

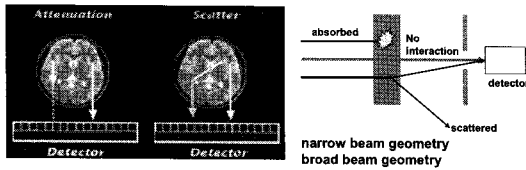
# Quantitative Brain SPECT

원자력의학원 핵의학과

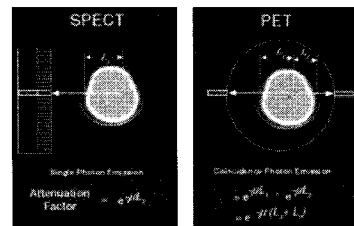
김 경 민

## Quantitative SPECT Image

- Accurate radioactivity estimation  
→ Quantitative physiologic parameter
- Attenuation & Scatter
  - ✓ Attenuation = absorption + scatter
  - ✓ Indispensable artifacts occurred during acquisition



## Attenuation in SPECT



### Attenuation Correction

- FBP : post-correction by scaling
- EM : modeling attenuation into system matrix & approximate correction by iterative calculation

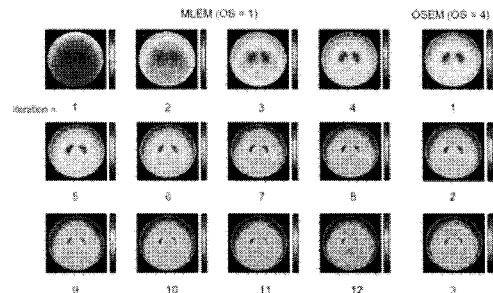
## FBP vs EM

- Image quality : FBP < EM
- Reconstruction speed : FBP > EM
- Speed-up of EM reconstruction by
  - ✓ OS (OS-EM)
  - ✓ Powerful computer performance
- Flexibility of implementation of correction of physical artifacts into EM construction

*Modeling*

$$\hat{f}_{ij}^{n+1} = \frac{\hat{f}_{ij}^n}{\sum_{i_0} H_{i_0,ij}} \cdot \sum_{i_0} \sum_{kl} H_{i_0,kl} \hat{f}_{kl}^n$$

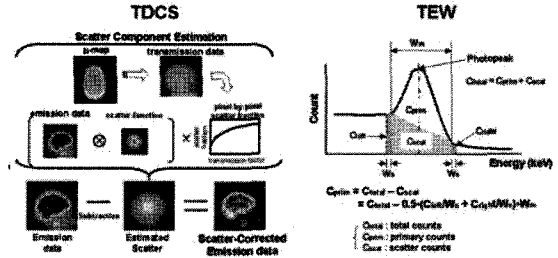
## ML-EM & OS-EM



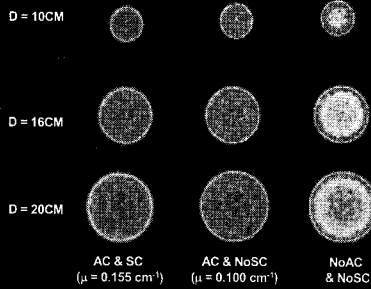
### Scatter in SPECT

- Energy loss of photon in object
  - ✓ Electrical energy discrimination & collimation
    - Not enough
  - ✓ Contribution to background in the image
  - ✓ Decrease of Image contrast
- Scatter Correction Methods
  - ✓ First-Order Correction
  - ✓ Convolution Subtraction or Deconvolution Method
  - ✓ Multiple-Energy Windows Method (DEW or TEW)
  - ✓ Correction with transmission information
    - System modeling into statistical reconstruction
    - Convolution subtraction technique
    - Transmission Dependent Convolution Subtraction

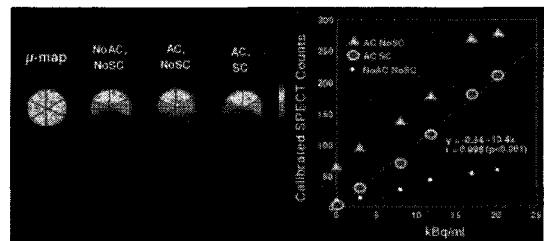
### TDCS & TEW



### Effect of SC on Activity Estimation (Cylindrical Phantom, <sup>99m</sup>Tc)

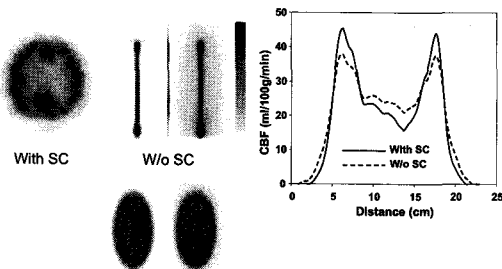


### Effect of AC & SC on Activity Estimation (Pai-phantom & <sup>201</sup>Tl)

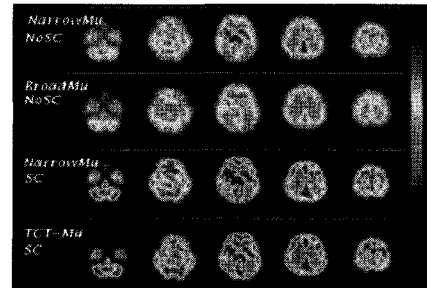


Iida et al. IEEE TMI, 2000

### Effect of SC on <sup>123</sup>I-IMP Image

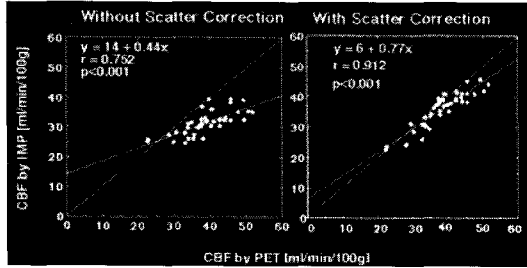


### Effect of SC on <sup>123</sup>I-IMP CBF Quantitation



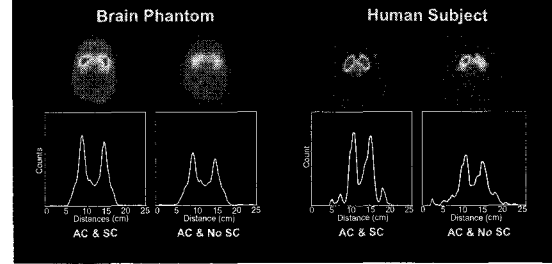
Iida et al. JNM, 1998

### Effect of SC on <sup>123</sup>I-IMP CBF Quantitation



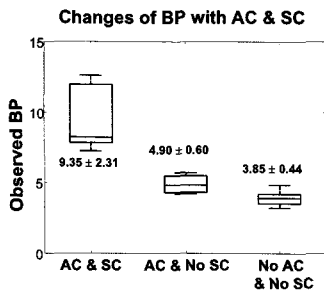
Iida et al. JNM, 1998

### Emission Image & Transverse Profile



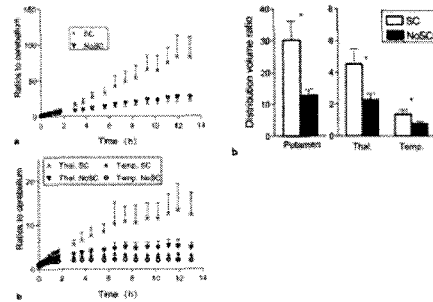
Kim et al. JNM, 2003

### Effect of SC in Human Study



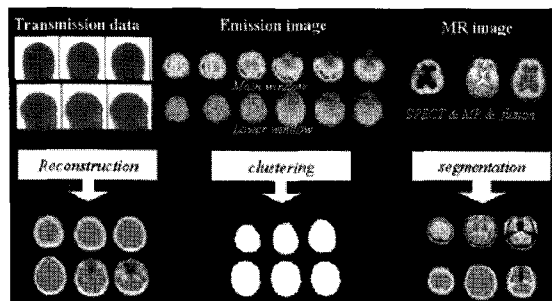
Kim et al. JNM, 2003

### Effect of SC on STR & BKG Activity (<sup>123</sup>I-Epidopride Dynamic Study)

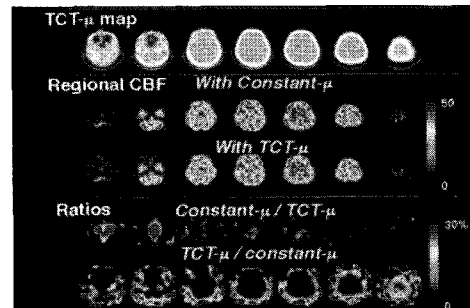


Fujita et al. EJNM, 2004

### Generation of Attenuation Map



### Measured v.s. Homogeneous $\mu$ -Map



Iida et al. JNM, 1998

**Current Standard Practice  
in Clinical SPECT**

- Multiple-headed acquisition (usually 2-headed)
- FBP (O) or OSEM ( $\Delta$ ) reconstruction
- Gated cardiac acquisition (O)
- Dynamic acquisition (X)
- Attenuation correction
  - ✓ Chang's method for brain (O)
  - ✓ Measured transmission (x)
- Scatter correction
  - ✓ DEW or TEW ( $\Delta$ )
  - ✓ Convolution-based technique (x)
- Resolution correction (x)
- Motion correction & Partial volume correction(x)

*MEMO*

*MEMO*