Supplementary Material

# Supplementary Figures

**Supplementary Figure 1. Correlation plots between mean cortical thickness of regions of interest and clinical characteristics in dystonia patients.**

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The mean values were extracted from regions of interest (ROIs) which mainly overlapped clusters with significant differences from previous vertex-wise comparisons, based on Desikan-Killiany Atlas (DK40). Cortical thickness of ROIs were correlated with patients’ clinical characteristics including age at onset, disease duration, and scores of rating scales. Significant statistical threshold was set at *P<*0.0025 after multiple comparisons correction, and Pearson correlation coefficients marked in the circles were present under a threshold of *P<*0.05 (trend level). BFMDRS, Burke-Fahn-Marsden Dystonia Rating Scale; TWSTRS, Toronto Western Spasmodic Torticollis Rating Scale.

# Supplementary Tables

**Supplementary Table 1. Cortical thickness alterations in dystonia patients.**

a. Increased cortical thickness in CD patients compared to HC.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | MNI coordinates(maximum vertex, mm) |  |  |
| Cluster no. | Cluster size (vertices) | Cluster-wise P | x | y | z | T-Value (maximum vertex) | Overlap of atlas region |
| 1 | 1000 | <0.001 | -9 | -49 | 32 | 11.55 | L lingual |
| 2 | 630 | <0.001 | -10 | -59 | 45 | 11.04 | L precuneus |
| 3 | 1397 | <0.001 | -57 | 25 | 65 | 8.30 | L postcentral |
| 4 | 1527 | 0.001 | -11 | 58 | 21 | 7.75 | L pericalcarine, lateraloccipital |
| 5 | 4275 | <0.001 | -19 | -36 | 88 | 7.55 | L superiorparietal |
| 6 | 782 | <0.001 | -6 | 82 | 49 | 6.63 | L superiorfrontal |
| 6 | 1779 | <0.001 | -21 | 86 | 47 | 6.97 | L rostralmiddlefrontal |
| 7 | 891 | <0.001 | 4 | -51 | 47 | 9.44 | R pericalcarine, lateraloccipital |
| 8 | 891 | <0.001 | 1 | -51 | 39 | 9.29 | R lingual |
| 9 | 1006 | <0.001 | 7 | -22 | 93 | 9.09 | R precuneus |
| 10 | 4528 | <0.001 | 30 | -13 | 87 | 7.42 | R superiorparietal |
| 11 | 498 | <0.001 | 7 | 64 | 19 | 8.23 | R laterlorbitofrontal |
| 12 | 1007 | 0.001 | 21 | 76 | 40 | 7.13 | R rostralmiddlefrontal |
| 13 | 1580 | <0.001 | 56 | 23 | 49 | 6.10 | R postcentral |

b. Decreased cortical thickness in CD patients compared to HC.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | MNI coordinates(maximum vertex, mm) |  |  |
| Cluster no. | Cluster size (vertices) | Cluster-wise P | x | y | z | T-Value (maximum vertex) | Overlap of atlas region |
| 1 | 4613 | <0.001 | -38 | 8 | 45 | 8.29 | L insula, transversetemporal, superiortemporal |
| 2 | 1663 | <0.001 | -3 | 9 | 67 | 7.93 | L posteriorcingulate, isthmuscingulate |
| 3 | 848 | 0.002 | -43 | -23 | 56 | 5.78 | L inferiorparietal |
| 4 | 925 | 0.001 | -30 | 27 | 9 | 6.25 | L entorhinal |
| 5 | 776 | 0.006 | -36  | -26 | 31 | 5.17 | L fusiform |
|  6 | 883 | <0.001 | 16 | 31 | 10 | 9.18 | R entorhinal |
| 7 | 3729 | <0.001 | 33 | 31 | 20 | 8.82 | R insula, transversetemporal, superiortemporal |
| 8 | 1867 | <0.001 | 3 | 12 | 68 | 7.30 | R posteriorcingulate, isthmuscingulate |
| 9 | 1172 | <0.001 | 20 | 3 | 95 | 6.41 | R precentral |
| 10 | 1072 | 0.001 | 27 | -9 | 18 | 6.14 | R fusiform |

c. Increased cortical thickness in GD patients compared to HC.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | MNI coordinates(maximum vertex, mm) |  |  |
| Cluster no. | Cluster size (vertices) | Cluster-wise P | x | y | z | T-Value (maximum vertex) | Overlap of atlas region |
| 1 | 1497 | <0.001 | -11 | -50 | 19 | 9.64 | L pericalcarine, lateraloccipital |
| 2 | 981 | <0.001 | -16 | -41 | 13 | 8.77 | L lingual |
| 3 | 4304 | <0.001 | -18 | -37 | 70 | 7.90 | L superiorparietal |
| 4 | 1009 | 0.001 | -15 | 70 | 9 | 6.94 | L medialorbitofrontal |
| 5 | 1363 | <0.001 | -63 | 29 | 56 | 6.05 | L postcentral  |
| 6 | 741 | <0.001 | -6 | 95 | 35 | 4.82 | L superiorfrontal |
| 7 | 1482 | <0.001 | -25 | 88 | 50 | 4.78 | L rostralmiddlefrontal |
| 8 | 890 | <0.001 | 5 | -44 | 32 | 10.86 | R pericalcarine, lateraloccipital |
| 9 | 890 | <0.001 | 3 | -29 | 15 | 8.35 | R lingual |
| 10 | 1062 | <0.001 | 8 | 78 | 2 | 9.54 | R medialorbitofrontal |
| 11 | 4529 | <0.001 | 21 | -13 | 69 | 7.50 | R superiorparietal |
| 12 | 1500 | <0.001 | 51 | 20  | 60 | 5.22 | R postcentral |
| 13 | 1078 | <0.001 | 9 | -18 | 79 | 7.63 | L precuneus |

d. Decreased cortical thickness in GD patients compared to HC.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | MNI coordinates(maximum vertex, mm) |  |  |
| Cluster no. | Cluster size (vertices) | Cluster-wise P | x | y | z | T-Value (maximum vertex) | Overlap of atlas region |
| 1 | 1660 | <0.001 | -5 | 21 | 51 | 8.95 | L posteriorcingulate, isthmuscingulate |
| 2 | 4483 | <0.001 | -38 | 41 | 18 | 7.92 | L insula, transversetemporal, superiortemporal |
| 3 | 1834 | <0.001 | -36  | 15 | 37 | 5.8 | L supramarginal |
| 4 | 934 | 0.001 | -32 | 36 | -6 | 6.54 | L entorhinal |
| 5 | 891 | 0.003 | -27 | 11 | 85 | 5.79 | L precentral |
| 6 | 832 | 0.002 | -50 | -14 | 37 | 4.57 | L inferiorparietal |
| 7 | 8729 | <0.001 | 24 | 45 | -7 | 9.36 | R entorhinal |
| 8 | 1194 | <0.001 | 32 | -2 | 0 | 9.01 | R fusiform |
| 9 | 1869 | <0.001 | 3 | 22 | 54 | 7.97 | R posteriorcingulate, isthmuscingulate |
| 10 | 1172 | <0.001 | 25 | 13 | 81 | 7.06 | R precentral |
| 11 | 3686 | <0.001 | 35 | 41 | 11 | 7.44 | R insular, transversetemporal, superiortemporal |
| 12 | 2037 | <0.001 | 34 | 12 | 26 | 7.40 | R supramarginal |

Results of maximum vertices coordinates, T values, cluster sizes, and overlapped atlas regions. All results are considered significant at *P*<0.005 at cluster level (3 group comparisons for each hemisphere, 0.005 < 0.05/6), corrected for multiple comparisons with Family Wise Error (FWE). Coordinates are presented on standard MNI152 template (1.5mm\*1.5mm\*1.5mm). The clusters are listed in a random order. CD, cervical dystonia; GD, generalized dystonia; HC, healthy controls.

**Supplementary Table 2. Correlations between mean cortical thickness of regions of interest and clinical characteristics in dystonia patients (*P-*value matrix).**

a. Cervical dystonia

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Age at onset | Disease duration | TWSTRS Severity score | Disability score | Pain score |
| L precentral | 0.330  | 0.197  | 0.958  | 0.421  | 0.013  |
| R precentral | 0.212  | 0.086  | 0.942  | 0.400  | 0.118  |
| L postcentral | 0.080  | 0.214  | 0.683  | 0.672  | 0.025  |
| R postcentral | 0.596  | 0.233  | 0.186  | 0.022  | 0.014  |
| L insula | 0.224  | 0.571  | 0.203  | 0.265  | 0.642  |
| R insula | 0.262  | 0.069  | 0.283  | 0.338  | 0.797  |
| L superiorparietal | 0.733  | 0.347  | 0.050  | 0.004  | <0.001  |
| R superiorparietal | 0.614  | 0.434  | 0.386  | 0.124  | 0.227  |
| L inferiorparietal | 0.237  | 0.438  | 0.125  | 0.102  | 0.473  |
| R inferiorparietal | 0.533  | 0.719  | 0.153  | 0.245  | 0.803  |
| L rostralmiddlefrontal | 0.359  | 0.903  | 0.027  | 0.049  | 0.026  |
| R rostralmiddlefrontal | 0.637  | 0.687  | 0.012  | 0.006  | 0.001  |
| L supramarginal | 0.174  | 0.780  | 0.073  | 0.012  | 0.198  |
| R supramarginal | 0.025  | 0.756  | 0.056  | 0.248  | 0.535  |
| L transversetemporal | 0.013  | 0.024  | 0.792  | 0.474  | 0.344  |
| R transversetemporal | 0.501  | 0.154  | 0.724  | 0.612  | 0.640  |
| L inferiortemporal | 0.976  | 0.339  | 0.773  | 0.519  | 0.806  |
| R inferiortemporal | 0.989  | 0.824  | 0.958  | 0.913  | 0.268  |
| L superiortemporal | 0.908  | 0.567  | 0.200  | 0.135  | 0.355  |
| R superiortemporal | 0.905  | 0.889  | 0.781  | 0.787  | 0.990  |
| L lateraloccipital | 0.570  | 0.892  | 0.167  | 0.166  | 0.074  |
| R lateraloccipital | 0.244  | 0.626  | 0.754  | 0.890  | 0.933  |

b. Generalized dystonia

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Age at onset | Disease duration | BFMDRS total score | Motor score | Disability score |
| L precentral | 0.553  | 0.781  | 0.681  | 0.587  | 0.769  |
| R precentral | 0.517  | 0.919  | 0.337  | 0.279  | 0.764  |
| L postcentral | 0.100  | 0.949  | 0.253  | 0.204  | 0.508  |
| R postcentral | 0.313  | 0.569  | 0.704  | 0.576  | 0.836  |
| L insula | 0.585  | 0.970  | 0.918  | 0.971  | 0.730  |
| R insula | 0.084  | 0.690  | 0.100  | 0.062  | 0.166  |
| L superiorparietal | 0.869  | 0.886  | 0.219  | 0.213  | 0.130  |
| R superiorparietal | 0.638  | 0.573  | 0.452  | 0.488  | 0.416  |
| L inferiorparietal | 0.810  | 0.429  | 0.654  | 0.517  | 0.772  |
| R inferiorparietal | 0.843  | 0.766  | 0.147  | 0.157  | 0.049  |
| L rostralmiddlefrontal | 0.288  | 0.153  | 0.773  | 0.800  | 0.641  |
| R rostralmiddlefrontal | 0.287  | 0.179  | 0.911  | 0.925  | 0.770  |
| L supramarginal | 0.472  | 0.633  | 0.026  | 0.037  | 0.019  |
| R supramarginal | 0.244  | 0.866  | 0.958  | 0.972  | 0.469  |
| L transversetemporal | 0.360  | 0.887  | 0.651  | 0.662  | 0.785  |
| R transversetemporal | 0.189  | 0.946  | 0.720  | 0.628  | 0.715  |
| L inferiortemporal | 0.370  | 0.237  | 0.998  | 0.990  | 0.861  |
| R inferiortemporal | 0.471  | 0.559  | 0.467  | 0.473  | 0.854  |
| L superiortemporal | 0.677  | 0.286  | 0.209  | 0.268  | 0.093  |
| R superiortemporal | 0.542  | 0.968  | 0.897  | 0.953  | 0.567  |
| L lateraloccipital | 0.172  | 0.649  | 0.268  | 0.287  | 0.140  |
| R lateraloccipital | 0.197  | 0.574  | 0.272  | 0.277  | 0.159  |

Statistical *P*-value results in Pearson correlation analysis of cortical thickness and clinical characteristics.