Breast MRI: New and Abbreviated Protocols

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Topics

- What is our goal?
- Current status of screening
- How do we change screening
- Abbreviated Breast MRI (AB-MR)
- EA1141 AB-MR Trial
- Multiparametric Breast MRI
Beyond the scope of this talk!

- The debate over screening the benefit of mammography, particularly for women in their forties.
What is Our Goal?

- Decrease breast cancer mortality
- Reduction in the morbidities associated with surgery and chemotherapy

- Finding breast cancers at a smaller size and earlier stage leads to a reduction in mortality and the use of less aggressive therapies
Reservoir of Breast Cancer Present in 1000 Women Being Screened

• Is it 30, 40, 50, 60 or more breast cancers per 1000 women?
• Depends on risk of population
• Detection level (size and stage) depends on modality and frequency of screening
Reservoir of Breast Cancer Present in 1000 Women Being Screened

Tomo plus WB US
The Dissemination of Medical Technologies into Clinical Practice

• Innovations medical in technology and quality of information are the sole driving force in the acceptance and adoption of new technologies

• The dissemination of medical technologies depends on the social, political and ideological context into which they are introduced
Much Can Be Learned From the History of Mammography

• Despite improvements in technology, mammography languished from 1930s to 1970
  – 1930-1950 Stafford L. Warren, Jacob Gershon-Cohen and Raul Leborgne
  – 1950s Improved techniques, Robert Egan

• The production of better data alone did not eliminate the role that economics, authority and ideology played

“TO SEE TODAY WITH THE EYES OF TOMORROW” A HISTORY OF SCREENING MAMMOGRAPHY. Barron H. Lerner, MD, PhD
Background Paper for the Institute of Medicine report: “Mammography and Beyond: Developing Technologies for the Early Detection of Breast Cancer” March 2001
Much Can Be Learned From the History of Mammography

• HIP RTC: Beginning in 1963, Strax, Shapiro and surgeon Louis Venet randomized 62,000 women aged 40-64 with results published in JAMA 1971

• ACS growing public “War” on cancer and the perception of mammography as a “weapon” in the war on breast cancer

• 1960s mammography authority emerges as a subspecialty with radiology champions (Zuckerman and Strax)

“TO SEE TODAY WITH THE EYES OF TOMORROW” A HISTORY OF SCREENING MAMMOGRAPHY. Barron H. Lerner, MD, PhD
Background Paper for the Institute of Medicine report: “Mammography and Beyond: Developing Technologies for the Early Detection of Breast Cancer” March 2001
In the 1940s and 1950s, surgeons had been highly skeptical of mammography, refusing to operate if they could not palpate a lesion detected by x-ray. "If I can't feel it on examination, it's not there."

But as Egan and others published a growing number of articles claiming that mammography enhanced the detection of small breast cancers, it became more difficult for surgeons to ignore the potential benefits of the new technology as well as the help that radiologists could offer.
MSKCC breast surgeon Jerome A. Urban wrote to Zuckerman in 1964, "I think this is an exciting finding and represents the third carcinoma which we personally did not strongly suspect on clinical examination." Urban closed his letter by stating "More power to you" (Urban, 1964).
In September 1956 IBM launched the 305 RAMAC, the first ‘SUPER’ computer with a hard disk drive (HDD). The HDD weighed over a ton and stored a whopping 5 MB of data.

256 GB: That's 262,144 MB or 52,428 times the storage of the 1956 device! BOOM!
What have we done with breast cancer screening the since 1960s?

1969

1975

2013
Limitations of Mammography

1. 38% sensitivity in women with dense breast
2. 17% interval cancer rate
3. Interval cancers with higher grade histologies


# Mammographic Screening: DMIST Sensitivity

## Table 3. Diagnostic Accuracy of Digital and Film Mammography with the Use of the Seven-Point Malignancy Scale after 455 Days of Follow-up.*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Malignancy Score on Digital Mammography</th>
<th>Malignancy Score on Film Mammography</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>All women</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of tests</td>
<td>11</td>
<td>29</td>
<td>69</td>
</tr>
<tr>
<td>No. of breast cancers</td>
<td>10</td>
<td>18</td>
<td>25</td>
</tr>
<tr>
<td>Cumulative no. of tests</td>
<td>11</td>
<td>40</td>
<td>109</td>
</tr>
<tr>
<td>Cumulative no. of true positive results</td>
<td>10</td>
<td>28</td>
<td>53</td>
</tr>
<tr>
<td>Sensitivity for all cancers</td>
<td>0.03</td>
<td>0.08</td>
<td>0.16</td>
</tr>
<tr>
<td>Sensitivity for invasive cancers</td>
<td>0.04</td>
<td>0.11</td>
<td>0.19</td>
</tr>
<tr>
<td>Specificity for all cancers</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Positive predictive value</td>
<td>0.91</td>
<td>0.70</td>
<td>0.49</td>
</tr>
<tr>
<td>No. of women who underwent biopsies</td>
<td>11</td>
<td>22</td>
<td>41</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>0.41±0.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specificity</td>
<td>0.98±0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive predictive value</td>
<td>0.12±0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women &lt;50 yr old</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensitivity</td>
<td>0.49±0.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specificity</td>
<td>0.98±0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive predictive value</td>
<td>0.13±0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women with heterogeneously dense or extremely dense breasts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensitivity</td>
<td>0.38±0.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specificity</td>
<td>0.97±0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive predictive value</td>
<td>0.10±0.01</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Plus–minus values are means ±SE. Scores for the seven-point malignancy scale range from 1 (definitely not malignant) to 7 (definitely malignant). In the sensitivity analyses, scores of 4, 5, 6, and 7 were defined as positive and scores of 1, 2, and 3 were defined as negative. Premenopausal women had had their last menstrual period less than one month before mammography. All women had had a prior mammographic examination within the last 2 years of the study, and the last examination had been 6 months or less before the index examination.
Digital Breast Tomosynthesis (DBT): A little better….

1. 3D mammographic technique
2. Possible increase in cancer sensitivity and reduced call-back rates compared to FFDM

<table>
<thead>
<tr>
<th>Study</th>
<th>MG</th>
<th>MG +DBT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skaane et al, 2013</td>
<td>6.1/1000</td>
<td>8.0/1000</td>
</tr>
<tr>
<td>Ciatto et al, 2013</td>
<td>5.3/1000</td>
<td>8.1/1000</td>
</tr>
<tr>
<td>Haas et al, 2013</td>
<td>5.2/1000</td>
<td>5.7/1000</td>
</tr>
<tr>
<td>Friedwald et al, 2014</td>
<td>4.2/1000</td>
<td>5.4/1000</td>
</tr>
</tbody>
</table>
Tomosynthesis
Breast Density Legislation

1. Shortcomings of mammography has led to passage of breast density legislation in many states

2. Laws recommend women with dense breasts consider supplemental screening

3. Type of supplemental screening not specified
Breast Density Legislation

D.E.N.S.E.®
State Efforts

Click on your state to find information about "mandatory breast density notification" legislative efforts.

Whole Breast Screening Ultrasound

1. Default supplemental screening modality due to relatively low cost and wide availability

2. Supplemental cancer yield: 3-4/1000

3. Limitation of WBUS include:
   - Low PPV (8-9%)
   - High frequency of short-term follow recommendations
   - Time consuming
The real story is vascular based imaging

FFDM and MRI on same patient

8 mm IDC
The Use of MRI for Breast Cancer Screening

1. Not limited by breast density
2. No ionizing radiation
3. Most sensitive test for breast cancer screening
4. PPV similar to mammography
5. Preferentially detects higher grade lesions
Is MRI better than Mammography and US? –

The untold story!

From: Detection of Breast Cancer With Addition of Annual Screening Ultrasound or a Single Screening MRI to Mammography in Women With Elevated Breast Cancer Risk


Table 4. Screening Performance in 612 Participants Screened by Magnetic Resonance Imaging After 3 Annual Mammography and Ultrasound Screenings

<table>
<thead>
<tr>
<th></th>
<th>Combined Mammography Plus Ultrasound</th>
<th>Combined Mammography Plus MRI</th>
<th>Difference of (Mammography Plus Ultrasound or MRI) and (Mammography Plus Ultrasound)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate (95% CI)</td>
<td>P Value</td>
<td>Estimate (95% CI)</td>
</tr>
<tr>
<td>Yield (95% CI), per 1000</td>
<td>11.4 (4.6 to 23.4)</td>
<td>26.1 (15.0 to 42.1)</td>
<td>14.7 (3.5 to 25.9)</td>
</tr>
<tr>
<td>No./total</td>
<td>7/612</td>
<td>16/612</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: MRI, magnetic resonance imaging; PPV, positive predictive value.

- *P* value that observed difference of combined mammography plus ultrasound, and MRI vs mammography plus ultrasound occurred by chance.
- *P* value that observed difference of combined mammography and MRI vs mammography alone occurred by chance.
- Yield is the cancer detection rate.
- Defined as the malignancy rate among women with a positive screening test result, assessment of BI-RADS 3 or higher and recalled from screening for further testing or short interval follow-up.
1. Kuhl et al. JCO 2014
   - Intermediate to slightly increased risk women
   - 18.3/1000 additional cancers
   - All were Tis or T1, N0, M0 and almost all were path or nuclear grade II/III.
   - Median tumor size was 8.4mm
Why have we ignored MRI except for extremely high-risk women?

1. Cost
2. Time
3. Perceived low PPV
Why Have We Ignored MRI So Many Years?

• Breast MRI has remained relatively unchanged for over 20 years

• However, breast density advocacy and legislation has changed the current landscape
### Cost of US versus MRI

#### Breast Ultrasound (Average Cost)

<table>
<thead>
<tr>
<th>Location</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baltimore, MD</td>
<td>$390</td>
</tr>
<tr>
<td>Boston, MA</td>
<td>$430</td>
</tr>
<tr>
<td>Denver, CO</td>
<td>$360</td>
</tr>
<tr>
<td>Detroit, MI</td>
<td>$400</td>
</tr>
<tr>
<td>Minneapolis, MN</td>
<td>$360</td>
</tr>
<tr>
<td>St. Louis, MO</td>
<td>$360</td>
</tr>
<tr>
<td>San Diego, CA</td>
<td>$380</td>
</tr>
<tr>
<td>San Francisco, CA</td>
<td>$480</td>
</tr>
<tr>
<td>Seattle, WA</td>
<td>$380</td>
</tr>
<tr>
<td>Tampa, FL</td>
<td>$360</td>
</tr>
</tbody>
</table>

#### Breast MRI (Average Cost)

<table>
<thead>
<tr>
<th>Location</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baltimore, MD</td>
<td>$3,100</td>
</tr>
<tr>
<td>Boston, MA</td>
<td>$3,100</td>
</tr>
<tr>
<td>Denver, CO</td>
<td>$2,850</td>
</tr>
<tr>
<td>Detroit, MI</td>
<td>$3,200</td>
</tr>
<tr>
<td>Minneapolis, MN</td>
<td>$2,775</td>
</tr>
<tr>
<td>St. Louis, MO</td>
<td>$2,775</td>
</tr>
<tr>
<td>San Diego, CA</td>
<td>$2,550</td>
</tr>
<tr>
<td>San Francisco, CA</td>
<td>$3,000</td>
</tr>
<tr>
<td>Seattle, WA</td>
<td>$3,000</td>
</tr>
<tr>
<td>Tampa, FL</td>
<td>$2,775</td>
</tr>
</tbody>
</table>
How Do We Increase Access to Breast MRI?

• Change the mindset that MRI should be limited to only women extremely high-risk women.
  – Create a “different” breast MRI exam that is cheaper, faster and relatively accurate
  – Allow administrators a “distinction” in billing between full and AB-MR
  – Evaluate this “new” modality in a phase II multicenter NCI trial
Abbreviated MRI (AB-MR)

1. Low cost ($300-$500)
2. Quick (less than 10 min)
3. PPV similar to mammography (20-30%)
4. 150% increase in cancer detection
5. Optimal screening interval 1-3 yrs?
6. Quality accreditation
7. Reader qualifications
8. Interpretation guidelines
Interpretation Guidelines

Unique 4-5 mm Focus on Baseline AB-MR:
Single, dominant

CIRCUMSCRIBED MARGINS

IRREGULAR SHAPE AND MARGINS

YES

RIM ENHANCEMENT

NO

YES

INFLAMMATORY CYST (CENTRAL HIGH PRE-T1 OR T2)

NO

BENIGN

YES

HIGH T2

NO

BENIGN

6 MO FU

BX

BX
Interpretation Guidelines

Unique Mass on Baseline AB-MR

- NOT CIRCUMSCRIBED
  - BX
  - BENIGN
  - CLASSIC LYMPH NODE
    - HOMOGENEOUS OR HETEROGENEOUS ENHANCEMENT
      - 6 MO FU
    - RIM ENHANCEMENT
      - BX

- CIRCUMSCRIBED
  - HIGH T2
    - BENIGN
  - LOW T2
    - DEGENERATED FIBROADENOMA
      - BENIGN
    - HOMOGENEOUS ENHANCEMENT
      - 6 MO FU
    - HETEROGENEOUS OR RIM ENHANCEMENT
      - BX
What does it take to do a Multicenter Imaging NCI trial?

• Improve upon current practice and impact patient’s lives
• Low cost
• Wide access at both academic and community level
• Easy accrual
• “important” endpoints
Background on NCI Trials

Structure of NCI Cooperative Groups Program Prior to NCTN

Legend:
- Operations (O)
- Statistics & Data Management (S)
- Tissue Banks (T)
- Disease Committees (D)
- Member Sites (M)

NCI and CTSU

Other Centers, CCOPs/MB-CCOPs, & Canadian Collaborating Group
Background on NCI Trials

NCI National Clinical Trials Network Structure

LEGEND
- Centralized Functions:
  - Centralized Institutional Review Board
  - Cancer Trials Support Unit
  - Imaging and Radiation Oncology Core (IROC) Group
  - Common Data Management System Central Hosting
- 30 Lead Academic Participating Sites (LAPS)
- O Operations
- S Statistics & Data Management
- T Tissue Banks
- M Member Sites

NCORP Site Participation

SWOG
Alliance
Canadian Network Group
COG (Pediatric)
ECOG-ACRIN
NCTN Centralized Functions
NRG Oncology

SBI ACR Breast Imaging Symposium 2016
Comparison of Abbreviated Breast MRI and Digital Breast Tomosynthesis in Breast Cancer Screening in Women with Dense Breasts – EA1141

Christopher Comstock M.D.
Christiane Kuhl M.D.
Gillian Newstead M.D.

ECOG-ACRIN AB-MR Working Group
AB-MR Trial Concept

Comparison of Abbreviated Breast MRI and Digital Breast Tomosynthesis in Breast Cancer Screening Women with Dense Breasts

Primary aim: To compare the invasive cancer detection rate of AB-MR to DBT.
AB-MR Trial Concept

Secondary aims:
1. To compare the tumor biologies of invasive cancers and DCIS detected on AB-MR and DBT
2. To compare the PPV of biopsies, call back rates, and short-term follow up rates of AB-MR and DBT on both the initial and 1 year follow up studies
3. To evaluate the accuracy and interval cancer rate of AB-MR and DBT at 1 year
4. To perform a comparative cost analysis between DBT and AB-MR
Inclusion

1. Women over the age of 40 and scheduled for screening DBT;
2. Asymptomatic women;
3. Does not qualify for high-risk Breast MR screening as defined by the ACS recommendations.
4. No known breast cancer;
5. Have not had a breast US within the prior 12 months.
6. No prior MRI
7. Women who agree to not have screening US for the study period.
Women ages 40-75 with dense breasts already scheduled for routine screening DBT

**Randomization**

Arm A (DBT first)
- Years 0 and 1 DBT followed by AB-MR.
- Year 0 PRO/QOL assessments to be completed approximately 2 weeks after screening

Arm B (AB-MR first)
- Years 0 and 1 AB-MR followed by DBT.
- Year 0 PRO/QOL assessments to be completed approximately 2 weeks after screening

Return to routine mammographic screening and follow up for 3 years

Accrual Goal= 1450
1. Suspicious lesions detected on one or both of the modalities at the Year 0 or 1 time points will be biopsied as per local standard practice
2. Tissue collection and analysis for all cancers detected
1. The table shows that 1363 cases with complete data from both tests and pathology are needed to ensure power 90% for a difference in the rates of invasive cancer detection as low as 9/1000.

2. Assuming that inadequate information will be available on up to 6% of cases, a sample size of 1450 will provide power 90% to compare the diagnostic yield in invasive cancer of the two modalities.

<table>
<thead>
<tr>
<th>Power</th>
<th>Sample size</th>
<th>Difference in invasive cancer rates (ABMR –DBT)</th>
<th>Proportion of discordant cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.90</td>
<td>1191</td>
<td>0.009</td>
<td>0.010</td>
</tr>
<tr>
<td>0.90</td>
<td>1363</td>
<td>0.009</td>
<td>0.011</td>
</tr>
<tr>
<td>0.90</td>
<td>1552</td>
<td>0.009</td>
<td>0.012</td>
</tr>
<tr>
<td>0.90</td>
<td>1057</td>
<td>0.010</td>
<td>0.011</td>
</tr>
<tr>
<td>0.90</td>
<td>1197</td>
<td>0.010</td>
<td>0.012</td>
</tr>
<tr>
<td>0.90</td>
<td>949</td>
<td>0.011</td>
<td>0.012</td>
</tr>
</tbody>
</table>
Overdiagnosis and Overtreatment

1. Solutions to overdiagnosis (Unnecessary core biopsies):
   - Screening methods that don’t detect the entities responsible for “overdiagnosis”
   - Imaging biomarkers with high specificity to avoid biopsy of detected lesions

2. Solutions to overtreatment:
   - Decision by the medical community on which entities can be safely left untreated.
Tumor Biology

1. Exploration of the differences in the biological detection profiles (BDP) of Tomosynthesis and AB-MR. (PAM50 for invasive CA and DCIS score for DCIS)
AB-MR Working Group

- Chris Comstock M.D.
- Christiane Kuhl M.D.
- Gillian Newstead M.D.
- Liz Morris M.D.
- Connie Lehman M.D. PhD.
- Linda Moy M.D.
- Constantine Gatsonis PhD
- Bob Nishikawa PhD
- Nancy Sauers MS

- Seema Khan M.D
- Brian Leyland-Jones MB BS PhD
- Larry Solin M.D.
- Lori Goldstein M.D.
- David Brenin M.D.
- Toncred Styblo M.D.
- Kathy Miller M.D.
Technique and Protocols

Different Techniques and Equipment
Requires Gadolinium contrast to detect cancer.
Dynamic Contrast Enhanced MRI of the Breast (DCE MRI)

- Gadolinium pools in the interstitial space of lesions
- Gadolinium shortens T1 relaxation thereby increasing signal (enhancement)
- Multiple post-injection scans are performed to evaluate lesion enhancement over time (kinetics)
Gadolinium

- 20 ml bolus (0.5 mmol/ml)
- 20 sec prior to scan
- 0.1 mmol/kg
When to schedule Breast MR

- During 2nd week of cycle
- May have to repeat a small percentage of cases due to hormonal effects
## Technical Considerations

<table>
<thead>
<tr>
<th>Feature</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field Intensity</td>
<td>1.5 or 3.0 Tesla</td>
</tr>
<tr>
<td>Plane of acquisition</td>
<td>Axial vs. Sagittal</td>
</tr>
<tr>
<td>2D or 3D</td>
<td>3D</td>
</tr>
<tr>
<td>One breast / both at once</td>
<td>Both</td>
</tr>
<tr>
<td>High Res / Dynamic</td>
<td>Both (Morphology / Kinetics)</td>
</tr>
<tr>
<td>Fat Saturation</td>
<td>Yes</td>
</tr>
<tr>
<td>Subtraction</td>
<td>Yes</td>
</tr>
<tr>
<td>Registration</td>
<td>Helpful</td>
</tr>
<tr>
<td>MIPs</td>
<td>Helpful</td>
</tr>
</tbody>
</table>
Timing and K-space

- Cancer peak 60-120 (90) sec
- Optimal to time center of K-space at 90 sec post contrast
- Is vendor specific and may have to adjust injection timing
Dynamic Schematic

UCSD Protocol

pre

5 posts contrast scans 60 sec each

infect (20 cc @ 2 cc/sec) 10 sec prior to 1\textsuperscript{st} scan

Center of K-space

90 sec
Dynamic Schematic
MSKCC Protocol

inject (20 cc @ 2 cc/sec) 20 sec prior to 1st scan

pre
90 sec

3 posts contrast scans 95 sec each

Center of K-space
Our Technique

- 1mm slices (3D data set)
- Contiguous with no gap
- In-plane 300x300 matrix
- 300mm FOV
- 1x1x1mm voxel size
- Maintain in plane resolution w larger FOV
Protocol *(20 minutes)*

<table>
<thead>
<tr>
<th>Localizer</th>
<th>body coil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bilat pre-contrast T1 non fat sup</td>
<td>bilateral breast coil</td>
</tr>
<tr>
<td>Bilat T2-weighted fat-sat</td>
<td>bilateral breast coil</td>
</tr>
<tr>
<td>3D GRE non-fat-sat</td>
<td>bilateral breast coil</td>
</tr>
<tr>
<td>3D fat-sat dynamic (Pre+3)</td>
<td>bilateral breast coil</td>
</tr>
</tbody>
</table>
Spatial and Temporal Resolution

• Spatial resolution: Morphology (In-plane and slice thickness)
• Temporal resolution: Kinetics (Scan time)
• Bilateral scanning
• Most current systems can achieve both high spatial and temporal resolution
Importance of High Quality Breast MRI
Resolution and Specificity
Effect of Higher Resolution
Non-Isovolumetric

Original Sagittal

Reconstructed Axial
Isovolumetric

Original axial

Reconstructed Sagittal
1.5T versus 3T

- Potential for higher spatial resolution
- Shimming more difficult
- Software/coil optimization in early stages
- Limited clinical data
- Improved MR spectroscopy
Field Strength

1.5T  3T
Field Strength

1.5T
2.6mm every 1.6mm

3T
512X348
2.6mm every 1.3mm
Fat Saturation and Subtraction

No fat Sat

Unsubtracted
Image Subtraction
Fat suppressed
GRE
Kinetics
Kinetic Curves

Initial

Delayed

Fast

Persistent

Slow

Plateau

Washout
Low Temporal Resolution

Enhancement Typical of Cancer

Signal

0 1 2 3 4 5 6 Time (min)

Actual Enhancement Curve
Higher Temporal Resolution

![Graph showing enhancement typical of cancer over time](image)
Fast Scanning

Variable spatiotemporal resolution three-dimensional Dixon sequence for rapid dynamic contrast-enhanced breast MRI.

Saranathan M¹, Rettrmann DW, Hargreaves BA, Lipson JA, Daniel BL.

DISCO: DIFFERENTIAL SUB-SAMPLING WITH CARTESIAN ORDERING
TEMPORAL RESOLUTION 30 SECONDS
1 mm ISOTROPIC VOXELS
TEMPORAL RESOLUTION 10 SECONDS
1 mm ISOTROPIC VOXELS
CANCER: INCREASED CELLULARITY AND DECREASED EXTRACELLULAR SPACE

CANCER: LOW ADC (RESTRICTED DIFFUSION)
DWI

• POSSIBLE NON-CONTRAST ALTERNATIVE

• LIMITATIONS:
  – LOW SNR
  – POOR SPATIAL RESOLUTION
  – MOTION
  – INHOMOGENEOUS FAT SUPPRESSION
HIGH RESOLUTION MULTI B-VALUE DWI
IVIM: TISSUE MICROCAPILLARY PERFUSION AND TISSUE DIFFUSIVITY

SLIDE COURTESY OF SUNITHA THAKUR, PHD DEPARTMENT OF MEDICAL PHYSICS MSK
MULTIPARAMETRIC MRI

SLIDE COURTESY OF K PINKER, MD Department of Biomedical Imaging and Image-guided Therapy, Division of Molecular and Gender Imaging, Medical University Vienna
Specificity of Breast MRI

- Morphology (Spatial resolution)
- Composition
  - T2
  - Non fat suppressed imaging
- Kinetics (Temporal resolution)
- Perfusion
- DWI
Key Components of an AB-MR Screening Program

- Dedicated low cost Magnets with faster throughput
- Simplified “one button” scanning
- Socially responsible scanning
  - Quality/Accreditation
  - Tumor registries
  - Transfer service for prior MRIs
In the End

• Access to MRI will be widely expanded
• Women with dense breasts will have a faster, more sensitive and more accurate option to WBUS.
• AB-MR will be a misnomer: With competition, breast MRI will revert back to a singular study incorporating kinetics, perfusion, T2, and DWI all within an approximate 12-15min exam.
Thank You

• EA1141 AB-MR Trial
• ECOG-ACRIN Roster

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