

Supplementary Table 1
Extensive overview of 98 reports on ICDs in PD published between 2000–January 2013 including case reports, case series, case-control studies, experimental studies, and epidemiological studies.
The table provides information on sample size, gender distribution, treatment, age, and PD duration

Reference	Total N with PD	N (f:m) with ICDs	Treatment: N	Total LEDD, Mean (SD) mg/day DA LEDD/DA dose, Mean (SD) mg/day	Age Mean (SD) years	Age at PD onset Mean (SD) years
<i>Case reports and case series</i>						
Seedat et al. (2000) [16]	1	1 (1:0) PG: 1	Pergolide	NA	59	47
Giovannoni et al. (2000) [56]	15	15 (3:12) DDS: 15 HS: 2	Levodopa Bromocriptine Pergolide Apomorphine	Levodopa: 1875–5500 Bromocriptine: 15–70 Pergolide: 1.5 Apomorphine: 75–170	NA	43 (7.9)
Gschwandtner et al. (2001) [58]	2	2 (0:2) PG: 2 DDS: 2 Punding: 1	Levodopa Pergolide Ropinirole	Levodopa: 400–700, one patient took 1800 Pergolide: 3 Ropinirole: 6 prescribed, one patient took 18	(56 ±6)	(51 ±8)
Serrano-Duenas (2002) [132]	4	4 (1:3) PG: 4 DDS: 4 HS: 1 BE: 1	Levodopa Bromocriptine	Levodopa: 1437.5 (161.37) prescribed, mean dose actually taken: 2250 (204.12) Bromocriptine, mean dose prescribed: 20 (4.56), mean dose actually taken: 38.75 (6.61)	65.8 (5.37)	PD duration: 9.5 (1.11)
Kurlan (2004) [60]	6	6 PG: 2 Punding: 4 (3:1)	Levodopa PDI: Pramipexole: 2 PDI: Clonazepam: 1	Levodopa: 750–1800 PDI: Pramipexole: 1.5–3 PDI: Clonazepam: 1.5	67 PDI: 60.5 PDI: 70.3	54 PDI: 50.5 PDI: 55.8
Avanzi et al. (2004) [19]	2	2 (0:2) PG: 2 DDS: 2	Levodopa Ropinirole: 1 Cabergoline: 1	Levodopa: 425–525 Ropinirole: 15 Cabergoline: 4	57	50
Sensi et al. (2004) [93]	1	1 (0:1) Intermittent explosive disorder: 1 Kleptomania: 1	STN DBS During the 6 months prior to surgery: Levodopa Pergolide	During the 6 months prior to surgery: Levodopa: 600 Pergolide: 3	64	56
Dood et al. (2005) [20]	11	11 (2:9) PG: 11 HS, BE and/or CB: 6	Levodopa: 8 Pramipexole: 9 Ropinirole: 2	Levodopa: 300–1500 Pramipexole: 6.2 Ropinirole: 18	53.5	47.2

Supplementary Table 1
(continued)

Reference	Total N with PD	N (f:m) PD patients with ICDs	Treatment: N	Total LEDD, Mean (SD) mg/day DA LEDD/DA dose, Mean (SD) mg/day	Age Mean (SD) years	Age at PD onset Mean (SD) years
Witjas et al. (2005) [35]	2	2 (0:2) HS: 2 DDS: 2	Levodopa Ropinirole DBS in STN	Pre-DBS: 1450–2500 Post-DBS: 0–300 Ropinirole: 30 DBS in STN	45.5	39
Klos et al. (2005) [62]	13	13 (0:13) HS: 13 PG: 4 CB: 1 Walkabout: 2	Levodopa: 11 Pramipexole: 7 Pergolide: 3 Ropinirole: 4	Levodopa: 600–1750 Pramipexole: 3–13.5 Pergolide: 1.5–3 Ropinirole: 20–32	Median age at onset of ICD = 58 (range 44–75)	Median age at PD onset = 51 (range 40–70)
Larner (2006) [63]	1	1 (0:1) PG: 1 HS: 1	Levodopa Pergolide	Levodopa: NA Pergolide: 5	42	40
Drapier et al. (2006) [66]	6	6 (2:4) PG: 6	Levodopa: 6 Pergolide: 2 Bromocriptine: 2 Ropinirole: 1 Selegiline: 1 Levodopa Pramipexole	LEDD range: 300–1800 Pergolide: 5–6 Bromocriptine: 12.5–40 Ropinirole: 15 Selegiline: 10 Levodopa: 600 Pramipexole: 1.4	52.6 (6.6)	PD duration = 7.5 (2.8)
Spengos et al. (2006) [88]	1	1 (1:0) PG: 1	Levodopa: 2 Pramipexole: 1	Levodopa: 800–1200 Pramipexole: 4.2	64	63
Bandini et al. (2007) [41]	2	2 (0:2) PG: 2	Bromocriptine: 1 Levodopa: 8 Cabergoline: 3 Pergolide: 2	Bromocriptine: 30 859 (range: 450–1,300) Cabergoline: 4–6 Pergolide: 3–5	47 (4)	42.5 (3.5)
Wong et al. (2007) [70]	8	8 (2:6) PG: 8 HS, hobbyism, or BE: 3	DDS: 2 Levodopa: 8 Cabergoline: 3 Pergolide: 2 Ropinirole: 3	859 (range: 450–1,300) Cabergoline: 4–6 Pergolide: 3–5 Ropinirole: 10–21	57 (range: 48–78)	Mean PD duration prior to PG = 8 years (range: 4–15)
McKeon et al. (2007) [71]	PD: 6 MSA: 1	7 (2:5) BE: 2 (2:0) PG: 2 (1:1) CB: 1 (0:1) HS: 2 (0:2) Hobbyism/punding: 4 (1:3)	Levodopa: 5 Pramipexole: 4 Ropinirole: 2	Levodopa LEDD: 100–800 Pramipexole: 2–4.5 Ropinirole: 21–24	57.7 (range: 48–67)	7.8 (range: 1–13)

Supplementary Table 1
(continued)

Reference	Total N with PD	N (f:m) PD patients with ICDs	Treatment: N	Total LEDD, Mean (SD) mg/day DA LEDD/DA dose, Mean (SD) mg/day	Age Mean (SD) years	Age at PD onset Mean (SD) years
Smeding et al. (2007) [37]	1	1 (0:1) PG: 1	Bilateral STN DBS Levodopa Pergolide	Pre-DBS: Levodopa/Carbidopa: 600/150 Pergolide: 8 12 months post-DBS: Levodopa LEDD: 510 Pergolide: 3	63	53
Mamikonyan et al. (2008) [89]	15	15 (4:11) HS: 7 PG: 8 CB: 3 Multiple ICD: 2	Time 1: Levodopa Pergolide: 2 Pramipexole: 6 Ropinirole: 7 Time 2: Levodopa Pergolide: 1 Pramipexole: 5 Ropinirole: 2	Levodopa: 349.7 (381.3) Pergolide: 6.5 Pramipexole: 3.75 Ropinirole: 13 Time 2: Levodopa: 482.3 (358.9) Pergolide: 8 Pramipexole: 2 Ropinirole: 13.5	60.9 (11.1)	PD duration: 9.4 (4.6)
Knobel et al. (2008) [40]	1	1 (0:1) Pre-DBS DDS: 1 Pre-DBS PG: 1	Levodopa Ropinirole Cabergoline STN DBS	Pre-DBS: 1830 Ropinirole: 3 Cabergoline: 4 Post-DBS: 437.5 after 1 month, 560 after 6 months	55	39
Kimber et al. (2008) [115]	5	5 (1:4) Punding: 4 Walkabout: 1	Levodopa: 5 Cabergoline: 4 Pergolide: 2	Mean levodopa dose: 630 (range: 300–1250) mg/d Mean cabergoline dose: 5 (range: 4–8) mg/d Mean pergolide dose: 3.5 (range: 3–4) mg/d	56.4	49.6

Supplementary Table 1
(continued)

Reference	Total N with PD	N (f:m) PD patients with ICDs	Treatment: N	Total LEDD, Mean (SD) mg/day DA LEDD/DA dose, Mean (SD) mg/day	Age Mean (SD) years	Age at PD onset Mean (SD) years
Lim et al. (2009) [39]	21 (ICDs in all some time during PD)	HS: 2 PG: 4 CB: 1 BE: 1	Bilateral STN DBS: 18 Unilateral STN DBS: 1 Bilateral GPI DBS: 2 Levodopa: 21 DAs: 18	Post-DBS LEDD in poor outcome group (15 patients): 2745 (1328) DA LEDD: 293 (64) Post-DBS LEDD in good outcome group (6 patients): 329 (363) DA LEDD: 154 (57)	55.7	42 (9)
		After DBS: ICDs in 17 (2:15) DDS: 14 (1:13) PG: 4 (1:3) HS: 7 (0:7) CB: 3 (0:3) BE: 2 (0:2) Punding: 14 (2:12) Multiple ICDs: 14 (1:13)				
Wingo et al. (2009) [117]	3	3 (1:2) HS: 1 PG: 2 Punding: 1	Levodopa: 2 Rotigotine: 3 Selegiline: 2 Amantadine: 1	Mean levodopa dose: 333.3 (range: 300–400) mg/d Mean rotigotine dose: 19.5 (range: 18–22.5) Selegiline dose: 10 mg/d Amantadine dose: 200 mg/d	55.7 (range: 49–62)	50 (range: 44–58)

Supplementary Table 1
(continued)

Reference	Total N with PD	N (f:m) with ICDs	Treatment: N	Total LEDD, Mean (SD) mg/day DA LEDD/DA dose, Mean (SD) mg/day	Age Mean (SD) years	Age at PD onset Mean (SD) years
Fernández et al. (2009) [119]	1	1 (0:1) HS: 1 PG: 1 DDS: 1	Levodopa Amantadine Ropinirole Selegiline Entacapone Levodopa Pramipexole	Levodopa: 1000 mg/d Amantadine: 200 mg/d Ropinirole: 20 mg/d Selegiline: 10 mg/d Entacapone: 1000 mg/d Levodopa: 1250 Pramipexole: 3	48	37
Bonfanti et al. (2010) [126]	1	1 (1:0) CB: 1 Kleptomania: 1	PD: Levodopa: 3 Piribedil: 4 MSA: Levodopa: 1 Piribedil: 1	PD: Mean levodopa dose: 350 (range: 300–400) Mean piribedil dose: 187.5 (range: 150–250) MSA: Levodopa: 850 Piribedil: 150	68	54
Tschopp et al. (2010) [116]	4 PD 1 MSA	4 (1:3) Punding: 2 BE: 2 HS: 2 PG: 2 Jealousy: 1 MSA: 1 (1:0) BE: 1 HS: 1	PD: Levodopa: 3 Piribedil: 4 MSA: Levodopa: 1 Piribedil: 1	PD: 62.5 (range: 49–71) MSA: 68	PD duration: 4.5 (range: 2–6) MSA duration: 2	
Stefani et al. (2010) [118]	1	1 (0:1) PG: 1 HS: 1 CB: 1 DDS: 1 2 (0:2) PG: 2 HS: 1	Levodopa DBS in STN DBS in the nucleus of the pedunculopontine tegmentus Pramipexole	Levodopa: 450 STN DBS: 185Hz DBS in the nucleus of the pedunculopontine tegmentus: 20 Hz Pramipexole: 1.5 (range: 1–2)	51	39
Kolla et al. (2010) [124]	2				63 (range: 61–65)	NA

Supplementary Table 1
(continued)

Reference	Total N with PD	N (f:m) PD patients with ICDs	Treatment: N	Total LEDD, Mean (SD) mg/day DA LEDD/DA dose, Mean (SD) mg/day	Age Mean (SD) years	Age at PD onset Mean (SD) years
Avila et al. (2011) [84]	25	25 (6:19) PG: 4 HS: 9 CB: 4 BE: 2 DDS: 1 Punding: 11 Multiple ICDs: 5	Levodopa: 23 Pramipexole: 12 Ropinirole: 3 Rotigotine: 1 Pergolide: 1	LEDD: 765.04 (431.92) DA LEDD: 285.81 (117.72)	73.96 (6.72)	Median PD duration: 4 (range: 1–21)
Hinnell et al. (2011) [102]	1	1 (0:1) HS: 1 BE: 1	Levodopa Rotigotine	Levodopa: 850 Rotigotine: 13.5	66	58
Sriram et al. (2012) [34]	4	4 (2:2) DDS: 4 (2:2) CB: 1 (1:0) Punding: 1 (1:0) HS: 1 (1:0)	STN DBS: 2 GPI DBS: 1 Levodopa: 4 Ropinirole: 2 Apomorphine: 1	Pre-DBS: Levodopa LEDD: 600–1333 Ropinirole: 4–16 Apomorphine PRN: 5 doses Post-DBS: Levodopa LEDD: 1200–1383 Ropinirole: 2 Apomorphine PRN: 5 doses Levodopa: 750 Piribedil 200 mg/d prescribed but took 400 mg/d	62.3	52
Giugni et al. (2012) [81]	1	1 (1:0) DDS: 1 CB: 1	Levodopa Piribedil		73	NA

Supplementary Table 1
(continued)

Reference	Total N with PD	N (f:m) PD patients with ICDs	Treatment: N	Total LEDD, Mean (SD) mg/day DA LEDD/DA dose, Mean (SD) mg/day	Age Mean (SD) years	Age at PD onset Mean (SD) years
Solla et al. (2012) [103]	2	2 (1:1) DDS: 2 PG: 1 HS: 2	Levodopa: 2 Pergolide: 1	Levodopa: 1000–1400 mg/d prescribed, but actual dose was 2000 mg/d Pergolide: 3 mg/d	57.5 (range: 48–67)	48.5 (range: 42–55)
Vitale et al. (2013) [101]	2	2 (0:2) PG: 1 HS: 1	Levodopa: 2 Rasagiline: 2	Levodopa: 500–600 mg/d Rasagiline: 1 mg/d	63.5	58.5
<i>Case-control studies</i> Molina et al. (2000) [18]	250	12 (1:11) PG: 12 Punding: 3 BE: 1	PDI: Levodopa: 12	NA	56 (9)	43 (9)
Romito et al. (2002) [33]	30	4 (1:3) HS: 4	Levodopa Pergolide STN DBS	Pre-DBS: Levodopa: 400–1200 Pergolide: 5–6	53	41
Evans et al. (2004) [61]	50	17 (5:12) Punding: 17 HS: 4 PG: 1 DDS: 10	PDI: Levodopa: 16 Pergolide: 2 Bromocriptine: 1 PDC:	PDI: 1,707 PDC: 1,130, $p < 0.000$	PDI: 59 PDC: 63	PDI: 44 PDC: 49
Avanzi et al. (2006) [21]	98	6 (3:3) PG: 6 DDS: 2	Levodopa: 33 Pergolide: 10 Bromocriptine: 2 PDI: Levodopa: 6 DA: 4	PDI: 760 (208) PDC: 717 (463)	68 (6)	PDI: 60 (2) PDC: 63 (4)

Supplementary Table 1
(continued)

Reference	Total N with PD	N (f:m) PD patients with ICDs	Treatment: N	Total LEDD, Mean (SD) mg/day DA LEDD/DA dose, Mean (SD) mg/day	Age Mean (SD) years	Age at PD onset Mean (SD) years
Voon et al. (2007) [25]	63	21 (6:15) PG: 21	Levodopa in 20 Pramipexole: 5 Ropinirole: 8 Pergolide: 7 PDI: Pramipexole: 8 Ropinirole: 1 Pergolide: 1	PDI: 874 (496) DA LEDD: 268 (194) PDC: 747 (323) DA LEDD: 192 (105) PDI: 656 (252) PDC: 622 (294)	60(9)	PDI: 51 (9) PDC: 58 (10)
Isaias et al. (2008) [91]	50	14 (7:7) CB: 5 (4:1) Intermittent explosive disorder: 1 (1:0) HS: 2 (1:1) PG: 1 (1:0) Multiple ICDs: 5 (0:5)			PDI: 60 (9) PDC: 65 (9)	PDI: 51 PDC: 57
Cilia et al. (2008) [108]	51	11 (1:10) PG: 11 HS: 5 BE: 2 CB: 2 Hobbyism: 1	PDI: Levodopa: 11 Pramipexole: 6 Ropinirole: 2 Pergolide: 3 PDC: Levodopa: 40 Pramipexole: 20 Ropinirole: 7 Pergolide: 10 Cabergoline: 3	PDI: 812 (229) DA LEDD: 289 (58) PDC: 877 (289) DA LEDD: 340 (157)	PDI: 57 (6) PDC: 55 (7)	PDI: 50 (5) PDC: 46 (7)
Imamura et al. (2008) [122]	48	11 (0:11) PG: 11	PDI: Levodopa: 7 Pramipexole: 7 Ropinirole: 1 PDC: Levodopa: 32 Pramipexole: 12 Ropinirole: 3	PDI: 573 (548) Pramipexole: 4 (2) PDC: 879 (558) Pramipexole: 3 (2), $p < 0.001$	PDI: 60 (7) PDC: 62 (1)	PDI: 50 (13) PDC: 54 (12)

Supplementary Table 1
(continued)

Reference	Total N with PD	N (f:m) PD patients with ICDs	Treatment: N	Total LEDD, Mean (SD) mg/day DA LEDD/DA dose, Mean (SD) mg/day	Age Mean (SD) years	Age at PD onset Mean (SD) years
Hälbjg et al. (2009) [42]	53	6 (NA) PD with DBS: 3 PG: 1 CB: 2 PD without DBS: 3 PG: 1 CB: 2 HS: 1 Trichotillomania: 1 Multiple ICDs: 2 15 (4:11) PG: 15	Levodopa: 44 DA: 21 STN DBS: 16	PD with DBS: 682 (427) PD without DBS: 582 (460)	PD with DBS: 64 (10) PD without DBS: 66 (11)	PD with DBS: 52 PD without DBS: 60
Santangelo et al. (2009) [123]	30		PDI: Levodopa: 13 DA: 12 (Pramipexole: 10) PDC: Levodopa: 12 DA: 14 (Pramipexole: 9; Ropinirole: 2)	PDI: 774 (320) DA LEDD: 280 (209) PDC: 651 (284) DA LEDD: 293 (180)	PDI: 62 (10) PDC: 62 (9)	PDI: 53 (10) PDC: 55 (9)
Siri et al. (2010) [114]	63	21 (3:18) PG: 21	Levodopa DA	PDI: 731 (284) DA LEDD: 268 (114) PDC: 787 (284) DA LEDD: 239 (131)	PDI: 60 (8) PDC: 65 (6), $p=0.01$	PDI: 53 (9) PDC: 57 (7)
Voon et al. (2010) [75]	28	14 (4:10) PG: 9 CB: 5	Levodopa: 20 Pramipexole: 18 Ropinirole: 10	PDI: 589 (301) DA LEDD: 162 (43) PDC: 610 (298) DA LEDD: 156 (57)	PDI: 52 (8) PDC: 55 (13)	NA
Vitale et al. (2011) [78]	63	49 PG: 14 (4:10) HS: 13 (0:13) BE: 12 (6:6) Multiple ICDs: 10 (1:9)	Levodopa: 54 Pramipexole: 41 Ropinirole: 11	PDI: 719 DA LEDD: 243 PDC: 630 (312) DA LEDD: 267 (201)	PDI: 65 PDC: 61	PDI: 57 PDC: 53

Supplementary Table 1
(continued)

Reference	Total N with PD	N (f:m) PD patients with ICDs	Treatment: N	Total LEDD, Mean (SD) mg/day DA LEDD/DA dose, Mean (SD) mg/day	Age Mean (SD) years	Age at PD onset Mean (SD) years
Zahodne et al. (2011) [36]	96	36 BE: 9 (3:6) PG: 17 CB: 11 HS: 1 Punding: 8 Multiple ICDs: 67% of PD BE Multiple ICDs: 29% of PD without BE	DA: 42% DBS: 22 STN DBS: 16 GPi DBS: 6 STN DBS: 4 PD BE (44%) STN DBS: 14% of PD without BE	PD BE: 563 (251) PD without BE: 681 (490)	PD BE: 68 (5) PD without BE: 66 (10)	PD BE: 58 (8) PD without BE: 56 (13)
Leroi et al. (2011) [86]	99	35 (NA) PG: 12 HS: 9 CB: 5 BE: 3 DDS: 3 Punding: 3 35 (NA) PG: 2 HS: 16 CB: 17 BE: 1 Punding: 3 Hobbyism: 7 Multiple ICDs: 12	Levodopa DA	142 (165) LEDD range: 0–610 mg/d	63 (11)	55 (12)
Biundo et al. (2011) [87]	59	35 (NA) PG: 2 HS: 16 CB: 17 BE: 1 Punding: 3 Hobbyism: 7 Multiple ICDs: 12	Levodopa DA	PDI: 557 (305) DA LEDD: 187 (149) PDC: 497 (341) DA LEDD: 166 (109)	PDI: 61 (10) PDC: 70.4 (6.8), $p < 0.001$	PDI: 53 (11) PDC: 61 (10), $p = 0.012$
Voon et al. (2011) [80]	564	282 (91:191) PG: 54 (14:40) CB: 59 (28:31) HS: 47 (1:46) BE: 41 (20:21)	Levodopa DA	PDI: 946 (36) DA LEDD: 266 (14) PDC: 809 (36) DA LEDD: 265 (14)	PDI: 61 (1) PDC: 61 (1)	PDI: 54 (1) PDC: 54 (1)

Supplementary Table 1
(continued)

Reference	Total N with PD	N (f:m) PD patients with ICDs	Treatment: N	Total LEDD, Mean (SD) mg/day DA LEDD/DA dose, Mean (SD) mg/day	Age Mean (SD) years	Age at PD onset Mean (SD) years
Cilia et al. (2011) [94]	30	15 (1:14) PG: 15	Levodopa DA	PDI: 848 (253) DA LEDD: 296 (148) PDC: 880 (245) DA LEDD: 317 (116)	PDI: 59 (8) PDC: 59 (7)	PD duration: PDI: 9 (3) PDC: 9 (2)
Chazeron et al. (2011) [109]	115	PG: 1 Problem gambling: 14 HS: 2	Levodopa monotherapy: 40 DA monotherapy: 4 Levodopa + DA: 61 No levodopa or DA: 10	All patients: Levodopa LEDD: 631 (436) DA LEDD: 130 (168)	All patients: 67 (6)	All patients, PD duration: 7 (4)
Bentivoglio et al. (2012) [97]	34	17 (3:14) HS: 8 CB: 2 PG: 10 BE: 6	Levodopa DA	PDI: 606 (319) DA LEDD: 173 (112) PDC: 616 (368) DA LEDD: 193 (89)	PDI: 62 (10) PDC: 64 (9)	PD duration: PDI: 7 (4) PDC: 7 (4)
Djanshidian et al. (2012) [113]	43	Multiple ICDs: 7 26 (4:22) HS: 12 PG: 13 CB: 5 Punding: 7	Levodopa PDI: DA: 13 PDC: DA: 21	PDI: 934 (407) PDC: 740 (369)	PDI: 59 (10) PDC: 65 (5), $p < 0.001$	PDI: 48 (10) PDC: 55 (7), $p = 0.002$
<i>Experimental studies</i> Evans et al. (2006) [79]	16	8 (NA) DDS: 8 Punding: 8	Levodopa DA	PDI: 1,517 PDC: 848	PDI: 51 PDC: 60	PDI: 39 PDC: 48
Steeves et al. (2009) [74]	14	7 (2:5) PG: 7	Levodopa: 14 DA: 14 PDI: Pramipexole: 5 Ropinirole: 2 Levodopa: 16 DA: 17	PDI: 856 (407) DA LEDD: 138 (172) PDC: 756 (400) DA LEDD: 167 (113)	PDI: 47–72 PDC: 51–74	PD duration: PDI: 7 (3) PDC: 6 (3)
Rao et al. (2010) [92]	18	9 (2:7) BE: 5 PG: 4		PDI: 418 (306) DA LEDD: 278 (116) PDC: 309 (171)	PDI: 56 (11) PDC: 54 (10)	PDI: 49 PDC: 47

Supplementary Table 1
(continued)

Reference	Total N with PD	N (f:m) PD patients with ICDs	Treatment: N	Total LEDD, Mean (SD) mg/day DA LEDD/DA dose, Mean (SD) mg/day	Age Mean (SD) years	Age at PD onset Mean (SD) years
Cilia et al. (2010) [95]	29	CB: 3 HS: 4 Multiple ICDs: 4 8 (1:7) PG: 8 HS: 5 BE: 3 CB: 2	Levodopa: 29 DA: 29	DA LEDD: 319 (187)		
				PDI: 831 (294) DA LEDD: 241 (118) PDC: 852 (301) DA LEDD: 252 (121)	PDI: 61 (8) PDC: 60 (9)	PD duration: PDI: 6 (2) PDC: 6 (2)
				PDI: 508 (301) DA LEDD: 162 (43) PDC: 610 (298) DA LEDD: 155 (57)	PDI: 52 (8) PDC: 55 (13)	NA
Voon et al. (2010) [96]	28	Multiple ICDs: 6 14 (4:10) PG: 9 CB: 5	PDI: Levodopa: 10 Pramipexole: 9 Ropinirole: 5 PD wo ICD: Levodopa: 10 Pramipexole: 9 Ropinirole: 5 Levodopa			
Wu et al. (2010) [110]	15	5 (NA) NA	Levodopa	NA	NA	NA
Van Eimeren et al. (2010) [107]	14	7 (NA) PG: 7	Levodopa	PDI: 772 (318) DA LEDD: 143 (105) PDC: 700 (323) DA LEDD: 122 (85)	PDI: 60 (10) PDC: 62 (11)	PD duration: PDI: 7 (3) PDC: 7 (3)
			DA PDI: Pramipexole: 6 Ropinirole: 1 Levodopa			
Frosini et al. (2010) [112]	14	7 (NA) PG: 7 BE: 1 HS: 1	PDI: Pramipexole: 4 Ropinirole: 3 PDC: Pramipexole: 4 Ropinirole: 3	PDI: 520 (219) DA LEDD: 408 (156) PDC: 462 (229) DA LEDD: 325 (50)	PDI: 58 (11) PDC: 58 (9)	PD duration: PDI: 6 (2) PDC: 7 (4)

Supplementary Table 1
(continued)

Reference	Total N with PD	N (f:m) PD patients with ICDs	Treatment: N	Total LEDD, Mean (SD) mg/day DA LEDD/DA dose, Mean (SD) mg/day	Age Mean (SD) years	Age at PD onset Mean (SD) years
Rodriguez-Oroz et al. (2011) [38]	28	10 (1:9) PG: 5 HS: 5 CB: 5 BE: 2 DDS: 5 Punding: 5 Multiple ICDs: 7	Levodopa DA STN DBS: 28	PDI: 1041 (689) PD dyskinesia: 1170 (531) PDC: 1024 (465)	PDI: 53 (11) PD dyskinesia: 62 (4) PDC: 59 (5)	PDI: 44 PD dyskinesia: 46 PDC: 48
Voon et al. (2011) [45]	28	14 (4:10) PG: 9 CB: 5	PDI: Pramipexole: 9 Ropinirole: 5 PDC: Pramipexole: 9 Ropinirole: 5 Levodopa: 26 DA: 41	PDI: 589 (301) DA LEDD: 162 (43) PDC: 610 (298) DA LEDD: 156 (57)	PDI: 52 (8) PDC: 55 (13)	NA
Claassen et al. (2011) [51]	41	22 (9:13) PG: 2 HS: 13 CB: 12 BE: 10 Hobbyism: 17	11 (3:8) HS: 5 BE: 5 PG: 5 CB: 5 DDS: 5 Punding: 5 Multiple ICDs: 8	PDI: 736 (451) DA LEDD: 292 (161) PDC: 613 (325) DA LEDD: 230 (124)	PDI: 61 (6) PDC: 64 (8)	PD duration: PDI: 10 (7) PDC: 6 (4)
O'Sullivan et al. (2011) [111]	18	11 (3:8) HS: 5 BE: 5 PG: 5 CB: 5 DDS: 5 Punding: 5 Multiple ICDs: 8	Levodopa: 18 DA	PDI: 698 (337) DA LEDD: 62 (92) PDC: 949 (253) DA LEDD: 241 (143)	PDI: 57 (8) PDC: 58 (11)	PDI: 45 (11) PDC: 47 (9)
Ray et al. (2012) [82]	14	7 (NA) PG: 7	Levodopa: 13 DA: 12	PDI: 888 (480) PDC: 644 (338)	PDI: 60 (11) PDC: 61 (10)	PD duration: PDI: 10 (6) PDC: 8 (5)

Supplementary Table 1
(continued)

Reference	Total N with PD	N (f:m) with ICDs	Treatment: N	Total LEDD, Mean (SD) mg/day DA LEDD/DA dose, Mean (SD) mg/day	Age Mean (SD) years	Age at PD onset Mean (SD) years
Joutsa et al. (2012) [105]	20	10 (0:10) PG: 5 HS: 4 BE: 1	PDI: Levodopa: 9 DA: 9 PDC: Levodopa: 9 DA: 9	PDI: 635 (range: 250–876) DA LEDD: 172 (range: 0–280) PDC: 826 (range: 210–1127) DA LEDD: 200 (range: 0–320)	PDI: 62 (range: 45–71) PDC: 62 (range: 53–70)	PDI: 53 (range: 40–64) PDC: 57 (range: 47–63)
<i>Epidemiological studies</i>						
Driver-Dunckley et al. (2003) [59]	1,884	9 (2:7) PG: 9	Levodopa: 9 PDI Pramipexole: 529 Ropinirole: 421 Pergolide: 331	PDI: Levodopa LEDD: 883 Pramipexole: 4 Pergolide: 5	57	46
Pezzella et al. (2005) [98]	202	7 (2:5) DDS: 7 Compulsive behavior: 2 of 7 HS: 1 of 7 Violent behavior: 3 of 7	PD DDS: Levodopa: 6 DA: 7 PD without DDS (n = 32): Levodopa: 12 DA: 20	PD DDS: 961 (282) PD without DDS: 675 (372)	PD DDS: 59 (5) PD without DDS: 63 (5)	PD DDS: 51 (3) PD without DDS: 52 (3)
Ardouin et al. (2006) [64]	598	7 (1:6) PG: 7 HS: 5 CB: 2 BE: 2 DDS: 4	PDI: Levodopa: 7 Bromocriptine: 5 Ropinirole: 1	NA	<70 years.	NA

Supplementary Table 1
(continued)

Reference	Total N with PD	N (f:m) PD patients with ICDs	Treatment: N	Total LEDD, Mean (SD) mg/day DA LEDD/DA dose, Mean (SD) mg/day	Age Mean (SD) years	Age at PD onset Mean (SD) years
Grosset et al. (2006) [65]	388	17 (6:11) PG: 17	PDI: Levodopa: 9 Pramipexole: 9 Ropinirole: 7 Pergolide: 1 PDI: Levodopa: 4 Pramipexole: 4 Ropinirole: 1	PDI: Levodopa LEDD: 430 Pramipexole: 5 Ropinirole: 12 Pergolide: 1 PDI: Levodopa: 100–1000 Pramipexole: 3–6 Ropinirole: 5	PDI: 56 (7) PDC: 69 (10)	PDI: 52 PDC: 64
Imamura et al. (2006) [67]	1,411	6 (0:6) PG: 6 HS: 1	PDI: Levodopa: 11 Pergolide: 3 Pramipexole: 5 Ropinirole: 3 Levodopa: 244 Ropinirole: 135 Pramipexole: 165	PDI: 926 (535) PDC: 569 (369)	61 (range: 53–71)	51
Weintraub et al. (2006) [90]	272	11 (1:10) HS: 7 PG: 6 CB: 1	PDI: Levodopa: 11 Pergolide: 3 Pramipexole: 5 Ropinirole: 3 Levodopa: 244 Ropinirole: 135 Pramipexole: 165	PDI: 926 (535) PDC: 569 (369)	PDI: 60 (9) PDC: 67 (10), $p=0.006$	PDI: 48 PDC: 62 (6), $p=0.04$
Singh et al. (2007) [48]	300	58 HS: 25 PG: 17 (1:16) 27 (6:21) PG: 6 CB: 6 BE: 7 HS: 17 Multiple ICDs: 10	PDI: Levodopa: 11 Pergolide: 3 Pramipexole: 5 Ropinirole: 3 Levodopa: 244 Ropinirole: 135 Pramipexole: 165	DA: 16 NA	PDI: 61 PDC: 58 NA	NA PG: 0.5–10 years PDI: 52 (12) PDC: 59 (12)
Giladi et al. (2007) [69]	193	PG: 6 CB: 6 BE: 7 HS: 17 Multiple ICDs: 10	PDI: Levodopa: 11 Pergolide: 3 Pramipexole: 5 Ropinirole: 3 Levodopa: 244 Ropinirole: 135 Pramipexole: 165	DA: 16 NA	PDI: 61 PDC: 58 NA	NA PG: 0.5–10 years PDI: 52 (12) PDC: 59 (12)
Ondo et al. (2008) [72]	211	7 (3:4) PG: 7 CB: 3 HS: 1	Levodopa: 148 Pramipexole: 141 Ropinirole: 57 Pergolide: 12 Bromocriptine: 1	Total sample: Levodopa: 667 (325) DA: 3 (1) PDI: DA: 4 (2)	Total sample: 64 (10) PDI: 59 (6)	Total sample: 54 (12) PDI: 49 (11)

Supplementary Table 1
(continued)

Reference	Total N with PD	N (f:m) PD patients with ICDs	Treatment: N	Total LEDD, Mean (SD) mg/day DA LEDD/DA dose, Mean (SD) mg/day	Age Mean (SD) years	Age at PD onset Mean (SD) years
Crockford et al. (2008) [73]	140	13 (4:9) Problem gambling 6 (1:5), 4.3% HS: 6	Levodopa: 99% DA: 88% PDI: Levodopa: 4 DA: 5	PDI: 602 (355) PDC: 775 (472) NA	PDI: 62 (8) PDC: 66 (12) Total sample: 68 (10) PDI: 61 (range: 52–74)	NA PDI: 50 (3) PDC: 62 (1), $p < 0.05$
Cooper et al. (2009) [120]	141	HS symptoms: 15 27 (13%, NA) PG: 13%	PDI: DA: 65% PDC: DA: 59%	NA	Total PD sample: 58 (10)	PD duration: Total PD sample: 8 (7)
Wicks et al. (2009) [127]	208					
Fan et al. (2009) [128]	312	11 (1:10) PG: 1 HS: 6 BE: 1 DDS: 2 Punding: 1	PDI: Levodopa: 9 Piribedil: 10 Pramipexole: 1 Amantadine: 4 Total PD sample: Levodopa: 254 DA: 130 Amantadine: 97	PDI: 488 (289) DA LEDD: 142 (101) PDC: 392 (225) DA LEDD: 35 (50), $p = 0.005$	PDI: 64 (7) PDC: 66 (11)	PDI: 59 (7) PDC: 60 (11)

Table 1
(continued)

Reference	Total N with PD	N (f:m) PD patients with ICDs	Treatment: N	Total LEDD, Mean (SD) mg/day DA LEDD/DA dose, Mean (SD) mg/day	Age Mean (SD) years	Age at PD onset Mean (SD) years
Weintraub et al. (2010) [26]	3090	420 (153:267) Problem gambling: 154 PG: 89 HS: 108 CB: 177 BE: 132 Multiple ICDs: 120	Levodopa in 86.8% DA in 66.0%: DBS: PDI: 36 PDC: 264	Pramipexole LEDD: 307 (168) Ropinirole LEDD: 278 (165) Pergolide LEDD: 287 (169)	PDI: 60 (8) PDC: 64 (8), $p < 0.001$	PDI: median = 53 PDC: median = 58
Weintraub et al. (2010) [131]	3085	420 (153:267) PD on amantadine: PG: 54 (7.4%) HS: 37 (5.1%) CB: 58 (8%) BE: 32 (4.4%) PD off amantadine: PG: 100 (4.2%), $p < 0.001$ HS: 71 (3%), $p < 0.01$ CB: 119 (5%), $p < 0.01$ BE: 100 (4.2%)	PD on amantadine: ICD: 128 (18%) PD off amantadine: 292 (12%), $p < 0.001$ Levodopa: 2678 DA: 2038 DBS: 300	PD on amantadine: Median levodopa LEDD: 469 PD off amantadine: Median levodopa LEDD: 450, $P < 0.001$ DBS: PD on amantadine: 94 (12.9%) PD off amantadine: 206 (9%), $p < 0.01$	PD on amantadine: 62 (8) PD off amantadine: 64 (8) Age < 65: PD on amantadine: 446 (61%) PD off amantadine: 1177 (50%), $p < 0.0001$	Median PD duration: PD on amantadine: 10 PD off amantadine: 6, $p < 0.0001$
Weiss et al. (2010) [53]	250	32 (NA) PG: 8 Problem gambling: 5	Levodopa Pramipexole Ropinirole	NA	Onset of ICD: 57 (9)	PD duration before ICD onset: 7 (5)

Supplementary Table 1
(continued)

Reference	Total N with PD	N (f:m) with ICDs	PD patients with ICDs	Treatment: N	Total LEDD, Mean (SD) mg/day DA LEDD/DA dose, Mean (SD) mg/day	Age Mean (SD) years	Age at PD onset Mean (SD) years
Bharmal et al. (2010) [121]	146	6 (2:4)	PG: 6 Multiple ICDs: 12 Reckless spending and driving: 1	PDI:	PDI:	PDI: 58 (7)	PD duration: PDI: 12
				Levodopa monotherapy: 0	1226 (range: 600–2179)	Total sample: 68 (10), $p < 0.05$	Total sample: Males: 9 (7)
				Pramipexole: 5 Pergolide: 1 Total sample: Levodopa monotherapy: 80 Pramipexole: 41 Pergolide: 11 Ropinirole: 9 Bromocriptine: 5	Pramipexole: 5 (range: 2–8) Pergolide: 3 Total sample: NA		Females: 10 (5)
Kenangil et al. (2010) [125]	554	33 (6:27), 5.9%	Punding: 19 (57.5%) HS: 14 (42.4%) BE: 9 (27.2%) CB: 8 (24.2%) DDS: 7 (21.1%) PG: 4 (12.1%)	PDI:	PDI: 702 (369)	PDI: 58 (10)	PDI: 49 (9)
				Levodopa	DA LEDD: 368 (181)	PDC: 60 (10)	PDC: 52 (11)
				Pergolide: 12 Cabergoline: 7 Pramipexole: 7 Ropinirole: 4 Piribedil: 10 PDC: Levodopa Pergolide: 9 Cabergoline: 14 Pramipexole: 25 Ropinirole: 1 Piribedil: 15	PDC: 640 (357) DA LEDD: 319 (208)		

Supplementary Table 1
(continued)

Reference	Total N with PD	N (f:m) PD patients with ICDs	Treatment: N	Total LEDD, Mean (SD) mg/day DA LEDD/DA dose, Mean (SD) mg/day	Age Mean (SD) years	Age at PD onset Mean (SD) years
Lee et al. (2010) [129]	1167	118 (55:63) CB: 29 PG: 15 HS: 33 BE: 40 Punding: 49 Multiple ICDs: 34	Total sample: Levodopa: 1094 DA: 850 PDI: DA: 94 PDC: 756	Total sample: 659 (387) PDI: DA LEDD: 145 (150) PDC: DA LEDD: 99 (123)	PDI: 61 (12) PDC: 65 (10)	PDI: 53 (11) PDC: 59 (10)
Auyeung et al. (2011) [85]	213	15 (2:13)	PDI: Levodopa: 15 DA: 14 Bromocriptine: 11 Total sample: Levodopa: 81 % DA: 53 % Piribedil: 33.5 % Pramipexole: 11.5 % Ropinirole: 8 % Bromocriptine: 0.5 % Amantadine: 15 % DBS: 5.5 %	PDI: 1215 (636) DA LEDD: 277 (148) PDC: 634 (331) DA LEDD: 85 (99) Total sample: 528 (387) DA LEDD: 74 (84) Amantadine: 41 (106)	PDI: 60 (6) PDC: 68 (10), $p < 0.001$	PDI: 46 (6) PDC: 59 (11), $p < 0.001$
Lim et al. (2011) [99]	200	48 Any ICD: 30 BE: 17 HS: 16 CB: 7 PG: 5 Punding/hobbyism: 27 DDS: 4 Multiple ICD: 19	Total sample: Levodopa: 81 % DA: 53 % Piribedil: 33.5 % Pramipexole: 11.5 % Ropinirole: 8 % Bromocriptine: 0.5 % Amantadine: 15 % DBS: 5.5 %	Total sample: 528 (387) DA LEDD: 74 (84) Amantadine: 41 (106)	Total sample: 63 (10)	Total sample: 56 (12)
Hassan et al. (2011) [130]	321	69 (20:49) PG: 25 HS: 24 BE: 12	Levodopa DA PDI: Therapeutic DA dose (>6mg ropinirole or >2 mg pramipexole): 59	PD hobbyism: Pramipexole: 2 (range: 1–5) Ropinirole: 14 (range: 8–25) Otherwise NA	PD hobbyism: 56 (range: 34–72) Otherwise NA	PDI: 51 (10) PDC: 59 (10), $p < 0.0001$

Reference	Total N with PD	N (f:m) PD patients with ICDs	Treatment: N	Total LEDD, Mean (SD) mg/day DA LEDD/DA dose, Mean (SD) mg/day	Age Mean (SD) years	Age at PD onset Mean (SD) years
Limotai et al. (2012) [83]	1040	97 (NA) ICD: 89 DDS: 14 ICD + DDS: 6 Punding: 11	Target DA dose (>12 mg ropinirole or >4.5 mg pramipexole): 39 DBS: 9 PDC:			
			Therapeutic DA dose (>6 mg ropinirole or >2 mg pramipexole): 147			
			Target DA dose (>12 mg ropinirole or >4.5 mg pramipexole): 67 DBS: 12			
			Levodopa	PDI: 1122 (644)	PDI: 64 (10)	PDI: 52 (10)
			DA	DA LEDD: 292 (184)	PDC: 71 (10), $p < 0.001$	PDC: 60 (12), $p < 0.001$
				PDC: 779 (543), $p < 0.001$	PD DDS: 66 (12)	PD DDS: 53 (10)
				DA LEDD: 142 (176), $p < 0.001$	PDC: 71 (11)	PDC: 59 (12)
				PD DDS: 1713 (869)		
				DA LEDD: 309 (199)		
				PDC: 796 (546), $p < 0.001$		
Kim et al. (2012) [27]	297	46 (19:27) PG: 4 HS: 21 BE: 9 CB: 3 Punding: 14 Hobbyism: 5		DA LEDD: 152 (181), $p < 0.003$		
			PDI:	PDI: 844 (376)	PDI: 66 (11)	PDI: 60 (12)
			DA: 29	DA LEDD: 171 (187)	PDC: 71 (8)	PDC: 66 (9)
			PDC:	PDC: 614 (348), $p < 0.001$	$P < 0.009$	$P < 0.001$
			DA: 110, $p < 0.016$	DA LEDD: 90 (140), $p < 0.002$		

Supplementary Table 1
(continued)

Reference	Total N with PD	N (f:m) PD patients with ICDs	Treatment: N	Total LEDD, Mean (SD) mg/day DA LEDD/DA dose, Mean (SD) mg/day	Age Mean (SD) years	Age at PD onset Mean (SD) years
Moum et al. (2012) [32]	159	Walkabout: 3	DA: 4 PDI; 0 PD DDS; 1 PDI+DDS; 81 PDC DBS: 159 (STN or GPi) STN DBS: 3 PD DDS; 4 PDI Pre-DBS ICD+ DDS: 1 (0:1) GPi DBS: 1 PD DDS; 2 PDI; 1 PDI+ DDS Levodopa: 451 DA: 430	Pre-DBS: PDI: 735 (388) PD DDS: 1271 (744) PDI + DDS: 2250 PDC: 877 (511), $p < 0.03$ Median LEDD: 561 (range: 26–3230) Median DA LEDD: 160 (range: 105–210)	NA	PDI: 44 (7) PD DDS: 45 (1) PDI+ DDS: 40 PDC: 49 (10)
		DDS: 7				
		Multiple ICDs: 15				
		ICD: 24				
		DDS: 7				
Joutsa et al. (2012) [54]	575	Pre-DBS ICD: 6 (3:3)				Median PD duration: 6 (range < 1–29)
		Pre-DBS DDS: 4 (0:4)				
		Pre-DBS ICD + DDS: 1 (0:1)				
		192 (48:144)				
		Multiple ICDs: 69				
Perez-Lloret et al. (2012) [104]	203	PG: 48	PDI: Levodopa: 48 DA: 52 Amantadine: 2 PDC: Levodopa: 130 DA: 109 Amantadine: 7	LEDD>1050: PDI: 34 patients (63%) PDC: 63 patients (42%)	Age<68: PDI: 14 patients (26%) PDC: 86 patients (56%)	PD duration: PDI: 9 (1) PDC: 9 (1)
		HS: 124				
		CB: 55				
		BE: 64				
		Hobbyism: 125				
		Punding: 87				
		Walkabout: 32				
		52 (14:38)				
		HS: 20				
		CB: 13				
		PG: 5				
		BE: 28				
		Multiple ICDs: 11				

Supplementary Table 1
(continued)

Reference	Total N with PD	N (f:m) PD patients with ICDs	Treatment: N	Total LEDD, Mean (SD) mg/day DA LEDD/DA dose, Mean (SD) mg/day	Age Mean (SD) years	Age at PD onset Mean (SD) years
Joutsa et al. (2012) [55]	290	At baseline: 119 Multiple ICDs: 43 PG: 33 HS: 73 CB: 36 BE: 40 Hobbyism: 73 Punding: 48 Walkabout: 17	At baseline: PDI: Levodopa: 88 DA: 92 Amantadine: 6 PDC: Levodopa: 118 DA: 123 Amantadine: 9	At baseline: PD stable ICD (<i>n</i> = 82): Median LEDD: 609 Median DA LEDD: 210 PDC (<i>n</i> = 135): Median LEDD: 508 Median DA LEDD: 160	At baseline: PD stable ICD (<i>n</i> = 82): 62 PDC (<i>n</i> = 135): 65	At baseline: PD stable ICD (<i>n</i> = 82): 56 PDC (<i>n</i> = 135): 58
Bastiaens et al. (2013) [100]	164	18 of 46 (9:9) BE: 16 (7:9) HS: 6 (1:5) CB: 5 (3:2) PG: 1 (1:0) Punding: 12 Multiple ICDs: 8	PDI: Levodopa: 7 DA: 10 Amantadine: 3 PDC: Levodopa: 13 DA: 11 Amantadine: 0	PDI: Median LEDD: 150 (range: 0–2,320) Median DA LEDD: 106 (range: 0–450) PDC: Median LEDD: 150 (range: 0–1,510) Median DA LEDD: 0 (range: 0–450)	PDI: 62 (10) PDC: 62 (11)	PDI: 57 (10) PDC: 57 (9)

N = number of patients (f:m = females:males). PD = Parkinson's disease. ICDs = impulse control disorders. PG = pathological gambling. HS = hypersexuality. CB = compulsive buying. BE = binge-eating. DDS = dopamine dysregulation syndrome. PDI = PD patients with ICDs. PDC = PD controls. DA = dopamine agonist. DBS = deep brain stimulation. STN = subthalamic nucleus. GPI = globus pallidus pars interna. LEDD = levodopa equivalent daily dose. NA = not applicable. MSA = multiple system atrophy.

Supplementary Table 2

Extensive overview of 98 reports on ICDs in PD published between 2000–January 2013 including case reports, case series, case-control studies, experimental studies, and epidemiological studies. The table provides information on prior history of ICDs, psychiatric symptoms, Hoehn & Yahr, UPDRS, and additional information

Reference	Prior ICDs: N	Psychiatric symptoms	Mean H&Y (SD)	Mean UPDRS (SD)	Additional information
<i>Case reports and case series</i>					
Seedat et al. (2000) [16]	No prior ICD symptoms	Hypomania	NA	NA	PG occurred after treatment initiation
Giovannoni et al. (2000) [56]	No prior ICD symptoms	D: 3 Mania: 2	NA	NA	NA
Gschwandtner et al. (2001) [58]	No prior ICD symptoms	Psychotic symptoms: 3 Anxiety: 1 MD: 1	NA	NA	In both cases PG occurred parallel to increased dose of DA treatment In one case, PG disappeared while on the same dose of medication as when he started. In one case, PG disappeared after dosage reduction Enhanced novelty seeking was observed Medication reduction lead to decreased ICD symptoms in 2 of 4 patients
Serrano-Duenas (2002) [132]	No prior ICDs	OCD: 1 Anxiety: 1 D: 4	2.13 (0.25)	68.5 (10.47)	In none of the cases was the onset of ICDs associated with changes in DA treatment, nor did reduction in medication improve behavior
Kurlan (2004) [60]	Occasional gambling: 1	Anxiety: 2 Hypomania: 2 Hallucinations: 2	NA	NA	
Avanzi et al. (2004) [19]	No prior ICD symptoms	D: 1	NA	NA	In both cases PG occurred shortly after the patient increased dose of DA treatment. PG was ameliorated in both cases after modifying medication
Sensi et al. (2004) [93]	No prior ICD symptoms	No prior personal or family psychiatric history Symptoms of D and anxiety following DBS	NA	UPDRS III off: 54 UPDRS III on: 24	After 6 months with DBS the behavioral symptoms disappeared, perhaps as a result of habituation to chronic stimulation and alleviation of withdrawal symptoms

Supplementary Table 2
(continued)

Reference	Prior ICDs: N	Psychiatric symptoms	Mean H&Y (SD)	Mean UPDRS (SD)	Additional information
Dood et al. (2005) [20]	Occasional gambling: 6	D: 2 Alcohol abuse: 1 Adjustment disorder: 1	NA	NA	ICDs in all patients occurred after DA therapy. In 7 of 11 patients ICDs occurred within 3 months after treatment onset or dosage increase. ICDs resolved in 8 of 11 after discontinuing DA therapy
Witjas et al. (2005) [35]	NA	Alcohol abuse: 1 Hypomania: 1 D: 2 Aggression: 2 Increased impulsivity: 1 Paranoid delirium: 1 Visual hallucinations: 1	NA	NA	In both cases DBS in STN alleviated dyskinesia and reduced ICDs and dopaminergic drug addiction
Klos et al. (2005) [62]	No prior ICD symptoms	Prior D: 3 Prior ADHD: 1 Smoking: 6 Prior alcohol abuse: 3 Prior poly-substance addiction: 1 Hypomania: 1 OCD: 3	Median = 2 (range 1–3)	NA	HS developed within 8 months (on average) after onset of DA therapy in 14 of 15 cases and resolved in 7 cases and improved in 2 cases after changing treatment, 4 patients completely discontinued DA therapy. Spontaneous recovery in 2 cases. No follow-up in 4 cases
Larner (2006) [63]	No prior ICD symptoms	Prior D: 1	NA	NA	PG was resolved by discontinuing DA therapy
Drapier et al. (2006) [66]	No prior ICD symptoms	D: 1 after PG D: 2 prior to PG. Delusions of persecution: 1 after PG	Range: 1.5–2.5	Range: 21/108–41/108	All patients started gambling after onset of dopaminergic therapy or dosage increase. Gambling behavior disappeared or decreased after DA treatment was discontinued

Supplementary Table 2
(continued)

Reference	Prior ICDs; N	Psychiatric symptoms	Mean H&Y (SD)	Mean UPDRS (SD)	Additional information
Spengos et al. (2006) [88]	No prior ICD symptoms	No other psychiatric symptoms	NA	NA	After discontinued treatment with pramipexole, continuing on levodopa monotherapy, PG stopped within 2 months
Bandini et al. (2007) [41]	Occasional gambling: 1	D: 2 Insomnia: 1	4	66 (2)	In both patients, PG occurred within 2 months after increased dopaminergic therapy, and resolved after bilateral STN-DBS combined with reduction of dopaminergic therapy
Wong et al. (2007) [70]	No prior ICD symptoms	D: 2	2.7 (range: 2–3.5)	NA	PG stopped in all cases where treatment was adjusted or changed. However, PG switched to BE after psychotherapy
McKeon et al. (2007) [71]	NA	Anxiety: 2 D: 4 PD-dementia: 1 History of alcohol abuse: 1 (MSA patient)	At ICD onset: 2–3	NA	ICDs started within 11 months (range 1–24) after onset of DA therapy. ICDs started within 76.8 months (range 36–154) after onset of levodopa therapy. Follow-up was available in 4 patients. In all cases ICDs resolved after discontinued DA treatment
Smeding et al. (2007) [37]	No prior ICD symptoms	Prior history of alcohol abuse: 1	Pre-DBS: 3/3 12 months post-DBS: 3/2.5	Pre-DBS: 56/34 12 months post-DBS: 21/13	PG started within a month after STN DBS and disappeared after discontinuation of pergolide after DBS A slight cognitive decline was evident 12 months after surgery, on memory, selective attention, and category fluency. Further, stimulation of the most dorsal contact, with and without medication, induced impaired decision-making compared with stimulation of the more ventral contact In addition to PG, the patient experienced increased emotional lability and impulsivity, later D and 3 suicide attempts, after DBS

Supplementary Table 2
(continued)

Reference	Prior ICDs: N	Psychiatric symptoms	Mean H&Y (SD)	Mean UPDRS (SD)	Additional information
Mamikonyan et al. (2008) [89]	NA	NA	NA	Time 1: 22.6 (8.7) Time 2: 24.6 (10.2)	ICD disappeared (full remission in 11) or improved (partial remission in 3) after discontinued or decreased DAs
Knobel et al. (2008) [40]	No prior ICD symptoms	Personality disorder Hypomania MD	NA	Pre-DBS: UPDRS II: 17 UPDRS III: 42 off Levodopa, 10 on levodopa Post-DBS: UPDRS II: 8 UPDRS III: 10	DDS resolved after STN DBS and medication reduction
Kimber et al. (2008) [115]	NA	Anxiety: 1 D: 1	NA	NA	Improvement of ICD symptoms in 2 patients, while symptoms completely resolved in 2 other patients after cessation of cabergoline and complete resolution in 1 after cessation of pergolide
Lim et al. (2009) [39]	ICDs symptoms in all 21 pre-DBS	Pre-DBS: D: 48% Alcohol abuse: 24% Drug use: 14% Psychotic symptoms: 1 patient Post-DBS: Psychotic symptoms: 3 patients	NA	NA	DDS, ICDs or punting appeared, unimproved or worsened after DBS in 15, whereas it was resolved or improved in 6
Wingo et al. (2009) [117]	Occasional gambling: 1	NA	NA	NA	Discontinuation or marked reduction of DA resolved ICD symptoms
Fernández et al. (2009) [119]	NA	D Anxiety Psychotic symptoms following levodopa abuse (double the prescribed dose)	NA	NA	NA

Supplementary Table 2
(continued)

Reference	Prior ICDs: N	Psychiatric symptoms	Mean H&Y (SD)	Mean UPDRS (SD)	Additional information
Bonfanti et al. (2010) [126]	NA	D: 1	NA	NA	ICD symptoms improved for 2 months after pramipexole was changed to cabergoline, however after 2 two months symptoms recurred. Symptoms improved after DA was suppressed and a low dose of quetiapine was added
Tschopp et al. (2010) [116]	NA	Family history of alcohol abuse: 1 Personal history of alcohol abuse: 1 Hallucinations: 2 Delirium: 1	NA	NA	ICD symptoms persisted in 2 following either psychiatric and psychological therapy or reduction of prirbedil, though slightly less severe. In 3 patients ICD improved after discontinuation of DA and/or psychiatric therapy
Stefani et al. (2010) [118]	A prior episode of PG during PD while taking 3.5 mg/d of pramipexole	No psychiatric symptoms	3	NA	The prior episode of PG was resolved after discontinuation of pramipexole. The current episode of ICDs following DBS resolved once stimulation of the nucleus of the pedunculopontine tegmentus was turned off
Kolla et al. (2010) [124]	No prior ICD symptoms	No past psychiatric history, but PG-induced psychiatric symptoms: D: 1 Suicide attempt: 1 Amphetamine abuse: 1	NA	NA	In one patient PG resolved after discontinuation of pramipexole. In the other case, pramipexole was changed to ropinirole but without any effect on PG, which was in stead resolved via therapy
Avila et al. (2011) [84]	NA	5 patients received psychiatric treatment with either antidepressants, benzodiazepines or quetiapine	Median: 2.0 (range: 1.0–5.0)	16.08 (8.71)	At follow-up (after 13.9 months on average) partial or full remission of ICDs symptoms upon altered medication, particularly decreased or discontinued DA therapy (15 patients), were seen in: PG: 3 of 4; HS: 9 of 9; CB: 2 of 4; BE: 2 of 2; DDS: 0 of 1; Punding: 2 of 11

Supplementary Table 2
(continued)

Reference	Prior ICDs: N	Psychiatric symptoms	Mean H&Y (SD)	Mean UPDRS (SD)	Additional information
Hinnell et al. (2011) [102]	No prior ICD symptoms	No psychiatric history	NA	NA	ICDs started after treatment with Rotigotine and resolved within two months after discontinuation of DA
Sriram et al. (2012) [34]	No prior ICD symptoms	Prior marijuana use: 2 Prior cocaine use: 1 Mood disorder: 2 Insomnia: 1 PTSD: 2 Anxiety: 1 NA	NA	Pre-Valproate: 39 Post-Valproate: 37.3	DDS symptoms resolved within 2 weeks to 6 months after administration of Valproate
Giugni et al. (2012) [81]	NA	NA	NA	NA	DDS and CB improved after reduction in Piribedil to the prescribed 200 mg/d and an increase in Levodopa to 750 mg/d
Solla et al. (2012) [103]	NA	Anxiety: 1 D: 1	3.5 (range: 3–5)	NA	ICD symptoms resolved after discontinuation of pergolide and reduction of levodopa
Vitale et al. (2013) [101]	No prior ICD symptoms	No psychiatric history	2	28	ICDs resolved within 8 weeks after withdrawal of rasagiline
<i>Case-control studies</i>					
Molina et al. (2000) [18]	PG: 2	MD: 5 Anxiety: 1 Alcohol abuse: 5 Pathologic jealousy: 1	3.1	39.3	In 10 of 12 PG occurred after PD onset, and in 9 of them it was after starting levodopa therapy. PG improved after changes in treatment in 3, with psychotherapy and family control in 7, and with subthalamic stimulation in 2 patients
Romito et al. (2002) [33]	NA	MD: 1 Hypomania: 1 Mania: 3	NA	Pre-surgery: UPDRS motor: 60.5 ADL: 34 12 months post-surgery: UPDRS motor: 12.5 ADL: 4	Behavioral symptoms started within a few days after DBS surgery, and spontaneously improved or disappeared within 3–18 months post-surgery

Supplementary Table 2
(continued)

Reference	Prior ICDs: N	Psychiatric symptoms	Mean H&Y (SD)	Mean UPDRS (SD)	Additional information
Evans et al. (2004) [61]	NA	Alcohol abuse: 2 Prior psychotic symptoms: 5 Pathological jealousy: 1	NA	PDI: 18.4 PDC: 17.7	Punders were more likely to use apomorphine than non-punders ($p=0.002$) and took more daily rescue doses (mean = 3) than non-punders (mean = 0.2), $p=0.000$
Avanzi et al. (2006) [21]	No prior ICD symptoms	D: 3	2 (0.32) in PG patients and 2.28 (0.67) in nonPG patients	21.83 (3.37) in PG patients and 24.19 (6.63) in nonPG patients	All patients with PG started gambling after onset of treatment with dopaminergic medication and PG improved after adjusting treatment in 5 of 6 (treatment remained unadjusted in 1 of 6) PD patients with PG had a significantly younger age at PD onset ($p=0.006$), higher novelty seeking ($p<0.001$), medication-induced hyponomania/mania ($p=0.001$), impaired planning ($p=0.002$), personal or family history of alcohol use disorders ($p=0.002$)
Voon et al. (2007) [25]	No prior ICD symptoms	Personal or family history of alcohol use disorders: 12 Hyponomania or mania: 6 Anxiety: 6 D: 6	2.0 (0.5)	15.2 (6.9)	Logistic regression identified male gender and higher BIS-11A score as factors associated with increased risk of occurrence of at least one ICD. Furthermore, they found a higher score on the Geriatric Depression Scale (GDS-15) in patients without ICD (6.0 [3.7]) than patients without ICD (3.6 [3]), $p<0.02$
Isaias et al. (2008) [91]	NA	D: 12	NA	PDI: 16.7 (6) PDC: 18.8 (6.4)	Subjects underwent resting state SPECT brain scans, and PDI compared to PDC showed overactivity during rest in right hemisphere networks including the orbitofrontal cortex, the hippocampus, the amygdala, the insula, and the ventral pallidum. This abnormal resting state of the mesocorticolimbic network might be associated with medication-induced overstimulation of the relatively preserved reward-related neuronal systems
Cilia et al. (2008) [108]	No prior ICD symptoms	NA but patients were medically treated for psychiatric diseases	PDI: 2.1 (0.6) PDC: 2.3 (0.8)	PDI: 18.0 (11.0) PDC: 19.1 (8.5)	

Supplementary Table 2
(continued)

Reference	Prior ICDs: N	Psychiatric symptoms	Mean H&Y (SD)	Mean UPDRS (SD)	Additional information
Imamura et al. (2008) [122]	No prior ICD symptoms	NA	NA	NA	PD patients receiving pramipexole were 3.65 times more likely to develop PG than PD patients who did not take pramipexole
Hälbig et al. (2009) [42]	NA	NA	DBS patients: 2.23 (0.70) Non-DBS patients: 2.00 (0.51)	DBS patients: 17.97 (13.52) Non-DBS patients: 16.31 (10.57)	Increased impulsivity in DBS patients, $p < 0.04$
Santangelo et al. (2009) [123]	Prior PG symptoms: 7	PDI: D: 4 Anxiety: 2 PDC: D: 2 Anxiety: 2 Psychotic symptoms: 1	PDI: 1.93 (0.53) PDC: 1.63 (0.61)	PDI: 15.07 (7.28) PD wo PG: 12.40 (6.18)	PDI performed significantly worse than PDC on cognitive task s evaluating visuo-spatial long-term memory and several frontal lobe functions, including the Frontal Assessment Battery (FAB), phonological fluency, and the Trail Making Test. Low scores on the FAB was the only independent predictor of PG suggesting that non-demented PD patients with poor FAB performance are at high risk for developing PG
Siri et al. (2010) [114]	Non-problem gambling: 9	Family history of PG: 2	PDI: 2.06 (0.7)	UPDRS III (on)	PD with and without PG were compared on neuropsychological tests of general cognitive abilities (mini-mental state examination, MMSE) executive functions (verbal fluencies using both phonemic and category cues, Raven's Coloured Progressive Matrices Sets, Frontal Assessment Battery), attention (attentive matrices), verbal learning and long term memory (Rey Auditory Verbal Learning Test, RAVLT), and visuospatial and verbal short term memory (Corsi Block Tapping test and Digit Span Test). PDI had higher MMSE and performed better at RAVLT, verbal phonemic fluencies, verbal semantic fluencies, and attentive matrices. The remaining cognitive performances were comparable to PDC. Thus, executive functions were preserved in PDI in this study

Supplementary Table 2
(continued)

Reference	Prior ICDs: N	Psychiatric symptoms	Mean H&Y (SD)	Mean UPDRS (SD)	Additional information
Voon et al. (2010) [75]	No prior ICD symptoms	PDI: D: 3 Anxiety: 7 Substance abuse: 3 Psychotic symptoms: 4 PDC: D: 2 Anxiety: 6 Substance abuse: 0, Psychotic symptoms: 5 D: 6 Anxiety: 0 Bipolar: 0	PDC: 2.32 (0.39) PDI: 1.99 (0.55) PDC: 2.35 (0.56)	PDI: 16.58 (7.7) PDC: 20.18 (12.5) NA	Moreover, PDI had higher levels of aggressiveness, irritability, disinhibition, and more eating disorders than PDC DA status was associated with increased impulsive choices on an experimental discounting task and shorter reaction time in PDI ($p=0.02$ and $p=0.001$, respectively) but not in PDC. Also, PDI had greater spatial working memory deficits than PDC ($p=0.04$)
Vitale et al. (2011) [78]	PG: 6 BE: 1		PDI: 2 (0.6) PD HS: 1.8 (0.5) PD BE: 1.5 (0.5) PD multiple ICDs: 1.5 (0.7) PDC: 1.8 (0.8)	PDI: 15.4 (7.3) PD HS: 15.1 (6.5) PD BE: 13 (6.9) PD multiple ICDs: 13 (7.1) PDC: 11.7 (6)	All 4 groups of PDI were impaired on spatial-planning and set-shifting task compared to PDC. PD HS were more impaired on the Stroop test than PDI, and PD HS, BE, and multiple ICDs performed worse than PDI on verbal learning and memory tests
Zahodne et al. (2011) [36]	NA	Mania: 1 OCD: 7 D: 17	NA	PD BE: 28.7 (7.0) PD without BE: 31.1 (11.1)	PD BE were more impulsive than PD without BE

Supplementary Table 2
(continued)

Reference	Prior ICDs: N	Psychiatric symptoms	Mean H&Y (SD)	Mean UPDRS (SD)	Additional information
Leroi et al. (2011) [86]	NA	Apathy: 26	2.31 (0.7)	PDI: 26.85 (9.97) PDC: 24.11 (10.41)	Apathy and ICDs were found to have a negative impact on disability and health-related quality of life in PD. PD apathy revealed more globally cognitive impairments than both PDI and PD controls, as well as performing worse on working memory and verbal fluency
Biundo et al. (2011) [87]	NA	No differences in depressive symptoms between PD with and without ICD	NA	PDI: 30.2 (13.2) PDC: 32.3 (12.8)	Findings indicate that cognitive functioning in PDI is relatively preserved except for slower performance in the Trail Making Test, which suggests difficulties in maintaining goal-directed tasks and suppressing irrelevant responses. Furthermore the results suggest an overall gray matter reduction in PD
Voon et al. (2011) [80]	NA	PDI: D scores: 4.96 (0.21) Anxiety scores: 41.55 OCD scores: 13.67 (0.61) PDC: D scores: 2.81 (0.21) Anxiety scores: 34.93 OCD scores: 8.78 (0.61). More PDI were smoking (48.6%) than PDC (37.9%), $p < 0.02$. No differences between groups in alcohol abuse or mania	NA	UPDRS I-IV: PDI: 2.75–19.24 PDC: 1.83–19.62 UPDRS dyskinesia: PDI: 0.85 (0.08) PDC: 0.69 (0.08)	PDI had more functional impairment ($p < 0.001$), more depressive symptoms ($p < 0.0001$), more anxiety symptoms ($p < 0.0001$), more OCD symptoms ($p < 0.0001$), increased novelty seeking ($p < 0.001$), increased impulsivity ($p < 0.001$) than PDCs Furthermore, PD multiple ICDs had more severe dyskinesia than PD single ICDs ($p < 0.01$)

Supplementary Table 2
(continued)

Reference	Prior ICDs: N	Psychiatric symptoms	Mean H&Y (SD)	Mean UPDRS (SD)	Additional information
Cilia et al. (2011) [94]	No prior ICD symptoms	No psychiatric symptoms	PDI: 2.0 (0.6) PDC: 2.3 (0.7)	PDI: 16.9 (8.8) PDC: 18.3 (7.9)	Participants underwent SPECT brain scans at rest, and in PDI gambling severity correlated negatively with the ventrolateral prefrontal cortex, anterior cingulate cortex, posterior cingulate cortex, medial prefrontal cortex, insula and striatum. Furthermore, PDI showed a disconnection between the anterior cingulate cortex and the striatum, whereas this connection was intact in both PDC and healthy controls
Chazeron et al. (2011) [109]	NA	Smoking: 3 Alcohol dependence: 3 Problem drinking: 2	NA	NA	The objective of study was to compare the prevalence of ICDs, smoking, and alcohol addiction in PD patients with an age- and sex-matched control group. They found the prevalence of ICDs was comparable
Bentivoglio et al. (2012) [97]	NA	PDI: D: 2	PDI: 2.0 (0.8) PDC: 2.3 (0.5)	PDI: 23.8 (11.0) PDC: 22.5 (6.9)	PD with and without ICD were compared on a range of neuropsychological tests including the MMSE, short-term memory, episodic verbal memory, abstract reasoning, cognitive flexibility, response inhibition, the Frontal Assessment Battery, selective visual attention, verbal fluency, oral naming of verbs and nouns, and apraxia. No statistically significant differences were found, except for trends towards PDI performing worse on the Go-No-Go, oral verb naming, and on constructional apraxia requiring planning of actions, and they tended to make more errors on the interference subtest of the Stroop test than PDC. Furthermore, the groups were compared on the Iowa Gambling Task and on Barratt's Impulsiveness Scale, which revealed that PDI were significantly more impulsive than PDC. On the IGT PDI tended to loose more money and make more risky decisions than PDC, but the differences did not reach statistical significance

Supplementary Table 2
(continued)

Reference	Prior ICDs: N	Psychiatric symptoms	Mean H&Y (SD)	Mean UPDRS (SD)	Additional information
Djiamshidian et al. (2012) [113]	NA	Psychotic symptoms: 3	NA	PDI: UPDRS off: 31.0 (11.3) UPDRS on: 16.2 (10.6) PDC: UPDRS off: 32.1 (10.6) UPDRS on: 21.1 (9.0)	PD with and without ICDs were compared with substance abusers, pathological gamblers, and healthy controls on the beads task (a decision-making test of reflection impulsivity), and a working memory task. PD patients in general make more impulsive and irrational choices than controls on the beads task. Moreover, PDIs behave similarly to substance abusers, whereas PDCs behave more like pathological gamblers. In contrast, PD with and without ICD did not differ in working memory performance, though PDCs remembered distractors significantly less than all other participants during the working memory task
		PDC:			
		D: 4			
		PDI: Prior substance use disorder: 3			
<i>Experimental studies</i>					
Evans et al. (2006) [79]	NA	NA	NA	PD DDS: ON: 23.1 OFF: 52.7 PD controls: ON: 27.1 OFF: 37.1	PET imaging using [¹¹ C] raclopride to measure % changes in binding potentials in the striatum between an OFF and ON levodopa state. PD DDS release more dopamine in the ventral striatum upon levodopa intake than PD controls and in PD DDS the dopamine release was correlated with subjective feelings of drug wanting (craving) but not liking as well as increased punding (psychomotor activity)

Supplementary Table 2
(continued)

Reference	Prior ICDs: N	Psychiatric symptoms	Mean H&Y (SD)	Mean UPDRS (SD)	Additional information
Steeves et al. (2009) [74]	No prior ICD symptoms	All non-demented patients. Otherwise, NA.	PDI: 2 (0.6) PDC: 1.9 (0.7)	PDI: 25.2 (4.5) PDC: 20.2 (5.4)	PG developed in all cases after exposure to DAs independent of the timing of initiation of levodopa therapy. The current study was a PET study, using [¹¹ C] raclopride indicate that patients with PG release more dopamine in the ventral striatum during gambling than patients without PG, $p < 0.05$
Rao et al. (2010) [92]	No prior ICD symptoms	No patient with DDS was included	PDI: 2.1 (0.3) PDC: 2.1 (0.2)	NA	ICDs started after onset of DA treatment in all cases. FMRI demonstrated that PD patients without ICDs activate the mesocortico-limbic pathway during risk taking, whereas PD patients with ICDs demonstrate significantly reduced BOLD activity in the right ventral striatum during risk taking, and significantly reduced resting cerebral blood flow in the right ventral striatum
Cilia et al. (2010) [95]	No prior ICD symptoms	No difference in depressive symptoms between PD w./without PG Otherwise NA	PDI: 2.1 (0.7) PDC: 2.0 (0.5)	PDI: 18.1 (9.3) PDC: 20.2 (5.6)	Subjects underwent SPECT scans after withdrawal of dopaminergic medication with the radiotracer FP-CIT. PDI had a lower tracer binding in the ventral striatum compared to PDC, which might reflect either a reduction of mesolimbic projections, or a lower dopamine transporter density combined with increased synaptic dopamine levels
Voon et al. (2010) [96]	No prior ICD symptoms	PDI: D: 3 Anxiety: 7 Hallucinations: 4 Substance use disorders: 3 PDC: D: 2 Anxiety: 6 Hallucinations: 5 Substance use disorders: 0	PDI: 2.0 (0.6) PDC: 2.4 (0.6)	NA	PDI had poorer working memory performance than PDC. Furthermore, subjects underwent fMRI on/off dopaminergic medication performing a reinforcement learning task. Results indicate that DA increase the rate of learning from gain and increase ventral striatal activity to positive prediction error signifying a “better than expected” outcome possibly resulting in a reward bias in PDI but not in PDC. In contrast, DA decreased the rate of learning from loss in PDC but not in PDI. Finally, PDI had an overall greater orbitofrontal cortex activity to gains and loss omissions and lower activity to losses compared to PDC (both on and off medication)

Supplementary Table 2
(continued)

Reference	Prior ICDs: N	Psychiatric symptoms	Mean H&Y (SD)	Mean UPDRS (SD)	Additional information
Wu et al. (2010) [110]	NA	NA	NA	NA	Subjects underwent two PET-scans using the tracer 11C-raclopride while watching either neutral or rewarding images (gambling, sex, food, or money). Results indicated that PDI compared to PDC had a significant decrease in raclopride binding in the ventral striatum and the caudate nucleus, indicating an endogenous dopamine release induced by the visual cues
Van Eimeren et al. (2010) [107]	No prior ICD symptoms	No psychiatric symptoms	NA	PDI: UPDRS off: 28.3 (7.5) UPDRS on: 20.1 (3.7) PDC: UPDRS off: 27.3 (6.7) UPDRS on: 20.9 (7.8)	Subjects underwent PET-scans before and after administration of apomorphine during a probabilistic card game. PDC showed significantly increased activity in the lateral orbitofrontal cortex, the rostral cingulate zone, amygdala, and the external pallidum upon apomorphine intake, whereas PDI showed the opposite reaction of apomorphine-induced deactivation of the same brain areas which are involved in impulse control and response inhibition
Frosini et al. (2010) [112]	No prior ICD symptoms	No psychiatric symptoms	NA	PDI: 15.5 (1.3) PDC: 18.0 (6.3)	Subjects underwent fMRI scans while exposed to neutral and gambling-related visual cues. Compared with PDC, PDI showed increased BOLD response following gambling-related cues bilaterally in the anterior cingulate cortex, medial and superior frontal gyri, and preuncus, the right inferior parietal lobule, and the left ventral striatum
Rodriguez-Oroz et al. (2011) [38]	NA	No patients with severe D were included in the study. No information on prior psychiatric history	NA	PDI: ON: 14.1 (5.9) OFF: 40.5 (12.5) PD dyskinesia: ON: 11.3 (6.4) OFF: 42.7 (10.7) PD controls: ON: 9 (6.5) OFF: 38.1 (12.3)	In order to improve ICDs prior to surgery DAs were reduced or discontinued and SSRIs and/or atypical antipsychotics were prescribed for 1–2 months. ICDs improved in most cases but remained present at the time of surgery. Following surgery, ICDs were improved in 3 of 10, resolved in 6 of, and remained unchanged in 1 of 10

Supplementary Table 2
(continued)

Reference	Prior ICDs: N	Psychiatric symptoms	Mean H&Y (SD)	Mean UPDRS (SD)	Additional information
Voon et al. (2011) [45]	No prior history of ICD symptoms	D: 0 Dementia: 0	PDI: 1.9 (0.5) PDC: 2.4 (0.6)	NA	fMRI of PD with and without ICD while performing a novel risk taking task ON and OFF DAs. PDI made more risky choice and revealed decreased OFC and ACC activity. The opposite results were found in PDC. In PDI, DAs were associated with enhanced sensitivity towards risk and to a decreased ventral striatal activity, while the opposite was observed in PDC. DAs increased risk-taking in PDI, but no effect was seen in PDC.
Chassen et al. (2011) [51]	NA	D: 0	NA	PDI: 18.7 (7.2) PDC: 15.9 (8.4)	Subjects underwent 11C-raclopride PET-scans at baseline, a neutral condition and reward condition including visual stimuli. There were no significant differences in raclopride binding between PD with and without ICD at baseline, nor in %change in raclopride binding following neutral cues. However compared to PDC, PDI had a significant %decrease in raclopride binding between reward-related cues and neutral cues in the ventral striatum
O'Sullivan et al. (2011) [111]	NA	Dementia: 0 NA	NA	PDI: UPDRS on: 24.1 (9.3) UPDRS off: 43.3 (10.6) PDC: UPDRS on: 22.0 (8.2) UPDRS off: 37.4 (11.4)	
Ray et al. (2012) [82]	NA	NA	NA	PDI: 21.0 (8.04) PDC: 17.1 (6.4)	[11C] FLB-457 PET imaging revealed a decrease in binding potential in the midbrain in PDI compared to PDC, and the decrease correlated with impulsivity. [11C] FLB-457 binding was significantly greater in the anterior cingulate cortex correlating with impulsivity during the control task in PDI relative to PDC

Supplementary Table 2
(continued)

Reference	Prior ICDs; N	Psychiatric symptoms	Mean H&Y (SD)	Mean UPDRS (SD)	Additional information
Joutsa et al. (2012) [105]	No prior ICD symptoms	PDI: D: 1 Psychotic symptoms: 1 ADHD: 1 Bipolar II disorder: 1 PDC: Anxiety: 1 ADHD: 1	All patients: stage 2–3	PDI: UPDRS III on: 31 (range: 24–41) off: 39 (range: 28–48) PDC: UPDRS III on: 32 (range: 19–49) off: 42.5 (range: 25–52)	Subjects underwent 18F-fluorodopa PET scans and PDI showed a 35% higher 18F-fluorodopa uptake in the medial orbitofrontal cortex compared to PDC. There was no difference in the striatum. The results suggest that increased monoaminergic activity in the medial orbitofrontal cortex might be associated with increased sensitivity towards medication-induced ICDs in PD
<i>Epidemiological studies</i> Driver-Dunckley et al. (2003) [59]	No prior ICD symptoms	D: 4 Anxiety: 1	2.6	UPDRS I: range: 1–5	In 7 of 9 PD-PGs gambling started within 1 month of increasing DA dose. No patients on levodopa alone experienced PG
Pezzella et al. (2005) [98]	NA	PD DDS: D: 6 (85.7%) PD without DDS ($n = 32$): D: 8 (25%), $p < 0.01$	NA	PD DDS: 20.8 (17.6) PD without DDS: 24.4 (14.4)	The presence of DDS correlated significantly with a history of mood disorders, use of DA, presence of hallucinations, presence of dyskinesia, and a family history of psychiatric disorders. At 12 months follow-up 3 patients with DDS were no longer taking extra medication doses, which was a consequence of stricter supervision by caregivers

Supplementary Table 2
(continued)

Reference	Prior ICDs: N	Psychiatric symptoms	Mean H&Y (SD)	Mean UPDRS (SD)	Additional information
Ardouin et al. (2006) [64]	No prior ICD symptoms	Hypomania: 4 Prior alcohol abuse: 1 Prior OCD: 1	NA	37.9 (19.4) off drug and 9.9 (6.7) on drug	PG, hypomania, HS, and DDS disappeared after DBS in STN (at the same time the amount of dopaminergic medication was reduced by 74% over a three months period following surgery). CB and BE improved after DBS in STN, however symptoms remained in 1 of 7, respectively. All patients with PG were on DAs, and none of them had a prior history of PG. The 17 patients developing PG equaled 4.4% of the total sample ($n = 388$), however when just looking at patients treated with DAs ($n = 212$) 8% developed PG after treatment onset.
Grosset et al. (2006) [65]	No prior ICD symptoms	NA	NA	NA	Daily doses of pramipexole were significantly higher in patients with PG compared to patients without PG ($p = 0.04$). No cases of PG in patients on levodopa alone. The 3 patients who had prior PG experienced a worsening of symptoms after dopaminergic treatment. In 4 of 6 PG stopped after reduction of levodopa/DA dose. In the other 2 this information is not available.
Imamura et al. (2006) [67]	Prior PG: 3	Insomnia: 6	NA	NA	ICDs disappeared in 7 of 18 patients after either discontinuation of DA treatment ($n = 4$), reduction of DA dosage ($n = 2$), or counselling ($n = 1$). Patients with compulsions and PG were approx. 6 years younger than patients without compulsions ($p = 0.0006$). DAs were discontinued in most patients with PG and a 1-year follow-up showed ongoing but controlled gambling in 5 of 17, while the remaining 12 stopped gambling within 4 months.
Weintraub et al. (2006) [90]	Prior ICD: 4	NA	NA	NA	
Singh et al. (2007) [48]	NA	NA	NA	NA	

Supplementary Table 2
(continued)

Reference	Prior ICDs: N	Psychiatric symptoms	Mean H&Y (SD)	Mean UPDRS (SD)	Additional information
Giladi et al. (2007) [69]	No prior ICD symptoms	NA	2.7 (1.1)	NA	A longer duration of DA treatment was a significant risk factor for developing an ICD in PD, especially in men. Likewise, a younger age at PD onset increased the risk of ICDs in PD
Ondo et al. (2008) [72]	NA	NA	NA	NA	Younger age ($p=0.01$) and larger doses of DAs ($p<0.001$) were significantly associated with increased impulsive behavior, and development of PG, and marginally associated with longer disease duration ($p=0.11$) No association with the use of levodopa, levodopa dose, sex, and duration of DA therapy
Crockford et al. (2008) [73]	Problem gambling: 4 of 13 problem gamblers Non-problem gambling: 97 of 108 non-problem gamblers	Prior D: 24%	Problem-gamblers: 3.4 (0.5) Non-problem gamblers: 3.1 (0.7) Non-gamblers: 2.8 (0.6)	NA	The prevalence of problem and pathological gambling in PD was found to be 9.3% compared to 1.6% in an age-matched control sample in the general population. Further the increased prevalence of problem and pathological gambling in PD was related to DA agonists and younger age, but not to co-morbidities
Cooper et al. (2009) [120]	No prior HS symptoms	Past psychiatric history (including D): 4 Family psychiatric history: 4	NA	NA	PD patient with a younger age at PD onset were more likely to exhibit HS behaviour, however in this sample there was no significant association between HS and gender or DA use. In stead, a significant correlation was found between a history of smoking and not developing HS, $p<0.05$
Wicks et al. (2009) [127]	NA	Total PD sample: Family history of PG: 27% D: 15%	NA	NA	PD patients were compared to patients with amyotrophic lateral sclerosis (ALS), PG was more prevalent in PD than ALS suggesting that ICDs in PD may relate to damaged reward pathways or medication rather than to living with a chronic progressive disease

Supplementary Table 2
(continued)

Reference	Prior ICDs: N	Psychiatric symptoms	Mean H&Y (SD)	Mean UPDRS (SD)	Additional information
Fan et al. (2009) [128]	PG: 1	PDI: Alcohol addiction: 1 (9.1%) Anxiety/D: 3 (27.3%) PDC: Alcohol addiction: 10 (3.3%) Anxiety/D: 57 (19.1%) NA	NA	NA	ICDs were associated with higher DA LEDD and use of alcohol. PD patients using DA were significantly more likely to be diagnosed with an ICD (6.3%) than patients not using DA (0.6%)
Weintraub et al. (2010) [26]	NA	NA	Median: PDI: 2.0 (range: 2.0–2.5) PDC: 2.0 (range: 2.0–2.5)	NA	ICDs were more common in patients treated with DAs (17.1%) than in patients not taking DAs (6.9%). ICD frequency was similar for pramipexole (17.7%) and ropinirole (15.5%). Other factors independently associated with ICDs were levodopa use, younger age, current cigarette smoking, family history of gambling behavior, and being unmarried Use of amantadine was associated with ICDs, PG particularly
Weintraub et al. (2010) [131]	NA	PD on amantadine: Smoking: 33 (4.5%) Alcohol use: 281 (38.6%) Family history of gambling problems: 32 (4.4%) Current family gambling problems: 7 (1%) Family history of alcohol abuse: 155 (21.3%) PD off amantadine: Smoking: 85 (3.6%) Alcohol use: 990 (42%) Family history of gambling problems: 94 (4%) Current family gambling problems: 27 (1.2%) Family history of alcohol abuse: 571 (24.2%) NA	PD on amantadine: Median: 2 (25th–75th percentile: 2–3) PD off amantadine: Median: 2 (25th–75th percentile: 2–2.5), $p < 0.0001$	NA	
Weiss et al. (2010) [53]	No prior ICD symptoms	NA	NA	NA	PDI had a younger age at PD onset, longer PD duration, and received higher LEDDs than PDC. The strongest predictor for ICDs were DA treatment (OR = 11.3) or DA and levodopa combined (OR = 17.2) All PDI experienced partial or full remission of PG following discontinuation or reduction of DA or changing to another DA
Bharmal et al. (2010) [121]	Recreational gambling: 28	NA	NA	NA	

Supplementary Table 2
(continued)

Reference	Prior ICDs: N	Psychiatric symptoms	Mean H&Y (SD)	Mean UPDRS (SD)	Additional information
Kenangil et al. (2010) [125]	NA	NA	NA	PDI: 25.7 (16.6) PDC: 29.0 (17.5)	Several ICDs occurred in a small group of PD patients identified over a three-year period at a Movement Disorder Clinic in Turkey. PG was less prevalent in this sample than in Western samples, since gambling is illegal in Turkey. There was no association between ICDs and severity of PD or DA doses in this sample
Lee et al. (2010) [129]	NA	NA	PDI: 2.5 (0.8) PDC: 2.5 (0.8)	NA	ICDs were significantly related to DA dose for CB, PG, and HS. Punding was significantly correlated with levodopa dose. BE was not significantly associated with neither DA or levodopa dose
Auyeung et al. (2011) [85]	NA	Prior D or anxiety: PDI: 7 PDC: 21, $p < 0.001$ Hallucinations: PDI: 6 PDC: 45	PDI: 2.2 (0.7) PDC: 2.3 (0.9)	PDI: 24.5 (16.6) PDC: 28.4 (17.5)	Young PD patients treated with a high dose of DAs and with a history of D or anxiety were found to be at risk of developing ICDs
Lim et al. (2011) [99]	NA	NA	Total sample: 2.4 (0.7)	NA	Male gender, younger age at PD onset, longer PD duration, higher LEDD, use of DA, higher DA LEDD, use of amantadine, and higher amantadine dose were significantly associated with symptoms of ICDs and compulsive behaviors. Pramipexole and ropinirole were significantly associated with ICD symptoms, but piribedil was not. There was no significant difference in cognitive functioning and presence of apathy between PDIs and PDCs. Logistic regression revealed that only male gender and longer PD duration increased the odds of ICD symptoms significantly

Supplementary Table 2
(continued)

Reference	Prior ICDs: N	Psychiatric symptoms	Mean H&Y (SD)	Mean UPDRS (SD)	Additional information
Hassan et al. (2011) [130]	NA	NA	NA	NA	94% of PDI were taking both DA and levodopa, and ICDs improved or resolved in most patients when DA dose was reduced or ceased
Limotai et al. (2012) [83]	NA	PDI: Smoking: 20 Alcohol use: 37 D: 6 Family history of D: 4 PD DDS: Smoking: 3 Alcohol Use: 4 D: 1 Family history of D: 1 Hallucinations in 57 patients treated with DAs	PDI: 2.5 (0.8) PDC: 2.7 (0.8) PD DDS: 3.0 (1.0) PD without DDS: 2.7 (0.8)	PDI: 36.9 (14.7) PDC: 38.7 (12.9) PD DDS: 43.6 (14.6) PD without DDS: 38.4 (13.0)	NA
Kim et al. (2012) [27]	NA	NA	PDI: 2.5 (0.7) PDC: 2.4 (0.7)	PDI: 20.7 (11.7) PDC: 16.6 (9.6) $P < 0.016$	NA
Moum et al. (2012) [32]	NA	NA	On medication PDI: 2.1 PD DDS: 2.1 PDI+ DDS: 2.0 PDC/DDS: 2.3	On medication PDI: 28.2 (10.9) PD DDS: 20.0 (6.9) PDI+ DDS: 20.0 PDC/DDS: 23.6 (9.1)	No change in pre-existing DDS post-DBS, but 2 with pre-existing ICD developed in 2 DDS post-DBS. ICD resolved in 2 post-DBS, but developed in 17 post-DBS. No difference in this regard between STN DBS and GPI DBS
Joutsa et al. (2012) [54]	NA	Smoking: PDI: 9.4%, PDC: 6.0% Alcohol use: PDI: 81.7%, PDC: 74.1%, $p < 0.045$ Family history of PG: PDI: 10.4%, PDC: 6.1%, $p < 0.07$	NA	NA	D was found to be the most important factor explaining variance in risk for developing ICDs. Other risk factors were age, sex, age of disease onset, alcohol use, and medication

Supplementary Table 2
(continued)

Reference	Prior ICDs: N	Psychiatric symptoms	Mean H&Y (SD)	Mean UPDRS (SD)	Additional information
Perez-Lloret et al. (2012) [104]	NA	PDI: D: 2 Anxiety: 9 PDC: D: 7 Anxiety: 19 NA	NA	UPDRS III >23: PDI: 18 patients (36%) PDC: 78 (52%), $p < 0.05$	The strongest predictors for ICDs in PD were age younger than 68 (OR = 3.3), DA treatment (OR = 20.3), and MAO-B inhibitors (OR = 3.7)
Joutsa et al. (2012) [55]	NA	NA	NA	NA	At baseline 119 patients had ICDs, however only 113 hereof had full information on ICDs at both time-points. At 15 months follow-up 108 patients had ICDs. Of the 113 with ICD at baseline, symptoms resolved in 31 after reduction of DAs, with female patients having a better ICD prognosis than male patients. 22 patients without ICDs at baseline had symptoms at follow-up, which was significantly associated with an increase in depressive symptoms
Bastiaens et al. (2013) [100]	No prior ICD symptoms	PDI: D: 7 Anxiety: 7 Compulsive alcohol use: 3 PDC: D: 8 Anxiety: 13 Compulsive alcohol use: 3	PDI: Median: 2.0 (range: 1.0–2.0) PDC: Median: 2.0 (range: 1.0–3.0)	PDI: 33.9 (12.6) PDC: 33.7 (13.9)	ICD in PD correlated with cigarette smoking and caffeine use and more patients with ICD had motor complications. ICDs developed after a median of 23 months of DA treatment. ICDs resolved in 10 of 10 patients who discontinued DA, in 3 of 5 who reduced DA dose, and in 0 of 3 who continued on the same DA dose

N = number of patients. PD = Parkinson's disease. ICDs = impulse control disorders. PG = pathological gambling. HS = hypersexuality. CB = compulsive buying. BE = binge-eating. DDS = dopamine dysregulation syndrome. PDI = PD patients with ICDs. PDC = PD controls. DA = dopamine agonist. DBS = deep brain stimulation. STN = subthalamic nucleus. GPi = globus pallidus pars interna. LEDD = levodopa equivalent daily dose. NA = not applicable. MSA = multiple system atrophy. UPDRS = Unified Parkinson's Disease Rating Scale.