

## F-18-FPCIP 뇌 영상에서 True-X 재구성 기법을 기반으로 했을 때의 Iteration과 Subset의 영향

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### The Influence of Iteration and Subset on True X Method in F-18-FPCIT Brain Imaging

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**Purpose:** F-18-FPCIT that shows strong familiarity with DAT located at a neural terminal site offers diagnostic information about DAT density state in the region of the striatum especially Parkinson's disease. In this study, we altered the iteration and subset and measured SUV $\pm$ SD and Contrasts from phantom images which set up to specific iteration and subset. So, we are going to suggest the appropriate range of the iteration and subset. **Materials and Methods:** This study has been performed with 10 normal volunteers who don't have any history of Parkinson's disease or cerebral disease and Flangeless Esser PET Phantom from Data Spectrum Corporation. 5.3 $\pm$ 0.2 mCi of F-18-FPCIT was injected to the normal group and PET Phantom was assembled by ACR PET Phantom Instructions and it's actual ratio between hot spheres and background was 2.35 to 1. Brain and Phantom images were acquired after 3 hours from the time of the injection and images were acquired for ten minutes. Basically, SIEMENS Bio graph 40 True-point was used and True-X method was applied for image reconstruction method. The iteration and Subset were set to 2 iterations, 8 subsets, 3 iterations, 16 subsets, 6 iterations, 16 subsets, 8 iterations, 16 subsets and 8 iterations, 21 subsets respectively. To measure SUVs on the brain images, ROIs were drawn on the right Putamen. Also, Coefficient of variance (CV) was calculated to indicate the uniformity at each iteration and subset combinations. On the phantom study, we measured the actual ratio between hot spheres and back ground at each combinations. Same size's ROIs were drawn on the same slide and location. **Results:** Mean SUVs were 10.60, 12.83, 13.87, 13.98 and 13.5 at each combination. The range of fluctuation by sets were 22.36%, 10.34%, 1.1%, and 4.8% respectively. The range of fluctuation of mean SUV was lowest between 6 iterations 16 subsets and 8 iterations 16 subsets. CV showed 9.07%, 11.46%, 13.56%, 14.91% and 19.47% respectively. This means that the numerical value of the iteration and subset gets higher the image's uniformity gets worse. The range of fluctuation of CV by sets were 2.39, 2.1, 1.35, and 4.56. The range of fluctuation of uniformity was lowest between 6 iterations, 16 subsets and 8 iterations, 16 subsets. In the contrast test, it showed 1.92:1, 2.12:1, 2.10:1, 2.13:1 and 2.11:1 at each iteration and subset combinations. A Setting of 8 iterations and 16 subsets reappeared most close ratio between hot spheres and background. **Conclusion:** Findings on this study, SUVs and uniformity might be calculated differently caused by variable reconstruction parameters like filter or FWHM. Mean SUV and uniformity showed the lowest range of fluctuation at 6 iterations 16 subsets and 8 iterations 16 subsets. Also, 8 iterations 16 subsets showed the nearest hot sphere to background ratio compared with others. But it can not be concluded that only 6 iterations 16 subsets and 8 iterations 16 subsets can make right images for the clinical diagnosis. There might be more factors that can make better images. For more exact clinical diagnosis through the quantitative analysis of DAT density in the region of striatum we need to secure healthy people's quantitative values. (Korean J Nucl Med Technol 2010;14(1):122-126)

**Key Words :** F-18-FPCIT, Iteration, Subset, Reconstruction

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## PURPOSE

Many kinds of medicines have been developed for PET study and this became a guideline which decide patient's treatment planning. F-18-FPCIT shows strong familiarity with Dopamine Transporter located at a neural terminal site which offers diagnostic information about DAT density state in the region of the striatum especially Parkinson's disease. In this study, we altered the iteration and subset then measured SUV and subset. Then we measured  $SUV \pm SD$  and contrast from phantom images which set up to specific iteration and subset. So, we are going to suggest the appropriate range of the iteration and subset.

## Materials and Method

For this study, Biograph true point (SIEMENS, Germany, Berlin) 10 volunteers who don't have any cerebral disease and flangeless esser PET phantom of Data Spectrum Corporation were used. Volunteers visited Asan Medical Center (AMC) from July 1, 2008 to September 30, 2008. Sex ratio was five to five and their mean age was

M:  $52 \pm 19.14$  F:  $48 \pm 13.84$ .

5.3 mCi  $\pm$  0.2 mCi of F-18-FPCIT was injected to the volunteers.

AMC has been using flangeless esser PET phantom when evaluate the image's uniformity or contrast. when making

### PET Phantom Instructions for Evaluation of PET Image Quality



### ACR Nuclear Medicine Accreditation Program

### PET Module

Fig. 1. A description of American college of radiology has been referred.

the PET phantom, a description PET Phantom Instructions for Evaluation of PET Image Quality from America College of Radiology has been referred.

To make ratio of 4 to 1 between hot spheres and background I dropped 0.56 mCi and 1.32 mCi of F-18-FPCIT into the hot spheres and background each, and it showed a practical ratio of 2.35 to 1. CT and PET scan parameters were like this.

CT and PET imaging conditions were definitely same to the clinical conditions and SIEMENS syngo MI application version 7 was used for a quantitative analysis.

We reconstructed brain and phantom images these following reconstruction combination.

As you see above 2 multiplied 8 make 16 and 3 multiplied 16 make 48, 96, 128 and 168. The reason why we reconstructed following combinations is that we wanted to reconstruct images as regular interval as possible and usually multiply iteration by subset. So, based on the parametric val-



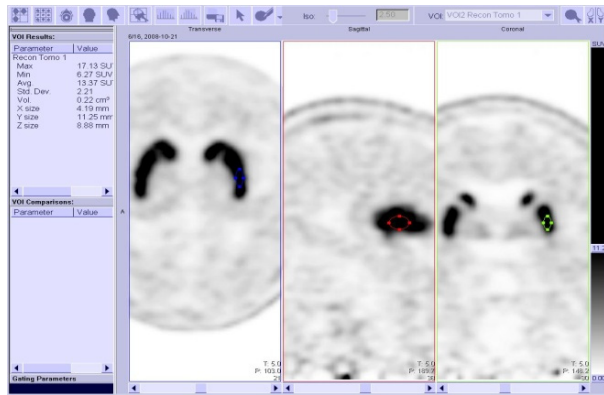
Fig. 2. Flangeless esser PET phantom from Data Spectrum Corporation

Table 1. CT, PET and Analysis software

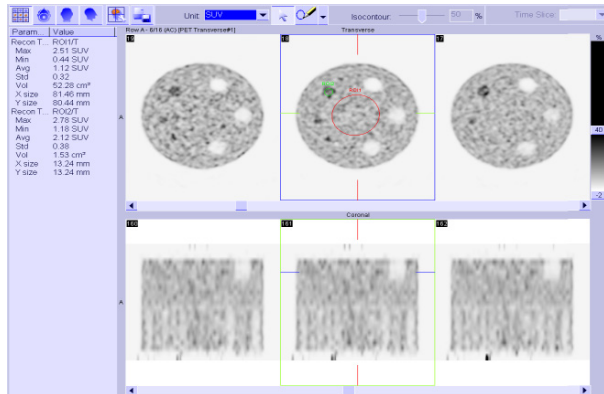
CT	120 KVp, 190 Eff.mAs Rotation time=1.0 Slice thickness=1.5 mm
PET	Scan Duration=10 min Filter=All Pass Filter Image size=336x336
Analysis Software	SIEMENS Syngo MI application Ver.7 SPSS ver.12 for windows

**Table 2.** Iteration and subset combinations

Iteration	Subset	Iteration * Subset
2	8	16
3	16	48
6	16	96
8	16	128
8	21	140



**Fig. 3.** Measuring SUV and SD. Coronal, Transverse and Sagittal images. ROI is drawn on the right Putamen.



**Fig. 4.** Evaluating contrast ROI is drawn on the background and hot sphere.

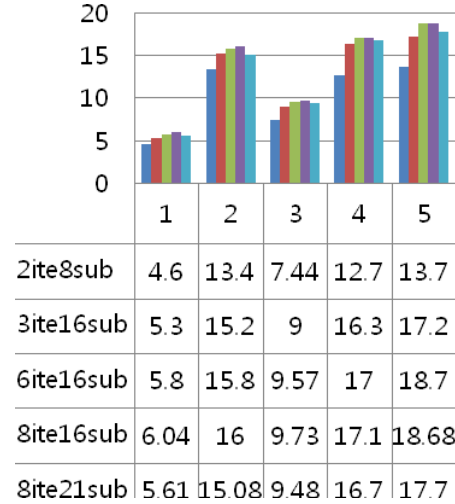
ue on biograph truepoint we roughly decided these values.

### Image Analysis

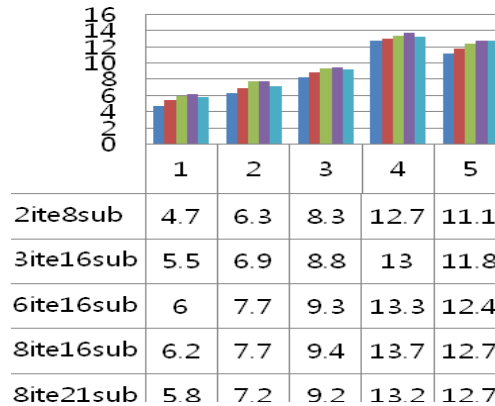
To measure SUV and SD on the image, we looked over coronal transverse and sagittal images and I draw rounded ROI on the right putamen. ROI was drawn on the same slide and their sizes were equal. so we got SUV and standard deviation of each ROI.

To evaluate contrast we compared mean SUVs between

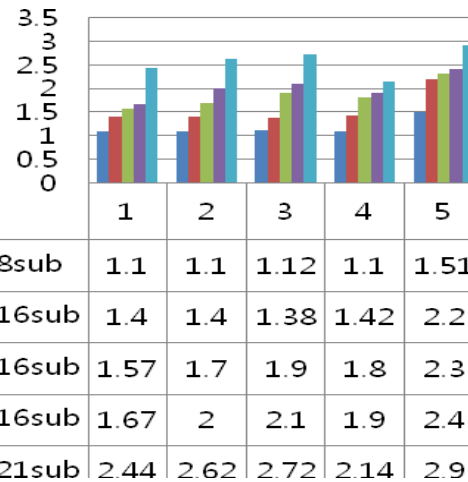
**Table 3-1.** Comparison of SUV at each iteration and subset combination (Volunteer 1 through 5)



**Table 3-2.** Comparison of SUV at each iteration and subset combination (Volunteer 6 through 10)



**Table 4-1.** Comparison of standard deviation at each iteration and subset combination (Volunteer 1 through 5)



hot spheres and background. and then I've checked which reconstruction method was closer to practical ratio of 2.35:1

## Results

SUVs were increased as iteration and subset combination were increased. And it showed slight decrease at 8 iterations and 21 subsets.

Standard deviation (SD) was increased as iteration and subset combination was increased. Also, the trend of increase of standard deviation according to the iteration and subset combination showed a positive correlation at one way anova test CV was calculated based on SUV and Standard deviation.

**Table 4-2.** Comparison of standard deviation at each iteration and subset combination (Volunteer 6 through 10).



**Table 5.** One Way ANOVA test at SD (SPSS Ver.12 for windows)

		ANOVA				
SD		Sum of Squares	df	Mean Square	F	Sig.
Between Groups		9.708	4	2.427	11.280	.000
Within Groups		9.682	45	.215		
Total		19.390	49			

**Table 6.** One Way ANOVA test at CV (SPSS Ver.12 for windows)

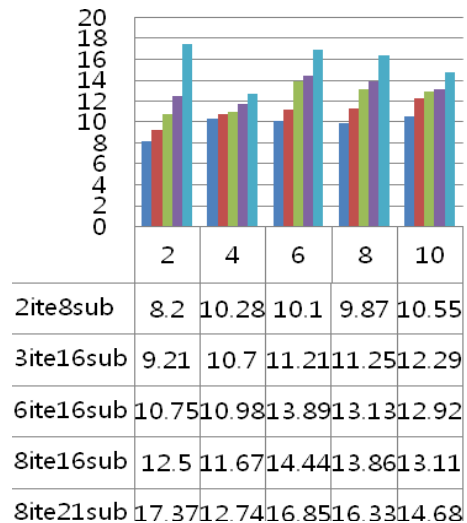
		ANOVA				
VAR0002		Sum of Squares	df	Mean Square	F	Sig.
Between Groups		383.859	4	95.965	5.560	.001
Within Groups		776.702	45	17.260		
Total		1,160.561	49			

As iteration and subset are getting increased, you can see CV is getting increased. And this means that the image's uniformity could be worse when iteration and subset are set too high. The trend of increase of CV according to the iteration and subset showed a positive correlation at one way anova test.

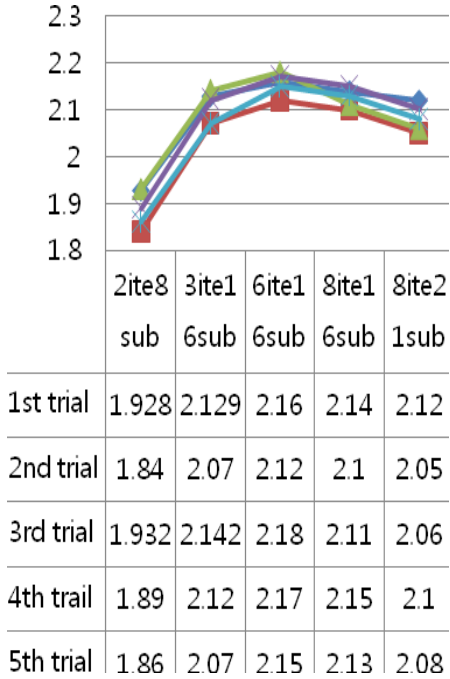
When we compared ration between hot sphere and background, 6 iteration and 16 subset showed the closest ratio of 2.35 to 1. Above or under this combination, it showed a tendency to stand apart from the actual ratio.

A trend of ratio according to iteration and subset showed a significance at one way anova test.

**Table 6.** Comparison of CV at each iteration and subset combination (Volunteer 1 through 10).



**Table 7.** Hot sphere vs Back ground ratio at every iteration and subset combination



**CONCLUSION**

At too high or low iteration and subset combination, SUV was calculated too high or too low. In this study 6 ite 16 subsets and 8 iterations 16 sub sets showed similar SUV than other subset iteration combinations. Too high or low iteration and subset combination may cause decrease the uniformity of the image. To revive the actual ratio of some object, it needs somewhat the standard for iteration and subset. In this study 6 iterations 16 subsets and 8 iterations 16 subsets revived the closest ratio between hot sphere and background. However this study worked with only normal volunteers and this was performed only limited number of iteration and subset. I think there could be more way to find better imaging process. And I think it's our duty.

**요 약**

F-18-FPCIT는 뇌 선조체에 주로 분포된 도파민 운반체에 강한 친화력을 보이며, 이는 파킨슨 씨 병의 진단에 유용한 진단적 정보를 제공한다. 본 연구에서는 iteration과 subset에 따른 영상의 변화를 관찰하고 적절한 iteration과 subset의 범위를 제안해 보고자 한다. 영상의 획득은 ACR 팬텀과 뇌 질환이 없는 정상인의 뇌 영상을 획득하였다. 정상인의 뇌영상은 F-18-FPCIT를 정맥주사 후 3시간째 획득하였으며, iteration과 subset의 조건을 5가지로 구분하여 영상을 재구성하였다. 영상의 분석은 동일한 위치에 같은 크기의 ROI를 그려 평균, 최대, 최소의 SUV를 측정하였고, 이를 바탕으로 표준편차, 변이계수를 계산하였다. 또한 팬텀영상에서는 각 조건별 열소와 냉소의 SUV를 비교하여 어떠한 조건에서 실제와 가장 비슷한 SUV ratio를 재현하는지 조사하였다. 위 실험에서 얻어진 값은 Spearman test를 통해 유의성을 유무를 판별하였다. 따라 SUV는 증가하였고 이러한 추세는 Spearman test에서 유의성을 나타내었다. 표준편차 역시 iteration, subset 조건이 증가함에 따라 값의 증가를 보였다. 산출된 값들은 통계적으로 유의하였다. 팬텀 연구에서는 6 iterations, 16 iterations 에서 실제와 가장 비슷한 SUV ratio를 재현하였다. 하지만 iteration, subset 조건별로 얻어진 SUV ratio들은 통계적으로 유의하지 않았다.

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