

# A simple method for automating neuron counts in vitro

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# Abstract

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## Introduction

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The quantification of cell numbers in *in vitro* and *in vivo* samples is a foundational variable in experimental biology. However, manually counting cells is a massively laborious and insipid task, often tasked to junior scientists. Furthermore, manually counting cells is a massively laborious and insipid task, often tasked to junior scientists. Classically, the task will be achieved either by sitting at the microscope, or computer – with a counting-clicker (or equivalent) – for days, if not weeks and months. With the advent of user-friendly automated imaging systems, relatively high throughput experiments can be imaged for cell number quantification by most wet-lab scientists. With relatively little computational nous, most biologists can use software such as ImageJ [1], CellProfiler [2] (and other similar projects) to achieve accurate quantifications of cells that have simple morphological features (such as stained nuclei). However, for neurons – and especially projecting neurons – this becomes a significant challenge. Not only do these types of cells have more complex morphologies, but these types of cells have received less attention from developers.

## The problem

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The current literature and documentation for methods for quantifying cell numbers are either limited to imaging segmentation tasks that are too simple, or describing methods that require one to be computationally-literate (and unperturbed by extensive mathematical formula within publications). In the context of *in vitro* experiments, the quantification of number of nuclei can be achieved with very simple segmentation techniques. However, when working with tissue samples, the task becomes significantly more complex. Open competitions have allowed machine learning and data science practitioners to apply their methods to these tasks, and have achieved very high accuracy in nuclei segmentation challenges[3]. However, wet-lab biologist struggle to use these specialized methods (one reason being, perhaps, due to an undervaluation of computational skills in most biological curricula).

For the more difficult task of automating the counting of neurons, multiple authors have described the application of state-of-the-art methods to achieve accurate quantifications [5]. Indeed, authors have also attempted to create deep learning solutions to the problem of counting neurons, that can be used as a plug-in in ImageJ. Albeit a valiant effort to “... present an ImageJ plugin that enables non-machine-learning experts to analyze their data with U-Net on either a local computer or a remote server/cloud service” [6], the implementation of such methods is still challenging for many biologists, and for *in vitro* contexts, unnecessarily performant.

## A solution

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Many of these more advanced methods lack a substantial pedagogical component. To implement many of the methods – which a junior scientists will likely find themselves doing on multiple occasions for their own use-case – specific domain expertise is required in the computational realm (this is especially significant when one considers that most biologists / neuroscientists will be unfamiliar (as was this author) of the simple term iterator [7]. One solution is for these methods and protocols to be contained within notebook interfaces such as Project Jupyter [8]. Not only can documentation be included with examples, but the methods can also be executed within a browser, and in systems where there is zero configuration required. In addition, using these formats for the sharing of methods may help instill a culture of open documentation and analysis. In this work we describe

unground-breaking, simple to use and apply methods, that allow wet-lab biologist / neuroscientists to quantify the number of projecting neurons cultured in multi-well plates.

## list of pubs for meta-analysis

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[9] [10] [11] [12] [13] [14] [15] [16] [17] [18] [19] [20] [21] [22] [23] [24] [25] [26] [27] [28] [29] [30] [31]  
[32] [33] [34] [35] [36] [37] [38] [39] [40] [41] [42] [43] [44] [45] [46] [47] [48] [49] [50] [51] [52] [53] [54]  
[55] [56] [57] [58] [59] [60] [PMID:143504126?] [61] [62] [63] [64] [65] [66] [67] [PMID:NID?] [68] [69]  
[70] [71] [72] [73] [74] [75] [76] [77] [78] [79] [80] [81] [82] [83] [84] [85] [86] [87] [88] [89] [90] [91] [92]  
[93] [94] [95] [96] [97] [98] [99] [100] [101] [102] [103] [104] [105] [106] [107] [108] [109] [110] [111]  
[112] [113] [114] [115] [116] [117] [118] [119] [120] [121] [122] [123] [124] [125] [126] [127] [128] [129]  
[130] [131] [132] [133] [134] [135] [136] [137] [138] [139] [140] [141] [142] [143] [144] [145] [146] [147]  
[148] [149] [150] [151] [152] [153] [154] [155] [156] [157] [158] [159] [160] [161] [162] [163] [164] [165]  
[166] [167] [168] [169] [170] [171] [172] [173] [174] [175] [176] [177] [178] [179] [180] [181] [182] [183]  
[184] [185] [186] [187] [188] [189] [190] [191] [192] [193] [194] [195] [196] [197] [198] [199] [200] [201]  
[202] [203] [204] [PMID:4661701968?] [205] [206] [207] [208]

# References

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1. **NIH Image to ImageJ: 25 years of image analysis**  
Caroline A Schneider, Wayne S Rasband, Kevin W Eliceiri  
*Nature Methods* (2012-06-28) <https://doi.org/gcwb4q>  
DOI: [10.1038/nmeth.2089](https://doi.org/10.1038/nmeth.2089) · PMID: [22930834](https://pubmed.ncbi.nlm.nih.gov/22930834/) · PMCID: [PMC5554542](https://pubmed.ncbi.nlm.nih.gov/PMC5554542/)
2. **CellProfiler 3.0: Next-generation image processing for biology**  
Claire McQuin, Allen Goodman, Vasilii Chernyshev, Lee Kametsky, Beth A Cimini, Kyle W Karhohs, Minh Doan, Liya Ding, Susanne M Rafelski, Derek Thirstrup, ... Anne E Carpenter  
*PLOS Biology* (2018-07-03) <https://doi.org/gdswbb>  
DOI: [10.1371/journal.pbio.2005970](https://doi.org/10.1371/journal.pbio.2005970) · PMID: [29969450](https://pubmed.ncbi.nlm.nih.gov/29969450/) · PMCID: [PMC6029841](https://pubmed.ncbi.nlm.nih.gov/PMC6029841/)
3. **Nucleus segmentation across imaging experiments: the 2018 Data Science Bowl**  
Juan C Caicedo, Allen Goodman, Kyle W Karhohs, Beth A Cimini, Jeanelle Ackerman, Marzieh Haghighi, Cherkeng Heng, Tim Becker, Minh Doan, Claire McQuin, ... Anne E Carpenter  
*Nature Methods* (2019-10-21) <https://doi.org/ggcd7h>  
DOI: [10.1038/s41592-019-0612-7](https://doi.org/10.1038/s41592-019-0612-7) · PMID: [31636459](https://pubmed.ncbi.nlm.nih.gov/31636459/) · PMCID: [PMC6919559](https://pubmed.ncbi.nlm.nih.gov/PMC6919559/)
4. **DeNeRD: high-throughput detection of neurons for brain-wide analysis with deep learning**  
Asim Iqbal, Asfandiyar Sheikh, Theofanis Karayannis  
*Scientific Reports* (2019-09-25) <https://doi.org/ghbd97>  
DOI: [10.1038/s41598-019-50137-9](https://doi.org/10.1038/s41598-019-50137-9) · PMID: [31554830](https://pubmed.ncbi.nlm.nih.gov/31554830/) · PMCID: [PMC6761257](https://pubmed.ncbi.nlm.nih.gov/PMC6761257/)
5. **A deep learning algorithm for 3D cell detection in whole mouse brain image datasets**  
Adam L Tyson, Charly V Rousseau, Christian J Niedworok, Sepiedeh Keshavarzi, Chryssanthi Tsitoura, Lee Cossell, Molly Strom, Troy W Margrie  
*Cold Spring Harbor Laboratory* (2021-03-04) <https://doi.org/gmrwnf>  
DOI: [10.1101/2020.10.21.348771](https://doi.org/10.1101/2020.10.21.348771)
6. **U-Net: deep learning for cell counting, detection, and morphometry**  
Thorsten Falk, Dominic Mai, Robert Besch, Özgün Çiçek, Ahmed Abdulkadir, Yassine Marrakchi, Anton Böhm, Jan Deubner, Zoe Jäckel, Katharina Seiwald, ... Olaf Ronneberger  
*Nature Methods* (2018-12-17) <https://doi.org/gfrfxw>  
DOI: [10.1038/s41592-018-0261-2](https://doi.org/10.1038/s41592-018-0261-2) · PMID: [30559429](https://pubmed.ncbi.nlm.nih.gov/30559429/)
7. **Iterator - Wikipedia** <https://en.wikipedia.org/wiki/Iterator>
8. **Project Jupyter** <https://www.jupyter.org>
9. **The external globus pallidus in patients with Parkinson's disease and progressive supranuclear palsy.**  
CD Hardman, GM Halliday  
*Movement disorders : official journal of the Movement Disorder Society* (1999-07)  
<https://www.ncbi.nlm.nih.gov/pubmed/10435500>  
DOI: [10.1002/1531-8257\(199907\)14:4<626::aid-mds1012>3.0.co;2-u](https://doi.org/10.1002/1531-8257(199907)14:4<626::aid-mds1012>3.0.co;2-u) · PMID: [10435500](https://pubmed.ncbi.nlm.nih.gov/10435500/)
10. **The internal globus pallidus is affected in progressive supranuclear palsy and Parkinson's disease.**  
CD Hardman, GM Halliday  
*Experimental neurology* (1999-07) <https://www.ncbi.nlm.nih.gov/pubmed/10448425>  
DOI: [10.1006/exnr.1999.7072](https://doi.org/10.1006/exnr.1999.7072) · PMID: [10448425](https://pubmed.ncbi.nlm.nih.gov/10448425/)

11. **On the survival time of a tangled neuron in the hippocampal CA4 region in parkinsonism dementia complex of Guam.**  
C Schwab, M Schulzer, JC Steele, PL McGeer  
*Neurobiology of aging* <https://www.ncbi.nlm.nih.gov/pubmed/10466894>  
DOI: [10.1016/s0197-4580\(99\)00005-6](https://doi.org/10.1016/s0197-4580(99)00005-6) · PMID: [10466894](https://pubmed.ncbi.nlm.nih.gov/10466894/)
12. **Involvement of the ventrolateral medulla in parkinsonism with autonomic failure.**  
EE Benarroch, AM Schmeichel, JE Parisi  
*Neurology* (2000-02-22) <https://www.ncbi.nlm.nih.gov/pubmed/10690993>  
DOI: [10.1212/wnl.54.4.963](https://doi.org/10.1212/wnl.54.4.963) · PMID: [10690993](https://pubmed.ncbi.nlm.nih.gov/10690993/)
13. **Ubiquitin-only intraneuronal inclusion in the substantia nigra is a characteristic feature of motor neurone disease with dementia.**  
S Al-Sarraj, S Maekawa, M Kibble, I Everall, N Leigh  
*Neuropathology and applied neurobiology* (2002-04)  
<https://www.ncbi.nlm.nih.gov/pubmed/11972798>  
DOI: [10.1046/j.1365-2990.2002.00384.x](https://doi.org/10.1046/j.1365-2990.2002.00384.x) · PMID: [11972798](https://pubmed.ncbi.nlm.nih.gov/11972798/)
14. **Midbrain dopaminergic cell loss in Parkinson's disease and MPTP-induced parkinsonism: sparing of calbindin-D28k-containing cells.**  
DC German, KF Manaye, PK Sonsalla, BA Brooks  
*Annals of the New York Academy of Sciences* (1992-05-11)  
<https://www.ncbi.nlm.nih.gov/pubmed/1353337>  
DOI: [10.1111/j.1749-6632.1992.tb24523.x](https://doi.org/10.1111/j.1749-6632.1992.tb24523.x) · PMID: [1353337](https://pubmed.ncbi.nlm.nih.gov/1353337/)
15. **Disease-specific patterns of locus coeruleus cell loss.**  
DC German, KF Manaye, CL White, DJ Woodward, DD McIntire, WK Smith, RN Kalaria, DM Mann  
*Annals of neurology* (1992-11) <https://www.ncbi.nlm.nih.gov/pubmed/1449247>  
DOI: [10.1002/ana.410320510](https://doi.org/10.1002/ana.410320510) · PMID: [1449247](https://pubmed.ncbi.nlm.nih.gov/1449247/)
16. **Pathological changes in dendrites of substantia nigra neurons in Parkinson's disease: a Golgi study.**  
S Patt, HJ Gertz, L Gerhard, J Cervós-Navarro  
*Histology and histopathology* (1991-07) <https://www.ncbi.nlm.nih.gov/pubmed/1725760>  
PMID: [1725760](https://pubmed.ncbi.nlm.nih.gov/1725760/)
17. **Alterations in the locus coeruleus in dementias of Alzheimer's and Parkinson's disease.**  
V Chan-Palay  
*Progress in brain research* (1991) <https://www.ncbi.nlm.nih.gov/pubmed/1726030>  
DOI: [10.1016/s0079-6123\(08\)63839-x](https://doi.org/10.1016/s0079-6123(08)63839-x) · PMID: [1726030](https://pubmed.ncbi.nlm.nih.gov/1726030/)
18. **The neuropathologic basis of different clinical subgroups of Parkinson's disease.**  
W Paulus, K Jellinger  
*Journal of neuropathology and experimental neurology* (1991-11)  
<https://www.ncbi.nlm.nih.gov/pubmed/1748881>  
DOI: [10.1097/00005072-199111000-00006](https://doi.org/10.1097/00005072-199111000-00006) · PMID: [1748881](https://pubmed.ncbi.nlm.nih.gov/1748881/)
19. **Hypocretin (orexin) cell loss in Parkinson's disease.**  
Thomas C Thannickal, Yuan-Yang Lai, Jerome M Siegel  
*Brain : a journal of neurology* (2007-05-09) <https://www.ncbi.nlm.nih.gov/pubmed/17491094>  
DOI: [10.1093/brain/awm097](https://doi.org/10.1093/brain/awm097) · PMID: [17491094](https://pubmed.ncbi.nlm.nih.gov/17491094/)
20. **Morphometry of the human substantia nigra in ageing and Parkinson's disease.**  
Gay Rudow, Richard O'Brien, Alena V Savonenko, Susan M Resnick, Alan B Zonderman, Olga Pletnikova, Laura Marsh, Ted M Dawson, Barbara J Crain, Mark J West, Juan C Troncoso

*Acta neuropathologica* (2008-02-23) <https://www.ncbi.nlm.nih.gov/pubmed/18297291>  
DOI: [10.1007/s00401-008-0352-8](https://doi.org/10.1007/s00401-008-0352-8) · PMID: [18297291](https://pubmed.ncbi.nlm.nih.gov/18297291/) · PMCID: [PMC2431149](https://pubmed.ncbi.nlm.nih.gov/PMC2431149/)

21. **Nerve growth factor receptor immunoreactivity within the nucleus basalis (Ch4) in Parkinson's disease: reduced cell numbers and co-localization with cholinergic neurons.**  
EJ Mufson, LN Presley, JH Kordower  
*Brain research* (1991-01-18) <https://www.ncbi.nlm.nih.gov/pubmed/1849779>  
DOI: [10.1016/0006-8993\(91\)90682-I](https://doi.org/10.1016/0006-8993(91)90682-I) · PMID: [1849779](https://pubmed.ncbi.nlm.nih.gov/1849779/)
22. **Ageing and Parkinson's disease: substantia nigra regional selectivity.**  
JM Fearnley, AJ Lees  
*Brain : a journal of neurology* (1991-10) <https://www.ncbi.nlm.nih.gov/pubmed/1933245>  
DOI: [10.1093/brain/114.5.2283](https://doi.org/10.1093/brain/114.5.2283) · PMID: [1933245](https://pubmed.ncbi.nlm.nih.gov/1933245/)
23. **The absolute number of nerve cells in substantia nigra in normal subjects and in patients with Parkinson's disease estimated with an unbiased stereological method.**  
B Pakkenberg, A Møller, HJ Gundersen, A Mouritzen Dam, H Pakkenberg  
*Journal of neurology, neurosurgery, and psychiatry* (1991-01) <https://www.ncbi.nlm.nih.gov/pubmed/2010756>  
DOI: [10.1136/jnnp.54.1.30](https://doi.org/10.1136/jnnp.54.1.30) · PMID: [2010756](https://pubmed.ncbi.nlm.nih.gov/2010756/) · PMCID: [PMC1014294](https://pubmed.ncbi.nlm.nih.gov/PMC1014294/)
24. **Cerebellar Purkinje cell loss is not pathognomonic of essential tremor.**  
AH Rajput, CA Robinson, ML Rajput, A Rajput  
*Parkinsonism & related disorders* (2011-01) <https://www.ncbi.nlm.nih.gov/pubmed/20817536>  
DOI: [10.1016/j.parkreldis.2010.08.009](https://doi.org/10.1016/j.parkreldis.2010.08.009) · PMID: [20817536](https://pubmed.ncbi.nlm.nih.gov/20817536/)
25. **Colonic biopsies to assess the neuropathology of Parkinson's disease and its relationship with symptoms.**  
Thibaud Lebouvier, Michel Neunlist, Stanislas Bruley des Varannes, Emmanuel Coron, Anne Drouard, Jean-Michel N'Guyen, Tanguy Chaumette, Maddalena Tasselli, Sébastien Paillusson, Mathurin Flamand, ... Pascal Derkinderen  
*PloS one* (2010-09-14) <https://www.ncbi.nlm.nih.gov/pubmed/20856865>  
DOI: [10.1371/journal.pone.0012728](https://doi.org/10.1371/journal.pone.0012728) · PMID: [20856865](https://pubmed.ncbi.nlm.nih.gov/20856865/) · PMCID: [PMC2939055](https://pubmed.ncbi.nlm.nih.gov/PMC2939055/)
26. **Parkinson's disease is not associated with gastrointestinal myenteric ganglion neuron loss.**  
Dana M Annerino, Shawn Arshad, Georgia M Taylor, Charles H Adler, Thomas G Beach, James G Greene  
*Acta neuropathologica* (2012-09-02) <https://www.ncbi.nlm.nih.gov/pubmed/22941241>  
DOI: [10.1007/s00401-012-1040-2](https://doi.org/10.1007/s00401-012-1040-2) · PMID: [22941241](https://pubmed.ncbi.nlm.nih.gov/22941241/) · PMCID: [PMC3473167](https://pubmed.ncbi.nlm.nih.gov/PMC3473167/)
27. **Disease duration and the integrity of the nigrostriatal system in Parkinson's disease.**  
Jeffrey H Kordower, CWarren Olanow, Hemraj B Dodiya, Yaping Chu, Thomas G Beach, Charles H Adler, Glenda M Halliday, Raymond T Bartus  
*Brain : a journal of neurology* (2013-08) <https://www.ncbi.nlm.nih.gov/pubmed/23884810>  
DOI: [10.1093/brain/awt192](https://doi.org/10.1093/brain/awt192) · PMID: [23884810](https://pubmed.ncbi.nlm.nih.gov/23884810/) · PMCID: [PMC3722357](https://pubmed.ncbi.nlm.nih.gov/PMC3722357/)
28. **Alterations in catecholamine neurons of the locus coeruleus in senile dementia of the Alzheimer type and in Parkinson's disease with and without dementia and depression.**  
V Chan-Palay, E Asan  
*The Journal of comparative neurology* (1989-09-15) <https://www.ncbi.nlm.nih.gov/pubmed/2570794>  
DOI: [10.1002/cne.902870308](https://doi.org/10.1002/cne.902870308) · PMID: [2570794](https://pubmed.ncbi.nlm.nih.gov/2570794/)

29. **Clinical and pathological aspects of parkinsonism in Alzheimer's disease. A role for extranigral factors?**  
JC Morris, M Drazner, K Fulling, EA Grant, J Goldring  
*Archives of neurology* (1989-06) <https://www.ncbi.nlm.nih.gov/pubmed/2730377>  
DOI: [10.1001/archneur.1989.00520420071025](https://doi.org/10.1001/archneur.1989.00520420071025) · PMID: [2730377](https://pubmed.ncbi.nlm.nih.gov/2730377/)
30. **The nucleus basalis of Meynert in parkinsonism-dementia of Guam: a morphometric study.**  
C Masullo, M Pocchiari, P Mariotti, G Macchi, RM Garruto, CJ Gibbs, R Yanagihara, DC Gajdusek  
*Neuropathology and applied neurobiology* <https://www.ncbi.nlm.nih.gov/pubmed/2747841>  
DOI: [10.1111/j.1365-2990.1989.tb01222.x](https://doi.org/10.1111/j.1365-2990.1989.tb01222.x) · PMID: [2747841](https://pubmed.ncbi.nlm.nih.gov/2747841/)
31. **Midbrain dopaminergic cell loss in Parkinson's disease: computer visualization.**  
DC German, K Manaye, WK Smith, DJ Woodward, CB Saper  
*Annals of neurology* (1989-10) <https://www.ncbi.nlm.nih.gov/pubmed/2817827>  
DOI: [10.1002/ana.410260403](https://doi.org/10.1002/ana.410260403) · PMID: [2817827](https://pubmed.ncbi.nlm.nih.gov/2817827/)
32. **Calcineurin in human brain and its relation to extrapyramidal system. Immunohistochemical study on postmortem human brains.**  
S Goto, Y Matsukado, Y Mihara, N Inoue, E Miyamoto  
*Acta neuropathologica* (1986) <https://www.ncbi.nlm.nih.gov/pubmed/2950715>  
DOI: [10.1007/bf00685977](https://doi.org/10.1007/bf00685977) · PMID: [2950715](https://pubmed.ncbi.nlm.nih.gov/2950715/)
33. **The rostral mesencephalon in Parkinson's disease and Alzheimer's disease.**  
S Hunter  
*Acta neuropathologica* (1985) <https://www.ncbi.nlm.nih.gov/pubmed/2996284>  
DOI: [10.1007/bf00688956](https://doi.org/10.1007/bf00688956) · PMID: [2996284](https://pubmed.ncbi.nlm.nih.gov/2996284/)
34. **Astrogliosis and sexually dimorphic neurodegeneration and microgliosis in the olfactory bulb in Parkinson's disease.**  
Alicia Flores-Cuadrado, Daniel Saiz-Sanchez, Alicia Mohedano-Moriano, Elena Lamas-Cenfor, Victor Leon-Olmo, Alino Martinez-Marcos, Isabel Ubeda-Bañon  
*NPJ Parkinson's disease* (2021-01-21) <https://www.ncbi.nlm.nih.gov/pubmed/33479244>  
DOI: [10.1038/s41531-020-00154-7](https://doi.org/10.1038/s41531-020-00154-7) · PMID: [33479244](https://pubmed.ncbi.nlm.nih.gov/33479244/) · PMCID: [PMC7820595](https://pubmed.ncbi.nlm.nih.gov/PMC7820595/)
35. **The progression of idiopathic Parkinson's disease is not explained by age-related changes. Clinical and pathological comparisons with post-encephalitic parkinsonian syndrome.**  
WR Gibb, AJ Lees  
*Acta neuropathologica* (1987) <https://www.ncbi.nlm.nih.gov/pubmed/3604586>  
DOI: [10.1007/bf00693789](https://doi.org/10.1007/bf00693789) · PMID: [3604586](https://pubmed.ncbi.nlm.nih.gov/3604586/)
36. **Pathologic correlates of dementia in Parkinson's disease.**  
HC Chui, JA Mortimer, U Slager, C Zarow, W Bondareff, DD Webster  
*Archives of neurology* (1986-10) <https://www.ncbi.nlm.nih.gov/pubmed/3753274>  
DOI: [10.1001/archneur.1986.00520100013007](https://doi.org/10.1001/archneur.1986.00520100013007) · PMID: [3753274](https://pubmed.ncbi.nlm.nih.gov/3753274/)
37. **The nucleus basalis of Meynert in neurological disease: a quantitative morphological study.**  
JD Rogers, D Brogan, SS Mirra  
*Annals of neurology* (1985-02) <https://www.ncbi.nlm.nih.gov/pubmed/3883886>  
DOI: [10.1002/ana.410170210](https://doi.org/10.1002/ana.410170210) · PMID: [3883886](https://pubmed.ncbi.nlm.nih.gov/3883886/)
38. **Parkinson's disease: loss of neurons from the ventral tegmental area contralateral to therapeutic surgical lesions.**



GR Uhl, JC Hedreen, DL Price

*Neurology* (1985-08) <https://www.ncbi.nlm.nih.gov/pubmed/4022359>

DOI: [10.1212/wnl.35.8.1215](https://doi.org/10.1212/wnl.35.8.1215) · PMID: [4022359](https://pubmed.ncbi.nlm.nih.gov/4022359/)

39. **Preservation of hypothalamic dopaminergic neurons in Parkinson's disease.**  
MM Matzuk, CB Saper  
*Annals of neurology* (1985-11) <https://www.ncbi.nlm.nih.gov/pubmed/4073850>  
DOI: [10.1002/ana.410180507](https://doi.org/10.1002/ana.410180507) · PMID: [4073850](https://pubmed.ncbi.nlm.nih.gov/4073850/)
40. **Dementia in idiopathic Parkinson's disease. A neuropathological study of 32 cases.**  
P Gaspar, F Gray  
*Acta neuropathologica* (1984) <https://www.ncbi.nlm.nih.gov/pubmed/6089493>  
DOI: [10.1007/bf00695605](https://doi.org/10.1007/bf00695605) · PMID: [6089493](https://pubmed.ncbi.nlm.nih.gov/6089493/)
41. **Neuropathology of the locus ceruleus: a semi-quantitative study.**  
M Tomonaga  
*Journal of neurology* (1983) <https://www.ncbi.nlm.nih.gov/pubmed/6198483>  
DOI: [10.1007/bf00313699](https://doi.org/10.1007/bf00313699) · PMID: [6198483](https://pubmed.ncbi.nlm.nih.gov/6198483/)
42. **Lateral horn cells in progressive autonomic failure.**  
DR Oppenheimer  
*Journal of the neurological sciences* (1980-06) <https://www.ncbi.nlm.nih.gov/pubmed/6247458>  
DOI: [10.1016/0022-510x\(80\)90064-7](https://doi.org/10.1016/0022-510x(80)90064-7) · PMID: [6247458](https://pubmed.ncbi.nlm.nih.gov/6247458/)
43. **Parkinson's disease: neuron loss in the nucleus basalis without concomitant Alzheimer's disease.**  
I Nakano, A Hirano  
*Annals of neurology* (1984-05) <https://www.ncbi.nlm.nih.gov/pubmed/6732189>  
DOI: [10.1002/ana.410150503](https://doi.org/10.1002/ana.410150503) · PMID: [6732189](https://pubmed.ncbi.nlm.nih.gov/6732189/)
44. **Neuron loss in the nucleus basalis of Meynert in parkinsonism-dementia complex of Guam.**  
I Nakano, A Hirano  
*Annals of neurology* (1983-01) <https://www.ncbi.nlm.nih.gov/pubmed/6830170>  
DOI: [10.1002/ana.410130118](https://doi.org/10.1002/ana.410130118) · PMID: [6830170](https://pubmed.ncbi.nlm.nih.gov/6830170/)
45. **Possible role of neuromelanin in the pathogenesis of Parkinson's disease.**  
DM Mann, PO Yates  
*Mechanisms of ageing and development* (1983-02)  
<https://www.ncbi.nlm.nih.gov/pubmed/6865505>  
DOI: [10.1016/0047-6374\(83\)90074-x](https://doi.org/10.1016/0047-6374(83)90074-x) · PMID: [6865505](https://pubmed.ncbi.nlm.nih.gov/6865505/)
46. **The anterior olfactory nucleus in Parkinson's disease.**  
RK Pearce, CH Hawkes, SE Daniel  
*Movement disorders : official journal of the Movement Disorder Society* (1995-05)  
<https://www.ncbi.nlm.nih.gov/pubmed/7651444>  
DOI: [10.1002/mds.870100309](https://doi.org/10.1002/mds.870100309) · PMID: [7651444](https://pubmed.ncbi.nlm.nih.gov/7651444/)
47. **Cell counts in the substantia nigra: a comparison of single section counts and disector counts in patients with Parkinson's disease and in controls.**  
SY Ma, Y Collan, M R ytt , JO Rinne, UK Rinne  
*Neuropathology and applied neurobiology* (1995-02)  
<https://www.ncbi.nlm.nih.gov/pubmed/7770115>  
DOI: [10.1111/j.1365-2990.1995.tb01023.x](https://doi.org/10.1111/j.1365-2990.1995.tb01023.x) · PMID: [7770115](https://pubmed.ncbi.nlm.nih.gov/7770115/)



48. **Retention of basic fibroblast growth factor immunoreactivity in dopaminergic neurons of the substantia nigra during normal aging in humans contrasts with loss in Parkinson's disease.**  
I Tooyama, EG McGeer, T Kawamata, H Kimura, PL McGeer  
*Brain research* (1994-09-05) <https://www.ncbi.nlm.nih.gov/pubmed/7804831>  
DOI: [10.1016/0006-8993\(94\)91378-1](https://doi.org/10.1016/0006-8993(94)91378-1) · PMID: [7804831](https://pubmed.ncbi.nlm.nih.gov/7804831/)
49. **Image analyser-assisted morphometry of the locus coeruleus in Alzheimer's disease, Parkinson's disease and amyotrophic lateral sclerosis.**  
WJ Hoogendijk, CW Pool, D Troost, E van Zwieten, DF Swaab  
*Brain : a journal of neurology* (1995-02) <https://www.ncbi.nlm.nih.gov/pubmed/7894999>  
DOI: [10.1093/brain/118.1.131](https://doi.org/10.1093/brain/118.1.131) · PMID: [7894999](https://pubmed.ncbi.nlm.nih.gov/7894999/)
50. **Decreased number of oxytocin-immunoreactive neurons in the paraventricular nucleus of the hypothalamus in Parkinson's disease.**  
JS Purba, MA Hofman, DF Swaab  
*Neurology* (1994-01) <https://www.ncbi.nlm.nih.gov/pubmed/7904735>  
DOI: [10.1212/wnl.44.1.84](https://doi.org/10.1212/wnl.44.1.84) · PMID: [7904735](https://pubmed.ncbi.nlm.nih.gov/7904735/)
51. **Loss of non-phosphorylated neurofilament immunoreactivity, with preservation of tyrosine hydroxylase, in surviving substantia nigra neurons in Parkinson's disease.**  
WP Gai, JC Vickers, PC Blumbergs, WW Blessing  
*Journal of neurology, neurosurgery, and psychiatry* (1994-09)  
<https://www.ncbi.nlm.nih.gov/pubmed/7916375>  
DOI: [10.1136/jnnp.57.9.1039](https://doi.org/10.1136/jnnp.57.9.1039) · PMID: [7916375](https://pubmed.ncbi.nlm.nih.gov/7916375/) · PMCID: [PMC1073124](https://pubmed.ncbi.nlm.nih.gov/PMC1073124/)
52. **Depression and dementia in Parkinson's disease. Catecholamine changes in the locus ceruleus, a basis for therapy.**  
V Chan-Palay  
*Advances in neurology* (1993) <https://www.ncbi.nlm.nih.gov/pubmed/8093581>  
PMID: [8093581](https://pubmed.ncbi.nlm.nih.gov/8093581/)
53. **Calbindin D-28k and monoamine oxidase A immunoreactive neurons in the nucleus basalis of Meynert in senile dementia of the Alzheimer type and Parkinson's disease.**  
V Chan-Palay, M Höchli, E Savaskan, G Hungerecker  
*Dementia (Basel, Switzerland)* <https://www.ncbi.nlm.nih.gov/pubmed/8358501>  
DOI: [10.1159/000107290](https://doi.org/10.1159/000107290) · PMID: [8358501](https://pubmed.ncbi.nlm.nih.gov/8358501/)
54. **Loss of C1 and C3 epinephrine-synthesizing neurons in the medulla oblongata in Parkinson's disease.**  
WP Gai, LB Geffen, L Denoroy, WW Blessing  
*Annals of neurology* (1993-04) <https://www.ncbi.nlm.nih.gov/pubmed/8489206>  
DOI: [10.1002/ana.410330405](https://doi.org/10.1002/ana.410330405) · PMID: [8489206](https://pubmed.ncbi.nlm.nih.gov/8489206/)
55. **Immunohistochemical detection of 4-hydroxynonenal protein adducts in Parkinson disease.**  
A Yoritaka, N Hattori, K Uchida, M Tanaka, ER Stadtman, Y Mizuno  
*Proceedings of the National Academy of Sciences of the United States of America* (1996-04-02)  
<https://www.ncbi.nlm.nih.gov/pubmed/8610103>  
DOI: [10.1073/pnas.93.7.2696](https://doi.org/10.1073/pnas.93.7.2696) · PMID: [8610103](https://pubmed.ncbi.nlm.nih.gov/8610103/) · PMCID: [PMC39693](https://pubmed.ncbi.nlm.nih.gov/PMC39693/)
56. **Large neurons in the tuberomammillary nucleus in patients with Parkinson's disease and multiple system atrophy.**  
S Nakamura, K Ohnishi, M Nishimura, T Suenaga, I Akiguchi, J Kimura, T Kimura  
*Neurology* (1996-06) <https://www.ncbi.nlm.nih.gov/pubmed/8649572>

DOI: [10.1212/wnl.46.6.1693](https://doi.org/10.1212/wnl.46.6.1693) · PMID: [8649572](https://pubmed.ncbi.nlm.nih.gov/8649572/)

57. **Substantia nigra pars reticulata neurons in Parkinson's disease.**  
CD Hardman, DA McRitchie, GM Halliday, HR Cartwright, JG Morris  
*Neurodegeneration : a journal for neurodegenerative disorders, neuroprotection, and neuroregeneration* (1996-03) <https://www.ncbi.nlm.nih.gov/pubmed/8731382>  
DOI: [10.1006/neur.1996.0007](https://doi.org/10.1006/neur.1996.0007) · PMID: [8731382](https://pubmed.ncbi.nlm.nih.gov/8731382/)
58. **Specific A10 dopaminergic nuclei in the midbrain degenerate in Parkinson's disease.**  
DA McRitchie, HR Cartwright, GM Halliday  
*Experimental neurology* (1997-03) <https://www.ncbi.nlm.nih.gov/pubmed/9126172>  
DOI: [10.1006/exnr.1997.6418](https://doi.org/10.1006/exnr.1997.6418) · PMID: [9126172](https://pubmed.ncbi.nlm.nih.gov/9126172/)
59. **Decrease of medullary catecholaminergic neurons in multiple system atrophy and Parkinson's disease and their preservation in amyotrophic lateral sclerosis.**  
S Kato, M Oda, H Hayashi, T Shimizu, M Hayashi, A Kawata, H Tanabe  
*Journal of the neurological sciences* (1995-10) <https://www.ncbi.nlm.nih.gov/pubmed/8543951>  
DOI: [10.1016/0022-510x\(95\)00155-u](https://doi.org/10.1016/0022-510x(95)00155-u) · PMID: [8543951](https://pubmed.ncbi.nlm.nih.gov/8543951/)
60. **Alterations in the distribution of glutathione in the substantia nigra in Parkinson's disease.**  
RK Pearce, A Owen, S Daniel, P Jenner, CD Marsden  
*Journal of neural transmission (Vienna, Austria : 1996)* (1997)  
<https://www.ncbi.nlm.nih.gov/pubmed/9444566>  
DOI: [10.1007/bf01291884](https://doi.org/10.1007/bf01291884) · PMID: [9444566](https://pubmed.ncbi.nlm.nih.gov/9444566/)
61. **THE PATHOLOGY OF CERTAIN MEDULLARY NUCLEI IN PARKINSONISM.**  
MJ EADIE  
*Brain : a journal of neurology* (1963-12) <https://www.ncbi.nlm.nih.gov/pubmed/14090529>  
DOI: [10.1093/brain/86.4.781](https://doi.org/10.1093/brain/86.4.781) · PMID: [14090529](https://pubmed.ncbi.nlm.nih.gov/14090529/)
62. **Hypocretin (orexin) loss in Parkinson's disease.**  
Rolf Fronczek, Sebastiaan Overeem, Sandy YY Lee, Ingrid M Hegeman, Johannes van Pelt, Sjoerd G van Duinen, Gert Jan Lammers, Dick F Swaab  
*Brain : a journal of neurology* (2007-04-30) <https://www.ncbi.nlm.nih.gov/pubmed/17470494>  
DOI: [10.1093/brain/awm090](https://doi.org/10.1093/brain/awm090) · PMID: [17470494](https://pubmed.ncbi.nlm.nih.gov/17470494/)
63. **Nucleus raphe dorsalis in parkinsonism-dementia complex of Guam.**  
T Yamamoto, A Hirano  
*Acta neuropathologica* (1985) <https://www.ncbi.nlm.nih.gov/pubmed/4050345>  
DOI: [10.1007/bf00687815](https://doi.org/10.1007/bf00687815) · PMID: [4050345](https://pubmed.ncbi.nlm.nih.gov/4050345/)
64. **The number of nerve cells in the substantia nigra in paralysis agitans.**  
H Pakkenberg, H Brody  
*Acta neuropathologica* (1965-11-18) <https://www.ncbi.nlm.nih.gov/pubmed/5886206>  
DOI: [10.1007/bf00686528](https://doi.org/10.1007/bf00686528) · PMID: [5886206](https://pubmed.ncbi.nlm.nih.gov/5886206/)
65. **Loss of neurons in the nucleus basalis of Meynert in Alzheimer's disease, paralysis agitans and Korsakoff's Disease.**  
T Arendt, V Bigl, A Arendt, A Tennstedt  
*Acta neuropathologica* (1983) <https://www.ncbi.nlm.nih.gov/pubmed/6637393>  
DOI: [10.1007/bf00697388](https://doi.org/10.1007/bf00697388) · PMID: [6637393](https://pubmed.ncbi.nlm.nih.gov/6637393/)
66. **Depression in Parkinson's disease is not accompanied by more corticotropin-releasing hormone expressing neurons in the hypothalamic paraventricular nucleus.**  
WJ Hoogendijk, JS Purba, MA Hofman, RA de Vos, EN Jansen, DF Swaab

*Biological psychiatry* (1998-06-15) <https://www.ncbi.nlm.nih.gov/pubmed/9627747>  
DOI: [10.1016/s0006-3223\(97\)00338-7](https://doi.org/10.1016/s0006-3223(97)00338-7) · PMID: [9627747](https://pubmed.ncbi.nlm.nih.gov/9627747/)

67. **Biochemical neuropathology of Parkinson's disease.**  
F Javoy-Agid, M Ruberg, H Taquet, B Bokobza, Y Agid, P Gaspar, B Berger, J N'Guyen-Legros, C Alvarez, F Gray  
*Advances in neurology* (1984) <https://www.ncbi.nlm.nih.gov/pubmed/6695594>  
PMID: [6695594](https://pubmed.ncbi.nlm.nih.gov/6695594/)
68. **Reduced expression of brain-derived neurotrophic factor protein in Parkinson's disease substantia nigra.**  
K Parain, MG Murer, Q Yan, B Faucheux, Y Agid, E Hirsch, R Raisman-Vozari  
*Neuroreport* (1999-02-25) <https://www.ncbi.nlm.nih.gov/pubmed/10208589>  
DOI: [10.1097/00001756-199902250-00021](https://doi.org/10.1097/00001756-199902250-00021) · PMID: [10208589](https://pubmed.ncbi.nlm.nih.gov/10208589/)
69. **Blood vessels change in the mesencephalon of patients with Parkinson's disease.**  
BA Faucheux, AM Bonnet, Y Agid, EC Hirsch  
*Lancet (London, England)* (1999-03-20) <https://www.ncbi.nlm.nih.gov/pubmed/10459912>  
DOI: [10.1016/s0140-6736\(99\)00641-8](https://doi.org/10.1016/s0140-6736(99)00641-8) · PMID: [10459912](https://pubmed.ncbi.nlm.nih.gov/10459912/)
70. **Clinicopathologic correlates in temporal cortex in dementia with Lewy bodies.**  
T Gómez-Isla, WB Growdon, M McNamara, K Newell, E Gómez-Tortosa, ET Hedley-Whyte, BT Hyman  
*Neurology* (1999-12-10) <https://www.ncbi.nlm.nih.gov/pubmed/10599772>  
DOI: [10.1212/wnl.53.9.2003](https://doi.org/10.1212/wnl.53.9.2003) · PMID: [10599772](https://pubmed.ncbi.nlm.nih.gov/10599772/)
71. **Caspase-3: A vulnerability factor and final effector in apoptotic death of dopaminergic neurons in Parkinson's disease.**  
A Hartmann, S Hunot, PP Michel, MP Muriel, S Vyas, BA Faucheux, A Mouatt-Prigent, H Turmel, A Srinivasan, M Ruberg, ... EC Hirsch  
*Proceedings of the National Academy of Sciences of the United States of America* (2000-03-14) <https://www.ncbi.nlm.nih.gov/pubmed/10688892>  
DOI: [10.1073/pnas.040556597](https://doi.org/10.1073/pnas.040556597) · PMID: [10688892](https://pubmed.ncbi.nlm.nih.gov/10688892/) · PMCID: [PMC16023](https://pubmed.ncbi.nlm.nih.gov/pmc/PMC16023/)
72. **Degeneration of the centré median-parafascicular complex in Parkinson's disease.**  
JM Henderson, K Carpenter, H Cartwright, GM Halliday  
*Annals of neurology* (2000-03) <https://www.ncbi.nlm.nih.gov/pubmed/10716254>  
PMID: [10716254](https://pubmed.ncbi.nlm.nih.gov/10716254/)
73. **Calpastatin immunoreactivity in the monkey and human brain of control subjects and patients with Parkinson's disease.**  
A Mouatt-Prigent, JO Karlsson, J Yelnik, Y Agid, EC Hirsch  
*The Journal of comparative neurology* (2000-04-03) <https://www.ncbi.nlm.nih.gov/pubmed/10722997>  
DOI: [10.1002/\(sici\)1096-9861\(20000403\)419:2<175::aid-cne3>3.0.co;2-2](https://doi.org/10.1002/(sici)1096-9861(20000403)419:2<175::aid-cne3>3.0.co;2-2) · PMID: [10722997](https://pubmed.ncbi.nlm.nih.gov/10722997/)
74. **Loss of thalamic intralaminar nuclei in progressive supranuclear palsy and Parkinson's disease: clinical and therapeutic implications.**  
JM Henderson, K Carpenter, H Cartwright, GM Halliday  
*Brain : a journal of neurology* (2000-07) <https://www.ncbi.nlm.nih.gov/pubmed/10869053>  
DOI: [10.1093/brain/123.7.1410](https://doi.org/10.1093/brain/123.7.1410) · PMID: [10869053](https://pubmed.ncbi.nlm.nih.gov/10869053/)
75. **New dopaminergic neurons in Parkinson's disease striatum.**  
MJ Porritt, PE Batchelor, AJ Hughes, R Kalnins, GA Donnan, DW Howells  
*Lancet (London, England)* (2000-07-01) <https://www.ncbi.nlm.nih.gov/pubmed/10892768>

DOI: [10.1016/s0140-6736\(00\)02437-5](https://doi.org/10.1016/s0140-6736(00)02437-5) · PMID: [10892768](https://pubmed.ncbi.nlm.nih.gov/10892768/)

76. **Reduced BDNF mRNA expression in the Parkinson's disease substantia nigra.**  
DW Howells, MJ Porritt, JY Wong, PE Batchelor, R Kalnins, AJ Hughes, GA Donnan  
*Experimental neurology* (2000-11) <https://www.ncbi.nlm.nih.gov/pubmed/11031089>  
DOI: [10.1006/exnr.2000.7483](https://doi.org/10.1006/exnr.2000.7483) · PMID: [11031089](https://pubmed.ncbi.nlm.nih.gov/11031089/)
77. **Cellular expression of alpha7 nicotinic acetylcholine receptor protein in the temporal cortex in Alzheimer's and Parkinson's disease--a stereological approach.**  
C Banerjee, JR Nyengaard, A Wevers, RA de Vos, EN Jansen Steur, J Lindstrom, K Pilz, S Nowacki, W Bloch, H Schröder  
*Neurobiology of disease* (2000-12) <https://www.ncbi.nlm.nih.gov/pubmed/11114264>  
DOI: [10.1006/nbdi.2000.0317](https://doi.org/10.1006/nbdi.2000.0317) · PMID: [11114264](https://pubmed.ncbi.nlm.nih.gov/11114264/)
78. **Cortical neurons expressing calcium binding proteins are spared in dementia with Lewy bodies.**  
E Gómez-Tortosa, JL Sanders, K Newell, BT Hyman  
*Acta neuropathologica* (2001-01) <https://www.ncbi.nlm.nih.gov/pubmed/11194939>  
DOI: [10.1007/s004010000270](https://doi.org/10.1007/s004010000270) · PMID: [11194939](https://pubmed.ncbi.nlm.nih.gov/11194939/)
79. **Increased alpha 2-adrenergic receptor binding in locus coeruleus projection areas in dementia with Lewy bodies.**  
JB Leverenz, MA Miller, DJ Dobie, ER Peskind, MA Raskind  
*Neurobiology of aging* <https://www.ncbi.nlm.nih.gov/pubmed/11445255>  
DOI: [10.1016/s0197-4580\(01\)00221-4](https://doi.org/10.1016/s0197-4580(01)00221-4) · PMID: [11445255](https://pubmed.ncbi.nlm.nih.gov/11445255/)
80. **Depletion of cholinergic neurons of the medullary arcuate nucleus in multiple system atrophy.**  
EE Benarroch, AM Schmeichel, JE Parisi  
*Autonomic neuroscience : basic & clinical* (2001-03-23) <https://www.ncbi.nlm.nih.gov/pubmed/11476292>  
DOI: [10.1016/s1566-0702\(00\)00276-9](https://doi.org/10.1016/s1566-0702(00)00276-9) · PMID: [11476292](https://pubmed.ncbi.nlm.nih.gov/11476292/)
81. **Ceruloplasmin immunoreactivity in neurodegenerative disorders.**  
DA Loeffler, AA Sima, PA LeWitt  
*Free radical research* (2001-08) <https://www.ncbi.nlm.nih.gov/pubmed/11697191>  
DOI: [10.1080/10715760100300651](https://doi.org/10.1080/10715760100300651) · PMID: [11697191](https://pubmed.ncbi.nlm.nih.gov/11697191/)
82. **Selective hippocampal neuron loss in dementia with Lewy bodies.**  
Antony J Harding, Bronwyn Lakay, Glenda M Halliday  
*Annals of neurology* (2002-01) <https://www.ncbi.nlm.nih.gov/pubmed/11782993>  
DOI: [10.1002/ana.10071](https://doi.org/10.1002/ana.10071) · PMID: [11782993](https://pubmed.ncbi.nlm.nih.gov/11782993/)
83. **Clinical correlates of selective pathology in the amygdala of patients with Parkinson's disease.**  
Antony J Harding, Emily Stimson, Jasmine M Henderson, Glenda M Halliday  
*Brain : a journal of neurology* (2002-11) <https://www.ncbi.nlm.nih.gov/pubmed/12390970>  
DOI: [10.1093/brain/awf251](https://doi.org/10.1093/brain/awf251) · PMID: [12390970](https://pubmed.ncbi.nlm.nih.gov/12390970/)
84. **Loss of response to levodopa in Parkinson's disease and co-occurrence with dementia: role of D3 and not D2 receptors.**  
JN Joyce, HL Ryoo, TB Beach, JN Caviness, Mark Stacy, EV Gurevich, Mark Reiser, CH Adler  
*Brain research* (2002-11-15) <https://www.ncbi.nlm.nih.gov/pubmed/12419530>  
DOI: [10.1016/s0006-8993\(02\)03396-6](https://doi.org/10.1016/s0006-8993(02)03396-6) · PMID: [12419530](https://pubmed.ncbi.nlm.nih.gov/12419530/)

85. **Selective loss of pyramidal neurons in the pre-supplementary motor cortex in Parkinson's disease.**  
Virginia MacDonald, Glenda M Halliday  
*Movement disorders : official journal of the Movement Disorder Society* (2002-11) <https://www.ncbi.nlm.nih.gov/pubmed/12465053>  
DOI: [10.1002/mds.10258](https://doi.org/10.1002/mds.10258) · PMID: [12465053](https://pubmed.ncbi.nlm.nih.gov/12465053/)
86. **Neuronal loss is greater in the locus coeruleus than nucleus basalis and substantia nigra in Alzheimer and Parkinson diseases.**  
Chris Zarow, Scott A Lyness, James A Mortimer, Helena C Chui  
*Archives of neurology* (2003-03) <https://www.ncbi.nlm.nih.gov/pubmed/12633144>  
DOI: [10.1001/archneur.60.3.337](https://doi.org/10.1001/archneur.60.3.337) · PMID: [12633144](https://pubmed.ncbi.nlm.nih.gov/12633144/)
87. **Depletion of ventromedullary NK-1 receptor-immunoreactive neurons in multiple system atrophy.**  
Eduardo E Benarroch, Ann M Schmeichel, Phillip A Low, Joseph E Parisi  
*Brain : a journal of neurology* (2003-08-05) <https://www.ncbi.nlm.nih.gov/pubmed/12902309>  
DOI: [10.1093/brain/awg220](https://doi.org/10.1093/brain/awg220) · PMID: [12902309](https://pubmed.ncbi.nlm.nih.gov/12902309/)
88. **Clinico-pathological correlations in Parkinson's disease.**  
KA Jellinger, W Paulus  
*Clinical neurology and neurosurgery* (1992) <https://www.ncbi.nlm.nih.gov/pubmed/1320531>  
DOI: [10.1016/0303-8467\(92\)90033-y](https://doi.org/10.1016/0303-8467(92)90033-y) · PMID: [1320531](https://pubmed.ncbi.nlm.nih.gov/1320531/)
89. **Is the vulnerability of neurons in the substantia nigra of patients with Parkinson's disease related to their neuromelanin content?**  
A Kastner, EC Hirsch, O Lejeune, F Javoy-Agid, O Rascol, Y Agid  
*Journal of neurochemistry* (1992-09) <https://www.ncbi.nlm.nih.gov/pubmed/1494900>  
DOI: [10.1111/j.1471-4159.1992.tb08350.x](https://doi.org/10.1111/j.1471-4159.1992.tb08350.x) · PMID: [1494900](https://pubmed.ncbi.nlm.nih.gov/1494900/)
90. **Involvement of medullary serotonergic groups in multiple system atrophy.**  
Eduardo E Benarroch, Ann M Schmeichel, Phillip A Low, Joseph E Parisi  
*Annals of neurology* (2004-03) <https://www.ncbi.nlm.nih.gov/pubmed/14991820>  
DOI: [10.1002/ana.20021](https://doi.org/10.1002/ana.20021) · PMID: [14991820](https://pubmed.ncbi.nlm.nih.gov/14991820/)
91. **A 100% increase of dopaminergic cells in the olfactory bulb may explain hyposmia in Parkinson's disease.**  
Evelien Huisman, Harry BM Uylings, Piet V Hoogland  
*Movement disorders : official journal of the Movement Disorder Society* (2004-06) <https://www.ncbi.nlm.nih.gov/pubmed/15197709>  
DOI: [10.1002/mds.10713](https://doi.org/10.1002/mds.10713) · PMID: [15197709](https://pubmed.ncbi.nlm.nih.gov/15197709/)
92. **Parkinsonian signs and substantia nigra neuron density in decedents elders without PD.**  
GWebster Ross, Helen Petrovitch, Robert D Abbott, James Nelson, William Markesbery, Daron Davis, John Hardman, Lenore Launer, Kamal Masaki, Caroline M Tanner, Lon R White  
*Annals of neurology* (2004-10) <https://www.ncbi.nlm.nih.gov/pubmed/15389895>  
DOI: [10.1002/ana.20226](https://doi.org/10.1002/ana.20226) · PMID: [15389895](https://pubmed.ncbi.nlm.nih.gov/15389895/)
93. **No global loss of neocortical neurons in Parkinson's disease: a quantitative stereological study.**  
Kamilla M Pedersen, Lisbeth Marnier, Henning Pakkenberg, Bente Pakkenberg  
*Movement disorders : official journal of the Movement Disorder Society* (2005-02) <https://www.ncbi.nlm.nih.gov/pubmed/15468109>  
DOI: [10.1002/mds.20289](https://doi.org/10.1002/mds.20289) · PMID: [15468109](https://pubmed.ncbi.nlm.nih.gov/15468109/)



94. **Involvement of medullary regions controlling sympathetic output in Lewy body disease.**  
Eduardo E Benarroch, Ann M Schmeichel, Phillip A Low, Bradley F Boeve, Paola Sandroni, Joseph E Parisi  
*Brain : a journal of neurology* (2005-01-05) <https://www.ncbi.nlm.nih.gov/pubmed/15634729>  
DOI: [10.1093/brain/awh376](https://doi.org/10.1093/brain/awh376) · PMID: [15634729](https://pubmed.ncbi.nlm.nih.gov/15634729/)
95. **Functional anatomy of the basal ganglia in X-linked recessive dystonia-parkinsonism.**  
Satoshi Goto, Lillian V Lee, Edwin L Munoz, Ikuo Tooyama, Gen Tamiya, Satoshi Makino, Satoshi Ando, Marita B Dantes, Kazumichi Yamada, Sadayuki Matsumoto, ... Ryuji Kaji  
*Annals of neurology* (2005-07) <https://www.ncbi.nlm.nih.gov/pubmed/15912496>  
DOI: [10.1002/ana.20513](https://doi.org/10.1002/ana.20513) · PMID: [15912496](https://pubmed.ncbi.nlm.nih.gov/15912496/)
96. **A comparison of degeneration in motor thalamus and cortex between progressive supranuclear palsy and Parkinson's disease.**  
Glenda M Halliday, Virginia Macdonald, Jasmine M Henderson  
*Brain : a journal of neurology* (2005-07-13) <https://www.ncbi.nlm.nih.gov/pubmed/16014651>  
DOI: [10.1093/brain/awh596](https://doi.org/10.1093/brain/awh596) · PMID: [16014651](https://pubmed.ncbi.nlm.nih.gov/16014651/)
97. **Nurr1 in Parkinson's disease and related disorders.**  
Yaping Chu, Weidong Le, Katie Kompoliti, Joseph Jankovic, Elliott J Mufson, Jeffrey H Kordower  
*The Journal of comparative neurology* (2006-01-20)  
<https://www.ncbi.nlm.nih.gov/pubmed/16320253>  
DOI: [10.1002/cne.20828](https://doi.org/10.1002/cne.20828) · PMID: [16320253](https://pubmed.ncbi.nlm.nih.gov/16320253/) · PMCID: [PMC2564615](https://pubmed.ncbi.nlm.nih.gov/PMC2564615/)
98. **Compensatory changes in the noradrenergic nervous system in the locus ceruleus and hippocampus of postmortem subjects with Alzheimer's disease and dementia with Lewy bodies.**  
Patricia Szot, Sylvia S White, J Lynne Greenup, James B Leverenz, Elaine R Peskind, Murray A Raskind  
*The Journal of neuroscience : the official journal of the Society for Neuroscience* (2006-01-11)  
<https://www.ncbi.nlm.nih.gov/pubmed/16407544>  
DOI: [10.1523/jneurosci.4265-05.2006](https://doi.org/10.1523/jneurosci.4265-05.2006) · PMID: [16407544](https://pubmed.ncbi.nlm.nih.gov/16407544/) · PMCID: [PMC6674412](https://pubmed.ncbi.nlm.nih.gov/PMC6674412/)
99. **Depletion of cholinergic neurons in the nucleus of the medial septum and the vertical limb of the diagonal band in dementia with Lewy bodies.**  
Hiroshige Fujishiro, Hiroyuki Umegaki, Daisuke Isojima, Hiroyasu Akatsu, Akihisa Iguchi, Kenji Kosaka  
*Acta neuropathologica* (2006-01-19) <https://www.ncbi.nlm.nih.gov/pubmed/16421740>  
DOI: [10.1007/s00401-005-0004-1](https://doi.org/10.1007/s00401-005-0004-1) · PMID: [16421740](https://pubmed.ncbi.nlm.nih.gov/16421740/)
100. **Involvement of vagal autonomic nuclei in multiple system atrophy and Lewy body disease.**  
EE Benarroch, AM Schmeichel, P Sandroni, PA Low, JE Parisi  
*Neurology* (2006-02-14) <https://www.ncbi.nlm.nih.gov/pubmed/16476936>  
DOI: [10.1212/01.wnl.0000196638.98781.bb](https://doi.org/10.1212/01.wnl.0000196638.98781.bb) · PMID: [16476936](https://pubmed.ncbi.nlm.nih.gov/16476936/)
101. **Morphological alterations of the synapses in the locus coeruleus in Parkinson's disease.**  
Stavros J Baloyannis, Vassiliki Costa, Ioannis S Baloyannis  
*Journal of the neurological sciences* (2006-06-05)  
<https://www.ncbi.nlm.nih.gov/pubmed/16753180>  
DOI: [10.1016/j.jns.2006.05.006](https://doi.org/10.1016/j.jns.2006.05.006) · PMID: [16753180](https://pubmed.ncbi.nlm.nih.gov/16753180/)
102. **Relationship among alpha-synuclein accumulation, dopamine synthesis, and neurodegeneration in Parkinson disease substantia nigra.**

Fumiaki Mori, Makoto Nishie, Akiyoshi Kakita, Makoto Yoshimoto, Hitoshi Takahashi, Koichi Wakabayashi

*Journal of neuropathology and experimental neurology* (2006-08)

<https://www.ncbi.nlm.nih.gov/pubmed/16896314>

DOI: [10.1097/01.jnen.0000230520.47768.1a](https://doi.org/10.1097/01.jnen.0000230520.47768.1a) · PMID: [16896314](https://pubmed.ncbi.nlm.nih.gov/16896314/)

103. **Loss of brainstem serotonin- and substance P-containing neurons in Parkinson's disease.**  
GM Halliday, PC Blumbergs, RG Cotton, WW Blessing, LB Geffen  
*Brain research* (1990-02-26) <https://www.ncbi.nlm.nih.gov/pubmed/1691042>  
DOI: [10.1016/0006-8993\(90\)90733-r](https://doi.org/10.1016/0006-8993(90)90733-r) · PMID: [1691042](https://pubmed.ncbi.nlm.nih.gov/1691042/)
104. **Hippocampal neuron and glial cell numbers in Parkinson's disease--a stereological study.**  
FC Joelsing, R Billeskov, JR Christensen, M West, B Pakkenberg  
*Hippocampus* (2006) <https://www.ncbi.nlm.nih.gov/pubmed/16941622>  
DOI: [10.1002/hipo.20212](https://doi.org/10.1002/hipo.20212) · PMID: [16941622](https://pubmed.ncbi.nlm.nih.gov/16941622/)
105. **Immunohistochemical study of the striatal efferents and nigral dopaminergic neurons in parkinsonism-dementia complex on Guam in comparison with those in Parkinson's and Alzheimer's diseases.**  
S Goto, A Hirano, S Matsumoto  
*Annals of neurology* (1990-05) <https://www.ncbi.nlm.nih.gov/pubmed/1694418>  
DOI: [10.1002/ana.410270511](https://doi.org/10.1002/ana.410270511) · PMID: [1694418](https://pubmed.ncbi.nlm.nih.gov/1694418/)
106. **Striatal dopaminergic neurons are lost with Parkinson's disease progression.**  
Michelle J Porritt, Ann E Kingsbury, Andrew J Hughes, David W Howells  
*Movement disorders : official journal of the Movement Disorder Society* (2006-12)  
<https://www.ncbi.nlm.nih.gov/pubmed/17029264>  
DOI: [10.1002/mds.21129](https://doi.org/10.1002/mds.21129) · PMID: [17029264](https://pubmed.ncbi.nlm.nih.gov/17029264/)
107. **Complement activation in the Parkinson's disease substantia nigra: an immunocytochemical study.**  
David A Loeffler, Dianne M Camp, Stephanie B Conant  
*Journal of neuroinflammation* (2006-10-19) <https://www.ncbi.nlm.nih.gov/pubmed/17052351>  
DOI: [10.1186/1742-2094-3-29](https://doi.org/10.1186/1742-2094-3-29) · PMID: [17052351](https://pubmed.ncbi.nlm.nih.gov/17052351/) · PMCID: [PMC1626447](https://pubmed.ncbi.nlm.nih.gov/PMC1626447/)
108. **The fate of striatal dopaminergic neurons in Parkinson's disease and Huntington's chorea.**  
Philippe Huot, Martin Lévesque, André Parent  
*Brain : a journal of neurology* (2006-12-02) <https://www.ncbi.nlm.nih.gov/pubmed/17142832>  
DOI: [10.1093/brain/awl332](https://doi.org/10.1093/brain/awl332) · PMID: [17142832](https://pubmed.ncbi.nlm.nih.gov/17142832/)
109. **Substance P-containing neurons in the mesopontine tegmentum are severely affected in Parkinson's disease.**  
WP Gai, GM Halliday, PC Blumbergs, LB Geffen, WW Blessing  
*Brain : a journal of neurology* (1991-10) <https://www.ncbi.nlm.nih.gov/pubmed/1718530>  
DOI: [10.1093/brain/114.5.2253](https://doi.org/10.1093/brain/114.5.2253) · PMID: [1718530](https://pubmed.ncbi.nlm.nih.gov/1718530/)
110. **Rostral raphe involvement in Lewy body dementia and multiple system atrophy.**  
EE Benarroch, AM Schmeichel, P Sandroni, JE Parisi, PA Low  
*Acta neuropathologica* (2007-07-17) <https://www.ncbi.nlm.nih.gov/pubmed/17639427>  
DOI: [10.1007/s00401-007-0260-3](https://doi.org/10.1007/s00401-007-0260-3) · PMID: [17639427](https://pubmed.ncbi.nlm.nih.gov/17639427/)
111. **Compartmental loss of striatal medium spiny neurons in multiple system atrophy of parkinsonian type.**  
Kenta Sato, Ryuji Kaji, Sadayuki Matsumoto, Shinji Nagahiro, Satoshi Goto



*Movement disorders : official journal of the Movement Disorder Society* (2007-12)

<https://www.ncbi.nlm.nih.gov/pubmed/17894336>

DOI: [10.1002/mds.21732](https://doi.org/10.1002/mds.21732) · PMID: [17894336](https://pubmed.ncbi.nlm.nih.gov/17894336/)

112. **Excessive dopamine neuron loss in progressive supranuclear palsy.**

Karen E Murphy, Tanya Karaconji, Craig D Hardman, Glenda M Halliday

*Movement disorders : official journal of the Movement Disorder Society* (2008-03-15)

<https://www.ncbi.nlm.nih.gov/pubmed/18163454>

DOI: [10.1002/mds.21907](https://doi.org/10.1002/mds.21907) · PMID: [18163454](https://pubmed.ncbi.nlm.nih.gov/18163454/)

113. **Mesopontine cholinergic neuron involvement in Lewy body dementia and multiple system atrophy.**

AM Schmeichel, LC Buchhalter, PA Low, JE Parisi, BW Boeve, P Sandroni, EE Benarroch

*Neurology* (2008-01-29) <https://www.ncbi.nlm.nih.gov/pubmed/18227417>

DOI: [10.1212/01.wnl.0000298691.71637.96](https://doi.org/10.1212/01.wnl.0000298691.71637.96) · PMID: [18227417](https://pubmed.ncbi.nlm.nih.gov/18227417/)

114. **Evidence that incidental Lewy body disease is pre-symptomatic Parkinson's disease.**

Dennis W Dickson, Hiroshige Fujishiro, Anthony DelleDonne, Joshua Menke, Zeshan Ahmed, Kevin J Klos, Keith A Josephs, Roberta Frigerio, Melinda Burnett, Joseph E Parisi, JEric Ahlskog

*Acta neuropathologica* (2008-02-09) <https://www.ncbi.nlm.nih.gov/pubmed/18264713>

DOI: [10.1007/s00401-008-0345-7](https://doi.org/10.1007/s00401-008-0345-7) · PMID: [18264713](https://pubmed.ncbi.nlm.nih.gov/18264713/)

115. **Loss of cholinergic neurons in the pedunculo pontine nucleus in Parkinson's disease is related to disability of the patients.**

Juha O Rinne, Shuang Yong Ma, Myung Sik Lee, Yrjö Collan, Matias Røyttä

*Parkinsonism & related disorders* (2008-03-10)

<https://www.ncbi.nlm.nih.gov/pubmed/18329941>

DOI: [10.1016/j.parkreldis.2008.01.006](https://doi.org/10.1016/j.parkreldis.2008.01.006) · PMID: [18329941](https://pubmed.ncbi.nlm.nih.gov/18329941/)

116. **Gender-related changes in increase of dopaminergic neurons in the olfactory bulb of Parkinson's disease patients.**

Evelien Huisman, Harry BM Uylings, Piet V Hoogland

*Movement disorders : official journal of the Movement Disorder Society* (2008-07-30)

<https://www.ncbi.nlm.nih.gov/pubmed/18581481>

DOI: [10.1002/mds.22009](https://doi.org/10.1002/mds.22009) · PMID: [18581481](https://pubmed.ncbi.nlm.nih.gov/18581481/)

117. **Intralaminar nuclei of the thalamus in Lewy body diseases.**

Daniel Brooks, Glenda M Halliday

*Brain research bulletin* (2008-09-18) <https://www.ncbi.nlm.nih.gov/pubmed/18804518>

DOI: [10.1016/j.brainresbull.2008.08.014](https://doi.org/10.1016/j.brainresbull.2008.08.014) · PMID: [18804518](https://pubmed.ncbi.nlm.nih.gov/18804518/)

118. **Medullary catecholaminergic neurons in the normal human brain and in Parkinson's disease.**

CB Saper, DM Sorrentino, DC German, S de Lacalle

*Annals of neurology* (1991-06) <https://www.ncbi.nlm.nih.gov/pubmed/1892359>

DOI: [10.1002/ana.410290602](https://doi.org/10.1002/ana.410290602) · PMID: [1892359](https://pubmed.ncbi.nlm.nih.gov/1892359/)

119. **[Pigmented neuron/non-pigmented neuron ratio of the substantia nigra in relation to ageing and pathological conditions].**

D Ohno, T Mizutani, H Shimada, H Katsunuma

*Nihon Ronen Igakkai zasshi. Japanese journal of geriatrics* (1991-05)

<https://www.ncbi.nlm.nih.gov/pubmed/1895529>

DOI: [10.3143/geriatrics.28.351](https://doi.org/10.3143/geriatrics.28.351) · PMID: [1895529](https://pubmed.ncbi.nlm.nih.gov/1895529/)

120. **Pathological lesions in colonic biopsies during Parkinson's disease.**

T Lebouvier, T Chaumette, P Damier, E Coron, Y Touchefeu, S Vrignaud, P Naveilhan, J-P Galmiche, S Bruley des Varannes, P Derkinderen, M Neunlist  
*Gut* (2008-12) <https://www.ncbi.nlm.nih.gov/pubmed/19022934>  
DOI: [10.1136/gut.2008.162503](https://doi.org/10.1136/gut.2008.162503) · PMID: [19022934](https://pubmed.ncbi.nlm.nih.gov/19022934/)

121. **Tyrosine hydroxylase-immunoreactive neurons are decreased in number in the cerebral cortex of Parkinson's disease.**  
T Fukuda, J Takahashi, J Tanaka  
*Neuropathology : official journal of the Japanese Society of Neuropathology* (1999-01)  
<https://www.ncbi.nlm.nih.gov/pubmed/19519642>  
DOI: [10.1046/j.1440-1789.1999.00196.x](https://doi.org/10.1046/j.1440-1789.1999.00196.x) · PMID: [19519642](https://pubmed.ncbi.nlm.nih.gov/19519642/)
122. **Dopamine cell loss in the periaqueductal gray in multiple system atrophy and Lewy body dementia.**  
EE Benarroch, AM Schmeichel, BN Dugger, P Sandroni, JE Parisi, PA Low  
*Neurology* (2009-07-14) <https://www.ncbi.nlm.nih.gov/pubmed/19597132>  
DOI: [10.1212/wnl.0b013e3181ad53e7](https://doi.org/10.1212/wnl.0b013e3181ad53e7) · PMID: [19597132](https://pubmed.ncbi.nlm.nih.gov/19597132/) · PMCID: [PMC2713188](https://pubmed.ncbi.nlm.nih.gov/PMC2713188/)
123. **Neuropathology of immunohistochemically identified brainstem neurons in Parkinson's disease.**  
GM Halliday, YW Li, PC Blumbergs, TH Joh, RG Cotton, PR Howe, WW Blessing, LB Geffen  
*Annals of neurology* (1990-04) <https://www.ncbi.nlm.nih.gov/pubmed/1972319>  
DOI: [10.1002/ana.410270405](https://doi.org/10.1002/ana.410270405) · PMID: [1972319](https://pubmed.ncbi.nlm.nih.gov/1972319/)
124. **Relative preservation of thalamic centromedian nucleus in parkinsonian patients with dystonia.**  
Linda Truong, Daniel Brooks, Fabricio Amaral, Jasmine M Henderson, Glenda M Halliday  
*Movement disorders : official journal of the Movement Disorder Society* (2009-10-30)  
<https://www.ncbi.nlm.nih.gov/pubmed/19735086>  
DOI: [10.1002/mds.22747](https://doi.org/10.1002/mds.22747) · PMID: [19735086](https://pubmed.ncbi.nlm.nih.gov/19735086/)
125. **Catecholaminergic systems in the medulla oblongata in parkinsonian syndromes: a quantitative immunohistochemical study in Parkinson's disease, progressive supranuclear palsy, and striatonigral degeneration.**  
S Malessa, EC Hirsch, P Cervera, C Duyckaerts, Y Agid  
*Neurology* (1990-11) <https://www.ncbi.nlm.nih.gov/pubmed/1978260>  
DOI: [10.1212/wnl.40.11.1739](https://doi.org/10.1212/wnl.40.11.1739) · PMID: [1978260](https://pubmed.ncbi.nlm.nih.gov/1978260/)
126. **A comparison of changes in proteasomal subunit expression in the substantia nigra in Parkinson's disease, multiple system atrophy and progressive supranuclear palsy.**  
Salma Bukhatwa, Bai-Yun Zeng, Sarah Rose, Peter Jenner  
*Brain research* (2010-02-20) <https://www.ncbi.nlm.nih.gov/pubmed/20176003>  
DOI: [10.1016/j.brainres.2010.02.045](https://doi.org/10.1016/j.brainres.2010.02.045) · PMID: [20176003](https://pubmed.ncbi.nlm.nih.gov/20176003/)
127. **Nerve cell loss in the thalamus in Alzheimer's disease and Parkinson's disease.**  
JH Xuereb, RH Perry, JM Candy, EK Perry, E Marshall, JR Bonham  
*Brain : a journal of neurology* (1991-06) <https://www.ncbi.nlm.nih.gov/pubmed/2065255>  
PMID: [2065255](https://pubmed.ncbi.nlm.nih.gov/2065255/)
128. **Differential response of the central noradrenergic nervous system to the loss of locus coeruleus neurons in Parkinson's disease and Alzheimer's disease.**  
Pamela J McMillan, Sylvia S White, Allyn Franklin, J Lynne Greenup, James B Leverenz, Murray A Raskind, Patricia Szot  
*Brain research* (2010-12-11) <https://www.ncbi.nlm.nih.gov/pubmed/21147074>  
DOI: [10.1016/j.brainres.2010.12.015](https://doi.org/10.1016/j.brainres.2010.12.015) · PMID: [21147074](https://pubmed.ncbi.nlm.nih.gov/21147074/) · PMCID: [PMC3038670](https://pubmed.ncbi.nlm.nih.gov/PMC3038670/)

129. **Increased dopaminergic cells and protein aggregates in the olfactory bulb of patients with neurodegenerative disorders.**  
Iñaki-Carril Mundiñano, Maria-Cristina Caballero, Cristina Ordóñez, Maria Hernandez, Carla DiCaudo, Irene Marcilla, Maria-Elena Erro, Maria-Teresa Tuñon, Maria-Rosario Luquin  
*Acta neuropathologica* (2011-05-08) <https://www.ncbi.nlm.nih.gov/pubmed/21553300>  
DOI: [10.1007/s00401-011-0830-2](https://doi.org/10.1007/s00401-011-0830-2) · PMID: [21553300](https://pubmed.ncbi.nlm.nih.gov/21553300/)
130. **Serotonin and dopamine striatal innervation in Parkinson's disease and Huntington's chorea.**  
Catherine Bédard, Marie-Josée Wallman, Emmanuelle Pourcher, Peter V Gould, André Parent, Martin Parent  
*Parkinsonism & related disorders* (2011-06-12)  
<https://www.ncbi.nlm.nih.gov/pubmed/21664855>  
DOI: [10.1016/j.parkreldis.2011.05.012](https://doi.org/10.1016/j.parkreldis.2011.05.012) · PMID: [21664855](https://pubmed.ncbi.nlm.nih.gov/21664855/)
131. **Neuropathological analysis of brainstem cholinergic and catecholaminergic nuclei in relation to rapid eye movement (REM) sleep behaviour disorder.**  
BN Dugger, ME Murray, BF Boeve, JE Parisi, EE Benarroch, TJ Ferman, DW Dickson  
*Neuropathology and applied neurobiology* (2012-04)  
<https://www.ncbi.nlm.nih.gov/pubmed/21696423>  
DOI: [10.1111/j.1365-2990.2011.01203.x](https://doi.org/10.1111/j.1365-2990.2011.01203.x) · PMID: [21696423](https://pubmed.ncbi.nlm.nih.gov/21696423/) · PMCID: [PMC3218297](https://pubmed.ncbi.nlm.nih.gov/PMC3218297/)
132. **Essential tremor is not dependent upon cerebellar Purkinje cell loss.**  
AH Rajput, CA Robinson, ML Rajput, SL Robinson, A Rajput  
*Parkinsonism & related disorders* (2012-02-03)  
<https://www.ncbi.nlm.nih.gov/pubmed/22306459>  
DOI: [10.1016/j.parkreldis.2012.01.013](https://doi.org/10.1016/j.parkreldis.2012.01.013) · PMID: [22306459](https://pubmed.ncbi.nlm.nih.gov/22306459/)
133. **Relative sparing in Parkinson's disease of substantia nigra dopamine neurons containing calbindin-D28K.**  
T Yamada, PL McGeer, KG Baimbridge, EG McGeer  
*Brain research* (1990-09-03) <https://www.ncbi.nlm.nih.gov/pubmed/2257487>  
DOI: [10.1016/0006-8993\(90\)91236-a](https://doi.org/10.1016/0006-8993(90)91236-a) · PMID: [2257487](https://pubmed.ncbi.nlm.nih.gov/2257487/)
134. **Lewy pathology is not the first sign of degeneration in vulnerable neurons in Parkinson disease.**  
Joshua M Milber, Joseph V Noorigian, James F Morley, Helen Petrovitch, Lon White, GWebster Ross, John E Duda  
*Neurology* (2012-11-14) <https://www.ncbi.nlm.nih.gov/pubmed/23152586>  
DOI: [10.1212/wnl.0b013e318278fe32](https://doi.org/10.1212/wnl.0b013e318278fe32) · PMID: [23152586](https://pubmed.ncbi.nlm.nih.gov/23152586/) · PMCID: [PMC3578379](https://pubmed.ncbi.nlm.nih.gov/PMC3578379/)
135. **Cholinergic and dopaminergic activities in senile dementia of Lewy body type.**  
EK Perry, E Marshall, RH Perry, D Irving, CJ Smith, G Blessed, AF Fairbairn  
*Alzheimer disease and associated disorders* (1990)  
<https://www.ncbi.nlm.nih.gov/pubmed/2357341>  
PMID: [2357341](https://pubmed.ncbi.nlm.nih.gov/2357341/)
136. **Decreased parvalbumin mRNA expression in dorsolateral prefrontal cortex in Parkinson's disease.**  
Amélie C Lanoue, Gene J Blatt, Jean-Jacques Soghomonian  
*Brain research* (2013-07-23) <https://www.ncbi.nlm.nih.gov/pubmed/23891794>  
DOI: [10.1016/j.brainres.2013.07.025](https://doi.org/10.1016/j.brainres.2013.07.025) · PMID: [23891794](https://pubmed.ncbi.nlm.nih.gov/23891794/) · PMCID: [PMC3816277](https://pubmed.ncbi.nlm.nih.gov/PMC3816277/)
137. **A quantitative study of  $\alpha$ -synuclein pathology in fifteen cases of dementia associated with Parkinson disease.**

Richard A Armstrong, Paul T Kotzbauer, Joel S Perlmutter, Meghan C Campbell, Kyle M Hurth, Robert E Schmidt, Nigel J Cairns

*Journal of neural transmission (Vienna, Austria : 1996)* (2013-08-31)

<https://www.ncbi.nlm.nih.gov/pubmed/23996276>

DOI: [10.1007/s00702-013-1084-z](https://doi.org/10.1007/s00702-013-1084-z) · PMID: [23996276](https://pubmed.ncbi.nlm.nih.gov/23996276/) · PMCID: [PMC4041534](https://pubmed.ncbi.nlm.nih.gov/PMC4041534/)

138. **Mitochondrial abnormality associates with type-specific neuronal loss and cell morphology changes in the pedunculopontine nucleus in Parkinson disease.**  
Ilse S Pienaar, Joanna L Elson, Claudia Racca, Glyn Nelson, Douglass M Turnbull, Christopher M Morris  
*The American journal of pathology* (2013-10-04)  
<https://www.ncbi.nlm.nih.gov/pubmed/24099985>  
DOI: [10.1016/j.ajpath.2013.09.002](https://doi.org/10.1016/j.ajpath.2013.09.002) · PMID: [24099985](https://pubmed.ncbi.nlm.nih.gov/24099985/) · PMCID: [PMC4188170](https://pubmed.ncbi.nlm.nih.gov/PMC4188170/)
139. **Pedunculopontine cholinergic cell loss in hallucinating Parkinson disease patients but not in dementia with Lewy bodies patients.**  
Dagmar Hyacintha Hepp, AM Ruiter, Y Galis, P Voorn, AJM Rozemuller, HW Berendse, EMJ Foncke, WDJ van de Berg  
*Journal of neuropathology and experimental neurology* (2013-12)  
<https://www.ncbi.nlm.nih.gov/pubmed/24226265>  
DOI: [10.1097/nen.0000000000000014](https://doi.org/10.1097/nen.0000000000000014) · PMID: [24226265](https://pubmed.ncbi.nlm.nih.gov/24226265/)
140. **Degeneration of brainstem respiratory neurons in dementia with Lewy bodies.**  
Michael F Presti, Ann M Schmeichel, Phillip A Low, Joseph E Parisi, Eduardo E Benarroch  
*Sleep* (2014-02-01) <https://www.ncbi.nlm.nih.gov/pubmed/24501436>  
DOI: [10.5665/sleep.3418](https://doi.org/10.5665/sleep.3418) · PMID: [24501436](https://pubmed.ncbi.nlm.nih.gov/24501436/) · PMCID: [PMC3900631](https://pubmed.ncbi.nlm.nih.gov/PMC3900631/)
141. **Immunocytochemical studies on the basal ganglia and substantia nigra in Parkinson's disease and Huntington's chorea.**  
CM Waters, R Peck, M Rossor, GP Reynolds, SP Hunt  
*Neuroscience* (1988-05) <https://www.ncbi.nlm.nih.gov/pubmed/2456487>  
DOI: [10.1016/0306-4522\(88\)90249-7](https://doi.org/10.1016/0306-4522(88)90249-7) · PMID: [2456487](https://pubmed.ncbi.nlm.nih.gov/2456487/)
142. **Galanin hyperinnervates surviving neurons of the human basal nucleus of Meynert in dementias of Alzheimer's and Parkinson's disease: a hypothesis for the role of galanin in accentuating cholinergic dysfunction in dementia.**  
V Chan-Palay  
*The Journal of comparative neurology* (1988-07-22)  
<https://www.ncbi.nlm.nih.gov/pubmed/2463283>  
DOI: [10.1002/cne.902730409](https://doi.org/10.1002/cne.902730409) · PMID: [2463283](https://pubmed.ncbi.nlm.nih.gov/2463283/)
143. **Neuropathological investigation of hypocretin expression in brains of dementia with Lewy bodies.**  
Koji Kasanuki, Eizo Iseki, Daizo Kondo, Hiroshige Fujishiro, Michiko Minegishi, Kiyoshi Sato, Omi Katsuse, Hiroaki Hino, Kenji Kosaka, Heii Arai  
*Neuroscience letters* (2014-04-02) <https://www.ncbi.nlm.nih.gov/pubmed/24704327>  
DOI: [10.1016/j.neulet.2014.03.020](https://doi.org/10.1016/j.neulet.2014.03.020) · PMID: [24704327](https://pubmed.ncbi.nlm.nih.gov/24704327/)
144. **Stage-dependent nigral neuronal loss in incidental Lewy body and Parkinson's disease.**  
Anke A Dijkstra, Pieter Voorn, Henk W Berendse, Henk J Groenewegen, Annemieke JM Rozemuller, Wilma DJ van de Berg  
*Movement disorders : official journal of the Movement Disorder Society* (2014-07-03)  
<https://www.ncbi.nlm.nih.gov/pubmed/24996051>  
DOI: [10.1002/mds.25952](https://doi.org/10.1002/mds.25952) · PMID: [24996051](https://pubmed.ncbi.nlm.nih.gov/24996051/)

145. **Hippocampal Lewy pathology and cholinergic dysfunction are associated with dementia in Parkinson's disease.**  
Hélène Hall, Stefanie Reyes, Natalie Landeck, Chris Bye, Giampiero Leanza, Kay Double, Lachlan Thompson, Glenda Halliday, Deniz Kirik  
*Brain : a journal of neurology* (2014-07-24) <https://www.ncbi.nlm.nih.gov/pubmed/25062696>  
DOI: [10.1093/brain/awu193](https://doi.org/10.1093/brain/awu193) · PMID: [25062696](https://pubmed.ncbi.nlm.nih.gov/25062696/)
146. **Dementia in Parkinson's disease: the problem of clinicopathological correlation.**  
L Sudarsky, J Morris, J Romero, TM Walshe  
*The Journal of neuropsychiatry and clinical neurosciences* (1989)  
<https://www.ncbi.nlm.nih.gov/pubmed/2521057>  
DOI: [10.1176/jnp.1.2.159](https://doi.org/10.1176/jnp.1.2.159) · PMID: [2521057](https://pubmed.ncbi.nlm.nih.gov/2521057/)
147. **The significance of the Lewy body in the diagnosis of idiopathic Parkinson's disease.**  
WR Gibb, AJ Lees  
*Neuropathology and applied neurobiology* <https://www.ncbi.nlm.nih.gov/pubmed/2542825>  
DOI: [10.1111/j.1365-2990.1989.tb01147.x](https://doi.org/10.1111/j.1365-2990.1989.tb01147.x) · PMID: [2542825](https://pubmed.ncbi.nlm.nih.gov/2542825/)
148. **Dementia in Parkinson's disease is related to neuronal loss in the medial substantia nigra.**  
JO Rinne, J Rummukainen, L Paljärvi, UK Rinne  
*Annals of neurology* (1989-07) <https://www.ncbi.nlm.nih.gov/pubmed/2549846>  
DOI: [10.1002/ana.410260107](https://doi.org/10.1002/ana.410260107) · PMID: [2549846](https://pubmed.ncbi.nlm.nih.gov/2549846/)
149. **Subdivisional involvement of nigrostriatal loop in idiopathic Parkinson's disease and striatonigral degeneration.**  
S Goto, A Hirano, S Matsumoto  
*Annals of neurology* (1989-12) <https://www.ncbi.nlm.nih.gov/pubmed/2557795>  
DOI: [10.1002/ana.410260613](https://doi.org/10.1002/ana.410260613) · PMID: [2557795](https://pubmed.ncbi.nlm.nih.gov/2557795/)
150. **Serotonergic markers in Parkinson's disease and levodopa-induced dyskinesias.**  
Perdita Cheshire, Scott Ayton, Kelly L Bertram, Helen Ling, Abi Li, Catriona McLean, Glenda M Halliday, Sean S O'Sullivan, Tamas Revesz, David I Finkelstein, ... David R Williams  
*Movement disorders : official journal of the Movement Disorder Society* (2015-02-04)  
<https://www.ncbi.nlm.nih.gov/pubmed/25649148>  
DOI: [10.1002/mds.26144](https://doi.org/10.1002/mds.26144) · PMID: [25649148](https://pubmed.ncbi.nlm.nih.gov/25649148/)
151. **Selective vulnerability of pigmented dopaminergic neurons in Parkinson's disease.**  
EC Hirsch, AM Graybiel, Y Agid  
*Acta neurologica Scandinavica. Supplementum* (1989)  
<https://www.ncbi.nlm.nih.gov/pubmed/2575832>  
DOI: [10.1111/j.1600-0404.1989.tb01778.x](https://doi.org/10.1111/j.1600-0404.1989.tb01778.x) · PMID: [2575832](https://pubmed.ncbi.nlm.nih.gov/2575832/)
152. **Neuronal loss in the substantia nigra in patients with Alzheimer's disease and Parkinson's disease in relation to extrapyramidal symptoms and dementia.**  
JO Rinne, J Rummukainen, L Paljärvi, E Säkö, P Mölsä, UK Rinne  
*Progress in clinical and biological research* (1989)  
<https://www.ncbi.nlm.nih.gov/pubmed/2602422>  
PMID: [2602422](https://pubmed.ncbi.nlm.nih.gov/2602422/)
153. **Histaminergic tuberomammillary neuron loss in multiple system atrophy and dementia with Lewy bodies.**  
Eduardo E Benarroch, Ann M Schmeichel, Joseph E Parisi, Phillip A Low  
*Movement disorders : official journal of the Movement Disorder Society* (2015-06-22)  
<https://www.ncbi.nlm.nih.gov/pubmed/26095065>



DOI: [10.1002/mds.26287](https://doi.org/10.1002/mds.26287) · PMID: [26095065](https://pubmed.ncbi.nlm.nih.gov/26095065/)

154. **The Vulnerable Ventral Tegmental Area in Parkinson's Disease.**  
Stephanie L Alberico, Martin D Cassell, Nandakumar S Narayanan  
*Basal ganglia* (2015-08-01) <https://www.ncbi.nlm.nih.gov/pubmed/26251824>  
DOI: [10.1016/j.baga.2015.06.001](https://doi.org/10.1016/j.baga.2015.06.001) · PMID: [26251824](https://pubmed.ncbi.nlm.nih.gov/26251824/) · PMCID: [PMC4523275](https://pubmed.ncbi.nlm.nih.gov/PMC4523275/)
155. **PAX6 expression may be protective against dopaminergic cell loss in Parkinson's disease.**  
Meghan G Thomas, Caitlyn Welch, Leah Stone, Peter Allan, Roger A Barker, Robert B White  
*CNS & neurological disorders drug targets* (2016)  
<https://www.ncbi.nlm.nih.gov/pubmed/26295830>  
DOI: [10.2174/1871527314666150821101757](https://doi.org/10.2174/1871527314666150821101757) · PMID: [26295830](https://pubmed.ncbi.nlm.nih.gov/26295830/)
156. **Parkinson disease and incidental Lewy body disease: Just a question of time?**  
Diego Iacono, Maria Geraci-Erck, Marcie L Rabin, Charles H Adler, Geidy Serrano, Thomas G Beach, Roger Kurlan  
*Neurology* (2015-10-14) <https://www.ncbi.nlm.nih.gov/pubmed/26468408>  
DOI: [10.1212/wnl.00000000000002102](https://doi.org/10.1212/wnl.00000000000002102) · PMID: [26468408](https://pubmed.ncbi.nlm.nih.gov/26468408/) · PMCID: [PMC4653112](https://pubmed.ncbi.nlm.nih.gov/PMC4653112/)
157. **Alterations in Activity-Dependent Neuroprotective Protein in Sporadic and Experimental Parkinson's Disease.**  
Yaping Chu, Gerardo A Morfini, Jeffrey H Kordower  
*Journal of Parkinson's disease* (2016) <https://www.ncbi.nlm.nih.gov/pubmed/27003787>  
DOI: [10.3233/jpd-160812](https://doi.org/10.3233/jpd-160812) · PMID: [27003787](https://pubmed.ncbi.nlm.nih.gov/27003787/)
158. **Reduction of Small Fibers of Thoracic Ventral Roots and Neurons of Intermediolateral Nucleus in Parkinson Disease and Dementia with Lewy Bodies.**  
Hiroyuki Hatsuta, Masaki Takao, Yuta Nakano, Akane Nogami, Akiko Uchino, Hiroyuki Sumikura, Kazutomi Kanemaru, Tomio Arai, Yoshiaki Itoh, Shigeo Murayama  
*Journal of Parkinson's disease* (2016-04-02) <https://www.ncbi.nlm.nih.gov/pubmed/27061071>  
DOI: [10.3233/jpd-150773](https://doi.org/10.3233/jpd-150773) · PMID: [27061071](https://pubmed.ncbi.nlm.nih.gov/27061071/)
159. **Asymmetry of substantia nigra neuronal loss in Parkinson's disease and its relevance to the mechanism of levodopa related motor fluctuations.**  
PA Kempster, WR Gibb, GM Stern, AJ Lees  
*Journal of neurology, neurosurgery, and psychiatry* (1989-01)  
<https://www.ncbi.nlm.nih.gov/pubmed/2709038>  
DOI: [10.1136/jnnp.52.1.72](https://doi.org/10.1136/jnnp.52.1.72) · PMID: [2709038](https://pubmed.ncbi.nlm.nih.gov/2709038/) · PMCID: [PMC1032660](https://pubmed.ncbi.nlm.nih.gov/PMC1032660/)
160. **Analysis of primary visual cortex in dementia with Lewy bodies indicates GABAergic involvement associated with recurrent complex visual hallucinations.**  
Ahmad A Khundakar, Peter S Hanson, Daniel Erskine, Nichola Z Lax, Joseph Roscamp, Evangelia Karyka, Eliona Tsefou, Preeti Singh, Simon J Cockell, Andrew Gribben, ... Christopher M Morris  
*Acta neuropathologica communications* (2016-06-30)  
<https://www.ncbi.nlm.nih.gov/pubmed/27357212>  
DOI: [10.1186/s40478-016-0334-3](https://doi.org/10.1186/s40478-016-0334-3) · PMID: [27357212](https://pubmed.ncbi.nlm.nih.gov/27357212/) · PMCID: [PMC4928325](https://pubmed.ncbi.nlm.nih.gov/PMC4928325/)
161. **Downregulation of neuronal vasoactive intestinal polypeptide in Parkinson's disease and chronic constipation.**  
F Giancola, F Torresan, R Repossi, F Bianco, R Latorre, A Ioannou, M Guarino, U Volta, P Clavenzani, M Mazzoni, ... R De Giorgio  
*Neurogastroenterology and motility: the official journal of the European Gastrointestinal Motility Society* (2016-11-27) <https://www.ncbi.nlm.nih.gov/pubmed/27891695>  
DOI: [10.1111/nmo.12995](https://doi.org/10.1111/nmo.12995) · PMID: [27891695](https://pubmed.ncbi.nlm.nih.gov/27891695/) · PMCID: [PMC5393951](https://pubmed.ncbi.nlm.nih.gov/PMC5393951/)

162. **Specific patterns of neuronal loss in the pulvinar nucleus in dementia with lewy bodies.**  
Daniel Erskine, Alan J Thomas, Johannes Attems, John-Paul Taylor, Ian G McKeith, Christopher M Morris, Ahmad A Khundakar  
*Movement disorders : official journal of the Movement Disorder Society* (2017-01-06)  
<https://www.ncbi.nlm.nih.gov/pubmed/28059471>  
DOI: [10.1002/mds.26887](https://doi.org/10.1002/mds.26887) · PMID: [28059471](https://pubmed.ncbi.nlm.nih.gov/28059471/)
163. **Neuronal Loss and A-Synuclein Pathology in the Superior Colliculus and Its Relationship to Visual Hallucinations in Dementia with Lewy Bodies.**  
Daniel Erskine, Alan J Thomas, John-Paul Taylor, Michael A Savage, Johannes Attems, Ian G McKeith, Christopher M Morris, Ahmad A Khundakar  
*The American journal of geriatric psychiatry : official journal of the American Association for Geriatric Psychiatry* (2017-01-10) <https://www.ncbi.nlm.nih.gov/pubmed/28190674>  
DOI: [10.1016/j.jagp.2017.01.005](https://doi.org/10.1016/j.jagp.2017.01.005) · PMID: [28190674](https://pubmed.ncbi.nlm.nih.gov/28190674/)
164. **Marinesco bodies and substantia nigra neuron density in Parkinson's disease.**  
RD Abbott, JS Nelson, GW Ross, JH Uyehara-Lock, CM Tanner, KH Masaki, LJ Launer, LR White, H Petrovitch  
*Neuropathology and applied neurobiology* (2017-07-09)  
<https://www.ncbi.nlm.nih.gov/pubmed/28626918>  
DOI: [10.1111/nan.12419](https://doi.org/10.1111/nan.12419) · PMID: [28626918](https://pubmed.ncbi.nlm.nih.gov/28626918/) · PMCID: [PMC5680094](https://pubmed.ncbi.nlm.nih.gov/PMC5680094/)
165. **Cytoarchitectural changes in the olfactory bulb of Parkinson's disease patients.**  
John W Cave, Nana Fujiwara, Ava R Weibman, Harriet Baker  
*NPJ Parkinson's disease* (2016-06-09) <https://www.ncbi.nlm.nih.gov/pubmed/28725697>  
DOI: [10.1038/npjparkd.2016.11](https://doi.org/10.1038/npjparkd.2016.11) · PMID: [28725697](https://pubmed.ncbi.nlm.nih.gov/28725697/) · PMCID: [PMC5516575](https://pubmed.ncbi.nlm.nih.gov/PMC5516575/)
166. **Melanized dopaminergic neurons are differentially susceptible to degeneration in Parkinson's disease.**  
E Hirsch, AM Graybiel, YA Agid  
*Nature* (1988-07-28) <https://www.ncbi.nlm.nih.gov/pubmed/2899295>  
DOI: [10.1038/334345a0](https://doi.org/10.1038/334345a0) · PMID: [2899295](https://pubmed.ncbi.nlm.nih.gov/2899295/)
167. **Do subjects with minimal motor features have prodromal Parkinson disease?**  
Yaping Chu, Aron S Buchman, CWarren Olanow, Jeffrey H Kordower  
*Annals of neurology* (2018-03-10) <https://www.ncbi.nlm.nih.gov/pubmed/29420861>  
DOI: [10.1002/ana.25179](https://doi.org/10.1002/ana.25179) · PMID: [29420861](https://pubmed.ncbi.nlm.nih.gov/29420861/) · PMCID: [PMC5867270](https://pubmed.ncbi.nlm.nih.gov/PMC5867270/)
168. **Somatic copy number gains of  $\alpha$ -synuclein (SNCA) in Parkinson's disease and multiple system atrophy brains.**  
Katya Mokretar, Daniel Pease, Jan-Willem Taanman, Aynur Soenmez, Ayesha Ejaz, Tammaryn Lashley, Helen Ling, Steve Gentleman, Henry Houlden, Janice L Holton, ... Christos Proukakis  
*Brain : a journal of neurology* (2018-08-01) <https://www.ncbi.nlm.nih.gov/pubmed/29917054>  
DOI: [10.1093/brain/awy157](https://doi.org/10.1093/brain/awy157) · PMID: [29917054](https://pubmed.ncbi.nlm.nih.gov/29917054/)
169. **Degeneration of human photosensitive retinal ganglion cells may explain sleep and circadian rhythms disorders in Parkinson's disease.**  
Isabel Ortuño-Lizarán, Gema Esquivia, Thomas G Beach, Geidy E Serrano, Charles H Adler, Pedro Lax, Nicolás Cuenca  
*Acta neuropathologica communications* (2018-09-10)  
<https://www.ncbi.nlm.nih.gov/pubmed/30201049>  
DOI: [10.1186/s40478-018-0596-z](https://doi.org/10.1186/s40478-018-0596-z) · PMID: [30201049](https://pubmed.ncbi.nlm.nih.gov/30201049/) · PMCID: [PMC6130068](https://pubmed.ncbi.nlm.nih.gov/PMC6130068/)
170. **Normal and pathological neuronal distribution of the human mesencephalic locomotor region.**



Sophie B Sébille, Anne-Sophie Rolland, Matthieu Faillot, Fernando Perez-Garcia, Antoine Colomb-Clerc, Brian Lau, Sylvie Dumas, Sara Fernandez Vidal, Marie-Laure Welter, Chantal Francois, ... Carine Karachi  
*Movement disorders : official journal of the Movement Disorder Society* (2018-11-28)  
<https://www.ncbi.nlm.nih.gov/pubmed/30485555>  
DOI: [10.1002/mds.27578](https://doi.org/10.1002/mds.27578) · PMID: [30485555](https://pubmed.ncbi.nlm.nih.gov/30485555/)

171. **A Quantitative Study of Empty Baskets in Essential Tremor and Other Motor Neurodegenerative Diseases.**  
Paul J Lee, Chloë A Kerridge, Debotri Chatterjee, Arnulf H Koeppen, Phyllis L Faust, Elan D Louis  
*Journal of neuropathology and experimental neurology* (2019-02-01)  
<https://www.ncbi.nlm.nih.gov/pubmed/30590599>  
DOI: [10.1093/jnen/nly114](https://doi.org/10.1093/jnen/nly114) · PMID: [30590599](https://pubmed.ncbi.nlm.nih.gov/30590599/) · PMCID: [PMC6330169](https://pubmed.ncbi.nlm.nih.gov/PMC6330169/)
172. **Cholinergic deficits and galaninergic hyperinnervation of the nucleus basalis of Meynert in Alzheimer's disease and Lewy body disorders.**  
AS Alexandris, L Walker, AKL Liu, KE McAleese, M Johnson, RKB Pearce, SM Gentleman, J Attems  
*Neuropathology and applied neurobiology* (2019-10-01)  
<https://www.ncbi.nlm.nih.gov/pubmed/31454423>  
DOI: [10.1111/nan.12577](https://doi.org/10.1111/nan.12577) · PMID: [31454423](https://pubmed.ncbi.nlm.nih.gov/31454423/)
173. **Pathological changes in the cerebellum of patients with multiple system atrophy and Parkinson's disease-a stereological study.**  
Elisabeth HL Rusholt, Lisette Salvesen, Tomasz Brudek, Betel Tesfay, Bente Pakkenberg, Mikkel V Olesen  
*Brain pathology (Zurich, Switzerland)* (2020-01-06)  
<https://www.ncbi.nlm.nih.gov/pubmed/31769073>  
DOI: [10.1111/bpa.12806](https://doi.org/10.1111/bpa.12806) · PMID: [31769073](https://pubmed.ncbi.nlm.nih.gov/31769073/) · PMCID: [PMC8018044](https://pubmed.ncbi.nlm.nih.gov/PMC8018044/)
174. **Rate of cell death in parkinsonism indicates active neuropathological process.**  
PL McGeer, S Itagaki, H Akiyama, EG McGeer  
*Annals of neurology* (1988-10) <https://www.ncbi.nlm.nih.gov/pubmed/3239957>  
DOI: [10.1002/ana.410240415](https://doi.org/10.1002/ana.410240415) · PMID: [3239957](https://pubmed.ncbi.nlm.nih.gov/3239957/)
175. **Dopaminergic Retinal Cell Loss and Visual Dysfunction in Parkinson Disease.**  
Isabel Ortuño-Lizarán, Xavier Sánchez-Sáez, Pedro Lax, Geidy E Serrano, Thomas G Beach, Charles H Adler, Nicolás Cuenca  
*Annals of neurology* (2020-09-19) <https://www.ncbi.nlm.nih.gov/pubmed/32881029>  
DOI: [10.1002/ana.25897](https://doi.org/10.1002/ana.25897) · PMID: [32881029](https://pubmed.ncbi.nlm.nih.gov/32881029/)
176. **GDNF signaling in subjects with minimal motor deficits and Parkinson's disease.**  
Yaping Chu, Jeffrey H Kordower  
*Neurobiology of disease* (2021-03-05) <https://www.ncbi.nlm.nih.gov/pubmed/33684514>  
DOI: [10.1016/j.nbd.2021.105298](https://doi.org/10.1016/j.nbd.2021.105298) · PMID: [33684514](https://pubmed.ncbi.nlm.nih.gov/33684514/)
177. **The pedunculopontine nucleus in Parkinson's disease, progressive supranuclear palsy and Alzheimer's disease.**  
K Jellinger  
*Journal of neurology, neurosurgery, and psychiatry* (1988-04)  
<https://www.ncbi.nlm.nih.gov/pubmed/3379428>  
DOI: [10.1136/jnnp.51.4.540](https://doi.org/10.1136/jnnp.51.4.540) · PMID: [3379428](https://pubmed.ncbi.nlm.nih.gov/3379428/) · PMCID: [PMC1032970](https://pubmed.ncbi.nlm.nih.gov/PMC1032970/)
178. **Comparison of Locus Coeruleus Pathology with Nigral and Forebrain Pathology in Parkinson's Disease.**  
Benjamin Huynh, Yuhong Fu, Deniz Kirik, James M Shine, Glenda M Halliday

179. **The Human Hippocampus in Parkinson's Disease: An Integrative Stereological and Proteomic Study.**  
Sandra Villar-Conde, Veronica Astillero-Lopez, Melania Gonzalez-Rodriguez, Patricia Villanueva-Anguita, Daniel Saiz-Sanchez, Alino Martinez-Marcos, Alicia Flores-Cuadrado, Isabel Ubeda-Bañon  
*Journal of Parkinson's disease* <https://www.ncbi.nlm.nih.gov/pubmed/34092653>  
DOI: [10.3233/jpd-202465](https://doi.org/10.3233/jpd-202465) · PMID: [34092653](https://pubmed.ncbi.nlm.nih.gov/34092653/) · PMCID: [PMC8461741](https://pubmed.ncbi.nlm.nih.gov/PMC8461741/)
180. **Cholinergic correlates of cognitive impairment in Parkinson's disease: comparisons with Alzheimer's disease.**  
EK Perry, M Curtis, DJ Dick, JM Candy, JR Attack, CA Bloxham, G Blessed, A Fairbairn, BE Tomlinson, RH Perry  
*Journal of neurology, neurosurgery, and psychiatry* (1985-05)  
<https://www.ncbi.nlm.nih.gov/pubmed/3998751>  
DOI: [10.1136/jnnp.48.5.413](https://doi.org/10.1136/jnnp.48.5.413) · PMID: [3998751](https://pubmed.ncbi.nlm.nih.gov/3998751/) · PMCID: [PMC1028327](https://pubmed.ncbi.nlm.nih.gov/PMC1028327/)
181. **The basal nucleus of Meynert in idiopathic Parkinson's disease.**  
F Tagliavini, G Pilleri, C Bouras, J Constantinidis  
*Acta neurologica Scandinavica* (1984-07) <https://www.ncbi.nlm.nih.gov/pubmed/6475484>  
DOI: [10.1111/j.1600-0404.1984.tb00798.x](https://doi.org/10.1111/j.1600-0404.1984.tb00798.x) · PMID: [6475484](https://pubmed.ncbi.nlm.nih.gov/6475484/)
182. **[Loss of neurons in the nucleus basalis of Meynert in Parkinson disease with dementia, "diffuse Lewy body disease" and senile dementia of Alzheimer type].**  
M Yoshimura, H Mori, M Tomonaga, H Yamanouchi, S Kuzuhara  
*Nihon Ronen Igakkai zasshi. Japanese journal of geriatrics* (1984-11)  
<https://www.ncbi.nlm.nih.gov/pubmed/6533352>  
DOI: [10.3143/geriatrics.21.580](https://doi.org/10.3143/geriatrics.21.580) · PMID: [6533352](https://pubmed.ncbi.nlm.nih.gov/6533352/)
183. **Basal forebrain neurons in the dementia of Parkinson disease.**  
PJ Whitehouse, JC Hedreen, CL White, DL Price  
*Annals of neurology* (1983-03) <https://www.ncbi.nlm.nih.gov/pubmed/6847136>  
DOI: [10.1002/ana.410130304](https://doi.org/10.1002/ana.410130304) · PMID: [6847136](https://pubmed.ncbi.nlm.nih.gov/6847136/)
184. **Loss of striatal neurons in Parkinson's disease: a cytometric study.**  
O Bugiani, F Perdelli, S Salvarani, A Leonardi, GL Mancardi  
*European neurology* (1980) <https://www.ncbi.nlm.nih.gov/pubmed/7398694>  
DOI: [10.1159/000115172](https://doi.org/10.1159/000115172) · PMID: [7398694](https://pubmed.ncbi.nlm.nih.gov/7398694/)
185. **Single section and disector counts in evaluating neuronal loss from the substantia nigra in patients with Parkinson's disease.**  
SY Ma, M R  ytt  , JO Rinne, Y Collan, UK Rinne  
*Neuropathology and applied neurobiology* (1995-08)  
<https://www.ncbi.nlm.nih.gov/pubmed/7494602>  
DOI: [10.1111/j.1365-2990.1995.tb01068.x](https://doi.org/10.1111/j.1365-2990.1995.tb01068.x) · PMID: [7494602](https://pubmed.ncbi.nlm.nih.gov/7494602/)
186. **NADPH-diaphorase/nitric oxide synthase containing neurons in normal and Parkinson's disease putamen.**  
R B  ckelmann, G Wolf, G Ransmayr, P Riederer  
*Journal of neural transmission. Parkinson's disease and dementia section* (1994)  
<https://www.ncbi.nlm.nih.gov/pubmed/7536004>  
DOI: [10.1007/bf02260966](https://doi.org/10.1007/bf02260966) · PMID: [7536004](https://pubmed.ncbi.nlm.nih.gov/7536004/)

187. **Alteration in nicotine binding sites in Parkinson's disease, Lewy body dementia and Alzheimer's disease: possible index of early neuropathology.**  
EK Perry, CM Morris, JA Court, A Cheng, AF Fairbairn, IG McKeith, D Irving, A Brown, RH Perry  
*Neuroscience* (1995-01) <https://www.ncbi.nlm.nih.gov/pubmed/7700528>  
DOI: [10.1016/0306-4522\(94\)00410-7](https://doi.org/10.1016/0306-4522(94)00410-7) · PMID: [7700528](https://pubmed.ncbi.nlm.nih.gov/7700528/)
188. **The neostriatum and nucleus accumbens in parkinsonism-dementia complex of Guam: a pathological comparison with Alzheimer's disease and progressive supranuclear palsy.**  
K Oyanagi, T Makifuchi, T Ohtoh, KM Chen, DC Gajdusek, TN Chase, F Ikuta  
*Acta neuropathologica* (1994) <https://www.ncbi.nlm.nih.gov/pubmed/7985492>  
DOI: [10.1007/bf00294504](https://doi.org/10.1007/bf00294504) · PMID: [7985492](https://pubmed.ncbi.nlm.nih.gov/7985492/)
189. **Sparing of NADPH-diaphorase striatal neurons in Parkinson's and Alzheimer's diseases.**  
EJ Mufson, MM Brandabur  
*Neuroreport* (1994-02-24) <https://www.ncbi.nlm.nih.gov/pubmed/8199342>  
DOI: [10.1097/00001756-199402000-00011](https://doi.org/10.1097/00001756-199402000-00011) · PMID: [8199342](https://pubmed.ncbi.nlm.nih.gov/8199342/)
190. **Alzheimer's disease and Lewy body disease: a comparative clinicopathological study.**  
CF Lippa, TW Smith, JM Swearer  
*Annals of neurology* (1994-01) <https://www.ncbi.nlm.nih.gov/pubmed/8285597>  
DOI: [10.1002/ana.410350113](https://doi.org/10.1002/ana.410350113) · PMID: [8285597](https://pubmed.ncbi.nlm.nih.gov/8285597/)
191. **Glutathione peroxidase, glial cells and Parkinson's disease.**  
P Damier, EC Hirsch, P Zhang, Y Agid, F Javoy-Agid  
*Neuroscience* (1993-01) <https://www.ncbi.nlm.nih.gov/pubmed/8433802>  
DOI: [10.1016/0306-4522\(93\)90175-f](https://doi.org/10.1016/0306-4522(93)90175-f) · PMID: [8433802](https://pubmed.ncbi.nlm.nih.gov/8433802/)
192. **Loss of basic fibroblast growth factor in substantia nigra neurons in Parkinson's disease.**  
I Tooyama, T Kawamata, D Walker, T Yamada, K Hanai, H Kimura, M Iwane, K Igarashi, EG McGeer, PL McGeer  
*Neurology* (1993-02) <https://www.ncbi.nlm.nih.gov/pubmed/8437705>  
DOI: [10.1212/wnl.43.2.372](https://doi.org/10.1212/wnl.43.2.372) · PMID: [8437705](https://pubmed.ncbi.nlm.nih.gov/8437705/)
193. **Does monoamine oxidase type B play a role in dopaminergic nerve cell death in Parkinson's disease?**  
P Damier, A Kastner, Y Agid, EC Hirsch  
*Neurology* (1996-05) <https://www.ncbi.nlm.nih.gov/pubmed/8628464>  
DOI: [10.1212/wnl.46.5.1262](https://doi.org/10.1212/wnl.46.5.1262) · PMID: [8628464](https://pubmed.ncbi.nlm.nih.gov/8628464/)
194. **Nitric oxide synthase and neuronal vulnerability in Parkinson's disease.**  
S Hunot, F Boissière, B Faucheux, B Brugg, A Mouatt-Prigent, Y Agid, EC Hirsch  
*Neuroscience* (1996-05) <https://www.ncbi.nlm.nih.gov/pubmed/8737406>  
DOI: [10.1016/0306-4522\(95\)00578-1](https://doi.org/10.1016/0306-4522(95)00578-1) · PMID: [8737406](https://pubmed.ncbi.nlm.nih.gov/8737406/)
195. **Increased M-calpain expression in the mesencephalon of patients with Parkinson's disease but not in other neurodegenerative disorders involving the mesencephalon: a role in nerve cell death?**  
A Mouatt-Prigent, JO Karlsson, Y Agid, EC Hirsch  
*Neuroscience* (1996-08) <https://www.ncbi.nlm.nih.gov/pubmed/8809817>  
DOI: [10.1016/0306-4522\(96\)00100-5](https://doi.org/10.1016/0306-4522(96)00100-5) · PMID: [8809817](https://pubmed.ncbi.nlm.nih.gov/8809817/)
196. **A quantitative morphometrical study of neuron degeneration in the substantia nigra in Parkinson's disease.**  
SY Ma, JO Rinne, Y Collan, M Røyttä, UK Rinne

*Journal of the neurological sciences* (1996-09-01)  
<https://www.ncbi.nlm.nih.gov/pubmed/8866425>  
DOI: [10.1016/0022-510x\(96\)00069-x](https://doi.org/10.1016/0022-510x(96)00069-x) · PMID: [8866425](https://pubmed.ncbi.nlm.nih.gov/8866425/)

197. **Defects of cytochrome c oxidase in the substantia nigra of Parkinson's disease: and immunohistochemical and morphometric study.**  
K Itoh, S Weis, P Mehraein, J Müller-Höcker  
*Movement disorders : official journal of the Movement Disorder Society* (1997-01)  
<https://www.ncbi.nlm.nih.gov/pubmed/8990048>  
DOI: [10.1002/mds.870120104](https://doi.org/10.1002/mds.870120104) · PMID: [8990048](https://pubmed.ncbi.nlm.nih.gov/8990048/)
198. **On the question of apoptosis in the parkinsonian substantia nigra.**  
S Kösel, R Egensperger, U von Eitzen, P Mehraein, MB Graeber  
*Acta neuropathologica* (1997-02) <https://www.ncbi.nlm.nih.gov/pubmed/9039456>  
DOI: [10.1007/s004010050590](https://doi.org/10.1007/s004010050590) · PMID: [9039456](https://pubmed.ncbi.nlm.nih.gov/9039456/)
199. **Alzheimer's disease, Lewy body disease and aging: a comparative study of the perforant pathway.**  
CF Lippa, D Pulaski-Salo, DW Dickson, TW Smith  
*Journal of the neurological sciences* (1997-04-15)  
<https://www.ncbi.nlm.nih.gov/pubmed/9106122>  
DOI: [10.1016/s0022-510x\(96\)05321-x](https://doi.org/10.1016/s0022-510x(96)05321-x) · PMID: [9106122](https://pubmed.ncbi.nlm.nih.gov/9106122/)
200. **Neuronal loss and plasticity in the supraoptic nucleus in Parkinson's disease.**  
O Ansorge, SE Daniel, RK Pearce  
*Neurology* (1997-08) <https://www.ncbi.nlm.nih.gov/pubmed/9270609>  
DOI: [10.1212/wnl.49.2.610](https://doi.org/10.1212/wnl.49.2.610) · PMID: [9270609](https://pubmed.ncbi.nlm.nih.gov/9270609/)
201. **Correlation between neuromorphometry in the substantia nigra and clinical features in Parkinson's disease using disector counts.**  
SY Ma, M Røyttä, JO Rinne, Y Collan, UK Rinne  
*Journal of the neurological sciences* (1997-10-03)  
<https://www.ncbi.nlm.nih.gov/pubmed/9335015>  
DOI: [10.1016/s0022-510x\(97\)00100-7](https://doi.org/10.1016/s0022-510x(97)00100-7) · PMID: [9335015](https://pubmed.ncbi.nlm.nih.gov/9335015/)
202. **Decrease of neurons in the medullary arcuate nucleus of multiple system atrophy: quantitative comparison with Parkinson's disease and amyotrophic lateral sclerosis.**  
K Noda, S Katayama, C Watanabe, Y Yamamura, S Nakamura  
*Journal of the neurological sciences* (1997-10-03)  
<https://www.ncbi.nlm.nih.gov/pubmed/9335016>  
DOI: [10.1016/s0022-510x\(97\)00101-9](https://doi.org/10.1016/s0022-510x(97)00101-9) · PMID: [9335016](https://pubmed.ncbi.nlm.nih.gov/9335016/)
203. **Neuropathology of autonomic nervous system in Parkinson's disease.**  
K Wakabayashi, H Takahashi  
*European neurology* (1997) <https://www.ncbi.nlm.nih.gov/pubmed/9387796>  
DOI: [10.1159/000113469](https://doi.org/10.1159/000113469) · PMID: [9387796](https://pubmed.ncbi.nlm.nih.gov/9387796/)
204. **Nigrostriatal dopaminergic activities in dementia with Lewy bodies in relation to neuroleptic sensitivity: comparisons with Parkinson's disease.**  
MA Piggott, EK Perry, EF Marshall, IG McKeith, M Johnson, HL Melrose, JA Court, S Lloyd, A Fairbairn, A Brown, ... RH Perry  
*Biological psychiatry* (1998-10-15) <https://www.ncbi.nlm.nih.gov/pubmed/9798081>  
DOI: [10.1016/s0006-3223\(98\)00127-9](https://doi.org/10.1016/s0006-3223(98)00127-9) · PMID: [9798081](https://pubmed.ncbi.nlm.nih.gov/9798081/)

205. **Motor score of the Unified Parkinson Disease Rating Scale as a good predictor of Lewy body-associated neuronal loss in the substantia nigra.**  
Sandrine Greffard, Marc Verny, Anne-Marie Bonnet, Jean-Yves Beinis, Claude Gallinari, Sylvie Meaume, François Piette, Jean-Jacques Hauw, Charles Duyckaerts  
*Archives of neurology* (2006-04) <https://www.ncbi.nlm.nih.gov/pubmed/16606773>  
DOI: [10.1001/archneur.63.4.584](https://doi.org/10.1001/archneur.63.4.584) · PMID: [16606773](https://pubmed.ncbi.nlm.nih.gov/16606773/)
206. **Cholinergic mesencephalic neurons are involved in gait and postural disorders in Parkinson disease.**  
Carine Karachi, David Grabli, Frédéric A Bernard, Dominique Tandé, Nicolas Wattiez, Hayat Belaid, Eric Bardin, Annick Prigent, Hans-Peter Nothacker, Stéphane Hunot, ... Chantal François  
*The Journal of clinical investigation* (2010-07-12)  
<https://www.ncbi.nlm.nih.gov/pubmed/20628197>  
DOI: [10.1172/jci42642](https://doi.org/10.1172/jci42642) · PMID: [20628197](https://pubmed.ncbi.nlm.nih.gov/20628197/) · PMCID: [PMC2912198](https://pubmed.ncbi.nlm.nih.gov/PMC2912198/)
207. **Neuronal loss in the pedunculopontine tegmental nucleus in Parkinson disease and in progressive supranuclear palsy.**  
EC Hirsch, AM Graybiel, C Duyckaerts, F Javoy-Agid  
*Proceedings of the National Academy of Sciences of the United States of America* (1987-08)  
<https://www.ncbi.nlm.nih.gov/pubmed/3475716>  
DOI: [10.1073/pnas.84.16.5976](https://doi.org/10.1073/pnas.84.16.5976) · PMID: [3475716](https://pubmed.ncbi.nlm.nih.gov/3475716/) · PMCID: [PMC298986](https://pubmed.ncbi.nlm.nih.gov/PMC298986/)
208. **Does the calcium binding protein calretinin protect dopaminergic neurons against degeneration in Parkinson's disease?**  
A Mouatt-Prigent, Y Agid, EC Hirsch  
*Brain research* (1994-12-30) <https://www.ncbi.nlm.nih.gov/pubmed/7704619>  
DOI: [10.1016/0006-8993\(94\)90511-8](https://doi.org/10.1016/0006-8993(94)90511-8) · PMID: [7704619](https://pubmed.ncbi.nlm.nih.gov/7704619/)