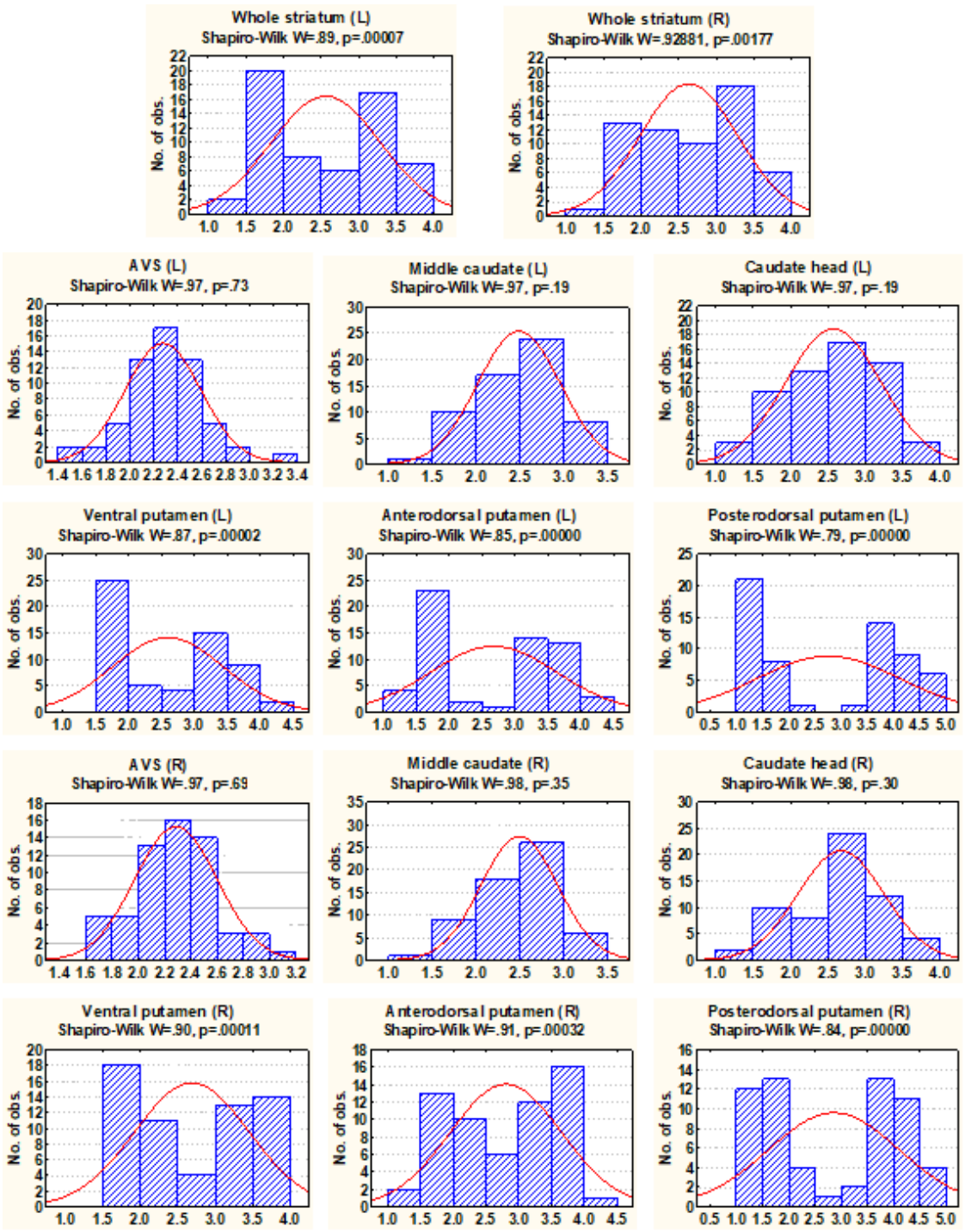


Supplemental Figure 1. Histograms of the whole striatum and sub-regions in the left (L) and right (R) hemispheres in the combined group. Only the anteroventral striatum (AVS), and caudate nucleus sub-regions showed normal distributions. The other sub-regions and the whole striatum also had more than one peak.

Supplemental Table 1. Pearson correlation coefficients and p-values between the whole striatum and sub-regions in each hemisphere in the combined group

Left*	**AVS**	**Middle caudate**	**Caudate head**	**Ventral putamen**	**Anterodorsal putamen**	**Posterodorsal putamen**
Whole striatum	*0.81*	*0.90*	*0.93*	*0.98*	*0.99*	*0.97*
	$p<10^{-6}$	$p<10^{-6}$	$p<10^{-6}$	$p<10^{-6}$	$p<10^{-6}$	$p<10^{-6}$
Right						
Whole striatum	*0.80*	*0.82*	*0.91*	*0.98*	*0.98*	*0.96*
	$p<10^{-6}$	$p<10^{-6}$	$p<10^{-6}$	$p<10^{-6}$	$p<10^{-6}$	$p<10^{-6}$

*The left hemisphere refers to the hemisphere clinically most affected in PD patients.

Supplemental Table 2. Pearson correlation and p-values between the whole striatum and sub-regions in each hemisphere in the control group.

Left*	**AVS**	**Middle caudate**	**Caudate head**	**Ventral putamen**	**Anterodorsal putamen**	**Posterodorsal putamen**
Whole striatum	*0.76*	*0.80*	*0.86*	*0.85*	*0.90*	*0.93*
	$p<10^{-6}$	$p<10^{-6}$	$p<10^{-6}$	$p<10^{-6}$	$p<10^{-6}$	$p<10^{-6}$
Right						
Whole striatum	*0.77*	*0.86*	*0.88*	*0.84*	*0.78*	*0.93*
	$p<10^{-6}$	$p<10^{-6}$	$p<10^{-6}$	$p<10^{-6}$	$p<10^{-6}$	$p<10^{-6}$

Supplemental Table 3. Pearson correlation and p-values between the whole striatum and sub-regions in each hemisphere in the PD group.

Left	**AVS**	**Middle caudate**	**Caudate head**	**Ventral putamen**	**Anterodorsal putamen**	**Posterodorsal putamen**
Whole striatum	*0.86*	*0.92*	*0.93*	*0.90*	*0.87*	*0.67*
	$p<10^{-6}$	$p<10^{-6}$	$p<10^{-6}$	$p<10^{-6}$	$p<10^{-6}$	$p<10^{-6}$
Right						
Whole striatum	*0.84*	*0.90*	*0.92*	*0.94*	*0.93*	*0.75*
	$p<10^{-6}$	$p<10^{-6}$	$p<10^{-6}$	$p<10^{-6}$	$p<10^{-6}$	$p<10^{-6}$

*The left hemisphere refers to the hemisphere clinically most affected in PD patients.

Supplemental Table 4. Coefficient of variation (*CoV)*, mean and standard deviation (*Std. Dev.)* of the whole striatum and sub-regions in the left and right hemispheres in the combined group.

	CoV. (%)		***Mean***		***Std. Dev.***	
	Left*	Right	Left*	Right	Left*	Right
Whole striatum	*28.52*	*24.71*	*2.56*	*2.63*	*0.73*	*0.65*
AVS	*14.04*	*13.54*	*2.28*	*2.29*	*0.32*	*0.31*
Middle caudate	*18.88*	*17.67*	*2.49*	*2.49*	*0.47*	*0.44*
Caudate head	*24.90*	*21.72*	*2.57*	*2.67*	*0.64*	*0.58*
Ventral putamen	*32.69*	*28.25*	*2.60*	*2.69*	*0.85*	*0.76*
Anterodorsal putamen	*35.82*	*30.36*	*2.68*	*2.80*	*0.96*	*0.85*
Posterodorsal putamen	*48.91*	*43.71*	*2.76*	*2.86*	*1.35*	*1.25*

*The left hemisphere refers to the hemisphere clinically most affected in PD patients.

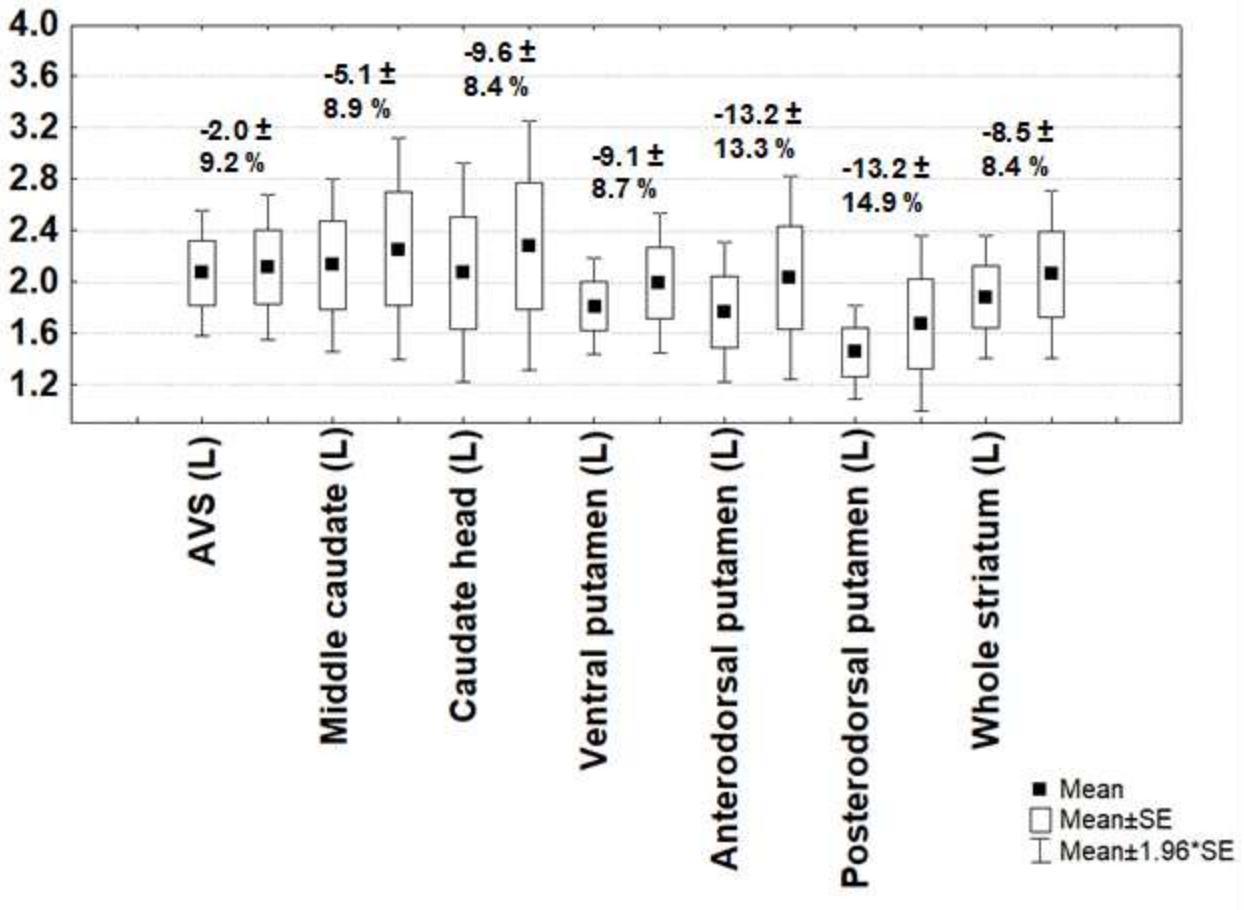
Supplemental Table 5. Coefficient of variation (*CoV)*, mean and standard deviation (*Std. Dev.)* of the whole striatum and sub-regions in the left and right hemispheres in the control group.

	CoV (%)		***Mean***		***Std. Dev.***	
	Left	Right	Left	Right	Left	Right
Whole striatum	*8.02*	*8.13*	*3.24*	*3.2*	*0.26*	*0.26*
AVS	*9.27*	*9.76*	*2.48*	*2.46*	*0.23*	*0.24*
Middle caudate	*9.51*	*12.79*	*2.84*	*2.19*	*0.27*	*0.28*
Caudate head	*13.03*	*14.05*	*3.07*	*2.42*	*0.4*	*0.34*
Ventral putamen	*10.32*	*10.04*	*3.39*	*2.79*	*0.35*	*0.28*
Anterodorsal putamen	*7.80*	*9.70*	*3.59*	*2.99*	*0.28*	*0.29*
Posterodorsal putamen	*9.58*	*11.40*	*4.07*	*3.42*	*0.39*	*0.39*

Supplemental Table 6. Coefficient of variation (*CoV)*, mean and standard deviation (*Std. Dev.)* of the whole striatum and sub-regions in the left and right hemispheres in the PD group.

	CoV (%)		***Mean***		***Std. Dev.***	
	Left*	Right	Left*	Right	Left*	Right
Whole striatum	*13.30*	*16.02*	*1.88*	*2.06*	*0.25*	*0.33*
AVS	*12.08*	*13.74*	*2.07*	*2.11*	*0.25*	*0.29*
Middle caudate	*15.96*	*19.47*	*2.13*	*2.26*	*0.34*	*0.44*
Caudate head	*19.50*	*21.26*	*2.41*	*2.07*	*0.47*	*0.44*
Ventral putamen	*10.50*	*14.07*	*1.81*	*1.99*	*0.19*	*0.28*
Anterodorsal putamen	*15.82*	*19.70*	*1.77*	*2.03*	*0.28*	*0.4*
Posterodorsal putamen	*13.10*	*20.96*	*1.45*	*1.67*	*0.19*	*0.35*

*The left hemisphere refers to the hemisphere clinically most affected in PD patients.

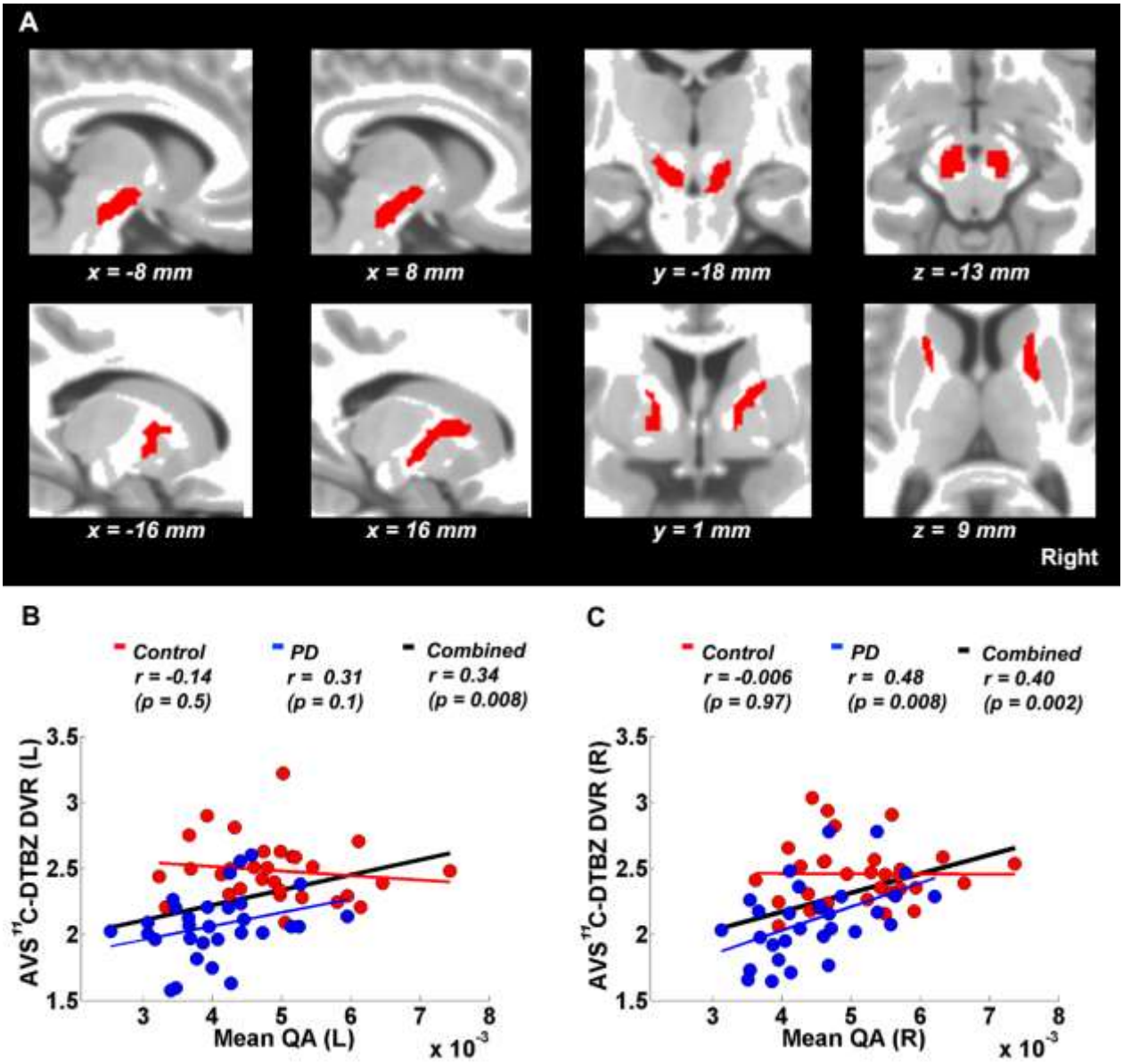


Supplemental Figure 2. Left-right asymmetry of ^{11}C-DTBZ DVR in the whole striatum and sub-regions in the PD group. Mean (± SD, in percent) asymmetry indices (AI) are shown at the top of the figure. AI = 100 x (left - right) / ((left + right) x 0.5). The anteroventral striatum (AVS) showed the lowest mean asymmetry. The left hemisphere refers to the hemisphere clinically most affected in PD patients.

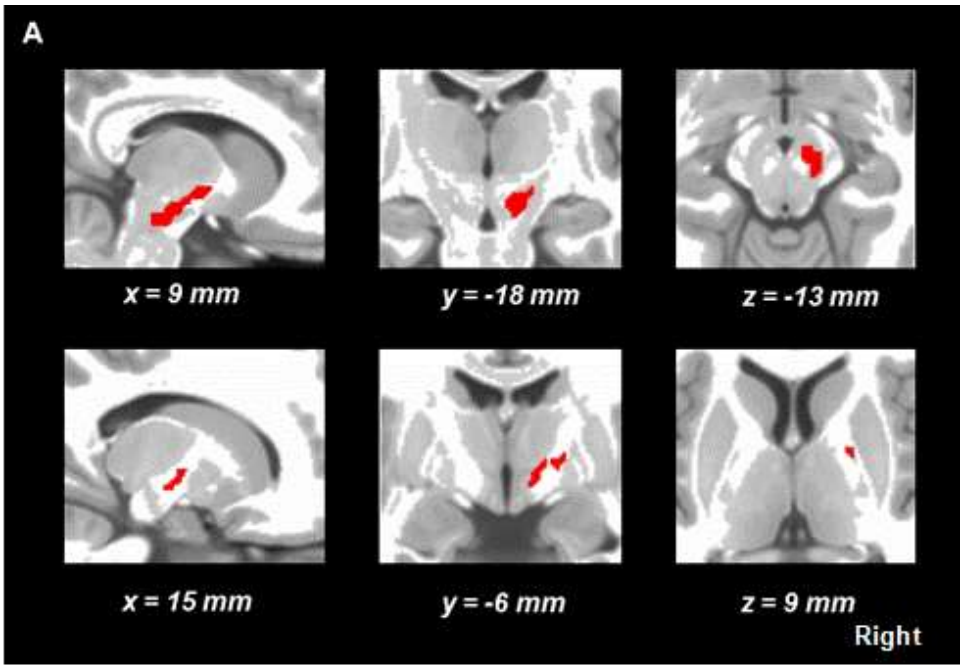
Supplemental Table 7. Shapiro-Wilk W statistic (and p-values) for all main study variables in the left and right hemispheres.

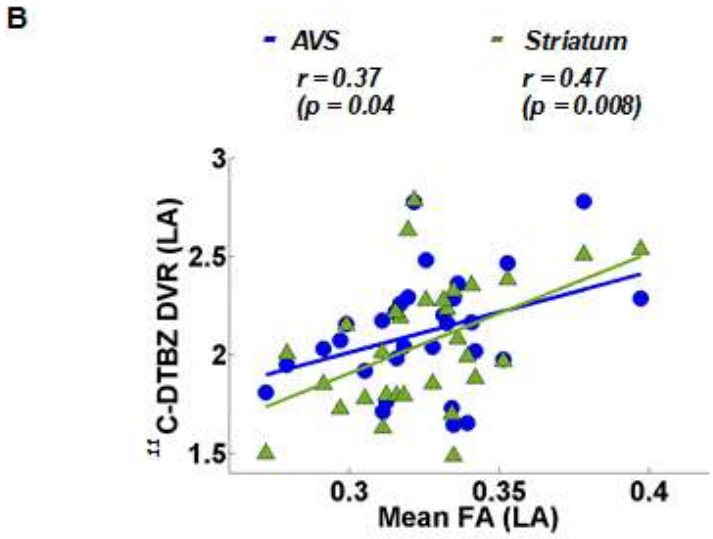
	PD group		Control group		Combined group	
	Left*	***Right***	***Left***	***Right***	***Left****	***Right***
AVS	0.96 (0.29)	0.96 (0.30)	0.94 (0.07)	0.95 (0.12)	0.97 (0.73)	0.97 (0.69)
Whole striatum	0.98 (0.85)	0.94 (0.76)	0.98 (0.69)	0.94 (0.10)	-	-
Mean QA	0.98 (0.79)	0.97 (0.43)	0.97 (0.62)	0.97 (0.55)	0.98 (0.28)	0.97 (0.21)
Mean QA (PD)†	0.94 (0.09)	0.94 (0.08)	-	-	-	-
Mean QA-LOO	0.97 (0.44)	0.97 (0.58)	-	-	-	-
Mean FA	0.96 (0.33)	0.97 (0.57)	0.97 (0.60)	0.98 (0.87)	0.97 (0.27)	0.98 (0.59)
Mean FA (PD)‡	-	0.97 (0.40)	-	-	-	-
Bradykinesia sub-score	0.96 (0.33)		-		-	

*The left hemisphere refers to the hemisphere clinically most affected in PD patients. Mean QA (PD)† and mean FA (PD)‡ are the respective values by using tract templates estimated in the PD group separately. AVS = Anteroventral striatum. LOO = leave-one-out.

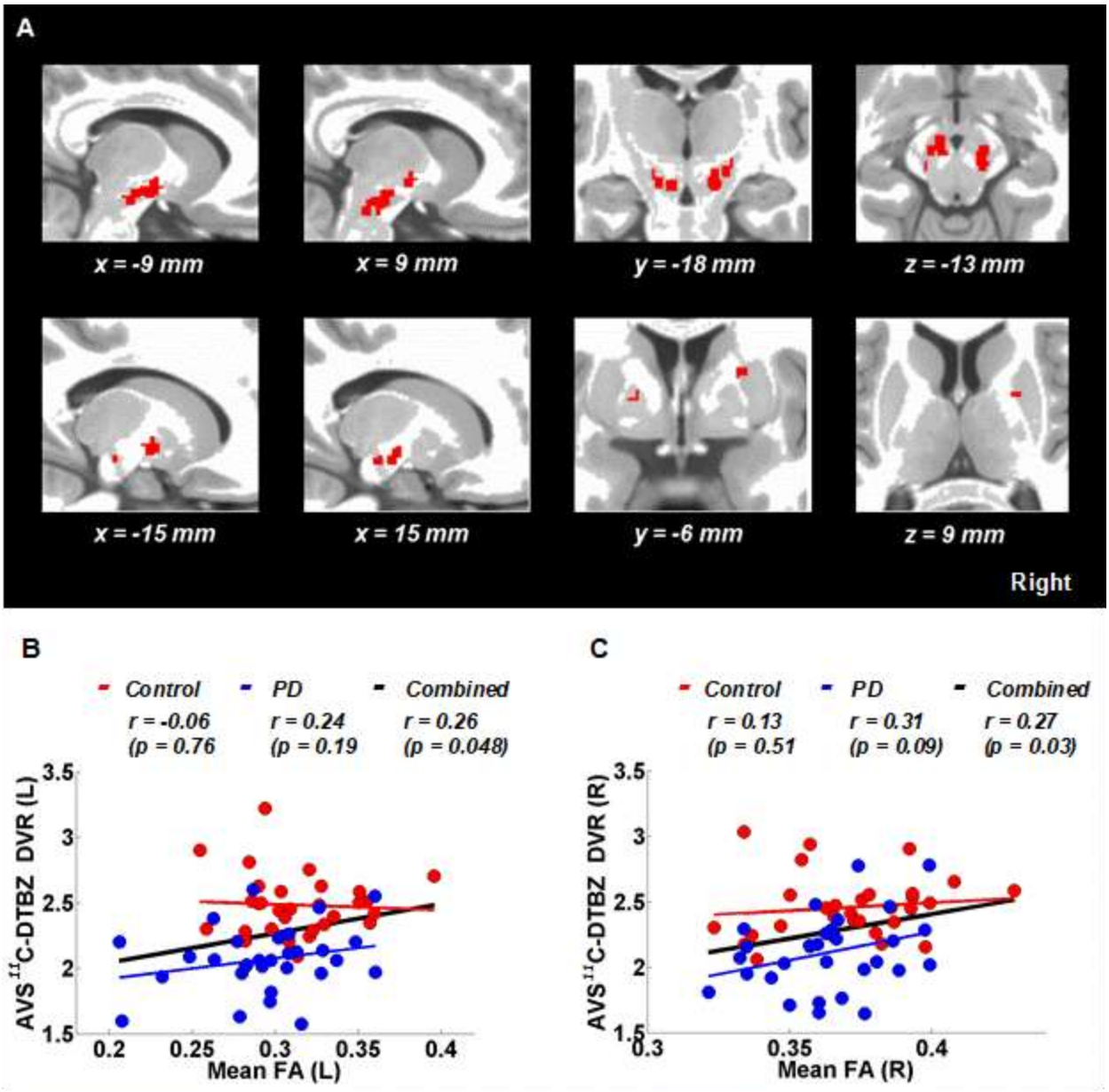


Supplemental Figure 3. (A) Tract templates identified in the combined group (overlaid on a T1-weighted MR image in MNI space). Tract templates followed similar paths to those observed in the PD group, but with higher volumes (left = 2.02 cm^3; right= 2.6 cm^3). **(B)** The mean QA (across the tract template) positively correlated with anteroventral striatum (AVS) ^{11}C-DTBZ DVR in the left hemisphere (black regression line). Analyses in separate groups (using the combined group tract template) showed no significant correlation in the control group (red line and circles) nor the PD group (blue regression line and circles). **(C)** The same as (B) for the right hemisphere, but unlike (A), a significant correlation was observed in the PD group. These analyses showed that the correlation found in the combined group was mainly influenced by the PD group, making separate PD group analysis more appropriate, especially for cross-validation. However, the combined group analysis allowed us to have mean QA estimates for each hemisphere and group using the same templates for comparison of mean QA between PD and control groups. The left hemisphere in the PD group refers to the hemisphere clinically most affected in PD patients.

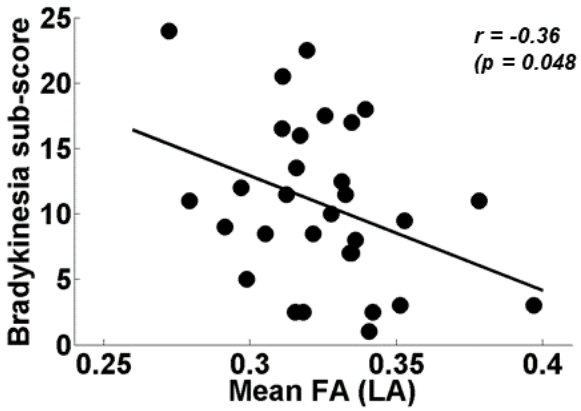




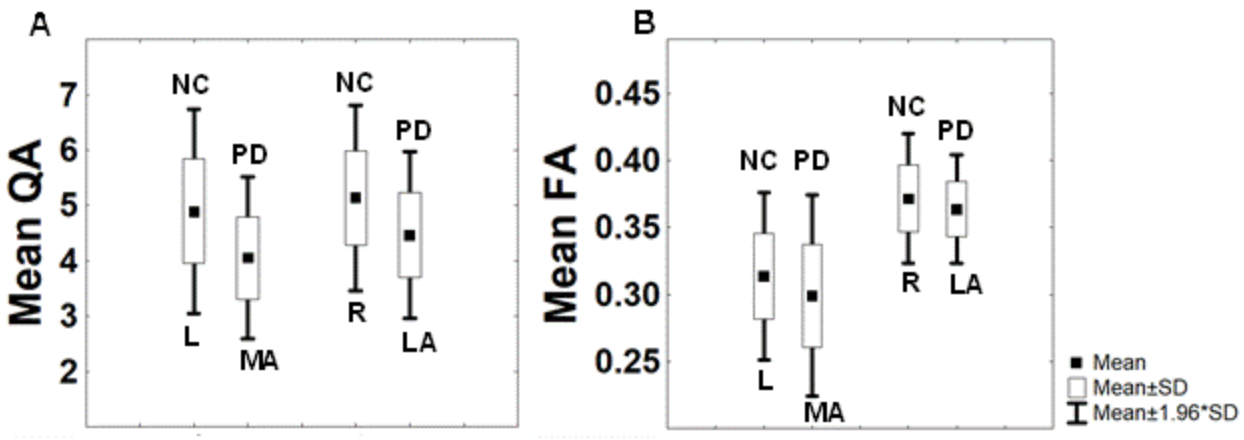
Supplemental Figure 4. (A) FA tract template identified in the PD group in the least affected (LA) hemisphere (overlaid on a T1-weighted MR image in the MNI space). No tract template was identified in the most affected hemisphere. **(B)** The mean FA (across the PD template) positively correlated with anteroventral striatum (AVS) (blue regression line and circles) and the whole striatum ^{11}C–DTBZ DVR values (green regression line and triangles) in the LA hemisphere. Note that the correlation with the whole striatum ^{11}C–DTBZ DVR values was lower compared with mean QA in the same hemisphere (Figs 1.C in the main text). The right hemisphere in the PD group refers to the hemisphere clinically least affected.



Supplemental Figure 5. (A) Tract templates identified in the combined group using the FA index (overlaid on a T1-weighted MR image in the MNI space). The tracts follow trajectories somewhat similar to those identified using QA but more fragmented and with volumes more than 50% smaller in both hemispheres (left = 0.92 cm^3; right = 1 cm^3). **(B)** The mean FA (across the tract template) positively correlated with anteroventral striatum (AVS) ^{11}C-DTBZ DVR in the left hemisphere (black regression line). Analyses in the separate groups (using the combined group tract template) showed no significant correlation in the control group (red regression line and circles) nor in the PD group (blue regression line and circles). **(C)** The same as (B) for the right hemisphere. The left hemisphere in the PD group refers to the hemisphere clinically most affected in PD patients.



Supplemental Figure 6. Mean FA in the LA hemisphere was significantly negatively correlated with the MDS-UPDRS bradykinesia sub-score of PD subjects but the correlation coefficient was lower compared to the correlation found with the mean QA and mean QA-LOO for that hemisphere (Fig, 3.B and 3.D in the main text). The right hemisphere in the PD group refers to clinically least affected.



Supplemental Figure 7. (A) Control group versus PD group showed significant differences of the mean QA in both hemispheres (see also Table 4 in main text). The mean QA across the PD patients in the LA hemisphere was also significantly higher compared with the mean QA in the MA hemisphere (see also Table 4 in main text). **(B)** In contrast, the mean FA showed no significant differences between groups (Control left: 0.31± 0.03, PD left: 0.30 ± 0.04, t=1.58, p=0.12; Control right: 0.37± 0.02, PD right: 0.36 ± 0.02, t=1.34, p=0.18). As the mean QA, there were significant differences between hemispheres in the control group (t= -11. 9, $p < 10^{-6}$) due to the differences between the left and right tract templates of the combined group (Supplemental Fig. 5.A) applied to the control group. With mean FA this effect was also more noticeable compared to mean QA **(A)**. The right hemisphere in the PD group refers to the hemisphere clinically least affected in PD patients.