



Drug Delivery: *(For scientific information purposes only; Therapies discussed may not be approved in all geographies or may be investigational and used only in pre-clinical and clinical studies.)*

Pino IP, Darrow DP, Chen CC. **MRI-aided SmartFlow convection delivery of DNX-2401: a pilot, prospective case series.** *World Neurosurgery.* 2023, ISSN 1878-8750. <https://doi.org/10.1016/j.wneu.2023.10.142>

The ClearPoint system enables intraprocedural MRI guidance for a number of neurological therapies and approved clinical trials.

Ford MM, George BE, Van Laar VS, et al. **GDNF gene therapy for alcohol use disorder in male non-human primates.** *Nat Med.* 29, 2030–2040 (2023). <https://doi.org/10.1038/s41591-023-02463-9>

Salegio E, Hancock K, Korszen S. **Pre-Clinical Delivery of Gene Therapy Products into the Cerebrospinal Fluid: Challenges and Considerations for Clinical Translation.** *Front. Mol. Neurosci. Sec. Brain Disease Mechanisms.* Vol. 16 – 2023. [doi:10.3389/fnmol.2023.1248271](https://doi.org/10.3389/fnmol.2023.1248271)

Cruz-Garza JG, Taghlabi KM, Bhenderu LS, Gupta S, et al. **Magnetic Resonance-Guided Stereotaxy for Infusions to the Pig Brain.** *JoVE Journal Neuroscience.* Published online: 31 March 2023. [doi:10.3791/64079-v](https://doi.org/10.3791/64079-v)

Compton DR, DeMarco SJ, Yalamanchili P. **AAV2-hAADC (Eladocogene Exuparvovec) Biodistribution and Expression: Superiority of Intraputaminal versus Intracerebroventricular and Intrathecal (Lumbar) Routes of Administration.** *International Journal of Toxicology.* 2023;42(2):135-145. [doi:10.1177/10915818221144424](https://doi.org/10.1177/10915818221144424)

Compton DR, DeMarco SJ, Yalamanchili P. **Supplemental Material – AAV2-hAADC (Eladocogene Exuparvovec) Biodistribution and Expression: Superiority of Intraputaminal versus Intracerebroventricular and Intrathecal (Lumbar) Routes of Administration.** *SAGE Journals.* Journal contribution posted 2022-12-06. doi.org/10.25384/SAGE.21685655.v1

Keam SJ. **Eladocogene Exuparvovec: First Approval.** *Drugs (2022).* Published online: 14 September 2022. [doi:10.1007/s40265-022-01775-3](https://doi.org/10.1007/s40265-022-01775-3)

Salegio EA, Cukrov M, Lortz R, Green A, et al. **Feasibility of Targeted Delivery of AAV5-GFP into the Cerebellum of Nonhuman Primates Following a Single Convection-Enhanced Delivery Infusion.** *Human Gene Therapy.* 2022;3: Epub ahead of print. [doi:10.1089/hum.2021.163](https://doi.org/10.1089/hum.2021.163)

Keiser MS, Ranum PT, Yrigollen CM, Carrell EM, et al. **Toxicity after AAV delivery of RNAi expression constructs into nonhuman primate brain.** *Nature Medicine.* 2021;27:1982-1989. [doi:10.1038/s41591-021-01522-3](https://doi.org/10.1038/s41591-021-01522-3)

Pearson TS, Gupta N, Sebastian WS, Imamura-Ching J, et al. **Gene therapy for aromatic L-amino acid decarboxylase deficiency by MR-guided direct delivery of AAV2-AADC to midbrain dopaminergic neurons.** *Nature Communications.* 2021;12, 4251. [doi:10.1038/s41467-021-24524-8](https://doi.org/10.1038/s41467-021-24524-8)

Rossmeisl JH, Herpai D, Quigley M, Cecere TE, et al. **Phase I trial of convection-enhanced delivery of IL13RA2 and EPHA2 receptor targeted cytotoxins in dogs with spontaneous intracranial gliomas.** *Neuro-Oncology.* 2021;23(3):422-434. [doi:10.1093/neuonc/noaa196](https://doi.org/10.1093/neuonc/noaa196)

Bander ED, Ramos AD, Wembacher-Schroder E, Ivasyk I, et al. **Repeat convection-enhanced delivery for diffuse intrinsic pontine glioma.** *Journal of Neurosurgery.* 2020;26(6):661-667. [doi:10.3171/2020.6.PEDS20280](https://doi.org/10.3171/2020.6.PEDS20280)

Buttery PC, Barker RA. **Gene and cell-based therapies for Parkinson's disease: Where are we?** *Neurotherapeutics*. 2020;17:1539-1562. [doi:10.1007/s13311-020-00940-4](https://doi.org/10.1007/s13311-020-00940-4)

Taghian T, Horn E, Shazeeb MS, Bierfeldt LJ, et al. **Volume and infusion rate dynamics of intraparenchymal central nervous system infusion in a large animal model.** *Human Gene Therapy*. 2020;31(11-12):617-625. [doi:10.1089/hum.2019.288](https://doi.org/10.1089/hum.2019.288)

Nutt JG, Curtze C, Hiller A, Anderson S, et al. **Aromatic L-Amino acid decarboxylase gene therapy enhances levodopa response in Parkinson's disease.** *Movement Disorders*. 2020;35(5):851-858. [doi:10.1002/mds.27993](https://doi.org/10.1002/mds.27993)

Richardson MR, Bankiewicz KS, Chadwick CW, Van Laar AD, et al. **Data-driven evolution of neurosurgical gene therapy delivery in Parkinson's disease.** *Journal of Neurology, Neurosurgery, & Psychiatry*. 2020. [doi:10.1136/jnnp-2020-322904](https://doi.org/10.1136/jnnp-2020-322904)

Souweidane MM, Tosi U. **Convection enhanced delivery for diffuse intrinsic pontine glioma: Review of a single institution experience.** *Pharmaceutics*. 2020;12(660). [doi:10.3390/pharmaceutics12070660](https://doi.org/10.3390/pharmaceutics12070660)

Chadwick CW, Bankiewicz KS, Van Laar AD, Richardson MR, et al. **Magnetic resonance imaging-guided phase 1 trial of putaminal AADC gene therapy for Parkinson's disease.** *Annals of Neurology*. 2019;85:704–714. [doi:10.1002/ana.25450](https://doi.org/10.1002/ana.25450)

Salegio EA, Campagna MV, Allen PC, Stockinger DE, Song Y, Hwa GC. **Targeted delivery and tolerability of MRI-guided CED infusion into the cerebellum of nonhuman primates.** *Human Gene Therapy Methods*. 2018;29(4). [doi:10.1089/hgtb.2018.049](https://doi.org/10.1089/hgtb.2018.049)

Talbott JF, Cooke DL, Mabray MC, Larson PS, et al. **Accuracy of image-guided percutaneous injection into a phantom spinal cord utilizing flat panel detector CT with MR fusion and integrated navigational software.** *Journal of NeuroInterventional Surgery*. 2018;10(12). [doi:10.1136/neurintsurg-2018-013878](https://doi.org/10.1136/neurintsurg-2018-013878)

Jahangiri A, Chin AT, Flanigan PM, Chen R, Bankiewicz KS, Aghi MK. **Convection-enhanced delivery in glioblastoma: a review of preclinical and clinical studies.** *Journal of Neurosurgery*. 2017;126(1):191–200. [doi:10.3171/2016.1.JNS151591](https://doi.org/10.3171/2016.1.JNS151591)

Vasconcellos E, Wembacher-Schroder E, Thomson R, Rube M, Souweidane M. **A flexible step design infusion catheter for prolonged drug delivery into the brain stem of children.** *Neuro-Oncology*. 2016;18(3):iii128. [doi:10.1093/neuonc/nov078.08](https://doi.org/10.1093/neuonc/nov078.08)

Han SJ, Bankiewicz K, Butowski NA, Larson PS, Aghi MK. **Interventional MRI-guided catheter placement and real time drug delivery to the central nervous system.** *Expert Review of Neurotherapeutics*. 2016;16(6):635–639. [doi:10.1080/14737175.2016.1175939](https://doi.org/10.1080/14737175.2016.1175939)

Rowland NC, Kalia SK, Kalia LV, Larson PS, et al. **Merging DBS with viral vector or stem cell implantation: "Hybrid" stereotactic surgery as an evolution in the surgical treatment of Parkinson's disease.** *Molecular Therapy Methods & Clinical Development*. 2016;3:15051. [doi:10.1038/mtm.2015.51](https://doi.org/10.1038/mtm.2015.51)

Vogelbaum MA & Aghi MK. **Convection-enhanced delivery for the treatment of glioblastoma.** *Neuro-Oncology*. 2015;7(2):ii3-ii8. [doi:10.1093/neuonc/nou354](https://doi.org/10.1093/neuonc/nou354)

Chittiboina P, Heiss JD, Lonser RR. **Accuracy of direct magnetic resonance imaging-guided placement of drug infusion cannulae.** *Journal of Neurosurgery*. 2015;122(5):1173–1179. [doi:10.3171/2014.11.JNS131888](https://doi.org/10.3171/2014.11.JNS131888)

Silvestrini MT, Yin D, Martin AJ, Coppes VG, et al. **Interventional magnetic resonance imaging-guided cell transplantation into the brain with radially branched deployment.** *Molecular Therapy Methods & Clinical Development*. 2015;23(1):119–129. [doi:10.1038/mt.2014.155](https://doi.org/10.1038/mt.2014.155)

Richardson MR, Kells AP, Martin AJ, Larson PS, et al. **Novel platform for MRI-guided convection-enhanced delivery of therapeutics: preclinical validation in nonhuman primate brain.** *Stereotactic and Functional Neurosurgery*. 2011;89(3):141–151. [doi:10.1159/000323544](https://doi.org/10.1159/000323544)

Richardson MR, Kells AP, Rosenbluth KH, Salegio EA, et al. **Interventional MRI-guided putaminal delivery of AAV2-GDNF for a planned clinical trial in Parkinson's disease.** *Molecular Therapy*. 2011;19(6):1048–1057. [doi:10.1038/mt.2011.11](https://doi.org/10.1038/mt.2011.11)

ClearPoint Neuro, Inc. Indications for Use (K142505): *The ClearPoint® System is intended to provide stereotactic guidance for the placement and operation of instruments or devices during planning and operation of neurological procedures within the MRI environment and in conjunction with MR imaging. The ClearPoint System is intended as an integral part of procedures that have traditionally used stereotactic methodology. These procedures include biopsies, catheter and electrode insertion including deep brain stimulation (DBS) lead placement. The System is intended for use only with 1.5 and 3.0 Tesla MRI scanners and MR Conditional implants and devices. The user should consult the “Navigational Accuracy” section of the User’s Guide to assess if the accuracy of the system is suitable for their needs.*

The SmartFlow® MR Compatible Ventricular Cannula has received 510(k) clearance from the FDA for use in the US for the aspiration of CSF or injection of the chemotherapy drug, Cytarabine, into the ventricle.