

:
 : 53
 - 700 HU - 990 HU
 1 , 1
 Pearson
 : 1 1
 - 940 HU - 910 HU
 가
 - 970 HU -
 960 HU 가
 : 가
 - 940 HU - 970 HU 가
 - 950 HU - 960 HU
 가 가 (3, 4, 9,
 10).
 가 (1). 가 가
 (2-8)가
 가

:

2005 6 12
가 , , , , , 53
가 , , , , ,
가 70%
- 10 / (pack/year)
가
1)
- 1
가
2)
3) 2005 12
48 5
(65.7 ± 6.9)
가
KOLD
(Somatom Sensation; Siemens Medical Systems, Germany)
0.75 mm collimation,
100 effmAs, 140 kVp, 1.0 pitch
가
- 1,024 HU(Housefield unit)
3,071 HU
(attenuation coefficients)
가 (supine)
(craniocaudally)
(Standard kernel, B30f; Siemens Medical Systems)

Table 1. Patient Characteristics and Results of PFT

	Mean ± SD	Range
Age, year	65.7 ± 6.9	50 - 78
FEV1, %predicted	43.88 ± 15.30	17.8 - 81.3
FVC, %predicted	74.96 ± 17.67	36.6 - 110.1
FEV1/FVC, %	43.05 ± 11.71	18.1 - 62.8
DLco	87.85 ± 24.04	40 - 133

PFT: Pulmonary function test, FEV1: Forced expiratory volume in 1 second
FVC: Forced expiratory vital capacity, DLco: Diffusion capacity of the lung for carbon monoxide

16

Table 2. Correlation Coefficients between Results of PFT and Emphysema Index

Inspiration		- 990 HU	- 980 HU	- 970 HU	- 960 HU	- 950 HU	- 940 HU	- 930 HU	- 920 HU	- 910 HU
FEV1	r	- 0.425	- 0.451	- 0.481	- 0.511	- 0.535	- 0.544	- 0.534	- 0.508	- 0.474
	p	(0.0015)	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)
FEV1 /FVC	r	- 0.500	- 0.528	- 0.562	- 0.596	- 0.621	- 0.631	- 0.621	- 0.596	- 0.563
	p	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)
DLco	r	- 0.642	- 0.655	- 0.655	- 0.655	- 0.594	- 0.527	- 0.443	- 0.361	- 0.289
	p	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)	(0.003)	(0.016)	(0.058)
		- 900 HU	- 890 HU	- 880 HU	- 870 HU	- 860 HU	- 850 HU	- 840 HU	- 830 HU	- 820 HU
FEV1	r	- 0.437	- 0.401	- 0.370	- 0.344	- 0.322	- 0.305	- 0.293	- 0.284	- 0.278
	p	(0.0011)	(0.003)	(0.006)	(0.012)	(0.019)	(0.026)	(0.033)	(0.039)	(0.044)
FEV1 /FVC	r	- 0.528	- 0.492	- 0.457	- 0.424	- 0.394	- 0.368	- 0.347	- 0.331	- 0.319
	p	(< .001)	(< .001)	(< .001)	(0.0016)	(0.004)	(0.007)	(0.010)	(0.016)	(0.020)
DLco	r	- 0.228	- 0.179	- 0.142	- 0.113	- 0.092	- 0.079	- 0.072	- 0.068	- 0.066
	p	(0.136)	(0.244)	(0.359)	(0.465)	(0.550)	(0.609)	(0.644)	(0.663)	(0.670)
Expiration		- 990 HU	- 980 HU	- 970 HU	- 960 HU	- 950 HU	- 940 HU	- 930 HU	- 920 HU	- 910 HU
FEV1	r	- 0.411	- 0.437	- 0.467	- 0.499	- 0.529	- 0.556	- 0.576	- 0.588	- 0.591
	p	(0.002)	(0.0011)	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)
FEV1 /FVC	r	- 0.448	- 0.470	- 0.500	- 0.532	- 0.562	- 0.587	- 0.605	- 0.615	- 0.615
	p	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)
DLco	r	- 0.611	- 0.628	- 0.642	- 0.650	- 0.649	- 0.639	- 0.621	- 0.596	- 0.567
	p	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)
		- 900 HU	- 890 HU	- 880 HU	- 870 HU	- 860 HU	- 850 HU	- 840 HU	- 830 HU	- 820 HU
FEV1	r	- 0.585	- 0.572	- 0.553	- 0.532	- 0.513	- 0.499	- 0.489	- 0.485	- 0.486
	p	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)
FEV1 /FVC	r	- 0.605	- 0.587	- 0.562	- 0.534	- 0.505	- 0.480	- 0.459	- 0.442	- 0.429
	p	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)	(< .001)	(0.0013)
DLco	r	- 0.534	- 0.498	- 0.460	- 0.424	- 0.389	- 0.356	- 0.326	- 0.298	- 0.272
	p	(< .001)	(< .001)	(0.002)	(0.004)	(0.009)	(0.017)	(0.031)	(0.049)	(0.073)

PFT: Pulmonary function test, FEV1: Forced expiratory volume in 1 second

FVC: Forced expiratory vital capacity, DLco: Diffusion capacity of the lung for carbon monoxide

512×512

(matrix)
(House - made software)
(pixel)

(11). 1

(FEV1), 1
(FEV1/FVC),

(DLco)

- 700 HU

- 990 HU

(%)

(single - breath carbon monoxide uptake (Vmax 22,
SensorMedics, California; PFDX, MedGraphics, Minnesota))

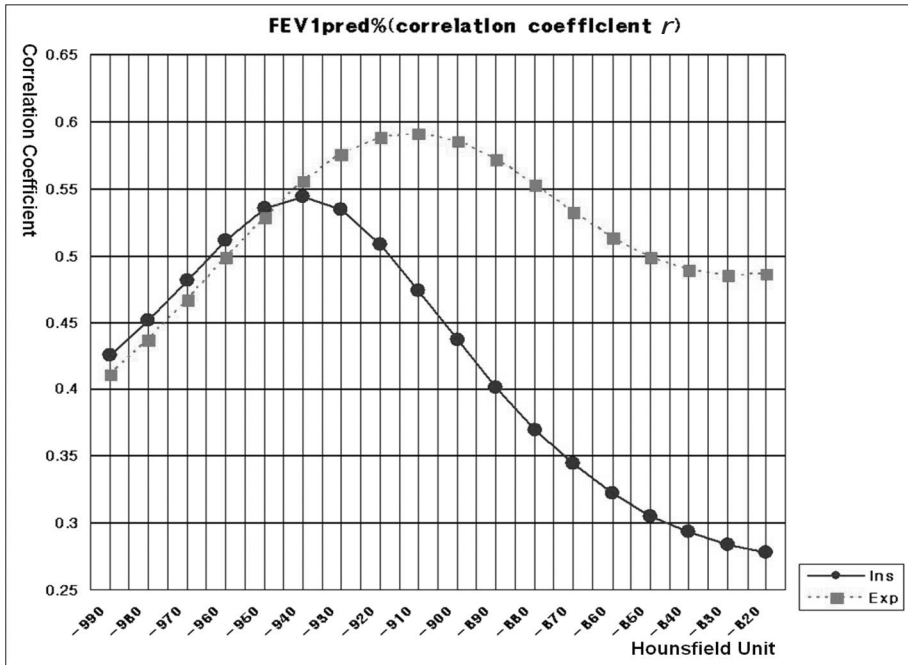


Fig. 1. Correlation between paired inspiratory/expiratory CT measurements and FEV1 pred%.

The strongest correlation with FEV1 and was observed with a threshold of - 940 HU at inspiration and - 910 HU at expiration CT scan.

FEV1: Forced expiratory volume in 1 second, Ins: Inspiration, Exp: Expiration

Pred%: Predicted

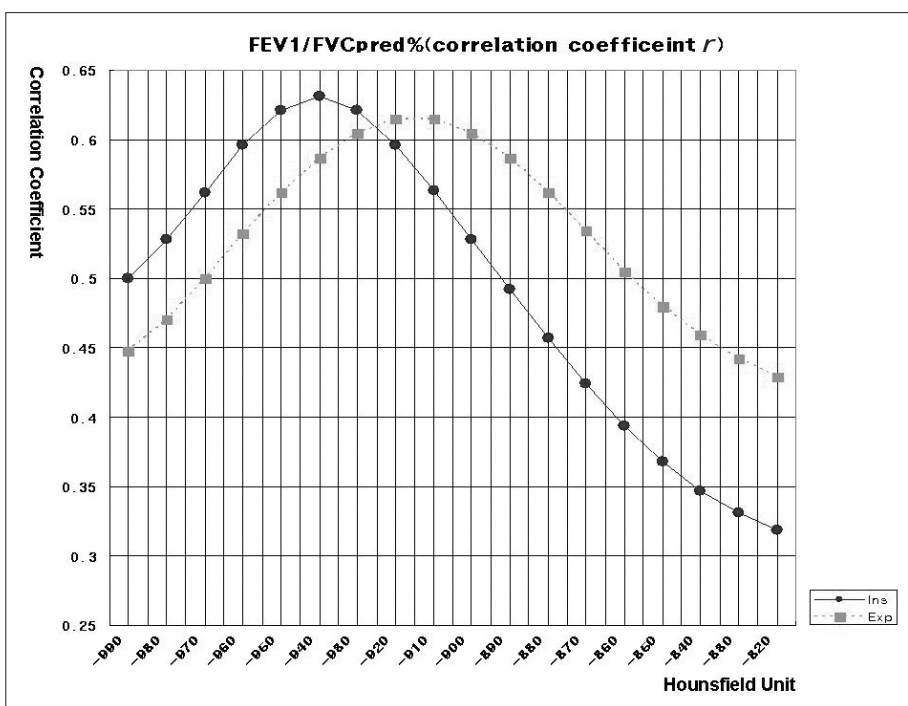


Fig. 2. Correlation between paired inspiratory/expiratory CT measurements and FEV1/FVC pred%.

The strongest correlation with FEV1/FVC was observed with a threshold of - 940 HU at inspiration and - 910 HU at expiration CT scan.

FEV1: Forced expiratory volume in 1 second, FVC: Forced expiratory vital capacity

Ins: Inspiration, Exp: Expiration, Pred%: Predicted

:

SPSS (statistical package)
(SPSS 12.1.1; SPSS; Chicago, IL).

±

Fig. 1

Pearson

- 940 HU

1

(correlation coefficients)

Pearson

Pearson

가 -0.544 가

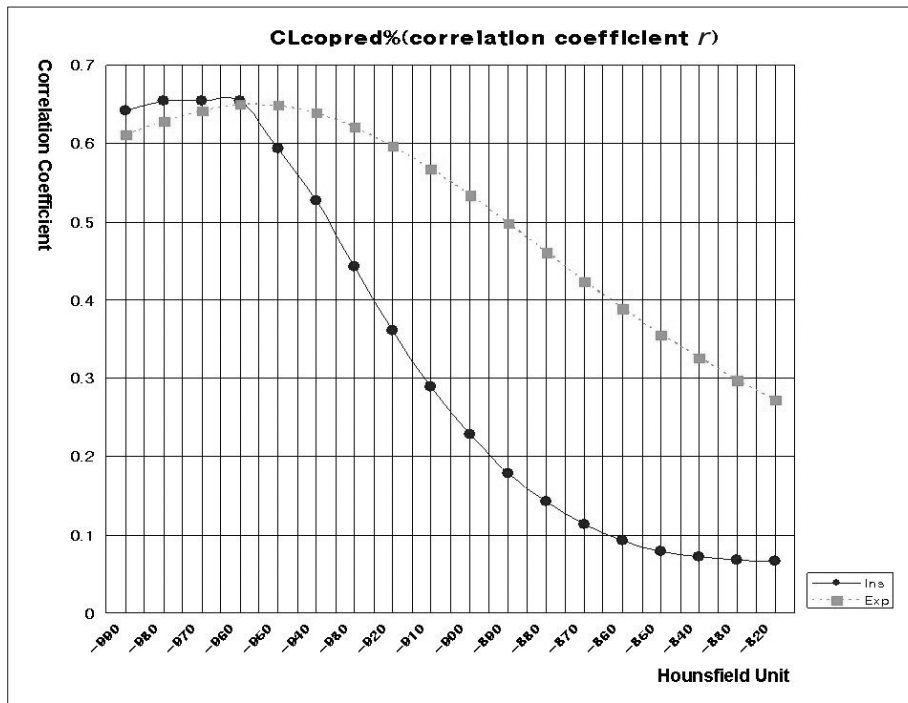


Fig. 3. Correlation between paired inspiratory/expiratory CT measurements and DLco pred%.

The strongest correlation with DLco was observed with a threshold of -970 HU at inspiration and -960 HU at expiration.

DLco: Diffusion capacity of the lung for carbon monoxide, Ins: Inspiration, Exp: Expiration, Pred%: Predicted

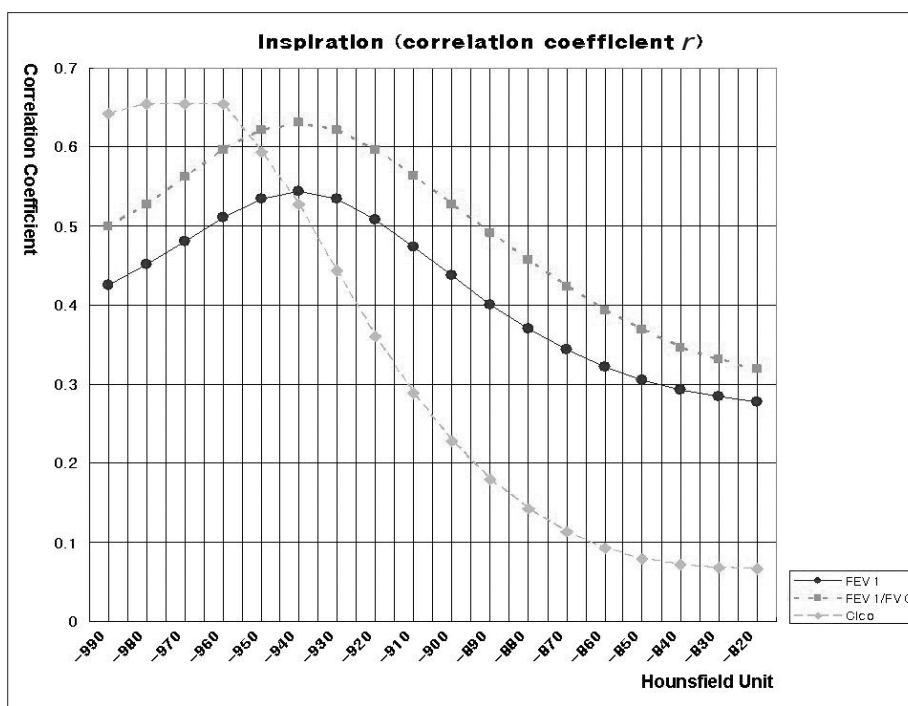


Fig. 4. Correlation between inspiratory CT measurements and PFTs.

In inspiration CT, the threshold area showing the relatively good correlation with PFTs was from -940 to -970 HU.

FEV1: Forced expiratory volume in 1 second, FVC: Forced expiratory vital capacity

DLco: Diffusion capacity of the lung for carbon monoxide

- 910 HU
 1 가 -0.591 가
 1
 Pearson Fig. 2 (maximum
 - 940 HU expiratory flow)
 (forced emptying of
 the lungs)
 1 Pearson
 가 -0.631 가 (chronic bronchitis), (obstructive
 - 910 HU bronchiolitis) (12).
 0.615 가 . 1 Pearson 가 - , 가
 (12).
 가 GOLD
 (13)가
 Pearson (14),
 Fig. 3 (2 -
 - 970 HU 9). 가
 Pearson 가 -0.656 가
 - 960 HU (2 - 6). 10 mm
 Pearson 가 -0.650 가 가 - 910 HU (5, 8). Gevenois (15) 1 mm
 Pearson Fig. 4 Fig. 5 - 950 HU
 - 970 HU - 940 HU (macroscopic), 가
 가 가 , 3
 2
 - 960 HU - 910 HU (9), Mandani (16)
 가 1 mm - 960 HU

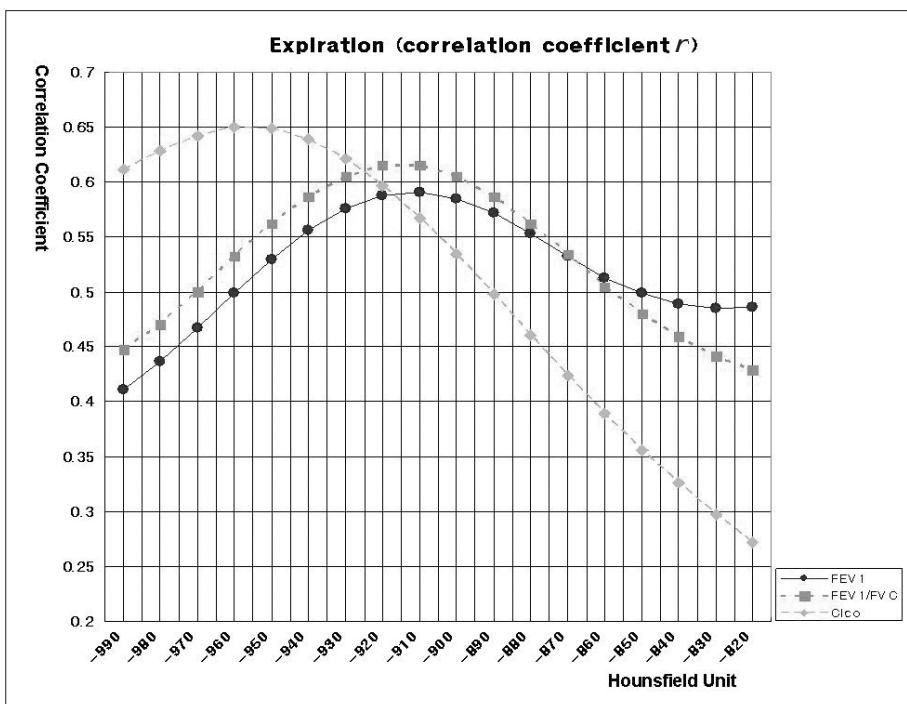


Fig. 5. Correlation between expiratory CT measurements and PFTs.

In expiration CT, the threshold area showing the relatively good correlation with PFTs was from -910 to -960 HU.

FEV1: Forced expiratory volume in 1 second, FVC: Forced expiratory vital capacity

DLco: Diffusion capacity of the lung for carbon monoxide

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 , 가 가
 가
 1 , 1
 1
 80% , 1 가 70%
 가
 1 1
 가 가
 가
 가 가 1
 1
 가
 가 , (lung
 compliance)가 가
 가 (10, 17, 18). - 900 HU
 가 (air - trapping)
 (19), - 950 HU
 . Matsuoka (20) - 900
 HU - 950 HU
 가
 1 1
 가
 가 가 - 940
 HU - 910 HU - 900 HU - 950 HU
 ,
 - 960 HU , - 950 HU - 970 HU,
 가 가
 1
 ,
 가
 1
 (15, 21 - 24) ,
 가
 가 (15, 25).
 가 가 가 - 970 HU - 960 HU
 ,

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A Study of the Relationship between the Pulmonary Function Test and the Threshold Value for the Emphysema Index at Volumetric Inspiration and Expiration CT in Cases of Chronic Obstructive Lung Disease¹

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Purpose: To determine the relationship between the pulmonary function test (PFT) and the optimal threshold value for the emphysema index at volumetric CT in chronic obstructive lung disease (COPD).

Materials and Methods: Volumetric CT scans were performed in 53 patients with COPD at inspiration and expiration using the same CT scanner. By using the in-house software, the emphysema index, which included the threshold value between - 700 and - 990 HU, was calculated automatically. The data were analyzed by calculating the Pearson correlation coefficient between each set of CT data and the forced expiratory volume occurring over 1 second (FEV1), the forced expiratory volume occurring over 1 second over the vital capacity ratio (FEV1/FVC), and the diffusion capacity of carbon monoxide (DLco).

Results: The strongest correlation between FEV1 and FEV1/FVC was found to have a threshold of - 940 HU at inspiration and - 910 HU during an expiration CT scan. The strongest correlation with DLco was observed with a threshold of - 970 HU at inspiration and - 960 HU at expiration.

Conclusion: The threshold showing the best correlation with the PFT parameters was variable. As for the inspiration CT scan, the threshold area, showing a relatively good correlation with PFT, occurred over - 940 to - 970 HU. Hence, it is pertinent that - 950 HU or - 960 HU was a common benchmark used for threshold of the emphysema index.

Index words : Pulmonary disease, Chronic obstructive
Respiratory function test
Tomography, X-Ray computed

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