

**Supplementary materials**

Table S1. Multivariate analysis to predict box-counting fractal dimension.

	beta	Adjusted. partial R <sup>2</sup>	p value
Minimal iCSA of trachea	$3.7 \times 10^{-4}$	0.27	<0.001
D <sub>4-10</sub>	$3.9 \times 10^{-2}$	0.06	0.001
D <sub>10</sub>	$9.5 \times 10^{-2}$	0.11	<0.001
Model		0.41	<0.001

iCSA, inner cross-sectional area

Table S2. Univariate regression coefficients of segmental Ds of inner cross-sectional area to predict pulmonary function measurements.

	D4-10			D10-		
	beta	Adjusted partial R <sup>2</sup>	p value	beta	Adjusted partial R <sup>2</sup>	p value
FEV <sub>1</sub>	1.00	0.10	< 0.001	1.52	0.06	0.001
FEV <sub>1</sub> %predicted	21.6	0.02	0.025	44.7	0.03	0.014
FEV <sub>1</sub> /FVC	16.9	0.07	< 0.001	27.9	0.05	0.002
PEF	3.17	0.10	< 0.001	4.90	0.06	0.001
FEF <sub>25%</sub>	3.60	0.11	< 0.001	7.19	0.12	< 0.001
FEF <sub>50%</sub>	1.07	0.07	< 0.001	2.11	0.08	< 0.001
FEF <sub>75%</sub>	0.15	0.02	0.036	0.41	0.05	0.003
MMEF	0.65	0.05	0.002	1.41	0.07	< 0.001
LAV%	-5.99	0.01	0.116	-5.00	0.00	0.489
AWT-Pi10	-0.29	0.26	< 0.001	-0.12	0.01	0.165
CAT	-0.73	-0.01	0.762	1.13	-0.01	0.801
MRC	-0.35	0.00	0.439	0.30	-0.01	0.721

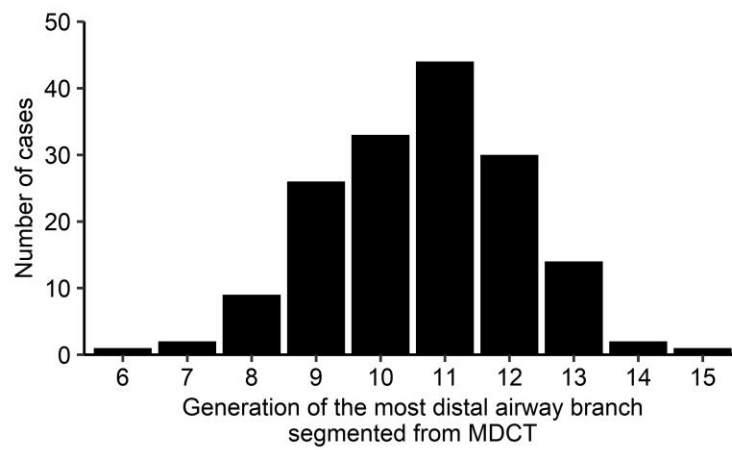
FEV<sub>1</sub>, forced expiratory volume in 1 second; FVC, forced vital volume; PEF, peak flow; FEF<sub>25%</sub>, forced expiratory flow at 25% of FVC; MMEF, maximal mid-expiratory flow; LAV%, percentage of low-attenuation voxels to total lung voxels; AWT-Pi10, standardized airway wall thickness at an inner perimeter of 10 mm; CAT, COPD assessment score; MRC, Medical Research Council Dyspnea Scale.

Table S3. Multivariate analysis including both D<sub>4-10</sub> and D<sub>10+</sub> of minimal internal cross-sectional area to predict lung function measurements corrected for the minimal inner cross-sectional area of the trachea, age, sex, BMI, smoking status, smoking pack-year, LAV%, and AWT-Pi10.

	D <sub>4-10</sub> of iCSA			D <sub>10+</sub> of iCSA		
	beta	Adjusted. partial R <sup>2</sup>	p value	beta	Adjusted. partial R <sup>2</sup>	p value
FEV <sub>1</sub>	0.24	0.00	0.320	1.16	0.05	0.003
FEV <sub>1</sub> %predicted	7.50	0.00	0.503	38.5	0.02	0.033
FEV <sub>1</sub> /FVC	0.46	0.00	0.544	4.13	0.07	0.001
PEF	0.97	0.00	0.263	5.99	0.11	< 0.001
FEF <sub>25%</sub>	0.29	0.00	0.390	1.68	0.06	0.002
FEF <sub>50%</sub>	-0.01	-0.01	0.920	0.38	0.04	0.007
FEF <sub>75%</sub>	0.09	-0.01	0.708	1.19	0.06	0.002
MMEF	0.24	0.00	0.320	1.16	0.05	0.003

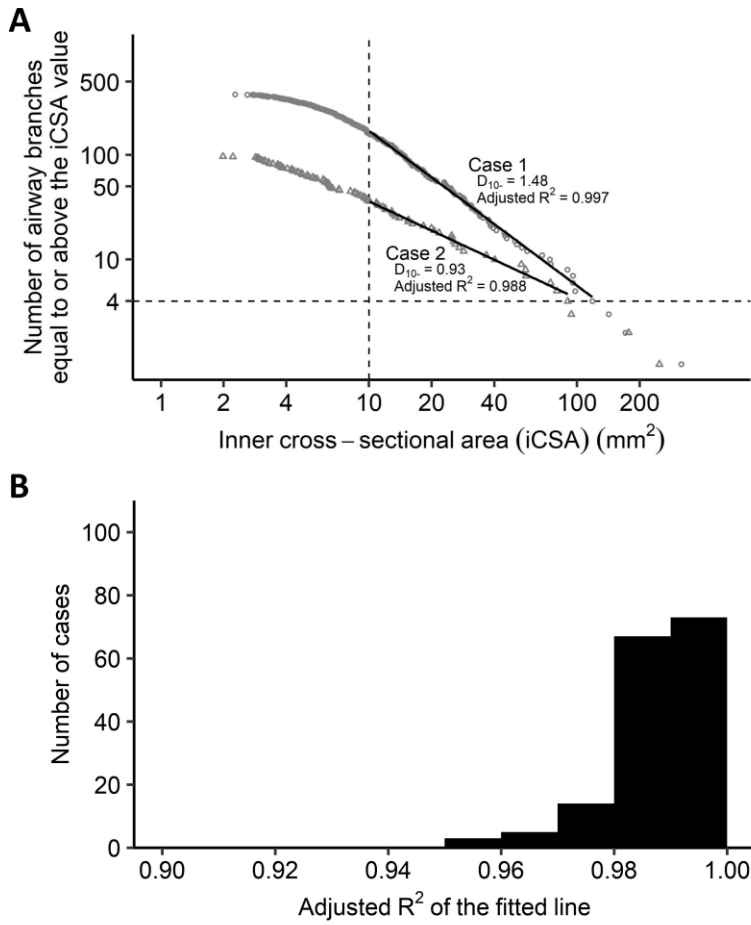
iCSA, inner cross-sectional area; FEV<sub>1</sub>, forced expiratory flow in 1 second; FVC, forced vital volume; PEF, peak flow; FEF<sub>25%</sub>, forced expiratory flow at 25% of FVC; MMEF, maximal mid-expiratory flow.

Figure S1. Distribution of maximum airway generations segmented in MDCT images (n = 162)



The airway generation of the most distal airway was identified for each case and plotted as a histogram. Typically, the airway branches were segmented upto 11<sup>th</sup> generation.

Figure S2. D of minimal inner cross-sectional area.



Minimal inner cross-sectional area (iCSA) of each airway branch was plotted against the cumulative count of branches that had equal or larger iCSA values, or their ranks in descending order, on a log-log scale. A linear model was applied to the observations whose iCSA values were greater than 10 mm<sup>2</sup> and whose ranks were greater than or equal to 4. D of iCSA was defined as an absolute value of the slope of the fitted linear line. A) Representative plots of minimal iCSA values and their ranks from two COPD cases.

B) Distribution of R<sup>2</sup> of the fitted linear model from all study participants (n = 162).

Figure S3. Distributions of the coefficients of determination for segmental Ds observed in all study participants (n = 162).

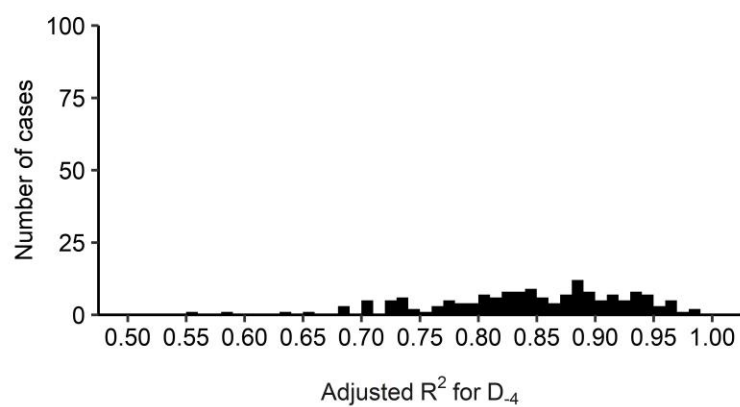
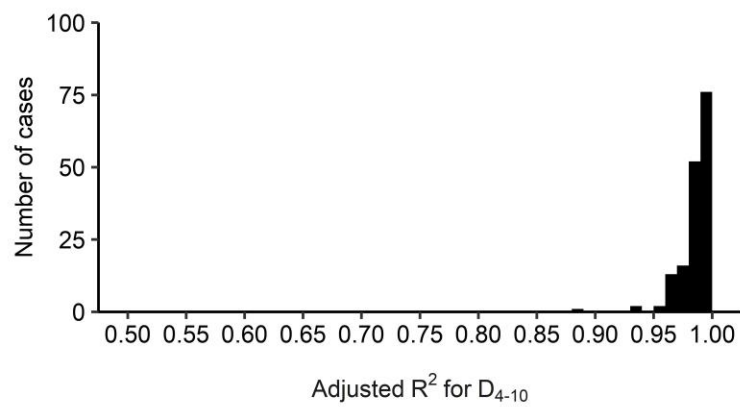
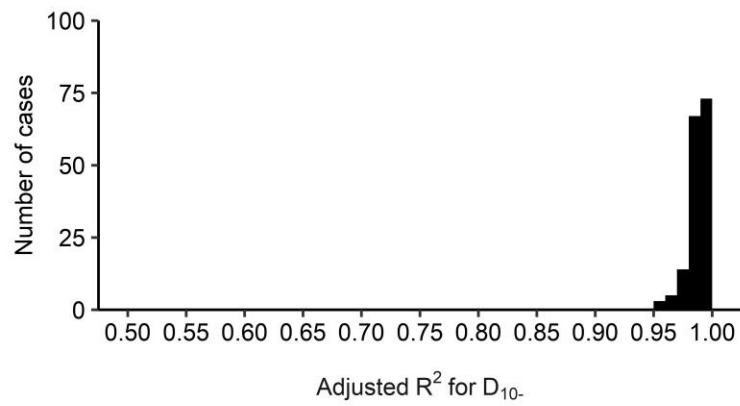
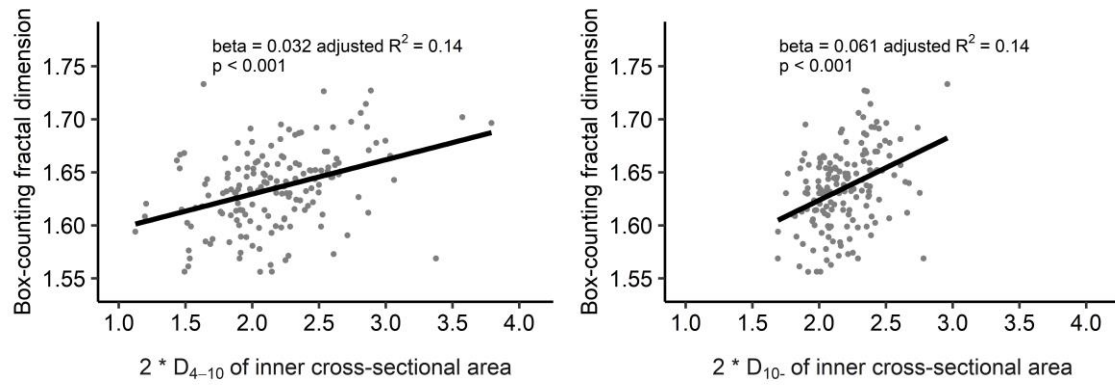
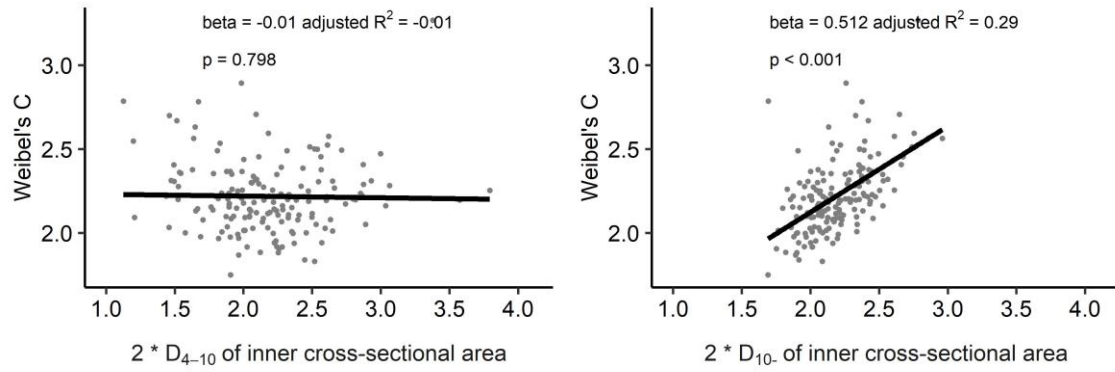


Figure S4. Relationship of  $D_{10^-}$  or  $D_{4-10}$  of the minimal inner cross-sectional area with box-counting fractal dimension.



$D_{10^-}$  or  $D_{4-10}$  and box-counting fractal dimensions were calculated using bronchial trees from all study participants ( $n = 162$ ).

Figure S5. Relationship of  $D_{10-}$  or  $D_{4-10}$  of the minimal inner cross-sectional area with Weibel's C.



Weibel's C in each study participant was calculated from the slope of a linear model to predict the binary logarithm of average diameter by a generation  $z$  ( $z = 2, 3, 4, 5$ , and  $6$ ) as  $C = -1/\text{slope}$ . This Weibel's C was compared with  $2 * D_s$  of iCSA in all study participants ( $n = 162$ ).