OR) require significant investment and collaboration between surgeons and hospital financial officers. With healthcare costs continuing to rise in the United States, it is imperative to increase OR efficiency in effort to decrease costs. Rush University Medical Center recently purchased the Kubtec MOZART system for three-dimensional intraoperative tomosynthesis of breast specimens. Prior to this, breast specimens were imaged in breast diagnostic radiology with the results called into the operating room by the radiologist. Imaging is performed several buildings away from the operating room, similar to other institutions after expansion, which is time-consuming as specimens must be walked over by staff. Margin assessment prior to the end of a case is essential to decrease re-excision rates. Recent studies show a reduction of re-excisions by more than 50% when imaging is used.¹ Specifically, intraoperative specimen imaging allows surgeons to immediately image and then electronically transfer the images to the breast radiologists. The radiologist and surgeon are then immediately able to discuss the findings over the phone, with a formal read by the radiologist. New data recently shows that the average cost of inpatient OR time is \$34.45 per minute with direct expenses accounting for 54.6% of total expenses and wages and benefits accounting for two-thirds of those direct expenses.² Technology that can simultaneously improve surgery and safely decrease OR time provides direct benefit to the patient and the hospital by providing the highest quality procedure at the lowest cost. This pilot study was performed to assess operative times and potential cost savings since implementing the Kubtec MOZART system for intraoperative imaging of breast specimens.

A retrospective chart review of all breast cancer patients from January 1, 2015 to December 31, 2016 with non-palpable lesions

requiring wire-localization for excision was conducted after approval from our Institutional Review Board (IRB). After lesion excision, type of specimen imaging was classified as either "intraoperative" or "diagnostic radiology" and was correlated with operative time. Further information gathered from patient charts included attending surgeon, procedure codes, total OR time, and duration of surgery. OR time was defined as the time from "patient in room" to "patient out of room" and surgical time was defined as "incision start" to "surgery complete." The mean and standard deviation was calculated for OR time and surgical time for each imaging modality. Nested multiple regressions were created and compared using Likelihood ratio tests and a Welch's *t*-test performed to obtain *P*-values. All analysis was conducted using R software.³

The mean OR time for a wire-localized segmental mastectomy with sentinel lymph node biopsy using diagnostic radiology was 101.3 minutes compared to only 93.7 minutes when intraoperative imaging was performed (Table 1). Mean surgical time was 63.3 minutes using diagnostic radiology and only 58.8 minutes when using intraoperative imaging (Table 2). On average, operating room time was 7.6 minutes shorter when using intraoperative imaging as opposed to sending the specimen to diagnostic radiology (Table 3). This time reduction translates into estimated OR cost savings of \$284.62 per case based on average national OR cost data.²

Analysis of surgical records for the first 6 months after implementation of the Kubtec MOZART system of intraoperative imaging showed a trend toward both decreased OR time and decreased surgical time. While the limitation of this study was small sample size, this preliminary analysis is reassuring and inspires further investigation. The importance of generating a return on investment for surgical technology cannot be underestimated, and cost saving

TABLE 1 Mean (SD) of OR time in minutes by imaging type

	Diagnostic radiology (N = 76)	Kubtec MOZART (N = 19)	P-value
Wire localized segmental mastectomy + sentinel lymph node biopsy (N = 95)	101.3 (51.4)	93.7 (26.5)	0.37

TABLE 2 Mean (SD) of surgical time in minutes by imaging type

	Diagnostic radiology (N = 76)	Kubtec MOZART (N = 19)	P-value
Wire localized segmental mastectomy + sentinel lymph node biopsy (N = 95)	63.3 (20.3)	58.8 (19.0)	0.37

TABLE 3 Time saved (in minutes)

	OR time difference between diagnostic radiology and Kubtec MOZART Imaging
Wire localized segmental mastectomy + sentinel lymph node biopsy	7.6

analyses is paramount for both surgeons and institutional finances. Because there are no similar studies describing this technology and its benefits, our data sparks a novel analysis of intraoperative imaging technology.

Wire-localized segmental mastectomy with sentinel lymph node biopsy using intraoperative imaging has saved an average of 7.6 minutes per surgery and a decrease in OR cost of \$284.62 per case. According to The Advisory Board, the typical volume for a dedicated breast surgeon ranges from 100-250 surgical procedures a year.⁴ By applying \$284.62 cost savings per case and then assuming a surgeon performs 175 cases per year, this translates into an overall cost reduction of \$49 808.50 per year per surgeon. As our surgical and operating room staff become more familiar with this new technology, we anticipate further reduction in OR time and thus further financial benefit for both the patient and the institution.

Assessment of margins in order to avoid re-excision is essential for successful breast conserving therapy. However, this can be a timely and costly task. Efficient use of operating room time is an important aspect of decreasing overall hospital costs. Proper management of the OR set the groundwork for efficiency.⁵ Methods for intraoperative margin assessment include finger palpation, ultrasound, frozen section, imprint cytology and two-view specimen mammography.^{6,7} Our institution used mammography but transporting samples to radiology takes time and extra OR personnel. New technology can assist in increasing efficiency and decreasing costs. Using OR time reduction as a way to extrapolate financial savings is a useful model for return on investment analysis. We are encouraged by the early results that the capital purchase of intraoperative breast imaging resulted in an average of 7.6-minute reduction in OR time and a \$284.62 charge savings for wire-localized segmental mastectomies with sentinel node biopsy. This three-dimensional intraoperative imaging allows the surgeon to make a more accurate decision

regarding targeted shave margins, which may improve both aesthetics and decrease re-excision rate, which would also provide a financial benefit. As we continue to use this technology at our institution, we plan to collaborate with other institutions to better analyze OR time, cost savings benefit, and re-excision rates.

Given that 12% of women will develop invasive breast cancer in their lifetime, this data can profoundly impact a number of patients.⁸ In breast conserving and oncoplastic surgeries 71.6% of patients achieve tumor-free margins during the primary surgery, however up to 37.8% of these patients require re-excision during the primary surgery and 24.8% require a second surgical procedure.⁹ Re-excisions have many negative effects on both the patient and the hospital.⁵ Multiple studies have shown that the likelihood of finding residual tumor in the surgical cavity is as high as 50% if there are positive margins, which can lead to increased local recurrence rates. Furthermore, re-excision has a negative impact on cosmesis, infection rates, and hospital costs.^{6,10} Intraoperative imaging has the potential to decrease the operative time needed for re-excision during the primary surgery by having imaging available in the OR. Due to the low frequency of re-excision in general, this data will take longer to obtain, but the potential implications of such outcomes are promising.

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REFERENCES

1. Thill M. Intraoperative margin assessment during breast conserving surgery by using radiofrequency spectroscopy. *Expert Rev Med Devices*. 2013;10(3):201-315.
2. Childers CP, Maggard-Gibbons M. Understanding costs of care in the operating room. *JAMA Surg*. 2018;153(4):e176233.
3. R Core Team. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing; 2016.
4. Typical Volumes for a Breast Surgeon. 2/17/2011 2011. <<https://www.advisory.com/research/oncology-roundtable/oncology-rounds/2011/02/typical-volumes-for-a-breast-surgeon>>
5. Macario A. Are your hospital operating rooms "efficient"? A scoring system with eight performance indicators. *Anesthesiology*. 2006;105:237-240.
6. Thill M, Röder K, Diedrich K, Dittmer C. Intraoperative assessment of surgical margins during breast conserving surgery of ductal

- carcinoma in situ by use of radiofrequency spectroscopy. *Breast*. 2011;20:579-580.
7. Keating J, Tchou J, Okusanya O, et al. Identification of breast cancer margins using intraoperative near-infrared imaging. *J Surg Oncol*. 2016;113(5):508-514.
 8. Jemal A, Siegel R, Ward E, et al. Cancer statistics. *CA Cancer J Clin*. 2008;58(2):71-96.
 9. Dieterich M, Dieterich H, Moch H, Rosso C. Re-excision rates and local recurrence in breast cancer patients undergoing breast conserving therapy. *Geburtshilfe Frauenheilkd*. 2012;72(11):1018-1023.
 10. Cabioglu N, Hunt KK, Sahin AA, et al. Role for intraoperative margin assessment in patients undergoing breast-conserving surgery. *Ann Surg Oncol*. 2007;14:1458-1471.