

Figure S1. Case1 pre-op.

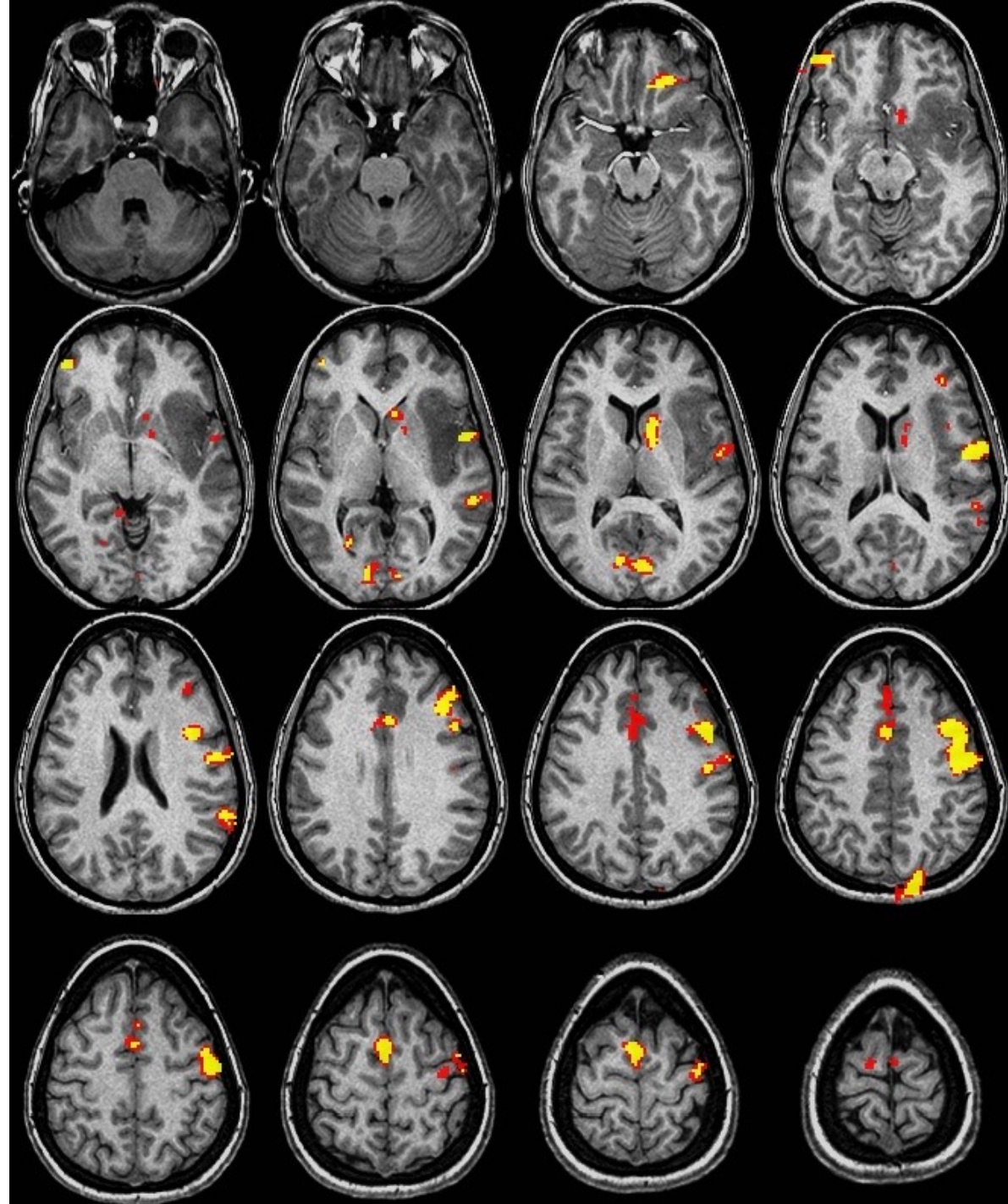
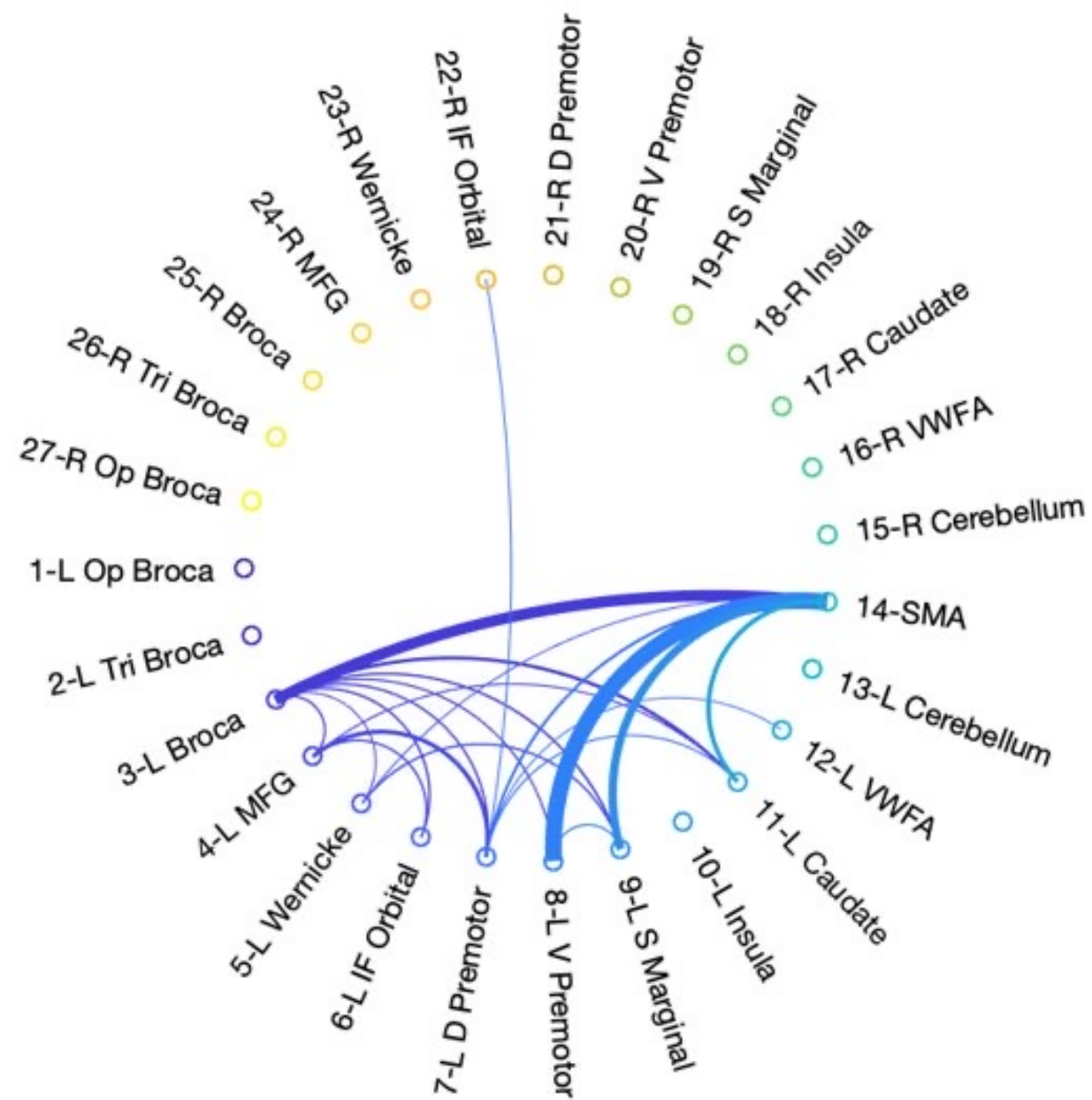


Figure S2. Case1 post-op1.

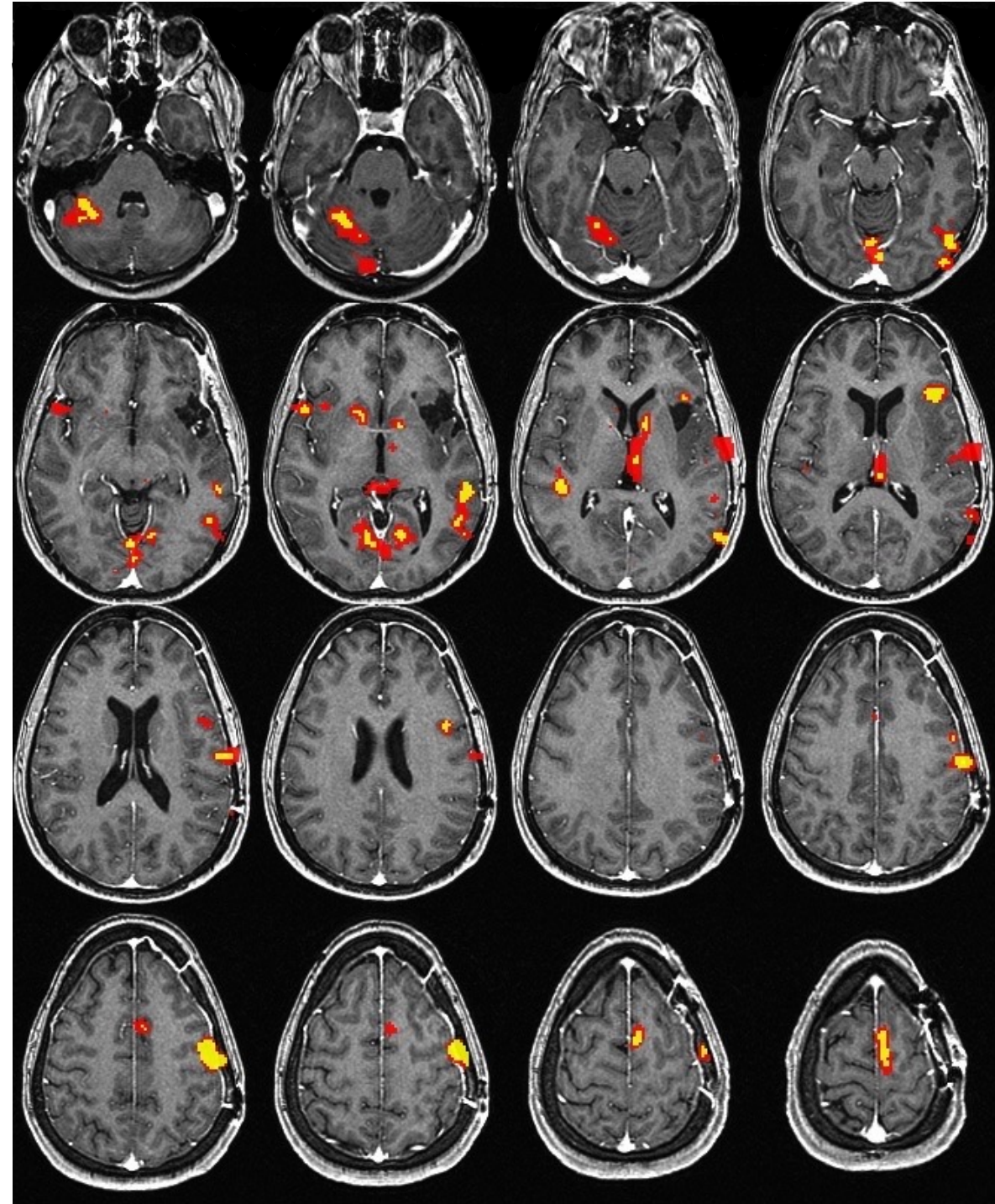
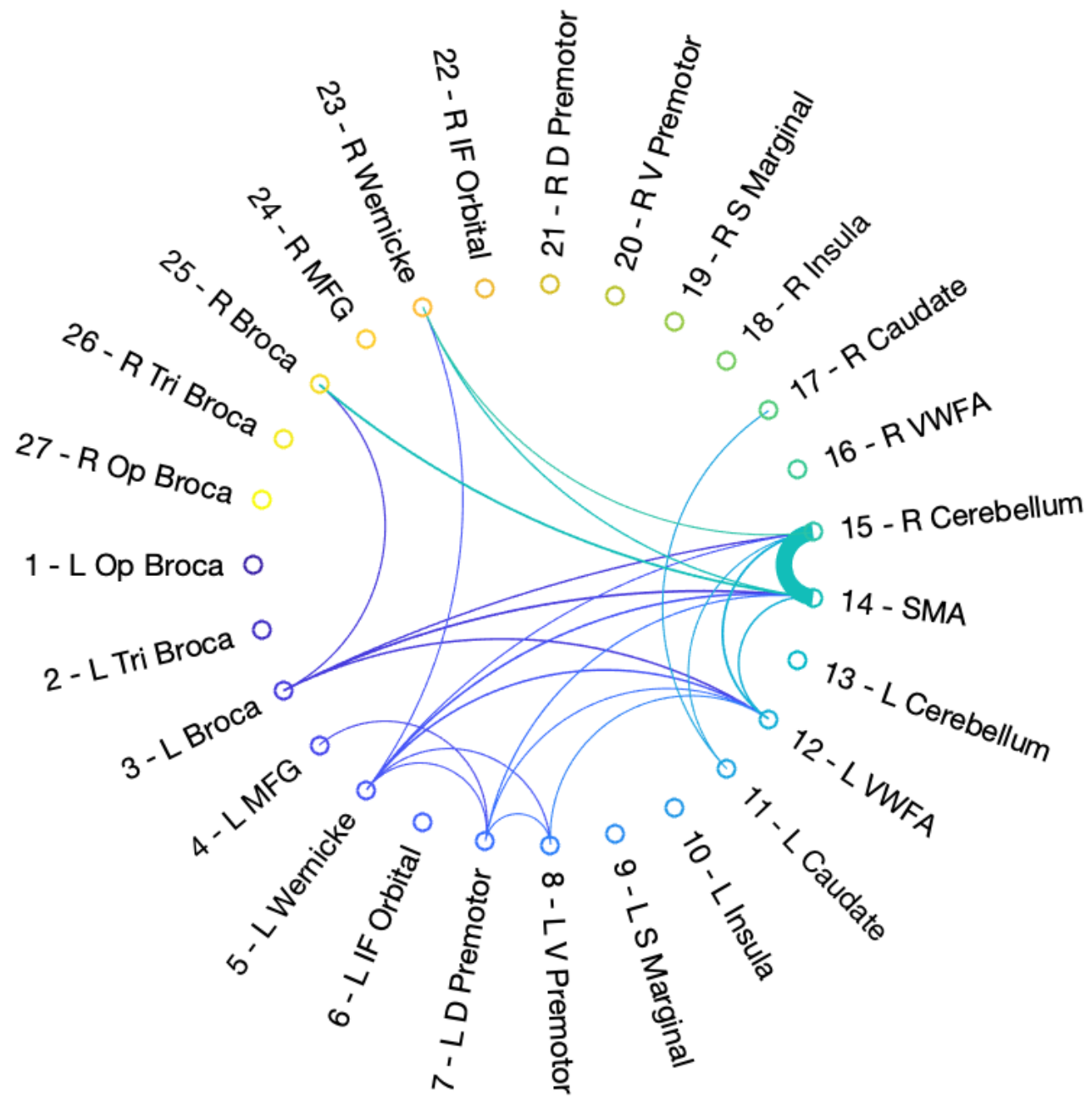


Figure S3. Case1 post-op2.

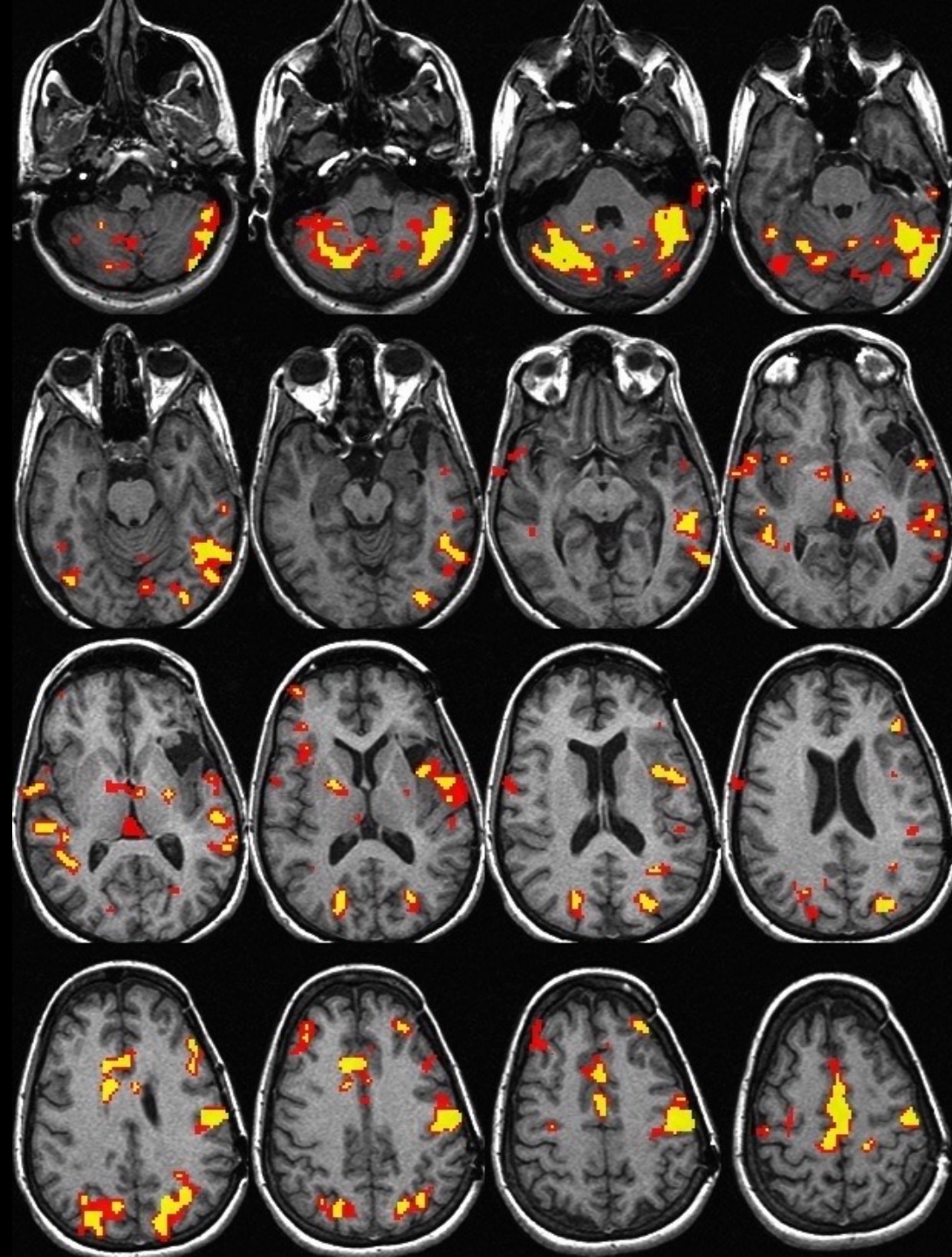
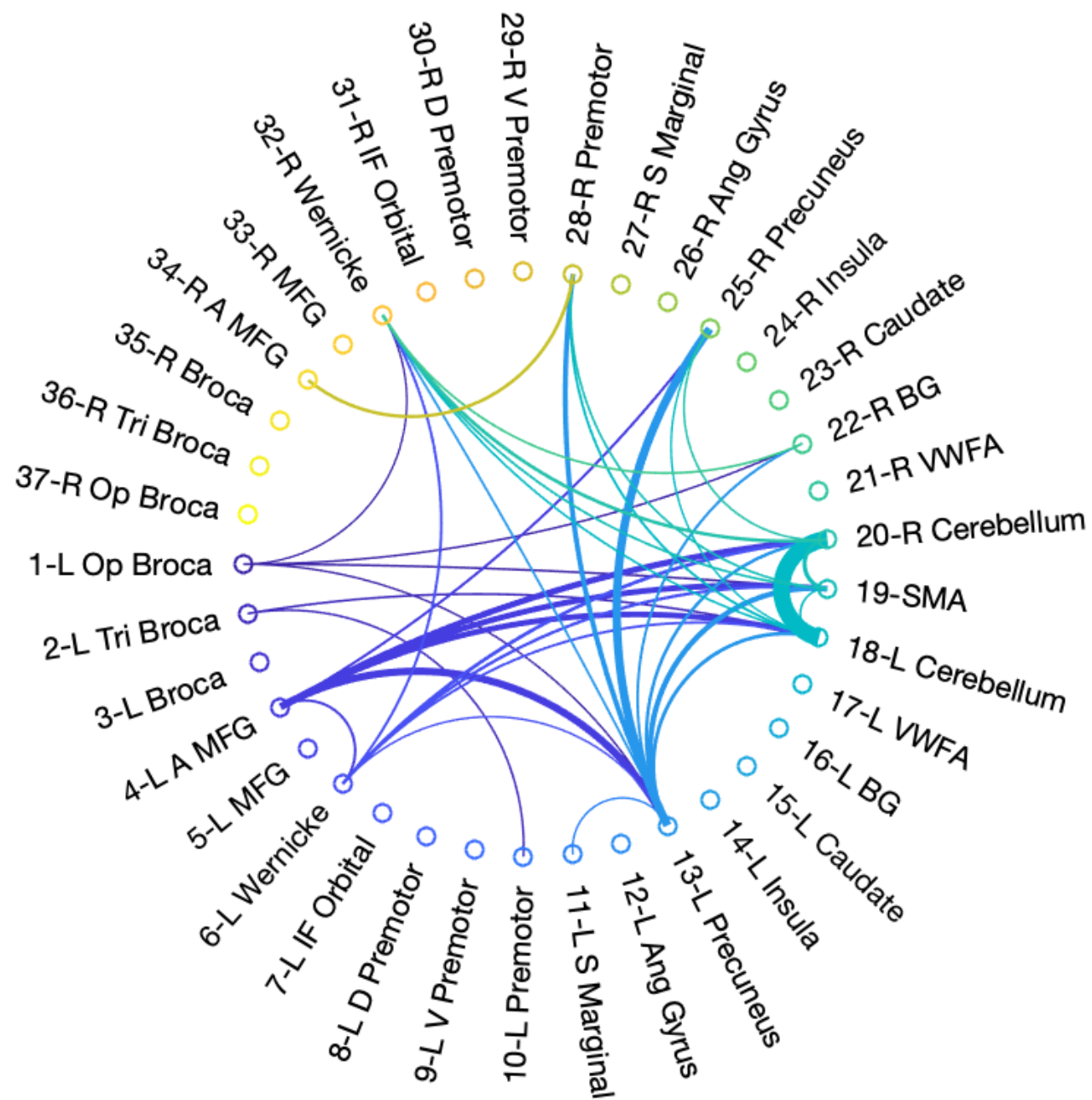


Figure S4. Case1 post-op3.

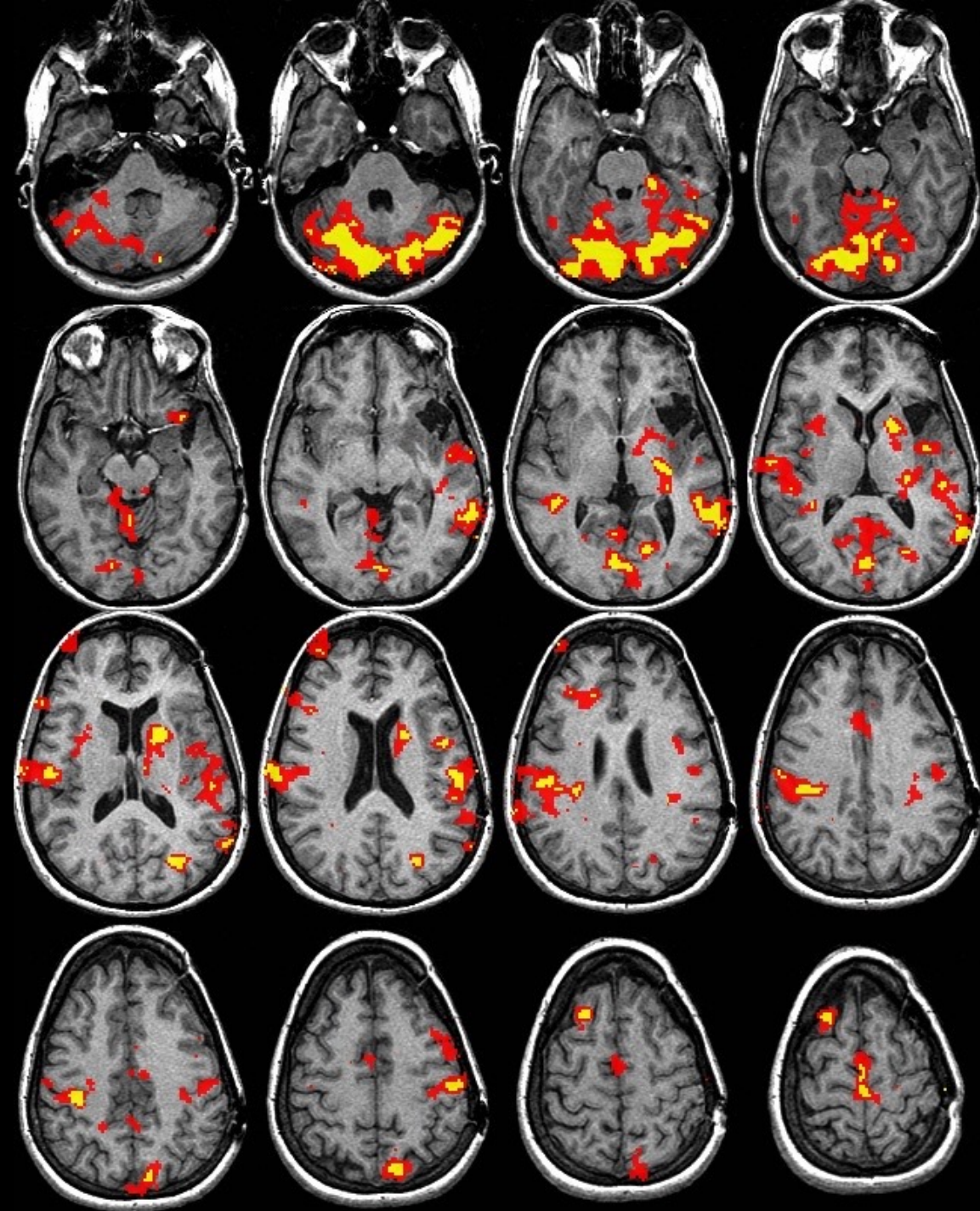
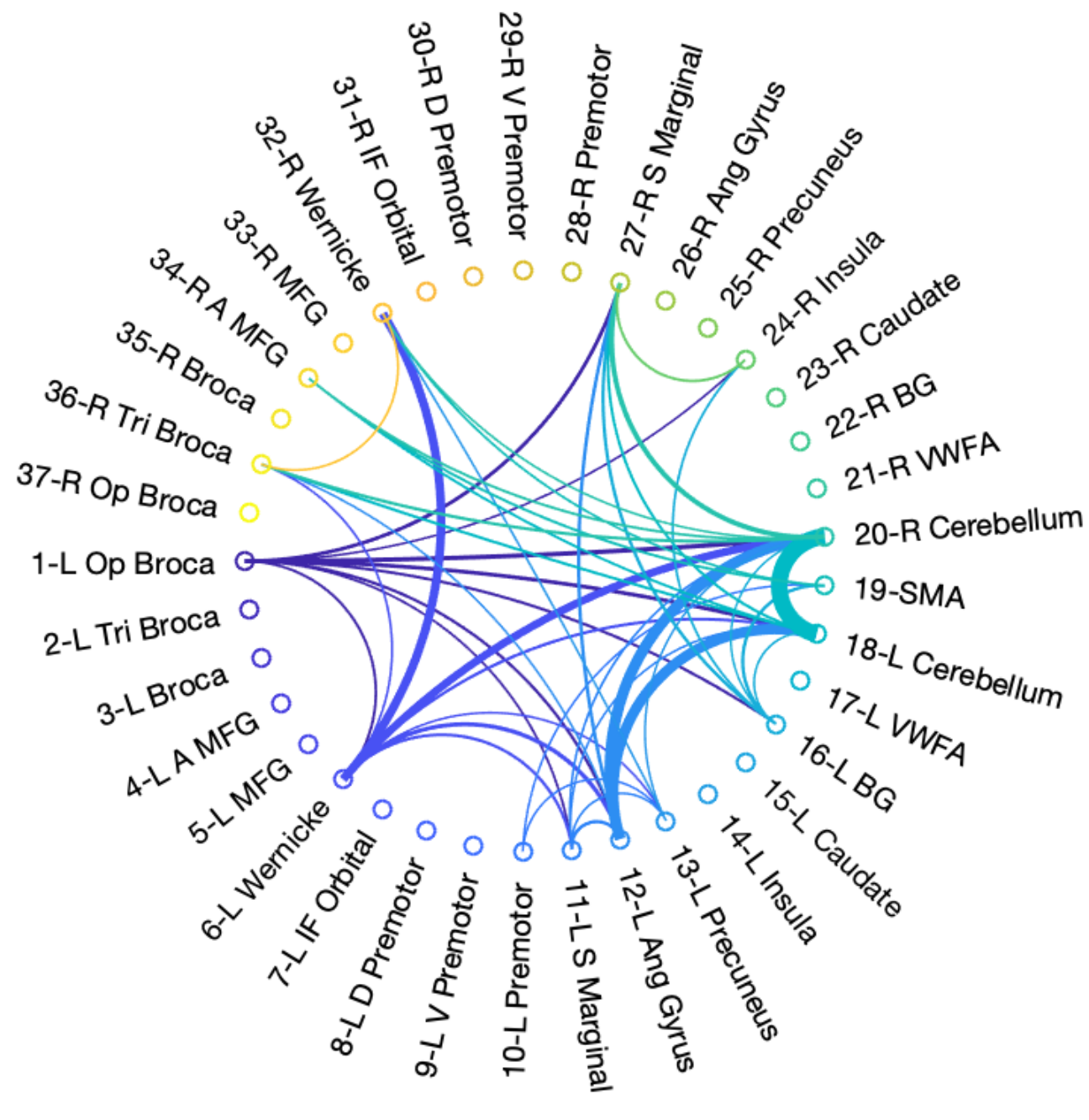


Figure S5. Case2 pre-op.

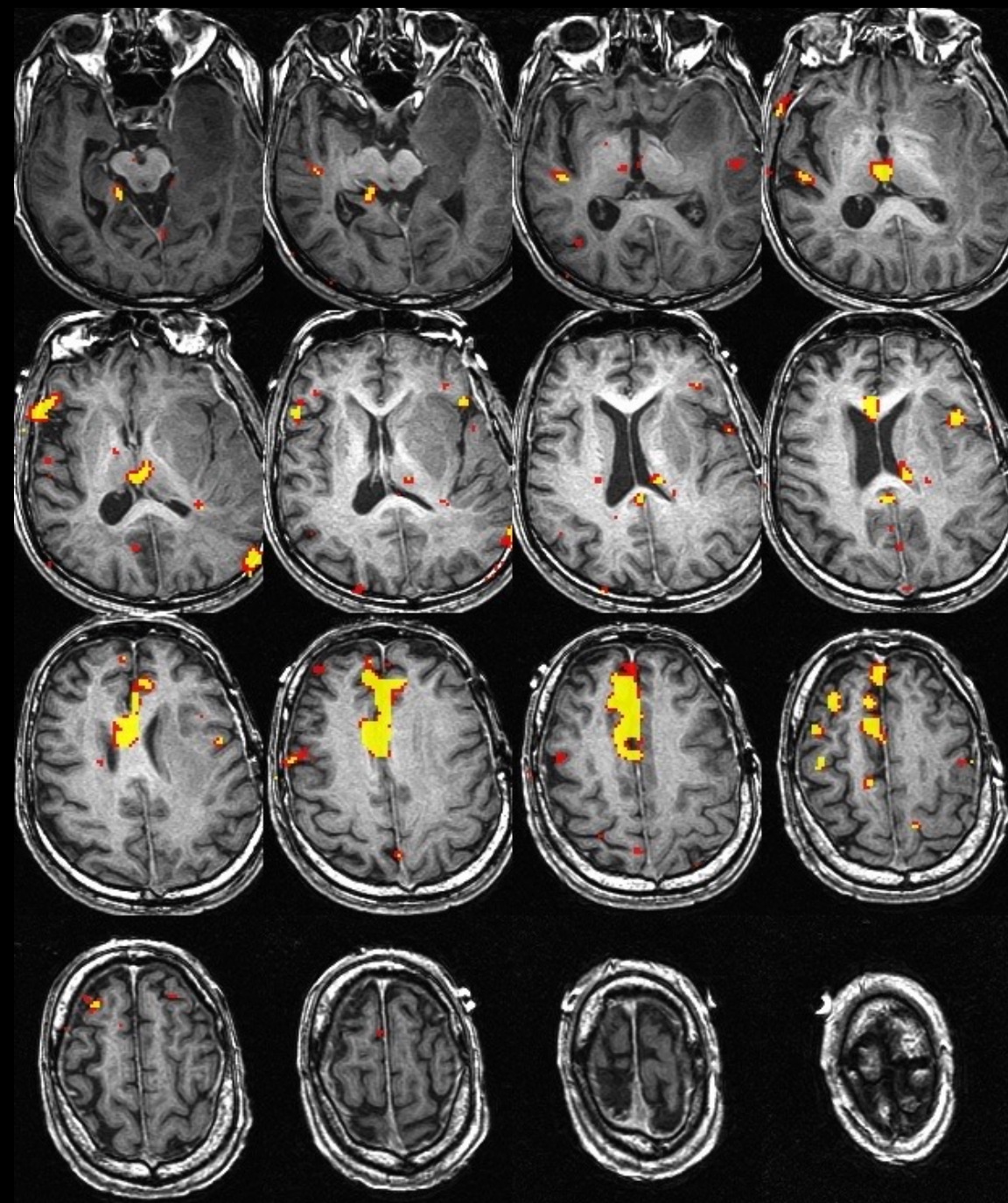
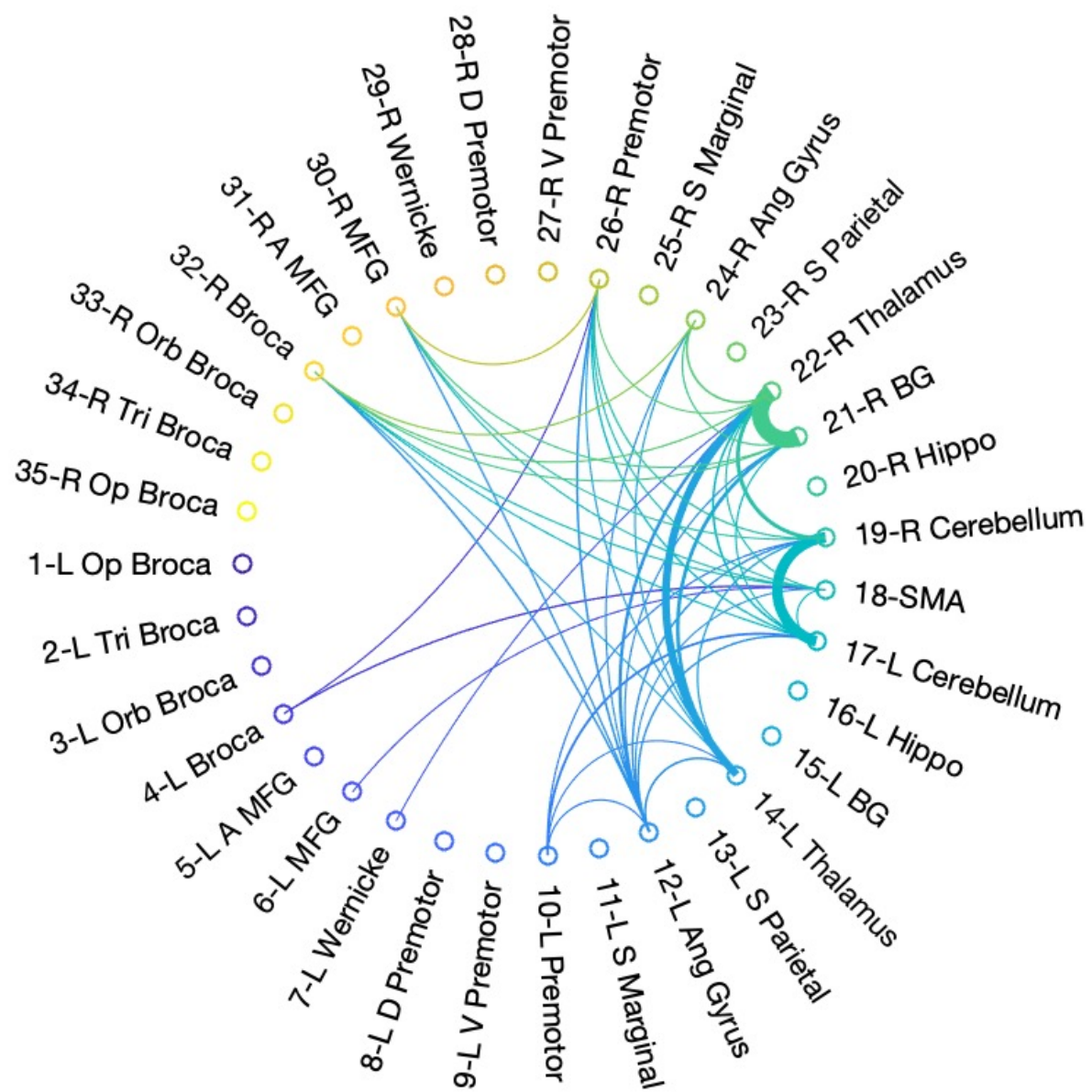


Figure S6. Case2 post-op1.

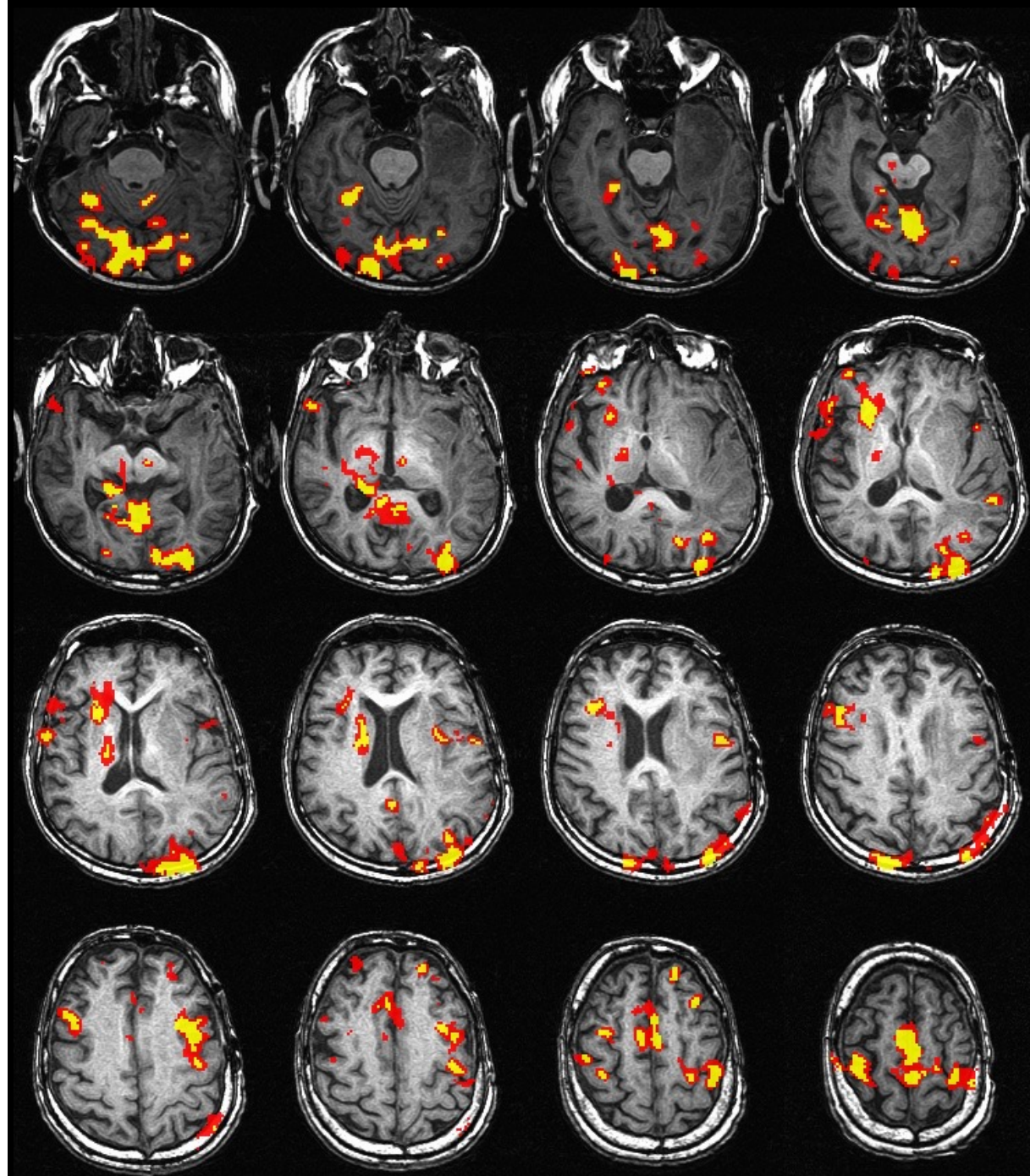
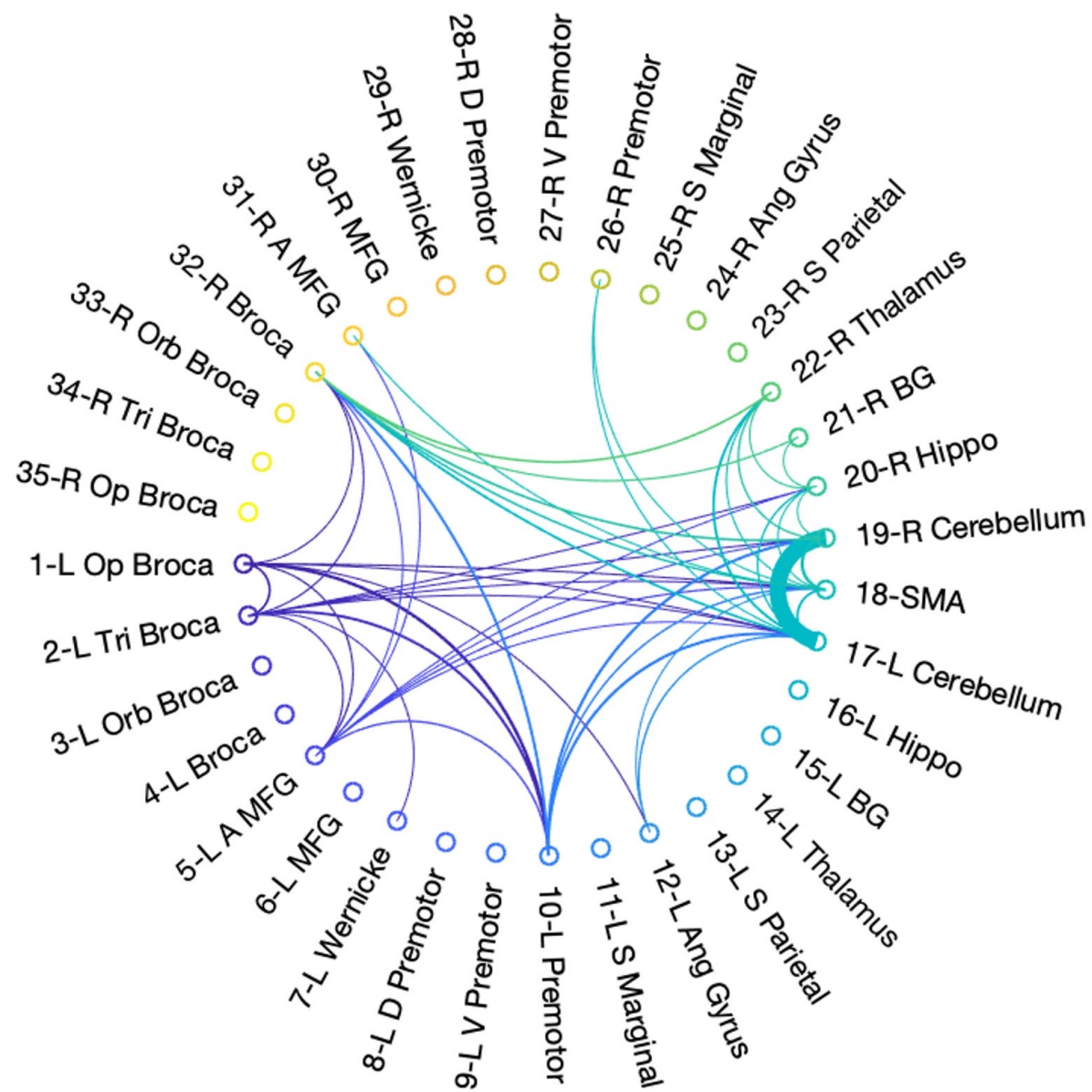


Figure S7. Case2 post-op2.

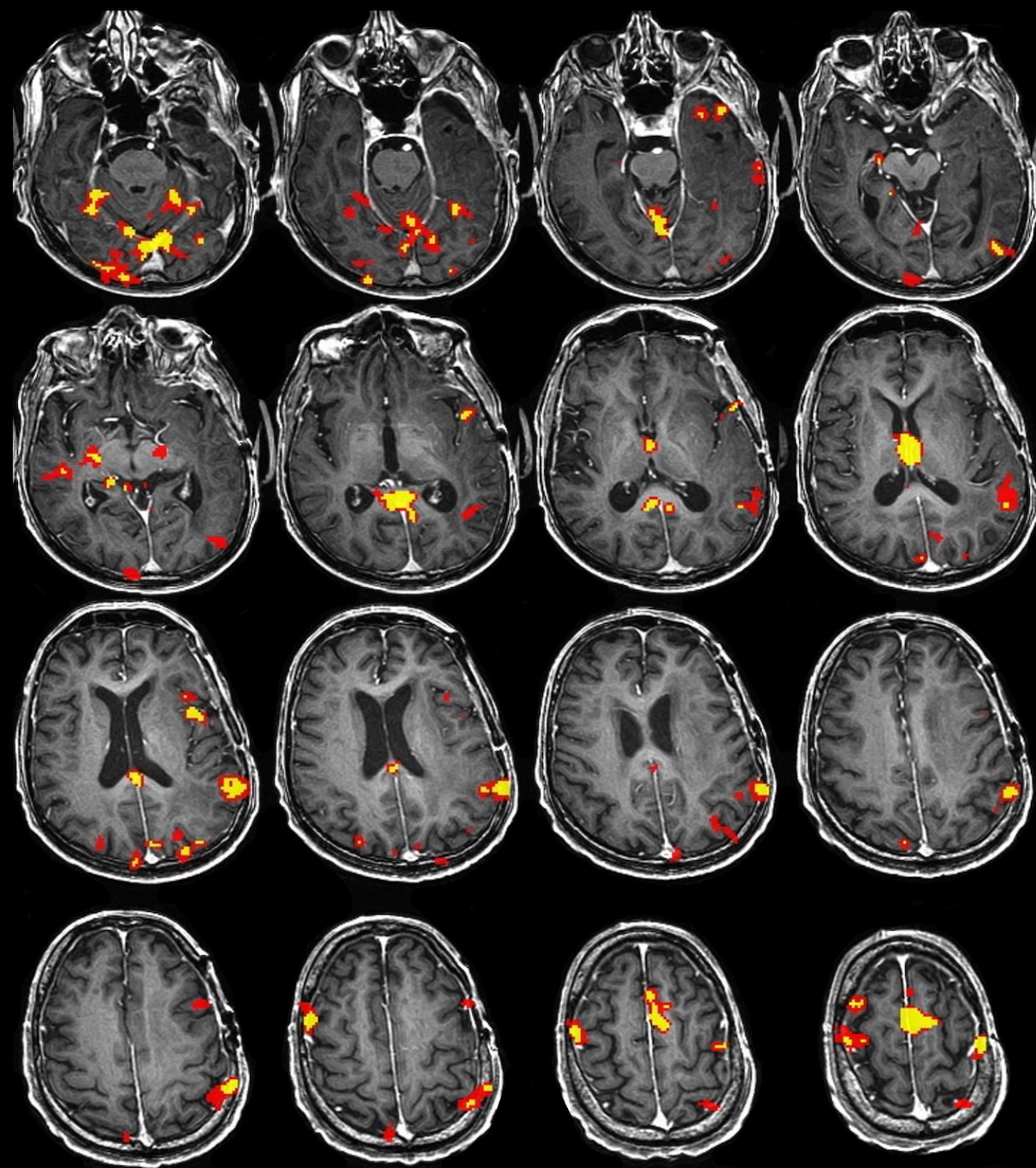
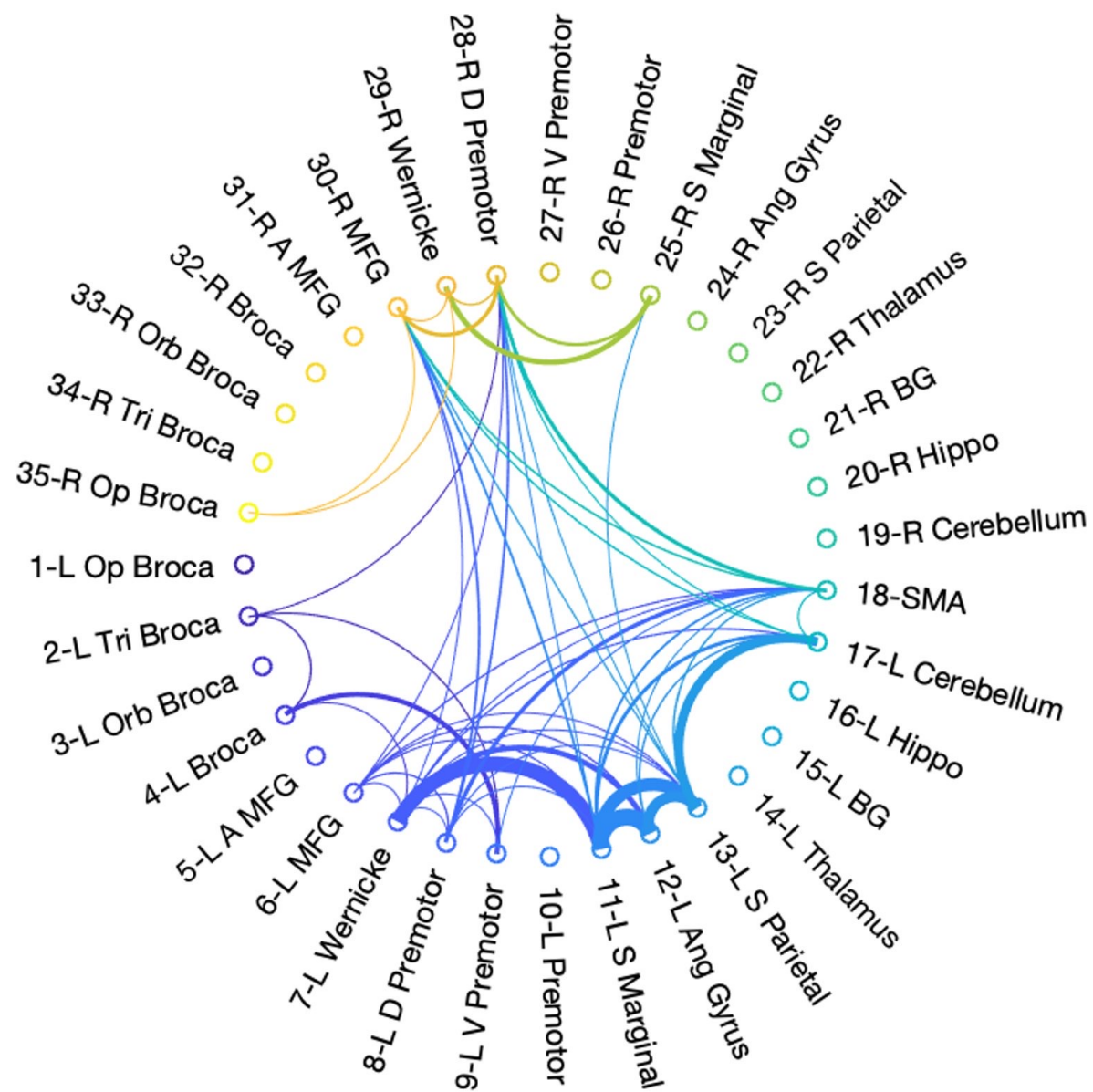


Figure S8. Case2 post-op3.

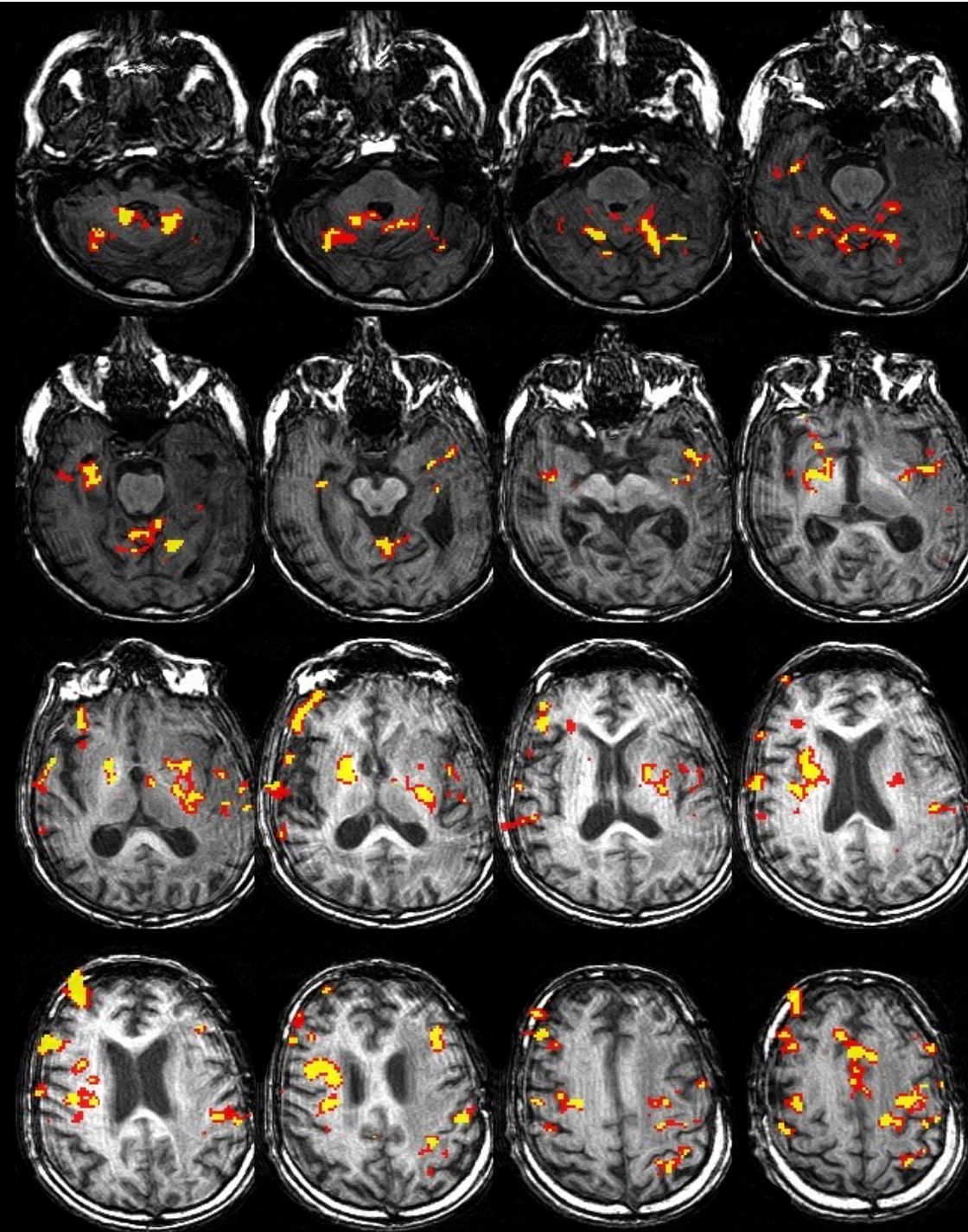
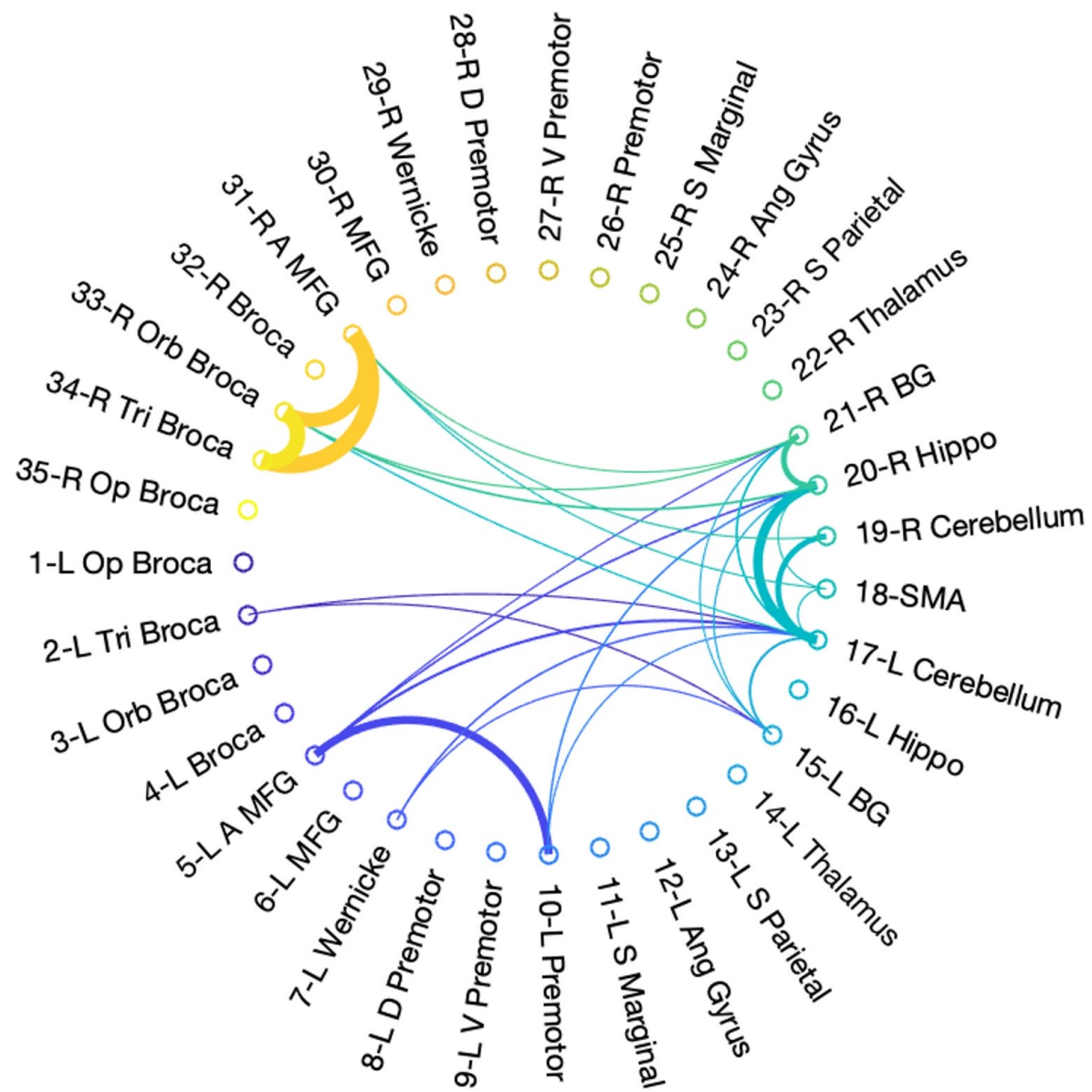


Figure S9. Case3 pre-op.

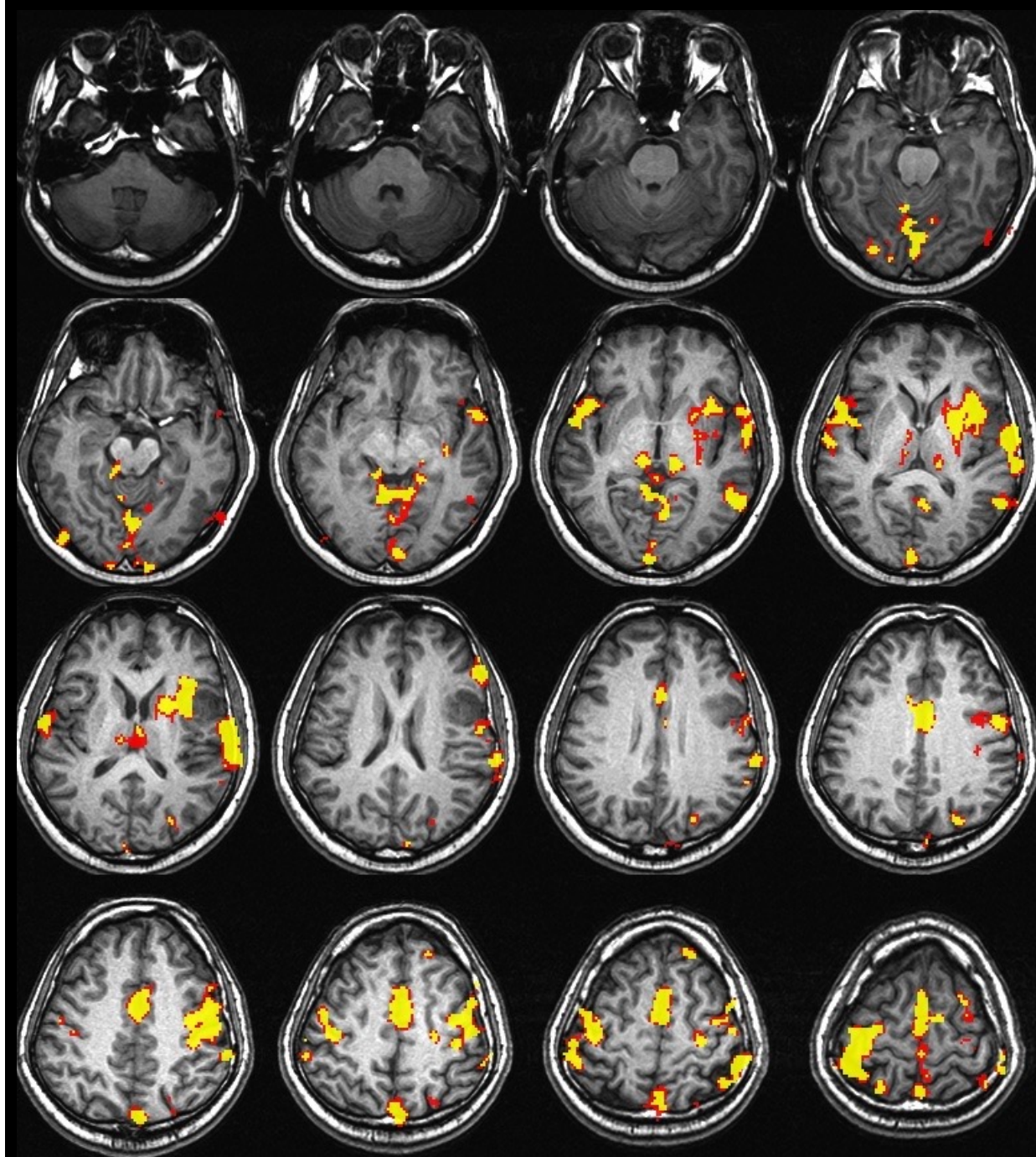
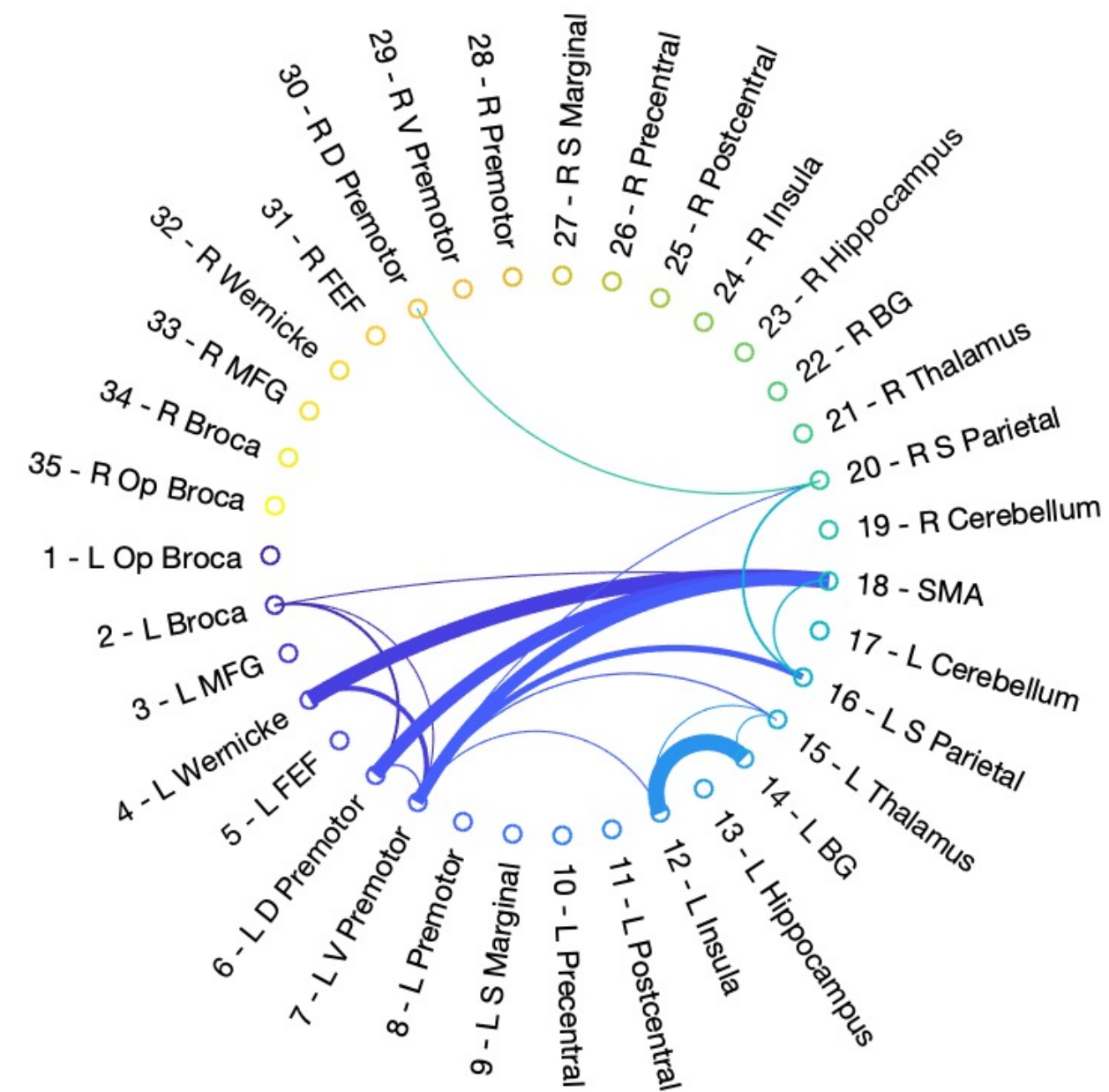


Figure S10. Case3 post-op1.

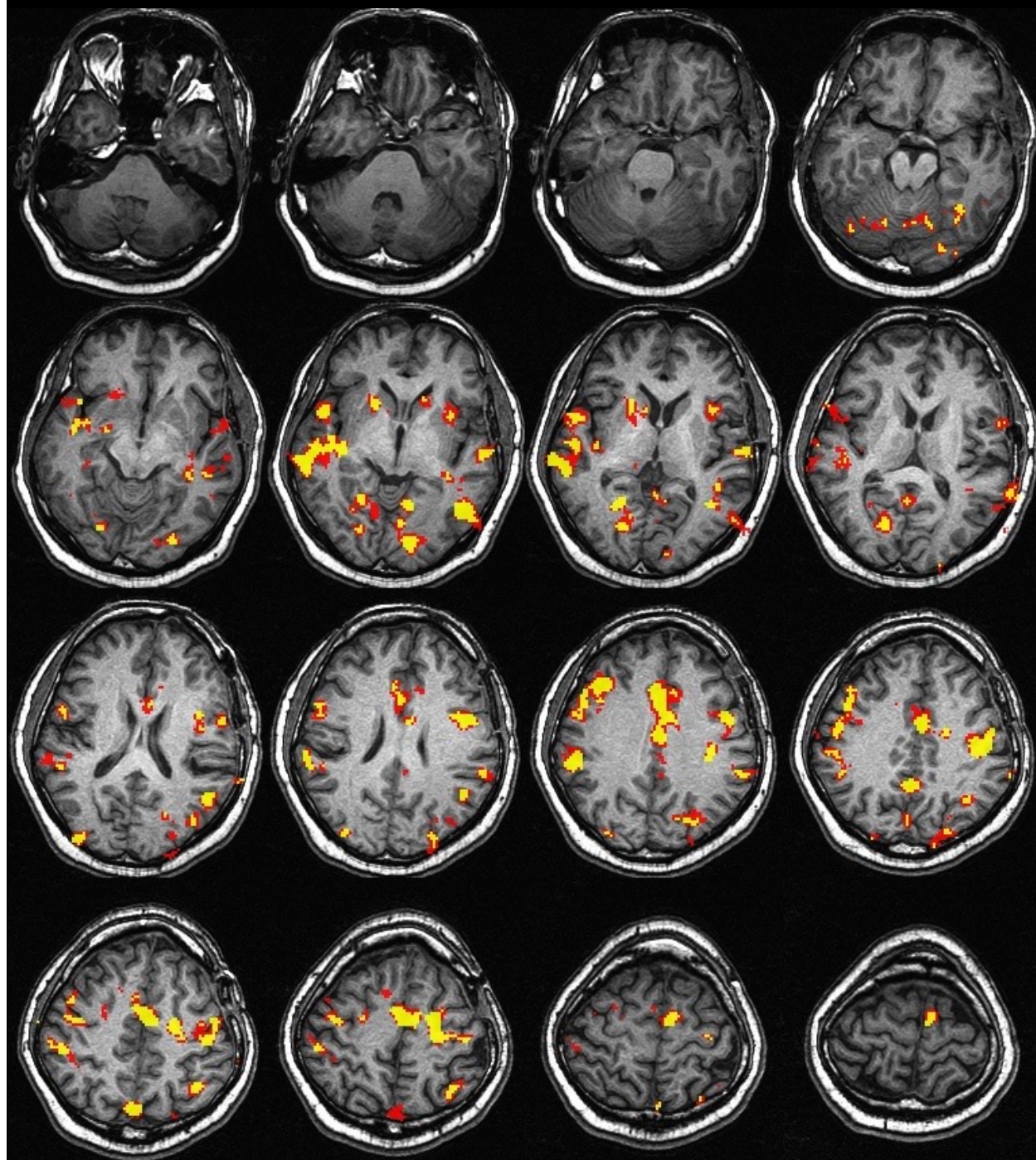
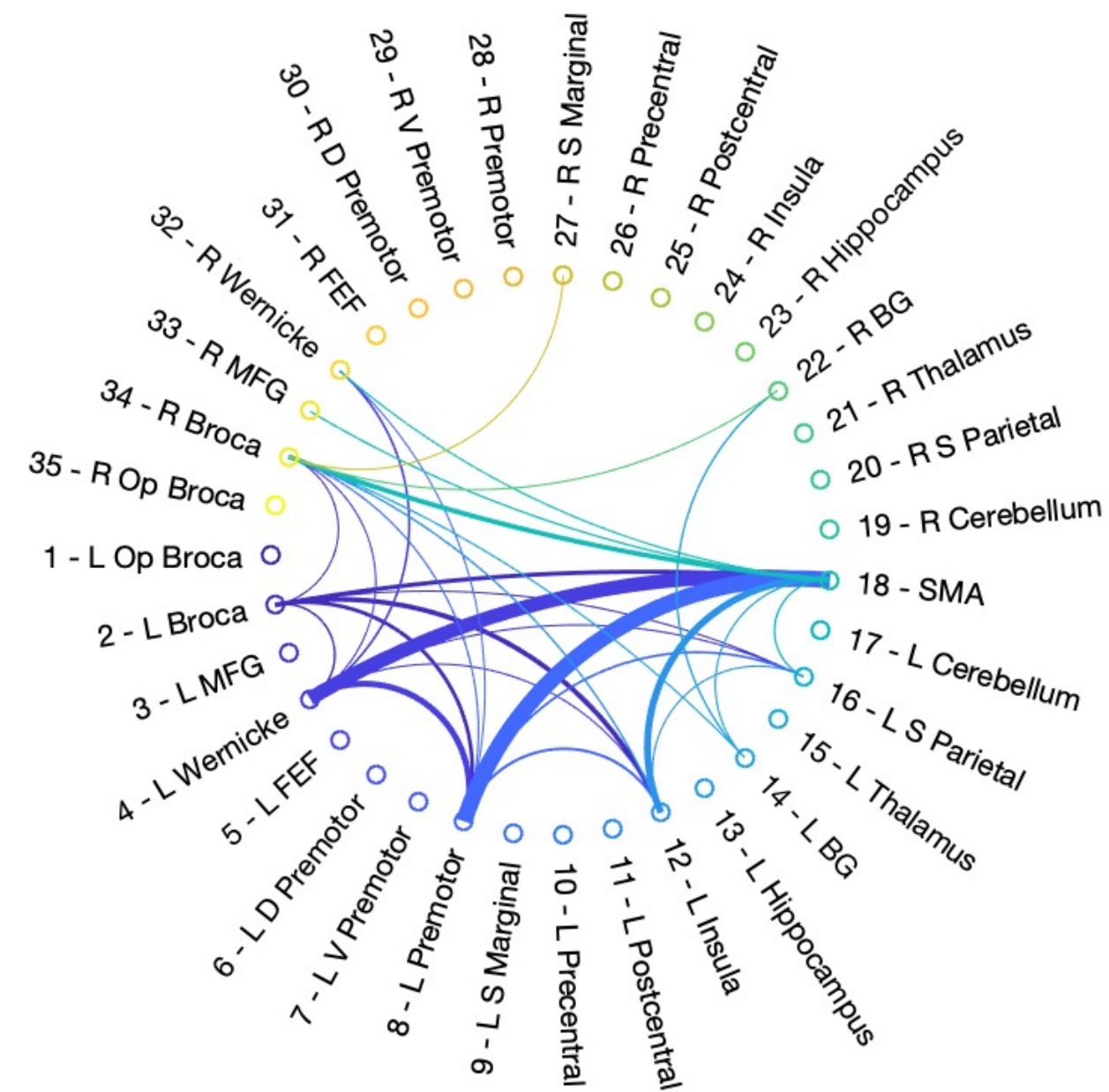


Figure S11. Case3 post-op2.

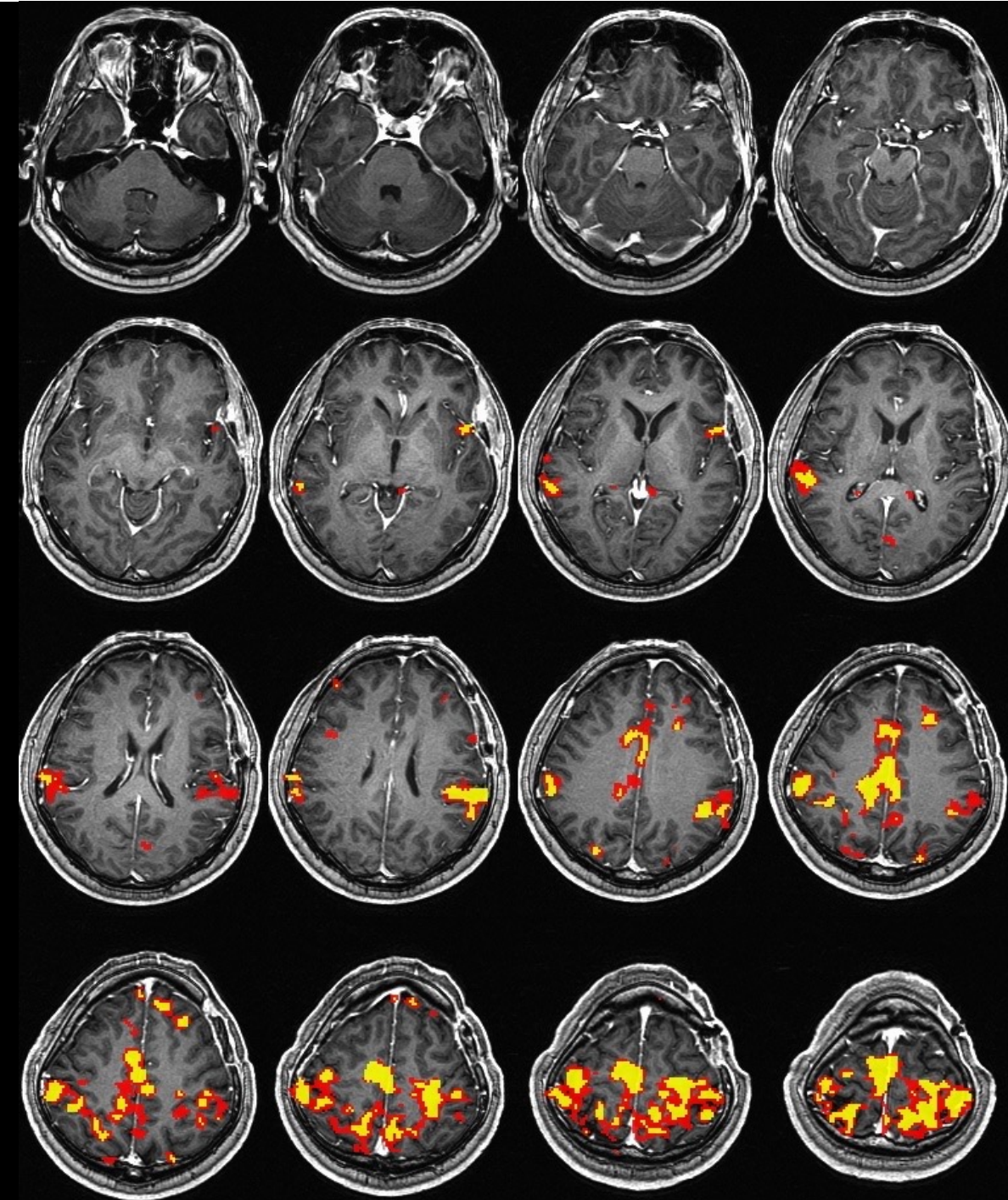
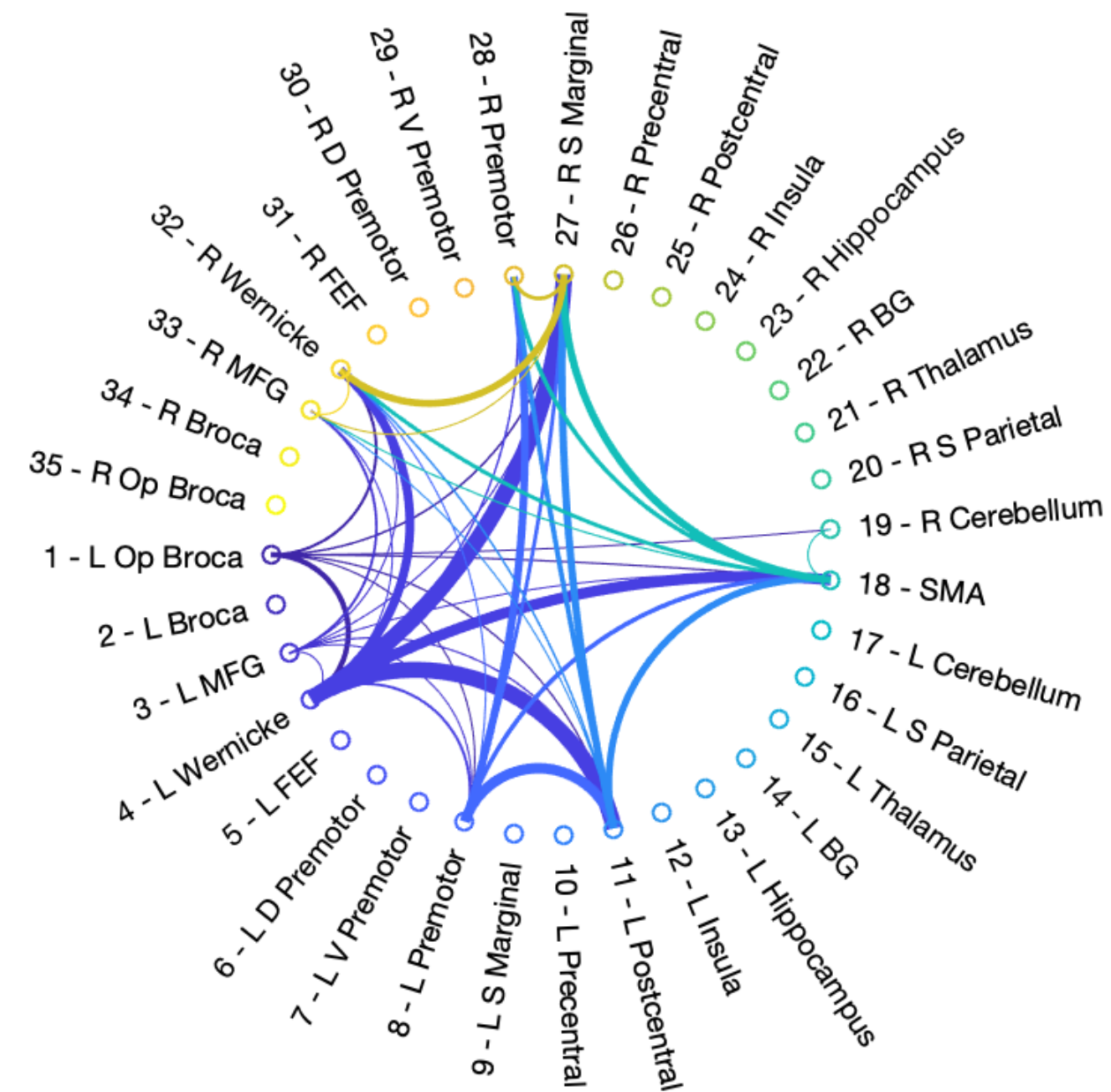


Figure S12. Case3 post-op3.

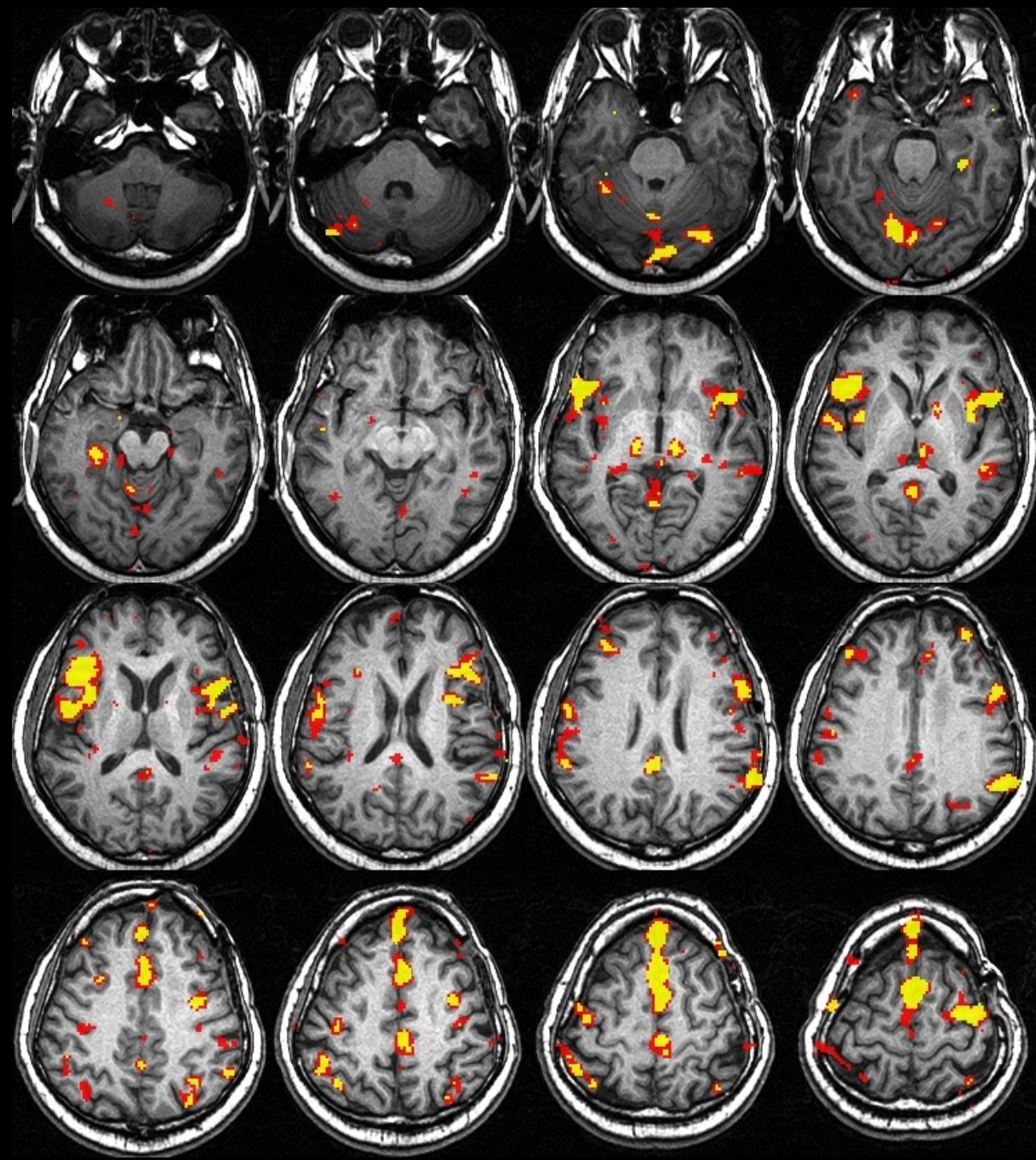
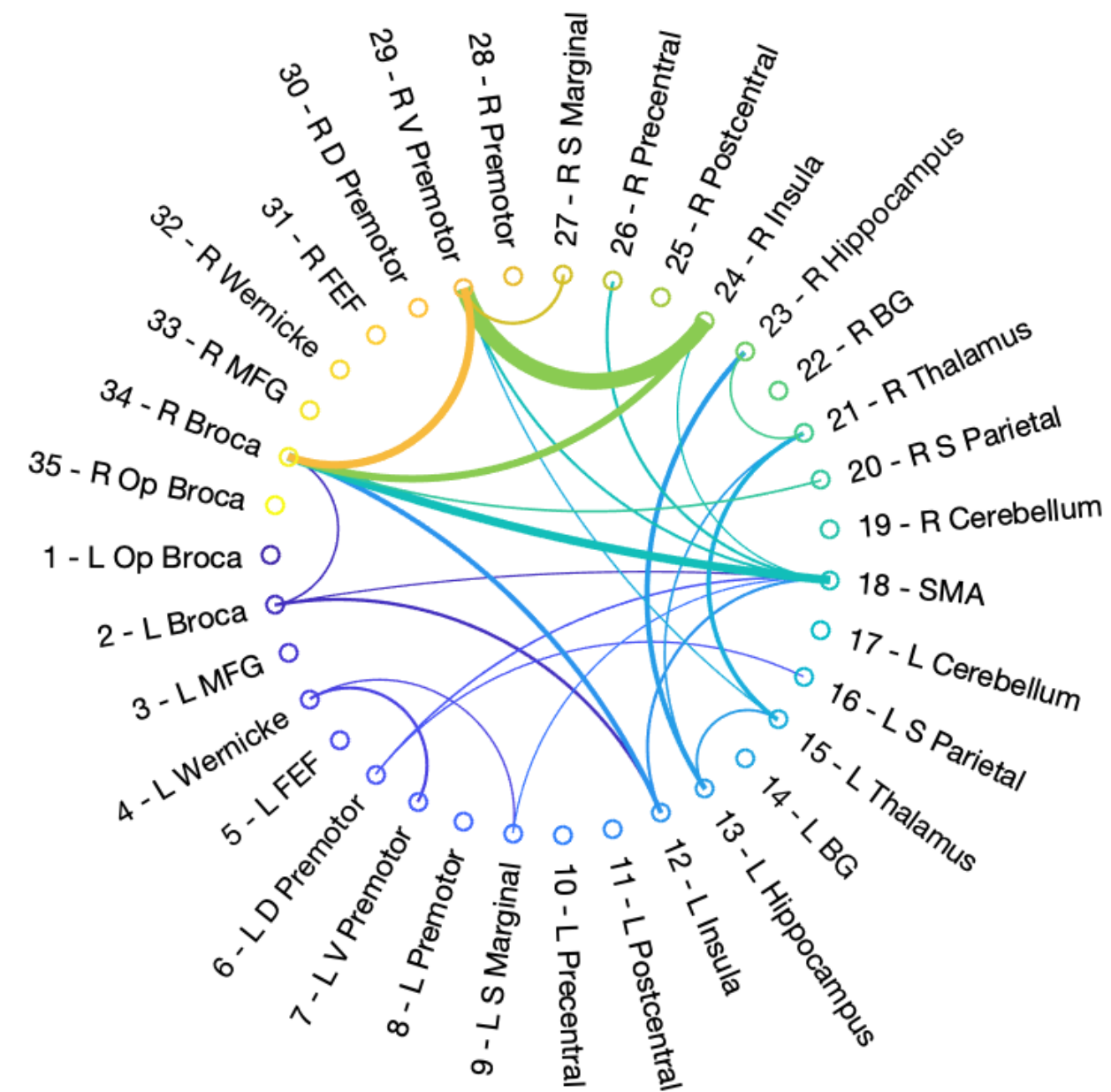


Figure S13. Case4 pre-op.

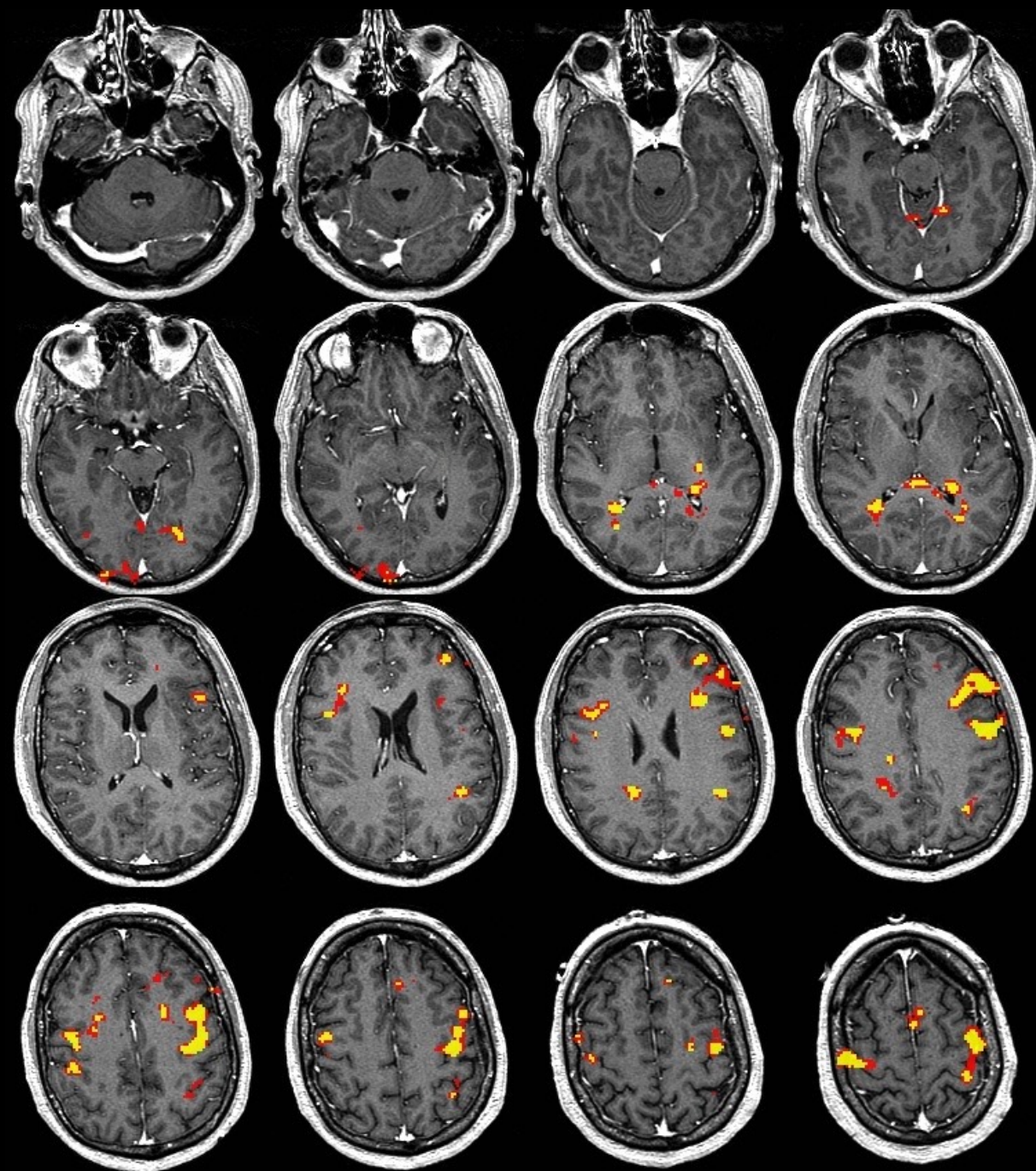
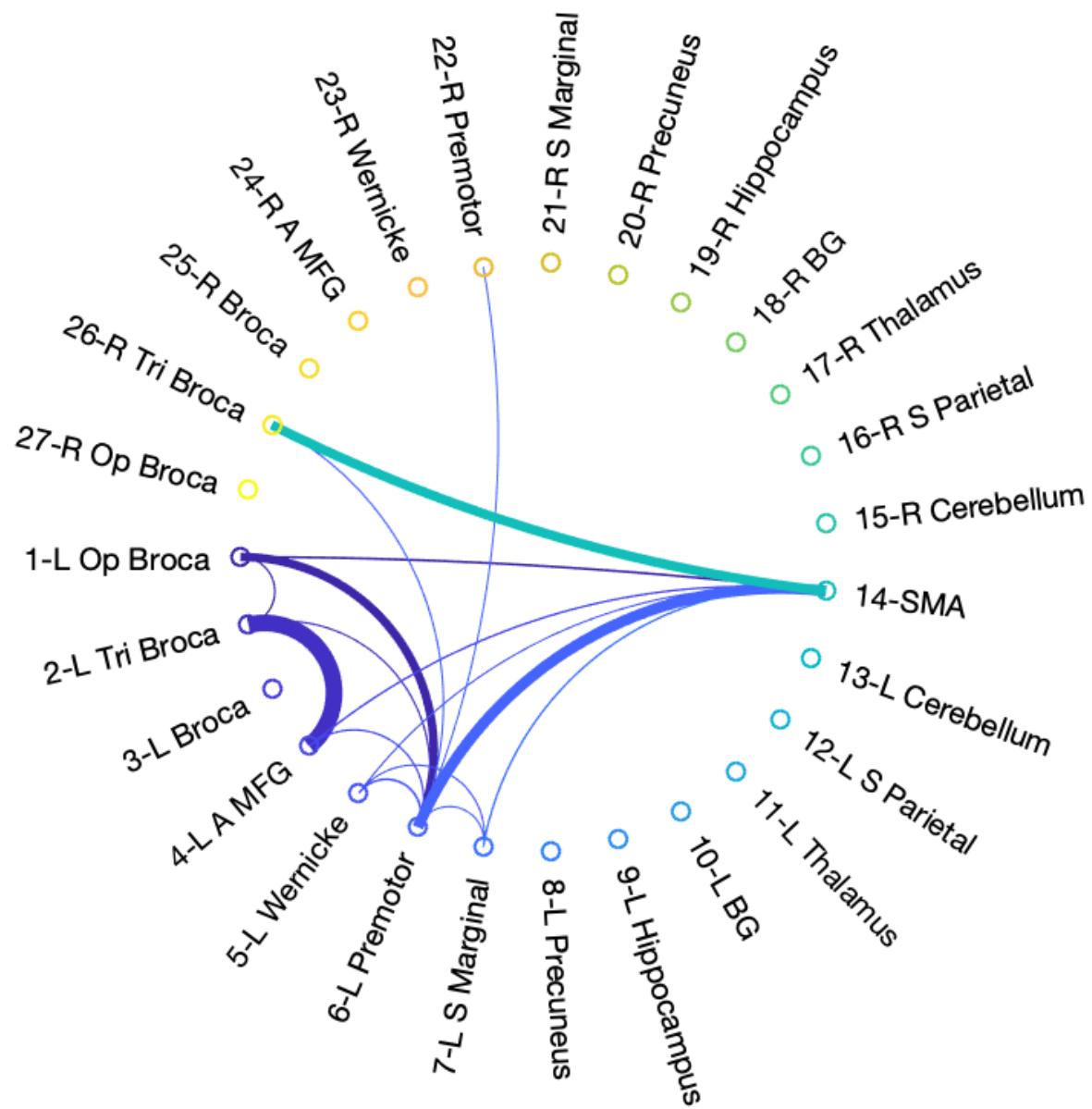


Figure S14. Case4 post-op1.

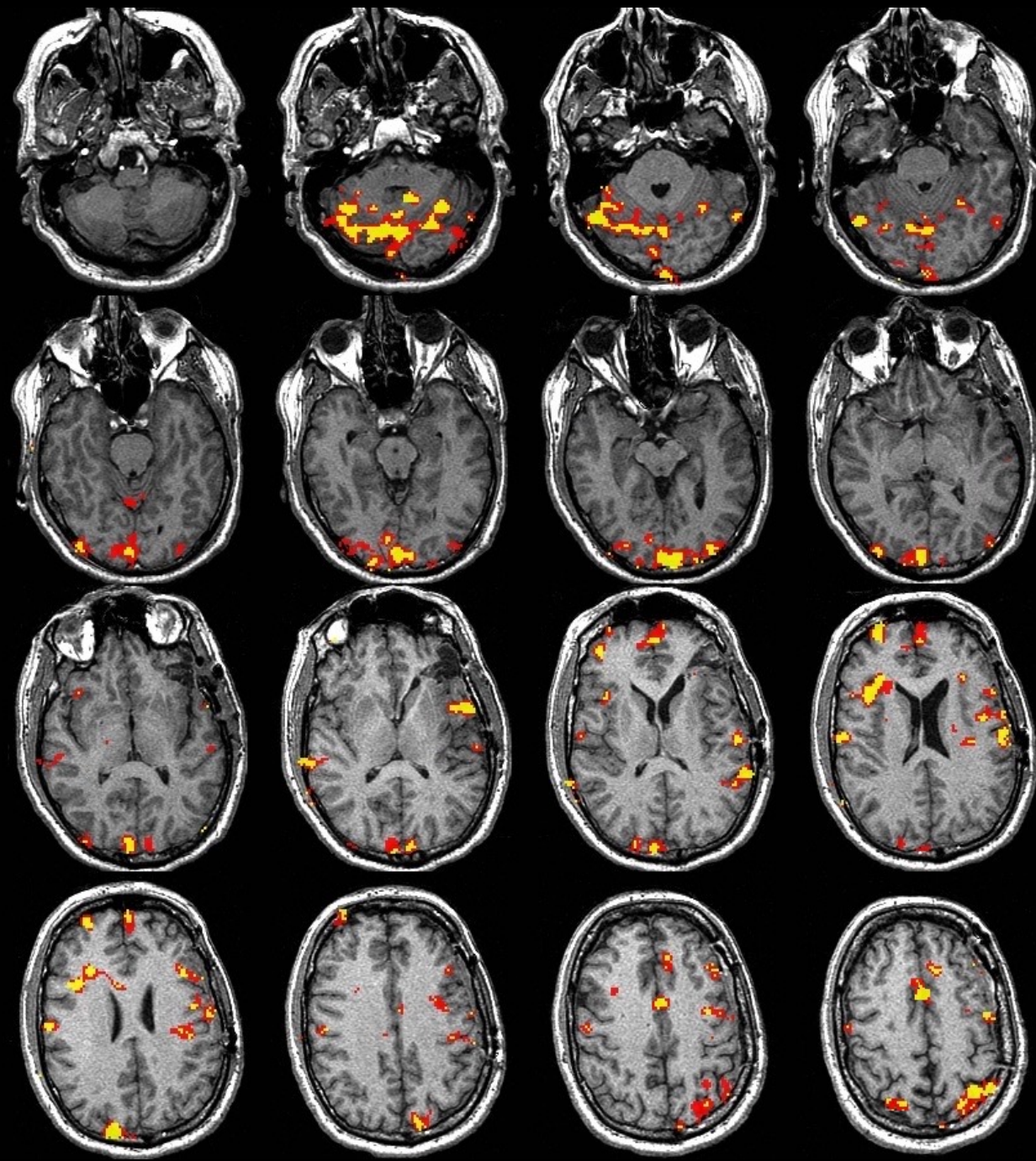
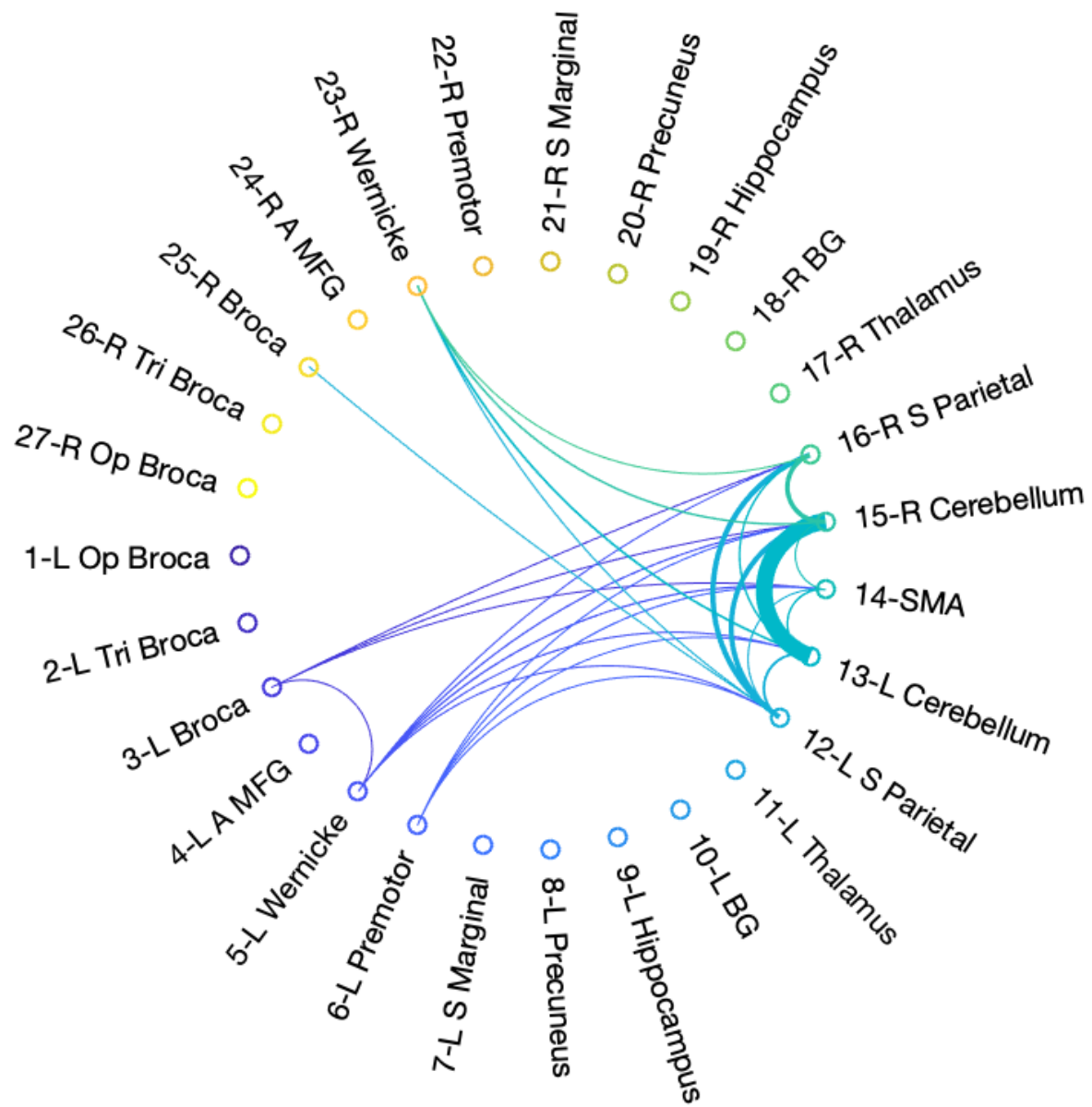


Figure S15. Case4 post-op2.

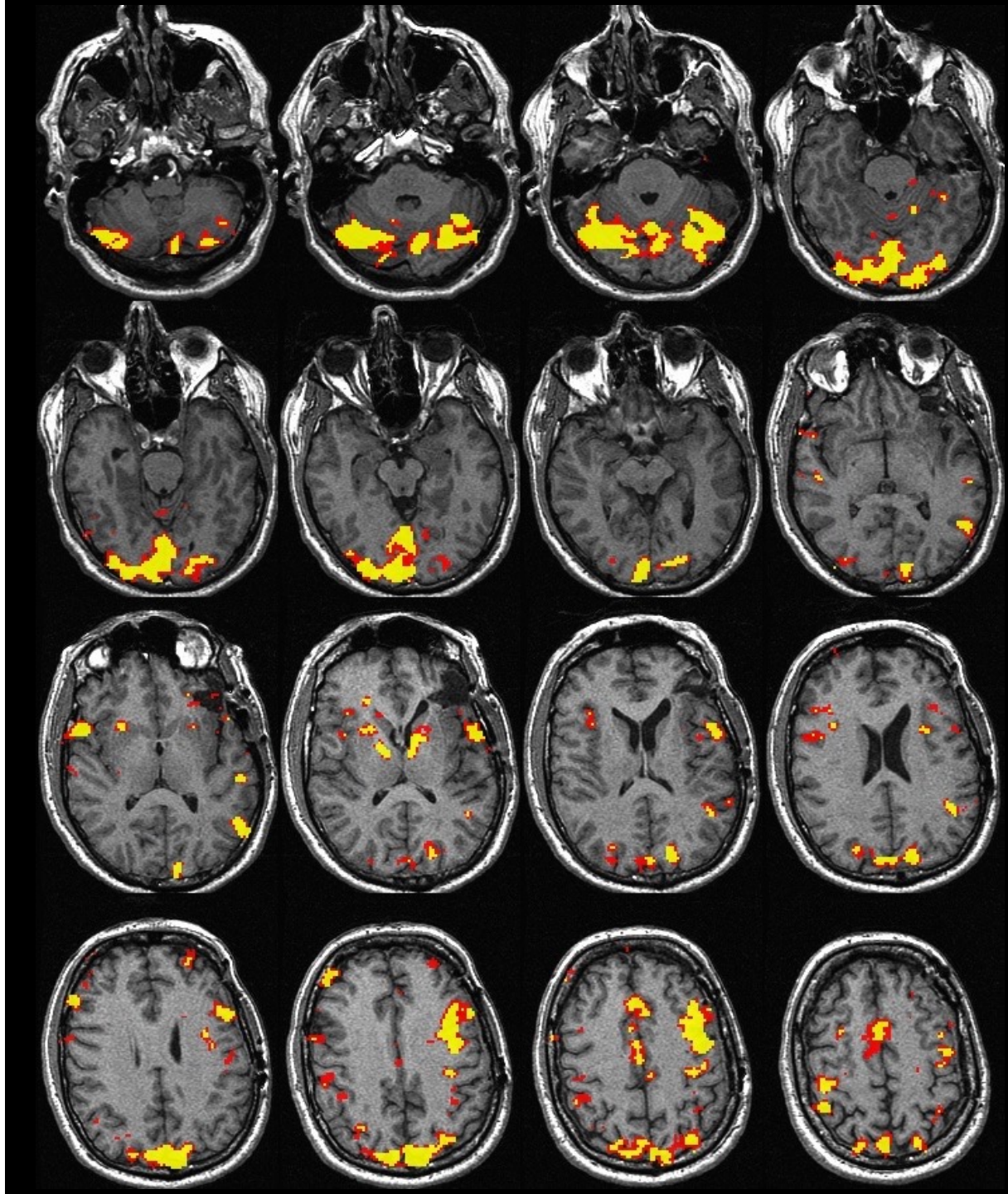
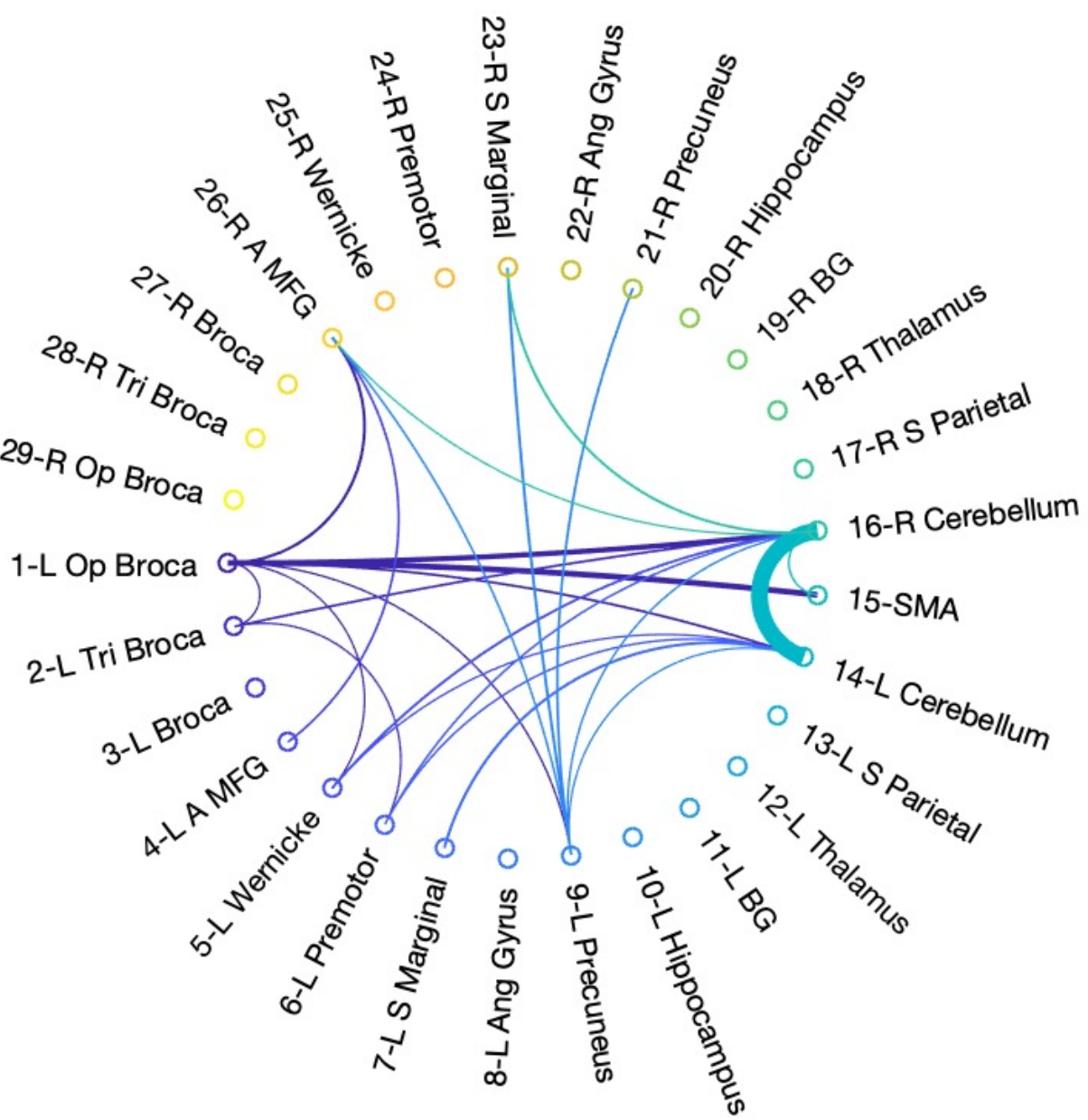


Figure S16. Case4 post-op3.

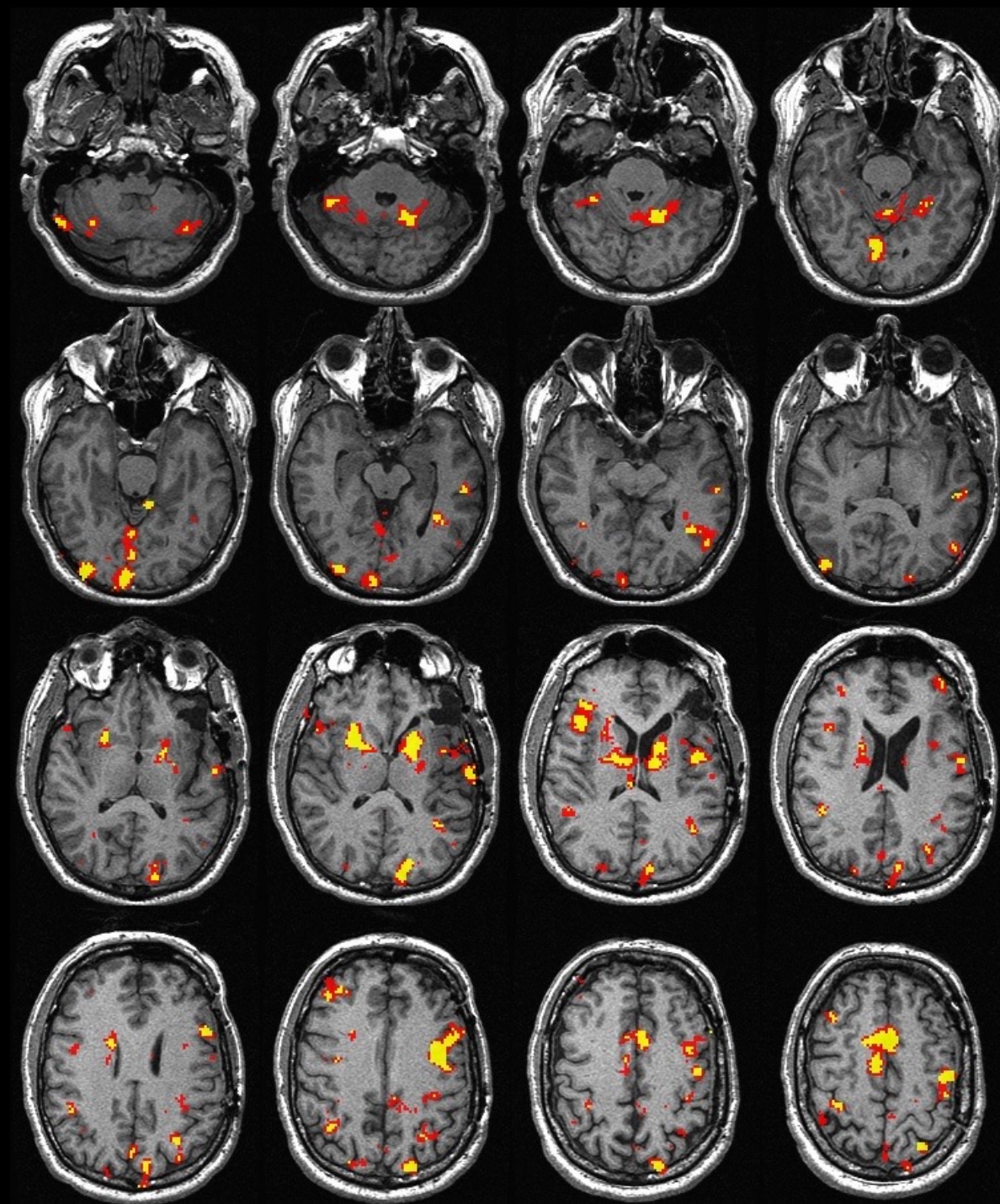
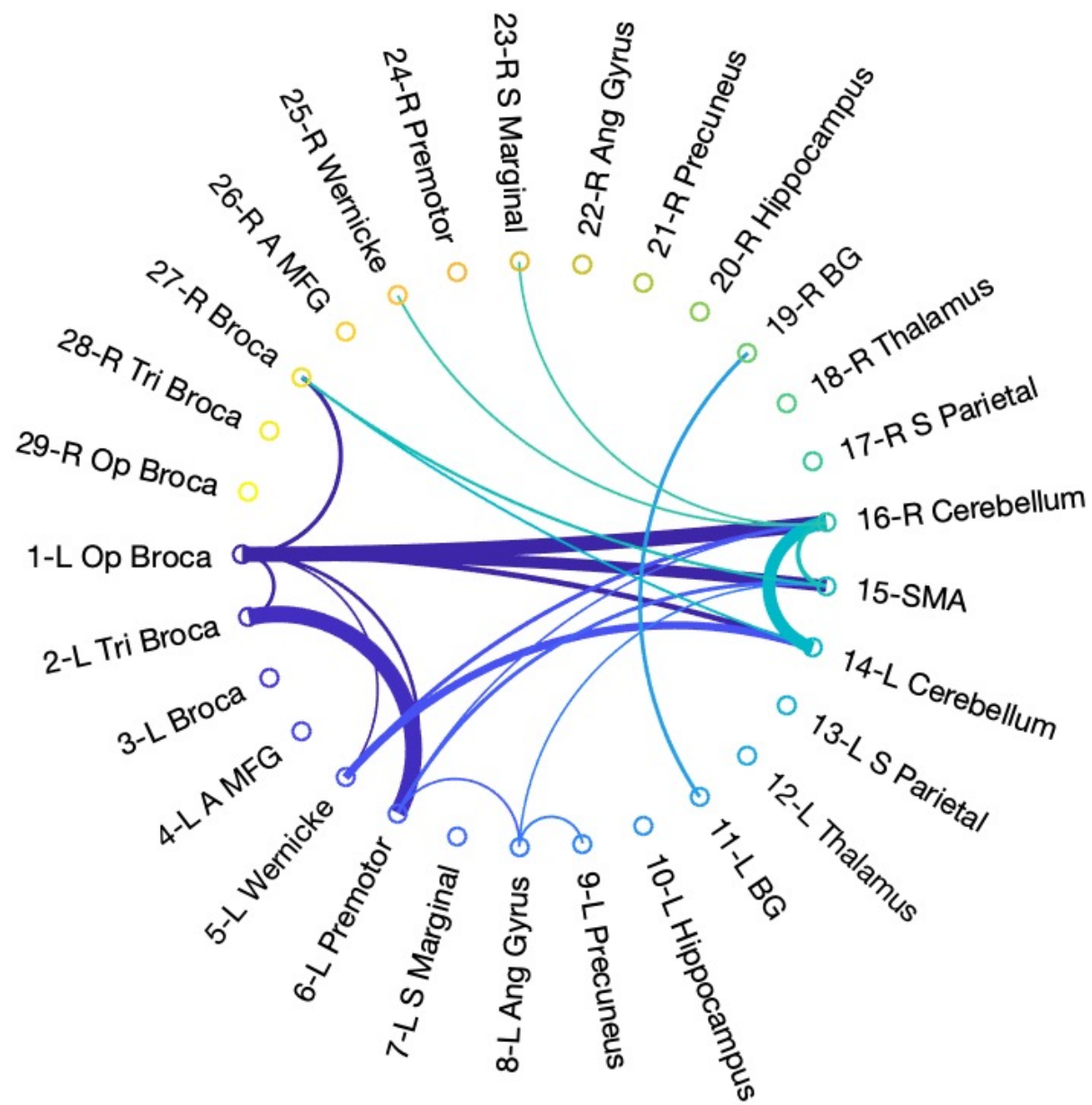


Figure S17. Case5 pre-op.

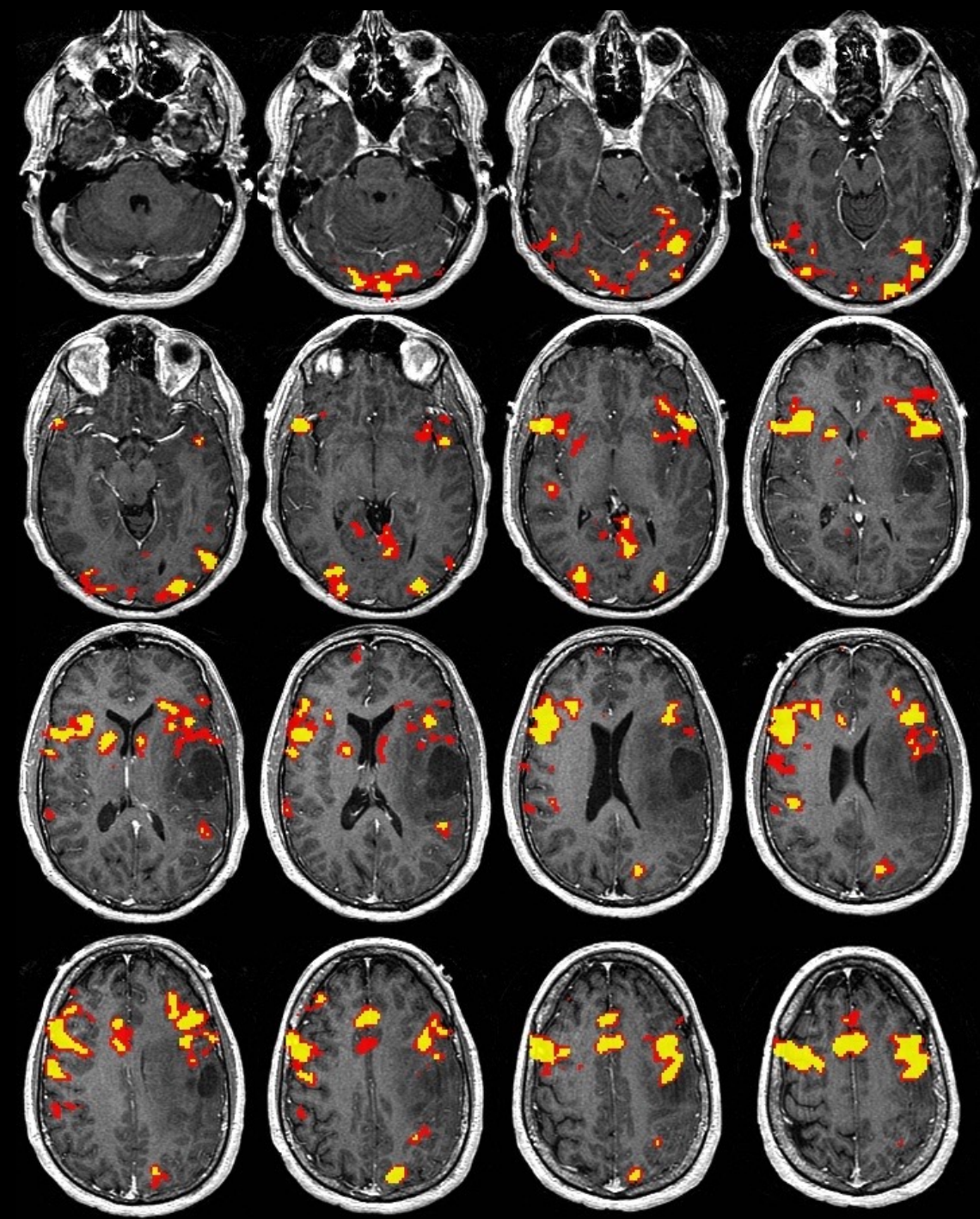
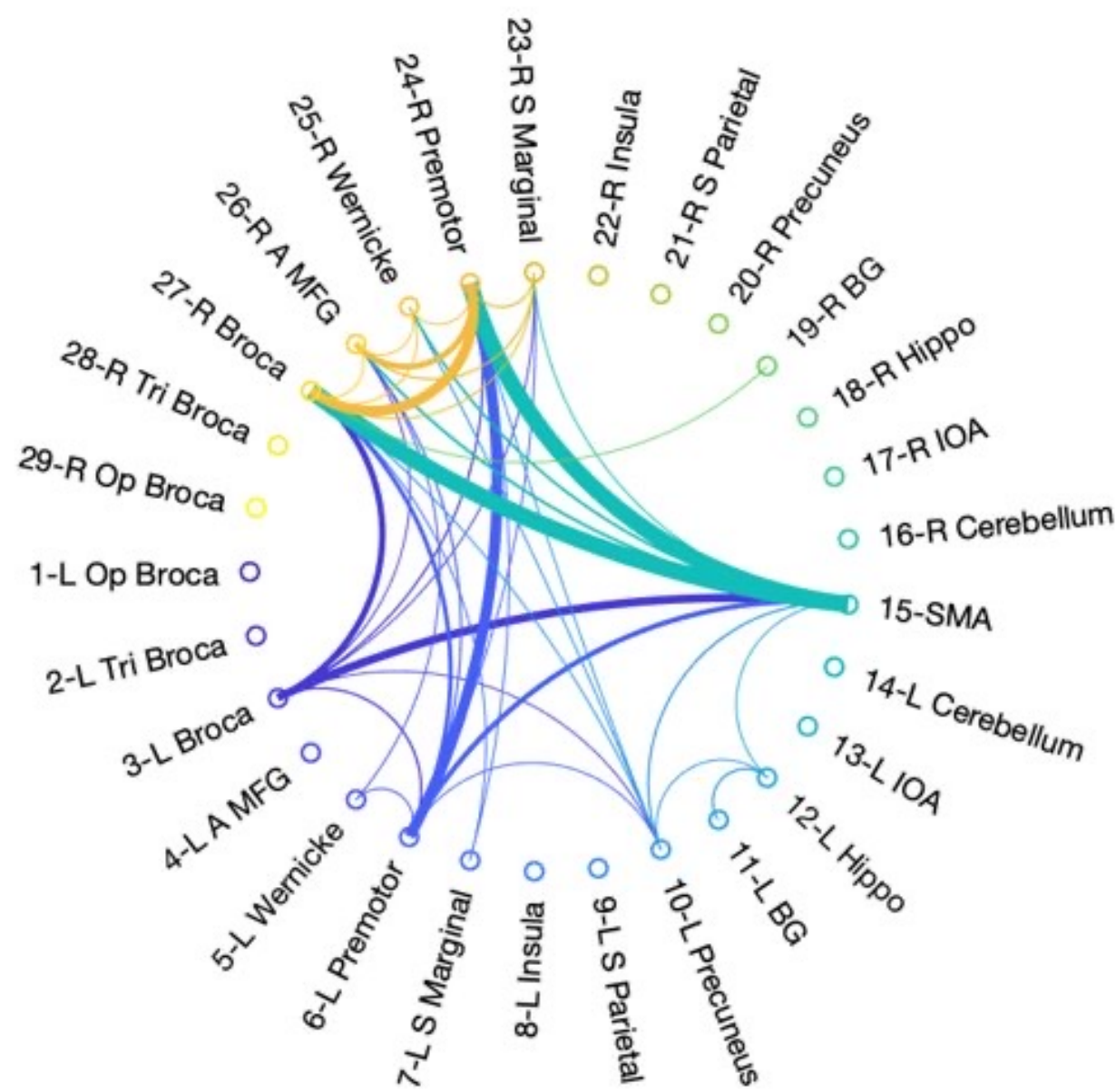


Figure S18. Case5 post-op1.

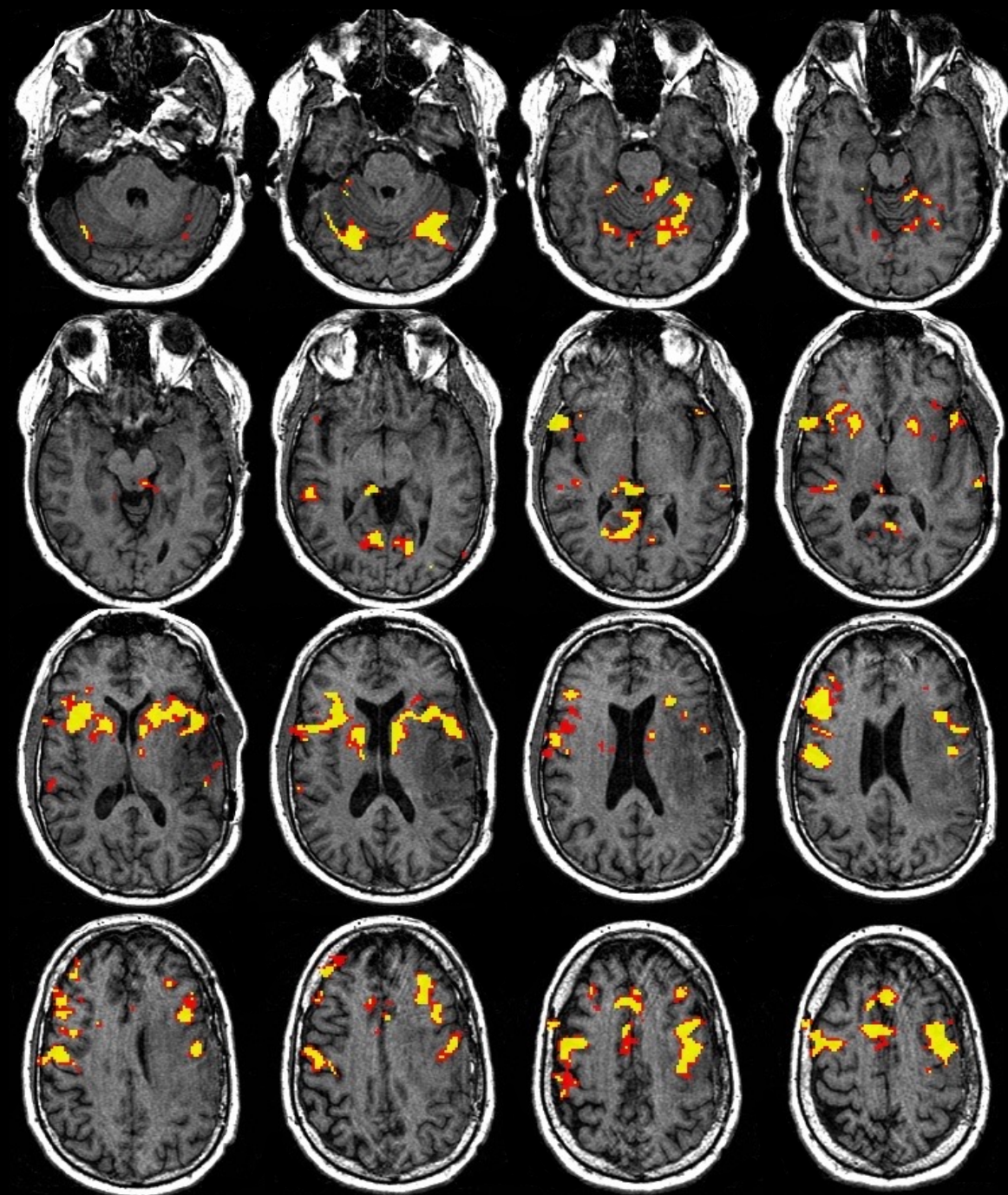
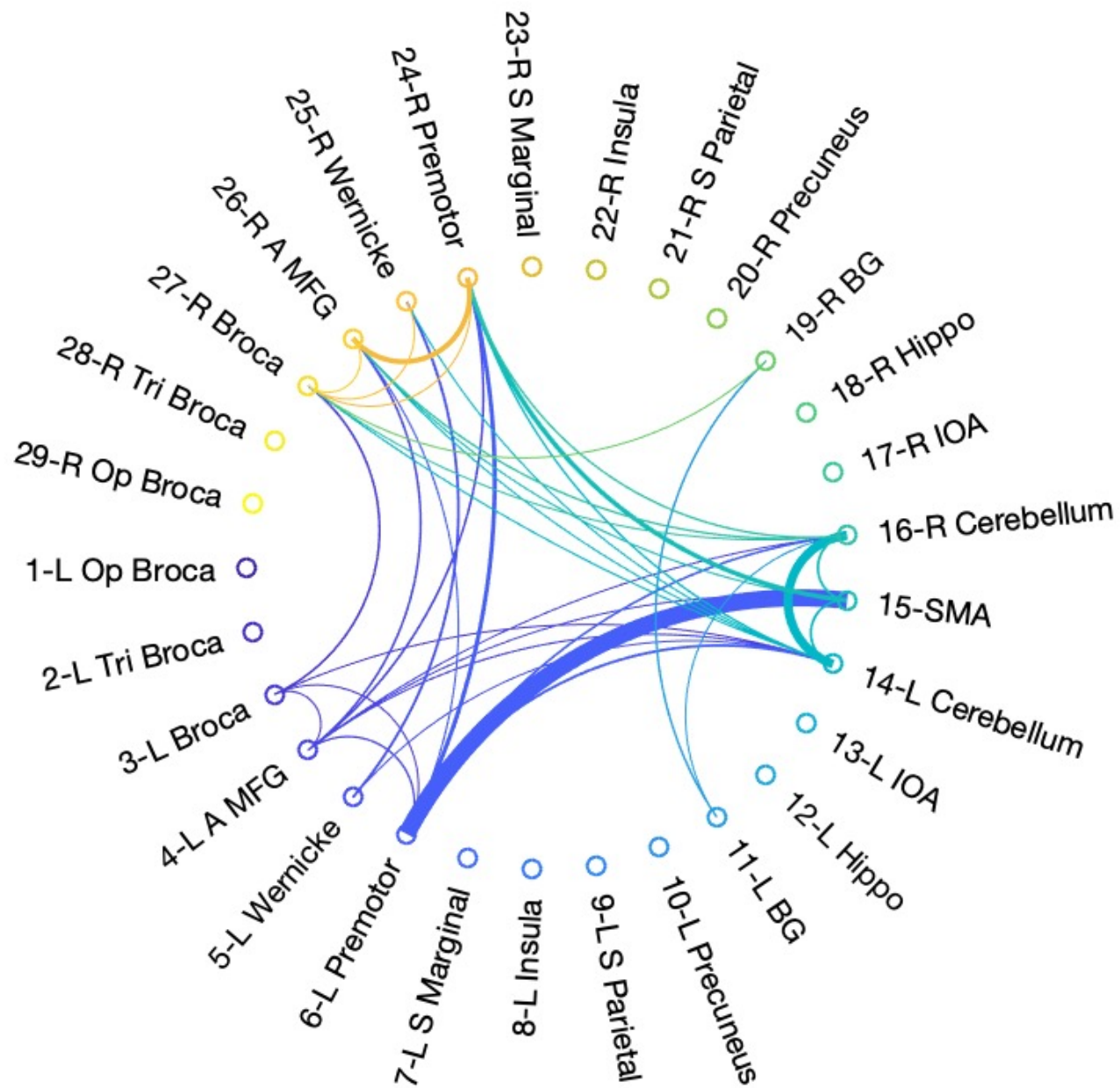


Figure S19. Case5 post-op2.

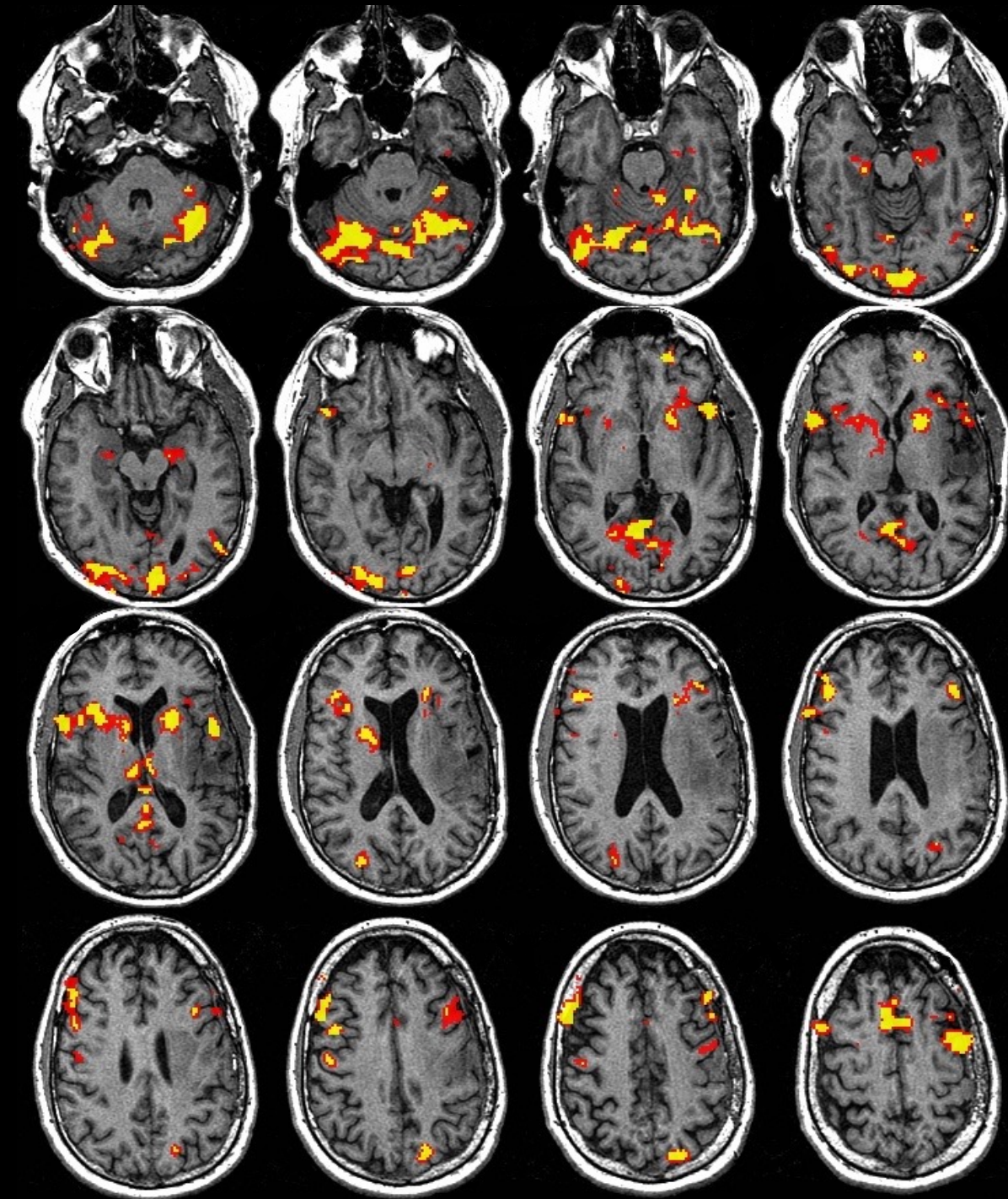
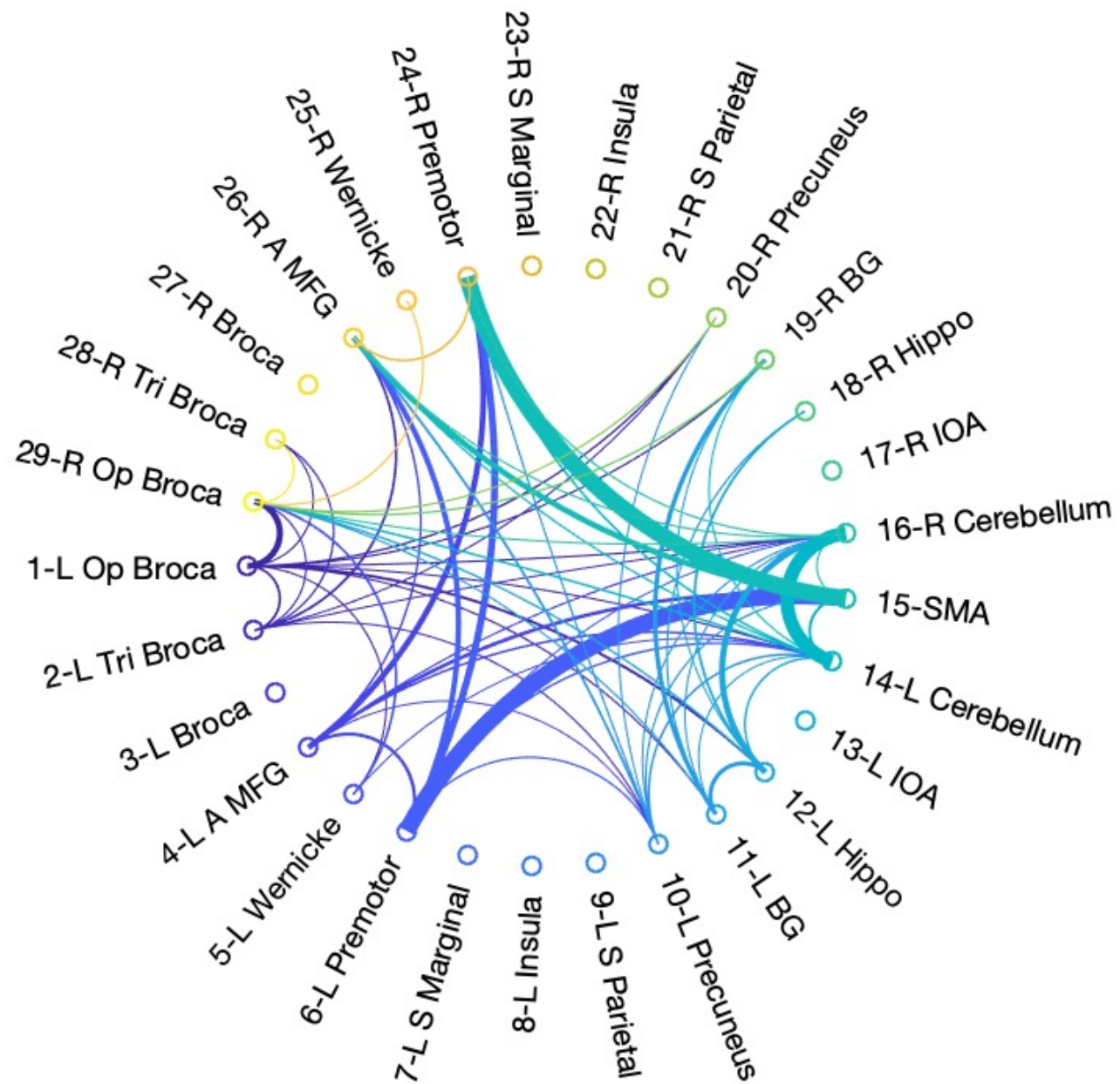


Figure S20. Case5 post-op3.

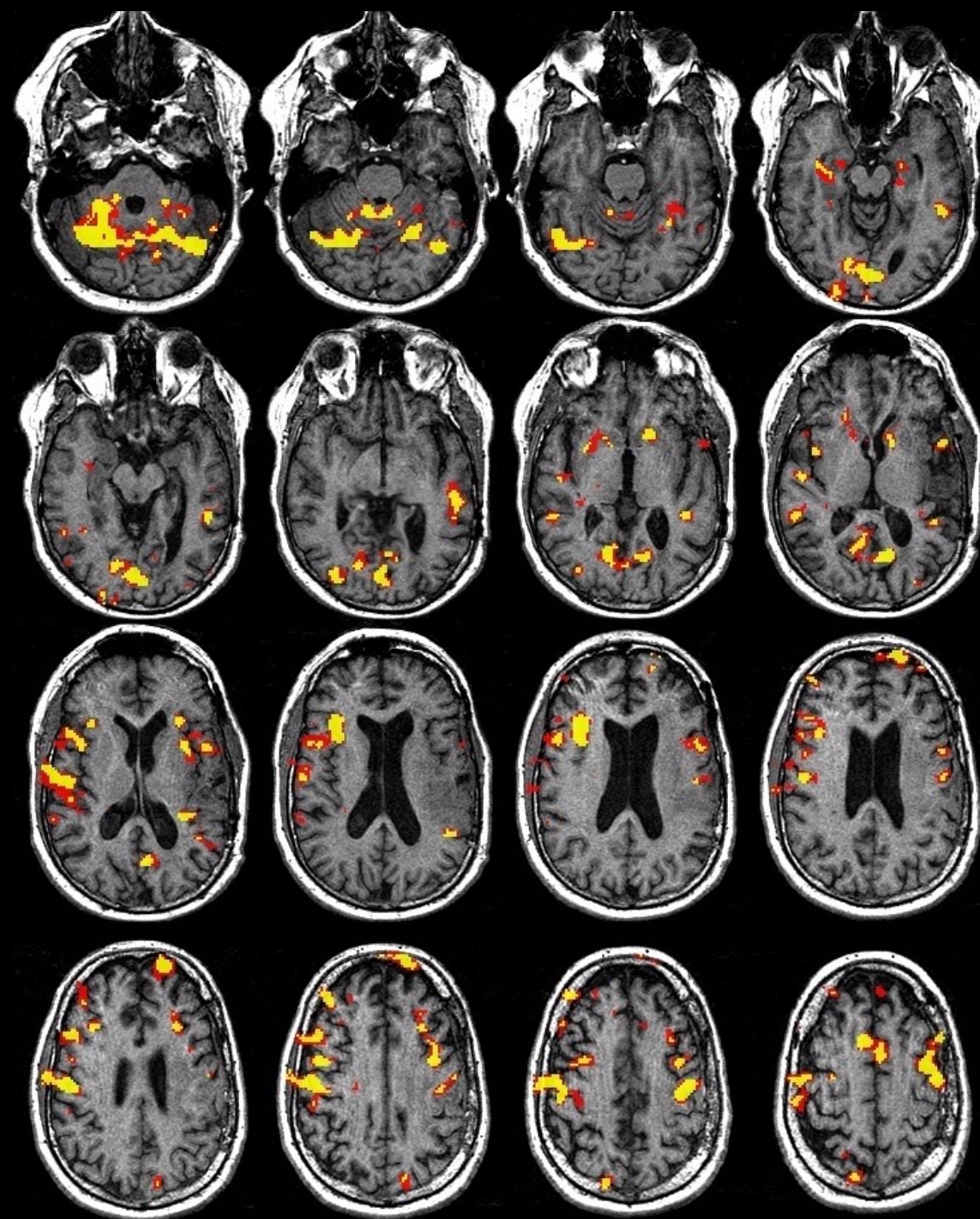
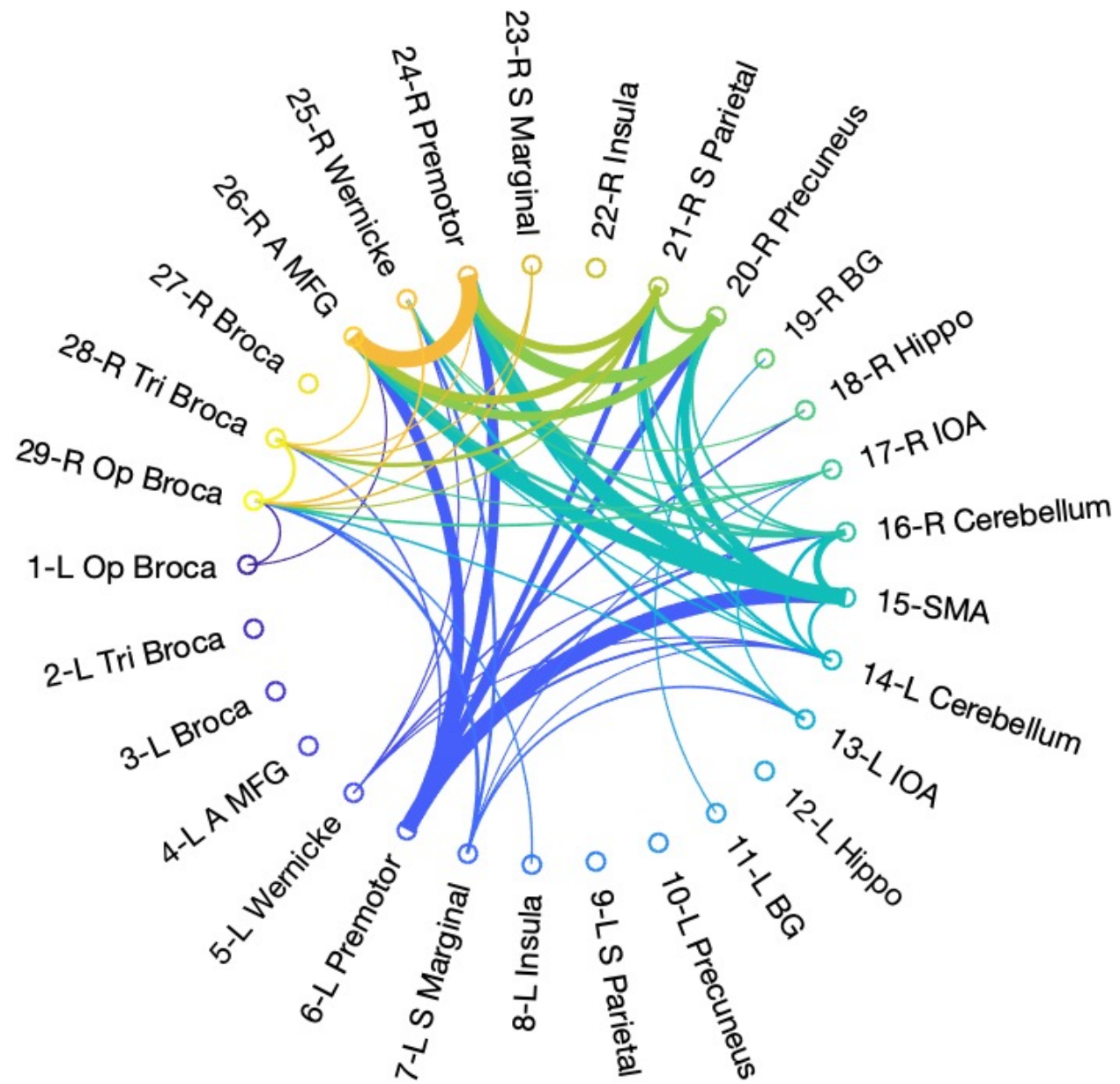


Table S1. Clinical evaluation of speech ability through neurocognitive tests.

<i>Timepoints</i>	BNT raw score (30/60 elements)	BNT Z-score	PVF raw score	PVF Z-score	CF raw score	CF Z-score
<i>CASE 1 Pre-op</i>	NA	NA	NA	NA	NA	NA
<i>CASE 1 Post-op 1</i>	25	0	57	0.89	22	-0.24
<i>CASE 1 Post-op 2</i>	28	0.78	67	1.68	22	-0.24
<i>CASE 1 Post-op 3</i>	NA	NA	NA	NA	NA	NA
<i>CASE 2 Pre-op</i>	8	-3	11	-2.44	8	-2.57
<i>CASE 2 Post-op 1</i>	7	-3	13	-2.3	5	-3
<i>CASE 2 Post-op 2</i>	4	-3	13	-2.3	3	-3
<i>CASE 2 Post-op 3</i>	NA	NA	NA	NA	NA	NA
<i>CASE 3 Pre-op</i>	24	-0.26	29	-1.01	14	-1.67
<i>CASE 3 Post-op 1</i>	28	0.79	34	-0.6	15	-1.43
<i>CASE 3 Post-op 2</i>	28	0.79	24	-1.42	12	-2.15
<i>CASE 3 Post-op 3</i>	27	0.53	28	-1.09	15	-1.43
<i>CASE 4 Pre-op</i>	NA	NA	NA	NA	NA	NA
<i>CASE 4 Post-op 1</i>	29	1.05	45	0.31	18	-0.71
<i>CASE 4 Post-op 2</i>	30	1.32	35	-0.51	20	-0.23
<i>CASE 4 Post-op 3</i>	29	1.05	46	0.39	22	0.25
<i>CASE 5 Pre-op</i>	26	0.26	14	-2.55	21	-0.44
<i>CASE 5 Post-op 1</i>	29	1.05	25	-1.67	23	-0.07
<i>CASE 5 Post-op 2</i>	27	0.53	12	-2.71	24	0.11
<i>CASE 5 Post-op 3</i>	28	0.79	23	-1.83	22	-0.26

BNT=Boston Naming Test; CF=category fluency; NA=non-available; PVF=phonemic verbal fluency

Table S2-6: Functional ROIs.

Here we present supplementary tables including functional ROIs of every patient. Overall, 51 fROIs were identified. Due to intra- and inter-subject variability, which are common in clinical fMRI of brain tumors, not all the areas were active at every timepoint and across patients. Active areas in the left (L) and right (R) hemisphere included: inferior frontal gyrus opercular part (OP BROCA), inferior frontal gyrus triangular part (TRI BROCA), inferior frontal gyrus orbital part (IF ORBITAL), middle frontal gyrus (MFG), middle frontal gyrus anterior division (A MFG), dorsal pre-motor cortex (D PREMOTOR), ventral pre-motor cortex (V PREMOTOR), frontal eye field (FEF), precentral gyrus (PRECENTRAL), post-central gyrus (POSTCENTRAL), Wernicke's area (WERNICKE), supramarginal gyrus (S MARGINAL), angular gyrus (ANG GYRUS), superior parietal lobule (S PARIETAL), precuneus, insula, insular-opercular angle (IOA), hippocampus, thalamus, caudate nucleus (CAUDATE), basal ganglia (BG), visual word form area (VWFA), cerebellum, pre-supplementary motor area (SMA). In some cases, an anatomical subdivision of the functional area was possible, for example when a separate activation was present in the opercular and/or triangular part of the inferior frontal gyrus (Broca's area). In these cases the labeling followed the anatomic subdivision, while in the other cases it followed the general cluster (BROCA).

Table S2 Active clusters for patient 1 at different timepoints (threshold criteria $r > 0.5$;uncorrected $p = 2 \times 10^{-11}$).

CASE 1	T1	T2	T3	T4
1-L OP BROCA			x	x
2-L TRI BROCA			x	

3-L BROCA	x	x		
4-L IF ORBITAL	x			
5-L A MFG			x	
6-L MFG	x	x		
7-L D PREMOTOR	x	x		
8-L V PREMOTOR	x	x		
9-L PREMOTOR			x	x
10-L FEF				
11-L PRECENTRAL				
12-L POSTCENTRAL				
13-L WERNICKE	x	x	x	x
14-L S MARGINAL	x		x	x
15-L ANG GYRUS				x
16-L S PARIETAL				
17-L PRECUNEUS			x	x
18-L INSULA				
19-L IOA				
20-L HIPPOCAMPUS				
21-L THALAMUS				
22-L CAUDATE	x	x		
23-L BG			x	x
24-L VWFA		x		
25-L CEREBELLUM			x	x
26-SMA	x	x	x	x
27-R CEREBELLUM		x	x	x
28-R VWFA				
29-R BG			x	

30-R CAUDATE	x			
31-R THALAMUS				
32-R HIPPOCAMPUS				
33-R-IOA				
34-R INSULA				x
35-R PRECUNEUS		x		
36-R S PARIETAL				
37-R ANG GYRUS				
38-R S MARGINAL				x
39-R WERNICKE	x	x	x	
40-R POSTCENTRAL				
41-R PRECENTRAL				
42-R FEF				
43-R PREMOTOR		x		
44-R V PREMOTOR				
45-R D PREMOTOR				
46-R MFG				
47-R A MFG			x	x
48-R IF ORBITAL	x			
49-R BROCA		x		
50-R TRI BROCA			x	x
51-R OP BROCA			x	

Table S3 Active clusters for patient 2 at different timepoints (threshold criteria $r > 0.5$; uncorrected $p = 2 \times 10^{-11}$).

CASE 2	T1	T2	T3	T4
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1-L OP BROCA	X			
2-L TRI BROCA	X		X	X
3-L BROCA	X		X	
4-L IF ORBITAL				
5-L A MFG	X			X
6-L MFG	X		X	
7-L D PREMOTOR			X	
8-L V PREMOTOR			X	
9-L PREMOTOR	X	X		X
10-L FEF				
11-L PRECENTRAL				
12-L POSTCENTRAL				
13-L WERNICKE	X	X	X	X
14-L S MARGINAL			X	
15-L ANG GYRUS	X	X	X	
16-L S PARIETAL			X	
17-L PRECUNEUS				
18-L INSULA				
19-L IOA				
20-L HIPPOCAMPUS				
21-L THALAMUS	X			
22-L CAUDATE				
23-L BG				X
24-L VWFA				
25-L CEREBELLUM	X	X	X	X
26-SMA	X	X	X	X
27-R CEREBELLUM	X	X		X
28-R VWFA				

29-R BG	x	x	x
30-R CAUDATE			
31-R THALAMUS	x	x	
32-R HIPPOCAMPUS		x	x
33-R-IOA			
34-R INSULA			
35-R PRECUNEUS			
36-R S PARIETAL			
37-R ANG GYRUS	x		
38-R S MARGINAL			x
39-R WERNICKE			x
40-R POSTCENTRAL			
41-R PRECENTRAL			
42-R FEF			
43-R PREMOTOR	x	x	
44-R V PREMOTOR			
45-R D PREMOTOR			x
46-R MFG	x		x
47-R A MFG		x	x
48-R IF ORBITAL			x
49-R BROCA	x	x	
50-R TRI BROCA			x
51-R OP BROCA			x

Table S4 Active clusters for patient 3 at different timepoints (threshold criteria $r > 0.5$; uncorrected $p = 2 \times 10^{-11}$).

CASE 3	T1	T2	T3	T4
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1-L OP BROCA	X			
2-L TRI BROCA				
3-L BROCA	X	X		X
4-L IF ORBITAL				
5-L A MFG				
6-L MFG			X	X
7-L D PREMOTOR	X			X
8-L V PREMOTOR	X			X
9-L PREMOTOR		X	X	
10-L FEF				
11-L PRECENTRAL				
12-L POSTCENTRAL			X	
13-L WERNICKE	X	X	X	X
14-L S MARGINAL				X
15-L ANG GYRUS				
16-L S PARIETAL	X	X		X
17-L PRECUNEUS				
18-L INSULA	X	X		X
19-L IOA				
20-L HIPPOCAMPUS				X
21-L THALAMUS	X			X
22-L CAUDATE				
23-L BG	X	X		
24-L VWFA				
25-L CEREBELLUM				X
26-SMA	X	X	X	X
27-R CEREBELLUM			X	X
28-R VWFA				

29-R BG	X			
30-R CAUDATE				
31-R THALAMUS	X			
32-R HIPPOCAMPUS	X			
33-R-IOA				
34-R INSULA	X			
35-R PRECUNEUS				
36-R S PARIETAL	X			X
37-R ANG GYRUS				
38-R S MARGINAL	X	X		X
39-R WERNICKE	X	X		
40-R POSTCENTRAL				
41-R PRECENTRAL	X			
42-R FEF				
43-R PREMOTOR	X			
44-R V PREMOTOR	X			
45-R D PREMOTOR	X			
46-R MFG	X	X		X
47-R A MFG				
48-R IF ORBITAL				
49-R BROCA	X			X
50-R TRI BROCA				
51-R OP BROCA				

Table S5 Active clusters for patient 4 at different timepoints (threshold criteria $r > 0.5$; uncorrected $p = 2 \times 10^{-11}$).

CASE 4	T1	T2	T3	T4
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1-L OP BROCA	X		X	X
2-L TRI BROCA	X		X	X
3-L BROCA		X		
4-L IF ORBITAL				
5-L A MFG	X		X	X
6-L MFG				
7-L D PREMOTOR				
8-L V PREMOTOR				
9-L PREMOTOR	X	X	X	X
10-L FEF				
11-L PRECENTRAL				
12-L POSTCENTRAL				
13-L WERNICKE	X	X	X	X
14-L S MARGINAL	X		X	
15-L ANG GYRUS				X
16-L S PARIETAL		X		
17-L PRECUNEUS			X	X
18-L INSULA				
19-L IOA				
20-L HIPPOCAMPUS			X	
21-L THALAMUS				
22-L CAUDATE				
23-L BG			X	X
24-L VWFA				
25-L CEREBELLUM		X	X	X
26-SMA	X	X	X	X
27-R CEREBELLUM		X	X	X
28-R VWFA				

29-R BG	X	X
30-R CAUDATE		
31-R THALAMUS		
32-R HIPPOCAMPUS	X	
33-R-IOA		
34-R INSULA		
35-R PRECUNEUS	X	X
36-R S PARIETAL	X	
37-R ANG GYRUS		
38-R S MARGINAL	X	X
39-R WERNICKE	X	X
40-R POSTCENTRAL		
41-R PRECENTRAL		
42-R FEF		
43-R PREMOTOR	X	
44-R V PREMOTOR		
45-R D PREMOTOR		
46-R MFG		
47-R A MFG	X	X
48-R IF ORBITAL		
49-R BROCA	X	X
50-R TRI BROCA	X	X
51-R OP BROCA	X	

Table S6 Active clusters for patient 5 at different timepoints (threshold criteria $r > 0.5$; uncorrected $p = 2 \times 10^{-11}$).

CASE 5	T1	T2	T3	T4
1-L OP BROCA			X	X
2-L TRI BROCA			X	
3-L BROCA	X	X		
4-L IF ORBITAL				
5-L A MFG		X	X	
6-L MFG				
7-L D PREMOTOR				
8-L V PREMOTOR				
9-L PREMOTOR	X	X	X	X
10-L FEF				
11-L PRECENTRAL				
12-L POSTCENTRAL				
13-L WERNICKE	X	X	X	X
14-L S MARGINAL	X			X
15-L ANG GYRUS				
16-L S PARIETAL				
17-L PRECUNEUS	X		X	
18-L INSULA				X
19-L IOA				X
20-L HIPPOCAMPUS	X		X	
21-L THALAMUS				
22-L CAUDATE				
23-L BG	X	X	X	X
24-L VWFA				
25-L CEREBELLUM			X	X
26-SMA	X	X	X	X
27-R CEREBELLUM			X	X

28-R VWFA				
29-R BG	X	X	X	X
30-R CAUDATE				
31-R THALAMUS				
32-R HIPPOCAMPUS			X	X
33-R-IOA				X
34-R INSULA				X
35-R PRECUNEUS			X	X
36-R S PARIETAL				X
37-R ANG GYRUS				
38-R S MARGINAL	X			X
39-R WERNICKE	X	X	X	X
40-R POSTCENTRAL				
41-R PRECENTRAL				
42-R FEF				
43-R PREMOTOR	X	X	X	X
44-R V PREMOTOR				
45-R D PREMOTOR				
46-R MFG				
47-R A MFG	X	X	X	X
48-R IF ORBITAL				
49-R BROCA	X	X		
50-R TRI BROCA			X	X
51-R OP BROCA			X	X