Dr. Roopa Rajan
MBBS, MD, DM
Associate Professor
Department of Neurology
Room number 708, 7th Floor,Neurosciences Centre
Phone No – 01126593662
Email: movementdisordersaiims@gmail.com, rooparajan@aiims.edu
OPD: Tuesday/Friday, Room No. 6, Neurosciences Centre, Ground Floor
Movement Disorder Clinic: Tuesday, Room No. 6, Neurosciences Centre, Ground Floor

Dr. Roopa Rajan completed her **MD in Internal Medicine and DM in Neurology** from the prestigious **Postgraduate Institute of Medical Education and Research, Chandigarh**. She then spent two years at the **Sree Chitra Tirunal Institute of Medical Sciences and Technology, Trivandrum** pursuing a **post doctoral fellowship in Movement Disorders** and subsequently as Assistant Professor at the Comprehensive Care Center for Movement Disorders at Sree Chitra. She joined the Department of Neurology at the **All India Institute of Medical Sciences** in 2016**.**

Dr. Roopa's field of expertise within Neurology is in the subspeciality of **Movement Disorders.** She has clinical expertise in the diagnosis and management of a variety of movement disorder conditions ranging from **Parkinson's disease, atypical parkinsonism, dystonias and tremor.** She is an integral part of the Deep Brain Stimulation team at AIIMS, and manages the selection, intraoperative and postoperative management of patients for **deep brain stimulation**. She regularly uses EMG guided **botulinum toxin injections** for a variety of dystonias.

Her research interests include the electrophysiology and genetics of Parkinson's disease, dystonia and tremor and effects of deep brain stimulation on the motor and non-motor manifestations of Parkinson's disease. She has over 100 publications including several original articles in indexed journals and chapters in books. She has presented her research at various national and international conferences. She is a recipient of the **Early Career Research Award (2017) from the Department of Science and Technology** for pursuing research into the electrophysiology of dystonia and tremor. In 2016, she received the **American Academy of Neurology International Scholarship Award** to present her research into the non-motor manifestations of Parkinson's disease. She is part of the **International Parkinson and Movement Disorder Society – LEAP program** class of 2019. She was part of the gold medal winning team in the Video Tournament at the 5th AOPMC in 2019. She is Co-Chair of the International MDS Young Members Group and Co-

Chair of the MDS Task Force on Management of Movement Disorders: Interdisciplinary and Integrated Care.

Movement Disorder Clinic
Movement disorder clinic is a subspecialty clinic for patients with a variety of diseases known collectively as "Movement Disorders". These include:

- Parkinson's disease, Atypical Parkinsonism, Progressive Supranuclear Palsy, Corticobasal Syndrome, Multiple System Atrophy, Dementia with Lewy bodies, Vascular Parkinsonism, Drug induced and other causes of Parkinsonism
- Dystonia, Generalised dystonia, Focal dystonia, Writer's cramp, blepharospasm, oromanndibular dystonia and others
- Tremor disorders including Essential Tremor, Dystonic tremor, task specific tremor, orthostatic tremor and others
- Chorea, tics, myoclonus, hemifacial spasm
- Movement disorders after trauma, perinatal insults, infections, stroke, metabolic problems
- Genetic movement disorders like Wilson's disease, Huntington's disease, Neurodegeneration with Brain Iron Accumulation
- Psychogenic or Functional Movement Disorders

Services provided through the Movement Disorder Clinic include:

- Clinical evaluation, diagnosis and treatment by Movement Disorder Specialists
- Investigations including neuroimaging (MRI, CT scan), electrophysiological tests (tremor analysis, autonomic function testing) and genetic testing
- Referral to and co-ordination with other specialised services like physiotherapy, speech and language therapy, neuropsychology, neuropsychiatry, sleep disorders clinic, dietitian and medical social worker
- Botulinum Toxin injections including EMG guided injections for dystonia, tremor and spasticity.
- Surgical treatment for movement disorders like Parkinson's disease, dystonia and tremor: Functional neurosurgery (Deep Brain Stimulation, Lesional surgeries (pallidotomy, thalamotomy)) is regularly performed by a comprehensive team including movement disorder specialists, neurosurgeons, neuropsychiatrists, psychologists, physiotherapy and rehabilitation specialists and others. For further information, please email: movementdisordersaiims@gmail.com

3. List of Intramural and extramural projects as PI

Our research projects aim to better understand the pathophysiology of movement disorders like tremor, dystonia and Parkinson's disease and in turn to contribute in developing better diagnostic and therapeutic modalities for these diseases.
Some of the research projects include:

Ongoing

1. **Genetic Architecture of Parkinson's disease in India (GAP-India) [Michael J Fox Foundation, Sep 2019- Sep 2022]**
   AIIMS, New Delhi is a nodal clincial centre for this large multicentric project that will perform the first pan-Indian genome wide association study, aiming to identify genetic variants associated with Parkinson's disease in the Indian population. Persons with Parkinson's disease and healthy volunteers are welcome to participate.
2. **The Indian Movement Disorder Registry and Biobank: clinical and genetic evaluation in Indian patients with movement disorders. [DBT, Sep 2018- Sep 2021]**
   This is a prospective, multi-centric study that aims to build a clinical registry and bio-repository for Indian patients with Movement Disorders and offers genetic testing to identify disease causing variants in selected patients. At AIIMS, New Delhi, we focus on identifying genetic associations in patients with dystonia, specifically early onset generalised dystonia, through this study. Persons with dystonia and healthy volunteers are welcome to participate.
3. **Unravelling the genetic landscape of Indian dystonia: a chromosomal microarray approach [AIIMS Institute Research Grant, Jan 2021- Jan 2023]**
   This study aims to understand whether chromosomal aberrations such as microduplications or deletions may be associated with dystonia in Indian patients.

4. **Spiral Dx: Tremor diagnosis and quantification using artificial intelligence [DBT, Aug 2021- Aug 2024]**
   Spiral drawings are often used in the clinic to detect and quantify upper limb tremor. This multicentric study aims use artificial intelligence approaches to explore whether spiral drawings maybe used to distinguish different types of tremors.
5. **Exploring the electrophysiological signatures of Essential Tremor and Essential Tremor Plus [AIIMS-UCL Collaborative Grant, Jan 2021- Dec 2021]**
   This is a collaborative study between AIIMS, New Delhi and UCL, London to explore electrophysiological differences between two types of tremors: essential tremor and essential tremor plus.
6. **Social Cognition in Parkinson's disease**
   This study aims to understand changes in social cognition (thought processes that govern social interactions) in patients with Parkinson's disease. Persons with Parkinson's disease and healthy volunteers are welcome to participate.

Completed

1. **Botulinum toxin injection for treatment of dystonic hand tremor: a randomized, placebo-controlled, parallel group trial. [AIIMS Institute Research Grant, Feb 2018- Feb 2020]**
   This study assessed the efficacy of botulinum toxin injections to reduce tremor severity in patients with dystonic hand tremor. The results suggested that electromyographically guided, individualised, botulinum toxin injections were safe and effective to reduce tremor severity in dystonic hand tremor.

2. **Automated hand-drawn spiral analysis platform as a tool to differentiate tremor syndromes. [DST SERB, Mar 2017- Mar 2020]**
   This study developed an automated algorithm for objective analysis of hand-drawn spirals to quantify the severity of tremor and differentiate tremor subtypes.
3. **A randomised controlled study of transcranial magnetic stimulation in patients with writer's cramp**
   This study assessed the effect of transcranial magnetic stimulation of specific brain areas on severity of writer's cramp.

For further details and participating in any of the above research studies, please mail: movementdisordersaiims@gmail.com

4. Publications

A. Top 25 publications

1. **Rajan R***, Srivastava AK, Anandapadmanabhan R, Saini A, Upadhyay A, Gupta A, Vishnu VY, Pandit AK, Vibha D, Singh MB, Bhatia R, Goyal V, Dwivedi SN, Srivastava P, Prasad K. Assessment of Botulinum Neurotoxin Injection for Dystonic Hand Tremor: A Randomized Clinical Trial. JAMA Neurol. 2021 Mar 1;78(3):302-311. doi: 10.1001/jamaneurol.2020.4766. PMID: 33346814; PMCID: PMC7754081.
2. **Rajan R**[$], Brennan L[$], Bloem BR, Dahodwala N, Gardner J, Goldman JG, Grimes DA, Iansek R, Kovács N, McGinley J, Parashos SA, Piemonte MEP, Eggers C. Integrated Care in Parkinson's Disease: A Systematic Review and Meta-Analysis. Mov Disord. 2020 Sep;35(9):1509-1531. doi: 10.1002/mds.28097. Epub 2020 Jun 29. PMID: 32598094.
3. **Rajan R***, Saini A, Verma B, Choudhary N, Gupta A, Vishnu VY, Bhatia R, Singh MB, Srivastava AK, Srivastava MVP. Anticholinergics May Carry Significant Cognitive and Gait Burden in Parkinson's Disease. Mov Disord Clin Pract. 2020 Aug 29;7(7):803-809. doi: 10.1002/mdc3.13032. PMID: 33043076; PMCID: PMC7533974
4. **Rajan R**, Divya KP, Kandadai RM, Yadav R, Satagopam VP, Madhusoodanan UK, Agarwal P, Kumar N, Ferreira T, Kumar H, Sreeram Prasad AV, Shetty K, Mehta S, Desai S, Kumar S, Prashanth LK, Bhatt M, Wadia P, Ramalingam S, Wali GM, Pandey S, Bartusch F, Hannussek M, Krüger J, Kumar-Sreelatha A, Grover S, Lichtner P, Sturm M, Roeper J, Busskamp V, Chandak GR, Schwamborn J, Seth P, Gasser T, Riess O, Goyal V, Pal PK, Borgohain R, Krüger R, Kishore A, Sharma M; Lux-GIANT Consortium. Genetic Architecture of Parkinson's Disease in the Indian Population: Harnessing Genetic Diversity to Address Critical Gaps in Parkinson's Disease Research. Front Neurol. 2020 Jun 18;11:524. doi: 10.3389/fneur.2020.00524. PMID: 32655481; PMCID: PMC7323575.
5. **Rajan R***, Garg K, Saini, A., Radhakrishnan, D.M., Carecchio, M., BK, B., Singh, M. and Srivastava, A.K. GPi-DBS for *KMT2B*-Associated Dystonia: Systematic

Review and Meta-Analysis. Mov Disord Clin Pract, 2022: 9: 31-37. https://doi.org/10.1002/mdc3.13374

6. **Rajan R**, Skorvanek M, Magocova V, Siddiqui J, AlSinaidi OA, Shinawi HM, AlSubaie F, AlOmar N, Deogaonkar M, Bajwa JA. Neuromodulation Options and Patient Selection for Parkinson's Disease. Neurol India. 2020 Nov-Dec;68(Supplement):S170-S178. doi: 10.4103/0028-3886.302473. PMID: 33318347.
7. Raina A[$], **Rajan R**[$], Sarma G, Krishnan S, Kesavapisharady K, Kishore A. Learning from negative consequences is impaired by STN-DBS and levodopa in Parkinson's disease. Ann Mov Disord 2021; Epub Ahead of Print https://www.aomd.in/preprintarticle.asp?id=318093;type=0
8. **Rajan R***, Pandey S, Anandapadmanabhan R, Srivastava AK. Interrater and intrarater agreement on the 2018 consensus statement on classification of tremors. Mov Disord. 2018; 33(12): 1966-67. doi: 10.1002/mds.27513
9. **Rajan R***, Srivastava AK, Anandapadmanabhan R, Vibha D, Pandit AK, Prasad K. Clinical spectrum of dystonia in a tertiary care movement disorders clinic in India. Ann Mov Disord 2018; 1 (1): 49-53
10. **Rajan R**, Khurana D, Lal V. Interictal cerebral and systemic endothelial function in patients with migraine: a case control study. J Neurol Neurosurg Psychiatry 2015; 86(11):1253-7
11. **Rajan R**, Krishnan S, Kesavapisharady K, Kishore A. Malignant subthalamic-stimulation withdrawal syndrome in Parkinson's disease. Movement Dis Clin Pract 2016. Epub ahead of print 31 MAR 2016 DOI: 10.1002/mdc3.12271
12. **Rajan R**, Krishnan S, Sarma G, Sarma SP, Kishore A. Dopamine receptor D3 rs6280 is associated with aberrant decision making in Parkinson's disease. Movement Disorders Clinical Practice 2018; 5(4):413-416
13. **Rajan R**, Popa T, Quartarone A, Ghilardi MF, Kishore A. Cortical plasticity and levodopa-induced dyskinesias in Parkinson's disease: connecting the dots in a multicomponent network. Clin Neurophysiol 2017; 128(6):992-9
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15. Krishnamoorthy S, **Rajan R,** Banerjee M, Kumar H, Sarma G, Krishnan S, Sarma S, Asha Kishore. Dopamine D3 receptor Ser9Gly variant is associated with impulse control disorders in Parkinson's disease patients. Parkinsonism and Related Disorders, 2016; 30: 13-7.
16. Krishnan S, Pisharady KK, **Rajan R,** Sarma SG, Sarma PS, Kishore A. Predictors of dementia-free survival after bilateral subthalamic deep brain stimulation for Parkinson's disease. Neurol India. 2019 Mar-Apr;67(2):459-466. doi: 10.4103/0028-3886.258056.

17. Kumar N, Gupta R, Kumar H, Mehta S, **Rajan R**, Kumar D, Kandadai RM, Desai S, Wadia P, Basu P, Mondal B, Sanchita, Rawat A, Meka SS, Mishal B, Prashanth LK, Srivastava AK, Goyal V. Impact of home confinement during COVID-19 pandemic on Parkinson's disease. Parkinsonism Relat Disord. 2020 Sep 6;80:32-34. doi: 10.1016/j.parkreldis.2020.09.003. Epub ahead of print. PMID: 32937224; PMCID: PMC7474806.
18. Zafar SM[$], **Rajan R**[$], Krishnan S, Kesavapisharady K, Kishore A. Interleaved Stimulation for Freezing of Gait in Advanced Parkinson's Disease Neurol India. 2021 Mar-Apr;69(2):457-460. doi: 10.4103/0028-3886.314570.
19. Agarwal A, Kaur H, Agarwal A, Nehra A, Pandey S, Garg A, Faruq M, **Rajan R**, Shukla G, Goyal V, Srivastava AK. Cognitive impairment in spinocerebellar ataxia type 12 Parkinsonism Relat Disord. 2021 Apr;85:52-56. doi: 10.1016/j.parkreldis.2021.03.010. Epub 2021 Mar 13.
20. Agrawal M, Garg K, Samala R, **Rajan R**, Naik V, Singh M.Outcome and Complications of MR Guided Focused Ultrasound for Essential Tremor: A Systematic Review and Meta-Analysis Front Neurol. 2021 May 7;12:654711. doi: 10.3389/fneur.2021.654711. eCollection 2021.
21. Agrawal M, Garg K, Samala R, **Rajan R**, Singh M: A Scientometric Analysis of the 100 Most Cited Articles on Pallidotomy. Stereotact Funct Neurosurg 2021. doi: 10.1159/000516237
22. Garg D, Srivastava AK, Jaryal AK, **Rajan R**, Singh A, Pandit AK, Vibha D, Shukla G, Garg A, Pandey RM, Prasad K. Is There a Difference in Autonomic Dysfunction Between Multiple System Atrophy Subtypes? Mov Disord Clin Pract. 2020 Apr 9;7(4):405-412. doi: 10.1002/mdc3.12936. PMID: 32373657; PMCID: PMC7197320.
23. Garg K, Samala R, Agrawal M, **Rajan R**, Singh M. Pallidotomy for Dystonia. Neurol India. 2020 Nov-Dec;68(Supplement):S322-S324. doi: 10.4103/0028-3886.302460. PMID: 33318369.
24. Parihar J, Dash D, Aggarwal B, Kabra M, **Rajan R**, Vibha D, Singh RK, Bhatia R, Gupta N, Tripathi M. Spectrum of Movement Disorders of Late-Onset Niemann-Pick Disease Type C. Can J Neurol Sci. 2021 Sep 16:1-5. doi: 10.1017/cjn.2021.222. Online ahead of print.
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B. List of all publications (year wise)

2022

Rajan, R., Garg, K., Saini, A., Radhakrishnan, D.M., Carecchio, M., BK, B., Singh, M. and Srivastava, A.K. (2022), GPi-DBS for *KMT2B*-Associated Dystonia: Systematic Review and Meta-Analysis. Mov Disord Clin Pract, 9: 31-37. https://doi.org/10.1002/mdc3.13374

2021

Agarwal A, Goyal A, **Rajan R***, Joseph L, Gupta A, Gupta A, Vishnu VY, Bhatia R, Singh MB, Srivastava MVP. Recurrent stroke in young: rule out a cervical rib. Ann Ind Acad Neurol 2021; 24(2):286 DOI: 10.4103/aian.AIAN_325_20 (accepted 27 May 2020)

Agarwal A, Kaur H, Agarwal A, Nehra A, Pandey S, Garg A, Faruq M, **Rajan R**, Shukla G, Goyal V, Srivastava AK. Cognitive impairment in spinocerebellar ataxia type 12. Parkinsonism Relat Disord. 2021 Mar 13;85:52-56. doi: 10.1016/j.parkreldis.2021.03.010. Epub ahead of print. PMID: 33740701.

Agarwal A, Sharma J, Padma Srivastava MV, Bhatia R, Singh MB, Gupta A, Pandit AK, Singh R, Rajan R, Dwivedi S, Upadhyay A, Garg A, Vishnu VY. Early Post-Stroke Seizures in Acute Ischemic Stroke: A Prospective Cohort StudyAnn Indian Acad Neurol. 2021 Jul-Aug;24(4):580-585. doi: 10.4103/aian.AIAN_1283_20. Epub 2021 Jun 29.

Agarwal M, Arushi A, Dhingra LS, Patel LJ, Agrawal S, Srivastava P, Tripathi M, Srivastava A, Bhatia R, Singh MB, Prasad K, Vibha D, Vishnu VY, **Rajan R**, Pandit AK, Singh RK, Gupta A, Radhakrishnan DM, Das A, Ramanujam B, Agarwal A, Elavarasi A. Patient experience of a neurology tele-follow-up program initiated during the coronavirus disease 2019 pandemic: a questionnaire-based study. Telemedicine Reports. Feb 2021; 2(1): 88-97. http://doi.org/10.1089/tmr.2020.0034. Published 1 Mar 2021

Aggarwal A, Parkipandla S, Salunkhe M, Gupta A, Garg A, **Rajan R**, Vishnu VY, Bhatia R, Singh MB, Srivastava MVP. Atypical subacute sclerosing panencephalitis (SSPE): All postpartum altered behavior Isn't CVT! Ann Indian Acad Neurol 2021; Epub ahead of print DOI: 10.4103/aian.AIAN_1313_20

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Gupta S, Rajendran SP, Reddy R, Roy J, Sharma A, Nambiar V, Rai NK, Upadhyay AD, Parkipandla S, Singh MB, Vibha D, Vishnu VY, Rajan R, Gupta A, Pandit AK, Agarwal A, Gaikwad SB, Garg A, Joseph L, Sreedharan SE, Reddy S, Sreela K, Ramachandran D, George GB, Panicker P, Suresh MK, Gupta V, Ray S, Suri V, Ahuja C, Kajal K, Lal V, Singh RK, Oza H, Halani H, Sanivarapu S, Sahonta R, Duggal A, Dixit P, Kulkarni GB, Taallapalli AVR, Parmar M, Chalasani V, Kashyap M, Misra B, Pachipala S, Yogeesh PM, Salunkhe M, Gupta P; COVID-19 Stroke Study Group (CSSG) India. Clinical profile and outcome of non-COVID strokes during pandemic and the pre pandemic period: COVID-Stroke Study Group (CSSG) India. J Neurol Sci. 2021 Sep 15;428:117583. doi: 10.1016/j.jns.2021.117583. Epub 2021 Jul 16.

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5. Public Education/ Events

The Department of Neurology conducts a patient education program every year to mark the World Parkinson's Day. Please follow this link to access the PD Day program for 2021:
World Parkinson Day AIIMS 2021
Or copy and paste the following address to your browser:
https://www.youtube.com/watch?v=ffNGwiinQBA

6.PhD (ongoing)

Mr. Anandapadmanabhan R
Ms. Arti Saini