



**Recent References (2017-2020) on the Intrathecal Administration of Agents
Using ALZET® Osmotic Pumps**

Q8593: Y. Kamata, *et al.* Paclitaxel Induces Upregulation of Transient Receptor Potential Vanilloid 1 Expression in the Rat Spinal Cord. *Int J Mol Sci* 2020;21(12):

Agents: siRNA, TRPV1 **Vehicle:** CSF, Artificial; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** Not stated; **Duration:** 3 days;

ALZET Comments: Dose (0.5 nmol/μL/h); Controls received mp w/ vehicle; animal info (Male Wistar rats weighing 250 to 320 g); behavioral testing (Mechanical or Thermal Stimulation); dependence;

Q8413: I. J. Chen, *et al.* The Circadian Hormone Melatonin Inhibits Morphine-Induced Tolerance and Inflammation via the Activation of Antioxidative Enzymes. *Antioxidants (Basel)* 2020;9(9):

Agents: Morphine **Vehicle:** DMSO; Saline; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** Not stated; **Duration:** 10 days;

ALZET Comments: 0.9% Saline used; Controls received mp w/ vehicle; animal info (adult male wistar rats, 300-350 g); behavioral testing (Nociceptive Test); dependence;

Q6999: S. J. Shiue, *et al.* Mesenchymal stem cell exosomes as a cell-free therapy for nerve injury-induced pain in rats. *Pain* 2019;160(1):210-223

Agents: Exosomes, human umbilical cord mesenchymal stem cell **Vehicle:** Saline; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2001; **Duration:** 7 days;

ALZET Comments: Dose (1.2 mg/mL/ hr); Controls received mp w/ vehicle; animal info (Male Sprague–Dawley rats, 200 to 250 g); Therapeutic indication (neuropathic pain);

Q7660: M. P. Schneider, *et al.* Anti-Nogo-A Antibodies As a Potential Causal Therapy for Lower Urinary Tract Dysfunction after Spinal Cord Injury. *J Neurosci* 2019;39(21):4066-4076

Agents: Antibody, anti-Nogo-A **Vehicle:** Not Stated; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2ML2; **Duration:** 14 days;

ALZET Comments: Dose (5 μL/h, 3 mg of antibody/ml); Controls received mp w/ inactive control antibody; animal info (4+/-1 months, female, Lewis, 210+/-20g); spinal cord injury; Pump and catheter were removed 15–16 d after implantation under 5% isoflurane; Therapeutic indication (reduction of the impairment of several key urodynamic functions such as recovery of the physiological EUS function during voiding after induced SCI);

Q7679: P. Liu, *et al.* Inhibitory effect of hyaluronidase-4 in a rat spinal cord hemisection model. *Cancer Translational Medicine* 2019;5(1):10-16

Agents: Antibody, anti-Hyal-4; IgG **Vehicle:** Not Stated; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 1004; **Duration:** 4 weeks;

ALZET Comments: animal info (Female Sprague–Dawley (SD) rats); spinal cord injury;

Q7622: S. Kokubu, *et al.* Characterization of Analgesic Actions of the Chronic Intrathecal Infusion of H-Dmt-D-Arg-Phe-Lys-NH₂ in Rat. *Neuromodulation* 2019;

Agents: DMT-DALDA; morphine sulfate **Vehicle:** Saline; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2001, 2002; **Duration:** 7 days, 14 days;

ALZET Comments: Dose ((DMT-DALDA 0.3, 1, 3, or 10 pmol/μL/hour), (MS 37.5 nmol/hour)); dose-response (Figure 1a graph on page 4); Controls received mp w/ vehicle; animal info (adult, male, Sprague-Dawley, 225-300g); behavioral testing (Hargreaves-type hind paw thermal stimulator, formalin-induced flinching); DMT-DALDA (H-Dmt-D-Arg-Phe-Lys-NH₂; Dmt = 2',6'-dimethyltyrosine) is a dermorphin analogue and selective mu opioid agonist; dependence; good methods (surgical techniques and pump/catheter implantation on p.2);

Q7286: X. J. Feng, *et al.* Nerve injury elevates functional Cav3.2 channels in superficial spinal dorsal horn. *Mol Pain* 2019;15(1744806919836569

Agents: Nickel Chloride; TTA-A2 **Vehicle:** Not Stated; **Route:** CSF/CNS (Intrathecal); **Species:** Rat; **Pump:** 1002; **Duration:** 14 days;



ALZET Comments: Dose (TTA-A2, 0.35 ug/h, Nickel Chloride, 0.5 ug/h); Controls received mp w/ Saline; animal info (Sprague-Dawley rats, 150–250 g); TTA-A2 aka ([2-(4-cyclopropylphenyl)-N-((1R)-1-{5-[(2,2,2-trifluoroethyl)oxo]-pyridin-2-yl)ethyl)acetamide]; Brain coordinates (rostrally about 2 cm); Catheter placement verified via tail-flick response; spinal nerve ligation;

Q7987: S. Dyck, *et al.* LAR and PTPsigma receptors are negative regulators of oligodendrogenesis and oligodendrocyte integrity in spinal cord injury. *Glia* 2019;67(1):125-145

Agents: peptide, intracellular LAR; peptide, intracellular sigma **Vehicle:** saline, BSA buffered; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2001D, 1003D, 2001, 2002, and 2004; **Duration:** 1, 3, 5, 7, 14, 28 days;

ALZET Comments: Dose ((ILP 10 µg/day), (ISP 10 µg/day)); 0.1% BSA in saline used; Controls received mp w/ vehicle; animal info (female, Sprague-Dawley, 250g); ILP (NH₂-GRKKRRQRRRCDLADNIERLKANDGLKFSQEYESI-NH₂) and ISP (NH₂-GRKKRRQRRRCDMAEHMERLKANDSLKLSQEYESI-NH₂) are peptides against LAR and PTPsigma; enzyme inhibitor (LAR and PTPsigma receptor); peptides; spinal cord injury; Therapeutic indication (inhibition of PTPsigma and LAR receptors promotes oligodendrogenesis by endogenous precursor cells, attenuates caspase 3-mediated cell death in mature oligodendrocytes, and preserves myelin);

Q7272: F. Bai, *et al.* Spinal Cord Glycine Transporter 2 Mediates Bilateral ST35 Acupoints Sensitization in Rats with Knee Osteoarthritis. *Evidence-Based Complementary and Alternative Medicine* 2019;2019(7493286

Agents: Glycine **Vehicle:** Saline; **Route:** CSF/CNS (Intrathecal); **Species:** Rat; **Pump:** 2002; **Duration:** 14 Days;

ALZET Comments: Dose (0.1 umol/h); Controls received mp w/ vehicle; animal info (Male Sprague-Dawley rats, 200-250 g); behavioral testing (PWMT test);

Q7942: G. L. Austin, *et al.* Central Nervous System Delivery and Biodistribution Analysis of an Antibody-Enzyme Fusion for the Treatment of Lafora Disease. *Mol Pharm* 2019;16(9):3791-3801

Agents: Fusion protein, VAL-0417; amylase, recombinant pancreatic **Vehicle:** PBS; **Route:** CSF/CNS (lateral ventricle); CSF/CNS (intrathecal); **Species:** Mice; **Pump:** Not stated; **Duration:** 14, 28 days;

ALZET Comments: Dose ((VAL-0417 0.08 mg/day), (amylase 0.04 mg/day)); Controls received mp w/ vehicle; animal info (WT or Epm2a(-/-)); VAL-0417 is an antibody-enzyme fusion protein; neurodegenerative (Lafora disease); generation of antibody-enzyme fusion protein on p.3792;

Q7163: Y. Zhang, *et al.* Combination Treatment of C16 Peptide and Angiopoietin-1 Alleviates Neuromyelitis Optica in an Experimental Model. *Mediators Inflamm* 2018;2018(4187347

Agents: Antibody, NMO-IgG; Complement, human **Vehicle:** Not Stated; **Route:** CSF/CNS (intrathecal); CSF/CNS (lateral ventricle); **Species:** Rat; **Pump:** 1003D; **Duration:** 3 days;

ALZET Comments: Dose (10 µg NMO-IgG and 50 µL (5µg/µL) human complement); NMO aka Neuromyelitis optica;

Q7542: Q. Wu, *et al.* Human menstrual blood-derived stem cells promote functional recovery in a rat spinal cord hemisection model. *Cell Death & Disease* 2018;9(9):882

Agents: TrkB-IgG; immunoglobulin G, human **Vehicle:** PBS; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2002; **Duration:** 4 weeks;

ALZET Comments: Dose (3 µg/day); Controls received mp w/ vehicle; animal info (adult, female, Sprague-Dawley, 220-250g); behavioral testing (BBB locomotion scale); pumps replaced at 3 weeks; enzyme inhibitor (BDNF-TrkB signaling); spinal cord injury;

Q7319: Q. Wang, *et al.* Danhong Injection Alleviates Mechanical Allodynia via Inhibiting ERK1/2 Activation and Elevates BDNF Level in Sciatic Nerve in Diabetic Rat. *Evidence-Based Complementary and Alternative Medicine* 2018;2018(5798453

Agents: U0126 **Vehicle:** DMSO; CSF, artificial; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 1007D; **Duration:** 1 week;

ALZET Comments: Dose (0.5 ug/ul/hr); 10% DMSO used; Controls received mp w/ vehicle; animal info (Male, Sprague-Dawley, 180-200 g); behavioral testing (Stimulus test); U0216 is a Mitogen-activated protein kinase (MAPK) kinase 1/2 inhibitor; enzyme inhibitor (Mitogen-activated protein kinase); Intrathecal catheters were inserted into subarachnoid spaces through atlantooccipital membrane; diabetes;



Q7304: K. Stockstill, *et al.* Dysregulation of sphingolipid metabolism contributes to bortezomib-induced neuropathic pain. *J Exp Med* 2018;215(5):1301-1313

Agents: FTY720, ponesimod, NIBR14 **Vehicle:** Saline; **Route:** CSF/CNS (intrathecal; L5/L6 lumbar); **Species:** Rat, Mice; **Pump:** 2001; **Duration:** 6 days;

ALZET Comments: 5% Tween 80, 5% ethanol, saline used; Controls received mp w/ vehicle; animal info (Male, Sprague Dawley rats, 200–220 g); animal info (Male, Sprague Dawley rats, 200–220 g); FTY720 AKA fingolimod; Ponesimod AKA ACT-128800; NIBR14 is a methyl ester pro-drug; FTY720 AKA fingolimod; Ponesimod AKA ACT-128800; NIBR14 is a methyl ester pro-drug;

Q7052: I. Rossetti, *et al.* Calcitonin gene-related peptide decreases IL-1beta, IL-6 as well as Ym1, Arg1, CD163 expression in a brain tissue context-dependent manner while ameliorating experimental autoimmune encephalomyelitis. *J Neuroimmunol* 2018;323(94-104)

Agents: Calcitonin gene-related peptide **Vehicle:** CSF, artificial; **Route:** CSF/CNS (intrathecal); **Species:** Mice; **Pump:** 2002; **Duration:** 2 weeks;

ALZET Comments: Controls received mp w/ vehicle; animal info (7-8 week old C57BL/6 female mice); peptides;

Q7264: C. Rivat, *et al.* Inhibition of neuronal FLT3 receptor tyrosine kinase alleviates peripheral neuropathic pain in mice. *Nat Commun* 2018;9(1):1042

Agents: RNA, small interfering (Flt3, scrambled) **Vehicle:** Not Stated; **Route:** CSF/CNS (intrathecal); **Species:** Mice; **Pump:** 1002; **Duration:** 6 days;

ALZET Comments: Dose (12.53 ng/ml); animal info (C57BL/6 naive mice, Flt3KO mice 25–30 g.); behavioral testing (reflexive tail flick); spinal cord injury; stress/adverse reaction: (see pg. 10);

Q7263: L. Riemann, *et al.* Transplantation of Neural Precursor Cells Attenuates Chronic Immune Environment in Cervical Spinal Cord Injury. *Front Neurol* 2018;9(428)

Agents: Platelet-Derived Growth Factor, Epidermal Growth Factor, Basic Fibroblast Growth Factor **Vehicle:** Platelet-Derived Growth Factor, Epidermal Growth Factor, Basic Fibroblast Growth Factor; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 1007D; **Duration:** 7 days;

ALZET Comments: Dose (PDGF-AA, 1 µg/100 µL; EGF, 3 µg/100 µL; bFGF, 3 µg/100µL); 0.1% rat serum albumin used; animal info (female Wistar rats 250 g); post op. care (moxifloxacin, buprenorphine); spinal cord injury;

Q8126: L. Micheli, *et al.* Involvement of the N/OFQ-NOP system in rat morphine antinociceptive tolerance: Are astrocytes the crossroad? *Eur J Pharmacol* 2018;823(79-86)

Agents: Nociceptin/orphanin FQ or Morphine **Vehicle:** Not stated; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 1002; **Duration:** 10 days;

ALZET Comments: Dose (1 and 3 nmol/h); animal info (Male, Sprague-Dawley, Wistar,); behavioral testing (Paw Pressure Test, Rota-rod Test); Nociceptin/orphanin FQ aka (N/OFQ); dependence;

Q6913: Michael Mousseau, *et al.* Microglial pannexin-1 channel activation is a spinal determinant of joint pain. *Science Advances* 2018;4(8):

Agents: A740003; mimetic peptide inhibitor of Panx1; 10panx; scspanx; Mac1-saporin; Saporin **Vehicle:** Not Stated; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** Not Stated; **Duration:** 7 days;

ALZET Comments: animal info (adult male Sprague-Dawley rats); enzyme inhibitor (P2X7R antagonist A740003); Therapeutic indication (arthritis);

Q7202: W. Liu, *et al.* Dextran-based biodegradable nanoparticles: an alternative and convenient strategy for treatment of traumatic spinal cord injury. *Int J Nanomedicine* 2018;13(4121-4132)

Agents: Taxol **Vehicle:** Cremophor EL; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2004; **Duration:** 7 days;

ALZET Comments: Dose (256 ng/day); animal info (Sprague Dawley rats); behavioral testing (Locomotor capacity, BBB open field 21 point scale); ALZET rat intrathecal catheter used; spinal cord injury; stress/adverse reaction: (see pg. 4130);



Q7216: G. Li, *et al.* MiR-103 alleviates autophagy and apoptosis by regulating SOX2 in LPS-injured PC12 cells and SCI rats. *Iran J Basic Med Sci* 2018;21(3):292-300

Agents: miR-103 agomir **Vehicle:** Saline; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 1003D; **Duration:** 3 days; **ALZET Comments:** Dose (1 ul/hr/day); Controls received mp w/ vehicle; animal info (Male, Sprague-Dawley, 180-220 g); post op. care (Penicillin G); spinal cord injury;

Q7026: P. M. Grace, *et al.* Protraction of neuropathic pain by morphine is mediated by spinal damage associated molecular patterns (DAMPs) in male rats. *Brain, Behavior, and Immunity* 2018;72(45-50

Agents: naloxone; A438079; YVAD-cmk, Ac- **Vehicle:** Not Stated; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2001; **Duration:** Not Stated;

ALZET Comments: Dose (naloxone: 60 ug/h; A438079: 30 ng/h; ac-YVAD-cmk: 1 ug/h); animal info (10-12 week old male Fischer 344 rats); enzyme inhibitor (caspase-1);

Q7141: N. Geribaldi-Doldan, *et al.* Specific inhibition of ADAM17/TACE promotes neurogenesis in the injured motor cortex. *Cell Death & Disease* 2018;9(9):862

Agents: GM6001(N-[(2R)-2-(hydroxami-docarbonylmethyl)-4-methylpentanoyl]-L-tryptophan methylamide) **Vehicle:** DMSO, PBS; **Route:** CSF/CNS (intrathecal); **Species:** Mice; **Pump:** 1002, 1004; **Duration:** 14 days, 28 days;

ALZET Comments: Dose (50-µM); 0.4% DMSO used; Controls received mp w/ vehicle; Controls received mp w/ vehicle; GM6001 is N-[(2R)-2-(hydroxami-docarbonylmethyl)-4-methylpentanoyl]-L-tryptophan methylamide; ALZET brain infusion kit II used;

Q7137: K. Fujita, *et al.* Targeting Tyro3 ameliorates a model of PGRN-mutant FTLTDP via tau-mediated synaptic pathology. *Nat Commun* 2018;9(1):433

Agents: Gö6976 **Vehicle:** PBS; **Route:** CSF/CNS (intrathecal); **Species:** Mouse; **Pump:** 2006; **Duration:** 2 weeks;

ALZET Comments: Dose (0.15 ul/h); animal info (PGRN-KI and C57BL/6J, 10-12 weeks old); behavioral testing (Morris water maze test, Fear-conditioning test, Probe test, Rotarod test, Open-field test, Light-dark box test); enzyme inhibitor (PKC inhibitor); gene therapy;

Q7031: M. Fregosi, *et al.* Changes of motor corticobulbar projections following different lesion types affecting the central nervous system in adult macaque monkeys. *European Journal of Neuroscience* 2018;48(4):2050-2070

Agents: Antibody, anti-Nogo-A **Vehicle:** Not Stated; **Route:** CSF/CNS (Intrathecal), SC; **Species:** Monkey (Macaca fascicularis); **Pump:** 2ML2; **Duration:** 4 weeks;

ALZET Comments: Dose (3 mg/ml); One pump administered the treatment intrathecally to the cervical spinal cord, whereas the other pump delivered the antibody close to the lesioned site in M1 below the dura; Multiple pumps per animal (2);

Q7131: S. Dyck, *et al.* Perturbing chondroitin sulfate proteoglycan signaling through LAR and PTPsigma receptors promotes a beneficial inflammatory response following spinal cord injury. *J Neuroinflammation* 2018;15(1):90

Agents: Intracellular leukocyte common antigen-related peptide (ILP), Intracellular sigma peptide (ISP), TAT- conjugated peptides **Vehicle:** Saline; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2001D, 1003D, 2001, 2002, 2004; **Duration:** 1, 3, 5, 7, or 14 days;

ALZET Comments: Dose (10 ug/day); Controls received mp w/ vehicle; animal info (Sprague-Dawley, adult, female, 250 g); animal info (Sprague-Dawley, adult, female, 250 g); spinal cord injury;

Q3539: Y. C. Cheng, *et al.* Melatonin regulation of transcription in the reversal of morphine tolerance: Microarray analysis of differential gene expression. *Int J Mol Med* 2018;

Agents: Morphine **Vehicle:** Saline; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** Not Stated; **Duration:** 7 days;

ALZET Comments: Dose (15 µg/h); Controls received mp w/ vehicle; animal info (27 Male Wistar rats (350 400 g), each rat (with 12 weeks of age)); neurodegenerative ();

Q7097: A. Alastrue-Agudo, *et al.* FM19G11 and Ependymal Progenitor/Stem Cell Combinatory Treatment Enhances Neuronal Preservation and Oligodendrogenesis after Severe Spinal Cord Injury. *Int J Mol Sci* 2018;19(1):

Agents: FM19G11 **Vehicle:** DMSO; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 1007D; **Duration:** 3 days;



ALZET Comments: Controls received mp w/ vehicle; animal info (2-month-old Sprague Dawley rats weighing ~200 g); FM19G11 is an inhibitor of Hypoxia inducible factor-alpha protein expression; spinal cord injury;

Q6332: J. Zhang, *et al.* Prevention and reversal of latent sensitization of dorsal horn neurons by glial blockers in a model of low back pain in male rats. *J Neurophysiol* 2017;118(4):2059-2069

Agents: Minocycline, fluorocitrate **Vehicle:** PBS, artificial cerebrospinal fluid; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2002; **Duration:** 6 days, 3 days;

ALZET Comments: Dose (200 µg/day); Controls received mp w/ vehicle; animal info (adult male Sprague- Dawley rats);

Q5911: X. Wang, *et al.* Threshold Effect of G9a/Glp on Peripheral Nerve Injury Induced Hypersensitivity. *Mol Pain* 2017;13(1744806917729305

Agents: Not Stated **Vehicle:** Not Stated; **Route:** CSF/CNS (intrathecal); **Species:** Mice; **Pump:** Not Stated; **Duration:** Not Stated;

ALZET Comments: animal info (male, C57BL6, 20-25g, 7-9 weeks old); post op. care (10000 IU sodium penicillin IM); ALZET intrathecal catheter only;

Q6270: A. S. Wahl, *et al.* Optogenetically stimulating intact rat corticospinal tract post-stroke restores motor control through regionalized functional circuit formation. *Nat Commun* 2017;8(1):1187

Agents: Antibody, anti-Nogo-A **Vehicle:** Not Stated; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2ML2; **Duration:** 2 weeks;

ALZET Comments: animal info (adult female Long-Evans rats); post op. care (animals received analgesics and antibiotics);

Q5992: H. Suzuki, *et al.* Neural stem cell mediated recovery is enhanced by Chondroitinase ABC pretreatment in chronic cervical spinal cord injury. *PLoS One* 2017;12(8):e0182339

Agents: Chondroitinase AB **Vehicle:** CSF, artificial; **Route:** CSF/CNS (intrathecal); **Species:** Mice; **Pump:** 1007D; **Duration:** 7 days;

ALZET Comments: Controls received mp w/ vehicle; animal info (female, 15-20g); spinal cord injury; Therapeutic indication (Spinal cord injury); Dose (2.64 mU/mL);

Q6181: R. Simeoli, *et al.* Exosomal cargo including microRNA regulates sensory neuron to macrophage communication after nerve trauma. *Nat Commun* 2017;8(1):1778

Agents: miR-21-5p antagomir **Vehicle:** in vivo transfection reagent; **Route:** SC; CSF/CNS (intrathecal); **Species:** Mice; **Pump:** 1007D; **Duration:** 7 days;

ALZET Comments: Dose (12 pmol/day); Controls received mp w/ vehicle and scrambled oligomer; functionality of mp verified (Catheter and pump were checked at the end of treatment to ascertain efficient delivery) ; spinal cord injury;

Q5981: S. Shen, *et al.* Regulation of transient receptor potential cation channel subfamily V1 protein synthesis by the phosphoinositide 3-kinase/Akt pathway in colonic hypersensitivity. *Experimental Neurology* 2017;295(104-115

Agents: LY294002 **Vehicle:** DMSO, Saline; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2001; **Duration:** Not Stated;

ALZET Comments: Controls received mp w/ vehicle; animal info (Sprague-dawley, 200g); enzyme inhibitor (PI3K); Dose (2.4 ug/rat/day or 90 ug/kg/body weight);

Q5891: K. T. Santhosh, *et al.* Design and optimization of PLGA microparticles for controlled and local delivery of Neuregulin-1 in traumatic spinal cord injury. *J Control Release* 2017;261(147-162

Agents: Neuregulin-1, human recombinant **Vehicle:** CSF, artificial; BSA; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 1003D; 2001; 2002; 2004; **Duration:** 3 days, 7 days, 14 days, 28 days;

ALZET Comments: Controls received mp w/ vehicle; animal info (female, Sprague Dawley, 250g); Dose (500ng/day); 1% BSA used; comparison of microparticles vs mp; spinal cord injury; peptides; Dose (500ng/day); Comparison of PLGA Microparticles with ALZET pumps;

Q6755: U. N. Ramirez-Jarquín, *et al.* Chronic GABAergic blockade in the spinal cord in vivo induces motor alterations and neurodegeneration. *Neuropharmacology* 2017;117(85-92



Agents: AMPA; CNQX; MK801; bicuculline methbromide; strychnine **Vehicle:** Ringer's solution; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2004; **Duration:** 16 days;

ALZET Comments: Dose (bicuculline methbromide 5, 10 or 17.5 mM; strychnine 20 mM; Bic 10 mM + CNQX 1 mM; Bic10 mM + MK801 14 mM; AMPA 3.8 mM; and AMPA 3.8 mM + Bic 10 mM.); Controls received mp w/ vehicle; animal info (adult Wistar male rats (270-300 g)); cyanoacrylate adhesive;

Q5884: U. N. Ramirez-Jarquin, *et al.* Chronic infusion of SOD1(G93A) astrocyte-secreted factors induces spinal motoneuron degeneration and neuromuscular dysfunction in healthy rats. *J Cell Physiol* 2017;232(10):2610-2615

Agents: ACM-hG93A **Vehicle:** Not Stated; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2004; **Duration:** 16 days;

ALZET Comments: animal info (male, Wistar, 270-300g, adult); neurodegenerative (amyotrophic lateral sclerosis); post op. care (IM penicillin); behavioral testing (rotarod test; paw grip endurance); Pumps primed in 37C saline for 28 hours; used wound clips;

Q6600: C. Mazur, *et al.* Development of a simple, rapid, and robust intrathecal catheterization method in the rat. *J Neurosci Methods* 2017;280(36-46

Agents: Oligonucleotide, antisense **Vehicle:** Not Stated; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** Not Stated; **Duration:** Not Stated;

ALZET Comments: animal info (Sixteen male Sprague-Dawley rats); Publication describes the development of a rapid and robust intrathecal catheterization method for the testing of putative ASO therapeutics for diseases of the CNS.

Q5828: K. Matoba, *et al.* Leptin sustains spontaneous remyelination in the adult central nervous system. *Sci Rep* 2017;7(40397

Agents: Antibody, leptin neutralizing; leptin, recombinant mouse **Vehicle:** PBS; **Route:** CSF/CNS (intrathecal); **Species:** Mice; **Pump:** 1007D, 1002; **Duration:** Not Stated;

ALZET Comments: Controls received mp w/ vehicle; animal info (7-8 weeks old) ; ALZET brain infusion kit used; neurodegenerative (Demyelination); Therapeutic indication (Demyelination); Dose ((12 µ g/kg body weight per day, 10 ug/kg of body weight per day);

Q5832: C. P. Lin, *et al.* CXCL12/CXCR4 Signaling Contributes to the Pathogenesis of Opioid Tolerance: A Translational Study. *Anesthesia & Analgesia* 2017;124(3):972-979

Agents: CXCL12 **Vehicle:** Saline; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2001; **Duration:** 5, 6 days;

ALZET Comments: Controls received mp w/ vehicle; animal info (250-275 g); Therapeutic indication (Analgesia, anesthesiology); Dose ((3.6 ng/h x 24 hrs);

Q5846: B. V. Ineichen, *et al.* Direct, long-term intrathecal application of therapeutics to the rodent CNS. *Nat Protoc* 2017;12(1):104-131

Agents: Not Stated **Vehicle:** Ringer's solution; **Route:** SC, CSF/CNS (Intrathecal); **Species:** Rat; **Pump:** 2ML2; **Duration:** 1 week - 6 weeks;

ALZET Comments: Controls received mp w/ vehicle; animal info (8-24 weeks old); dose-response; good methods p. 109; no stress; The pump does not interfere with behavioral assessments of animals, but from our experience we recommend a recovery interval of 2-3 d after surgery until behavioral testing is resumed; Therapeutic indication (CNS therapeutics);

Q6431: M. Hlavica, *et al.* Intrathecal insulin-like growth factor 1 but not insulin enhances myelin repair in young and aged rats. *Neurosci Lett* 2017;648(41-46

Agents: Insulin-like Growth Factor 1, insulin **Vehicle:** Acetic acid, Saline, Tween; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2ML2; **Duration:** 21 days;

ALZET Comments: Dose (100 µg/day); 0.1% Tween used; Controls received mp w/ vehicle; animal info (12-14 weeks-old and 12 months-old female Long Evans rats); Insulin-like Growth Factor 1 aka IGF-1;

Q6043: V. Hernandez-Torres, *et al.* BDNF effects on functional recovery across motor behaviors after cervical spinal cord injury. *J Neurophysiol* 2017;117(2):537-544



Agents: Brain-derived neurotrophic factor **Vehicle:** CSF, artificial; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2002; **Duration:** 14 days;

ALZET Comments: Controls received mp w/ vehicle; animal info (280-300g); spinal cord injury; Dose (180 ng/day);

Q5812: M. Flinspach, *et al.* Insensitivity to pain induced by a potent selective closed-state Nav1.7 inhibitor. *Sci Rep* 2017;7(39662

Agents: JNJ63955918, Morphine **Vehicle:** Saline; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2002, 2001; **Duration:** 14 days, 2 weeks;

ALZET Comments: Controls received mp w/ vehicle; animal info (250-300g) behavioral testing (Hargreaves test, hotplate test, tail-flick test, formalin flinching); JNJ63955918 is a tarantula venom-derived peptide (a potent, highly selective, closed-state Nav1.7 blocking peptide); Therapeutic indication (Pain, analgesia, electrophysiology);

Q5759: Y. Cao, *et al.* Synchrotron radiation micro-CT as a novel tool to evaluate the effect of agomir-210 in a rat spinal cord injury model. *Brain Research* 2017;1655(55-65

Agents: Agomir-210 **Vehicle:** Saline; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 1002; **Duration:** 3 days;

ALZET Comments: Controls received mp w/ vehicle saline, and Agomir-negative; animal info (180-220 g); spinal cord injury; Therapeutic indication (spinal cord injury);

Dose (agomir-NC (1 µL/h, 20 nmol/ mL) or agomir-210 (1 µL/h, 20 nmol/mL));

Q5871: J. E. Aguirre, *et al.* Neonatal immune challenge followed by adult immune challenge induces epigenetic-susceptibility to aggravated visceral hypersensitivity. *Neurogastroenterol Motil* 2017;29(9):

Agents: Garcinol **Vehicle:** DMSO, water; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** Not Stated; **Duration:** 7 days;

ALZET Comments: 50% DMSO; Garcinol is a HAT inhibitor; Therapeutic indication (Colon Inflammation);

Dose (4 nmol per µL);

Q5514: K. Zweckberger, *et al.* Self-assembling peptides optimize the post-traumatic milieu and synergistically enhance the effects of neural stem cell therapy after cervical spinal cord injury. *Acta Biomaterialia* 2016;42(77-89

Agents: Basic fibroblast growth factor; epidermal growth factor; brain-derived growth factor **Vehicle:** CSF; artificial; gentamycin; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 1007D; **Duration:** 7 days;

ALZET Comments: Controls received mp w/ vehicle; animal info (Wistar, 250g); spinal cord injury; post op. care (0.05 mg/kg buprenorphine SC; QD SC injection of cyclosporine A (10 mg/kg); QD minocycline 50 mg/kg); "catheter tip was located subdurally at the epicenter of the lesion. It was fixed with several sutures in the paraspinal muscles to avoid any movement-associated dislocation and finally connected to the pump located in a subcutaneous recess." pg 79; behavioral testing (Grip strength test, Basso, Beattie, Bresnahan Locomotor Rating Scale, Inclined plane test); Therapeutic indication (spinal cord injury); Dose (Gentamycin: 50ug/mL);

Q5106: A. Zendedel, *et al.* Activation and Regulation of NLRP3 Inflammasome by Intrathecal Application of SDF-1a in a Spinal Cord Injury Model. *Mol Neurobiol* 2016;53(5):3063-75

Agents: Stromal cell-derived factor-1, alpha **Vehicle:** PBS; BSA; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2001; **Duration:** 7 days;

ALZET Comments: Controls received mp w/ vehicle; animal info (male, Wistar, 14 weeks old, 350-400g); 1% BSA used; post op. care (saline rehydration; baytril 0.3 ml SC BID; manual bladder emptying BID); behavioral testing (BBB locomotor test); immunology;

Q5105: J. E. Zadina, *et al.* Endomorphin analog analgesics with reduced abuse liability, respiratory depression, motor impairment, tolerance, and glial activation relative to morphine. *Neuropharmacology* 2016;105(215-27

Agents: Morphine; endomorphine analog **Vehicle:** Saline; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2001; **Duration:** 7 days;

ALZET Comments: Controls received mp w/ vehicle; animal info (male, Sprague Dawley, 250-400g); half-life (p. 219); behavioral testing (tail flick test; rotarod testing); stability verified by (internal testing; stability >1 year at 37C); pumps primed in 37C saline for 16 hours; used PE-8 IT catheter; Dose (2 ug/hr morphine; 0.056-0.075 ug/hr analog);



Q4914: H. Yamanaka, *et al.* Annexin A2 in primary afferents contributes to neuropathic pain associated with tissue type plasminogen activator. *Neuroscience* 2016;314(189-99)

Agents: Homocysteine; tPA **Vehicle:** PBS; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2001; 2001D; **Duration:** 9 days; **ALZET Comments:** Controls received mp w/ vehicle; animal info (male, Sprague Dawley, 200-250g); dose-response (pg195); behavioral testing (mechanical withdrawal threshold); Dose (homocysteine 1.2 umol/day or 120 nmol/day; tPA 2 ug/day);

Q4781: Vipin Arora, *et al.* Disruption of Spinal Noradrenergic Activation Delays Recovery of Acute Incision-Induced Hypersensitivity and Increases Spinal Glial Activation in the Rat. *The Journal of Pain* 2016;17(2):190-202

Agents: Atipamezole **Vehicle:** Not Stated; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2002; **Duration:** 14 days; **ALZET Comments:** Controls received mp w/ vehicle; animal info (male, Sprague Dawley, 180-250g); dose-response (pg197); atipamezole is a selective alpha2 AR antagonist; Dose (0, 50, 100, 200 ug/day);

Q5076: R. Y. Tsai, *et al.* Resveratrol reverses morphine-induced neuroinflammation in morphine-tolerant rats by reversal HDAC1 expression. *J Formos Med Assoc* 2016;115(6):445-54

Agents: Morphine **Vehicle:** Not Stated; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** Not Stated; **Duration:** 120 hours; **ALZET Comments:** Controls received mp w/ saline; animal info (male, Wistar); behavioral testing (tail-flick); Dose (15 ug/h);

Q6179: M. Shinozaki, *et al.* Combined treatment with chondroitinase ABC and treadmill rehabilitation for chronic severe spinal cord injury in adult rats. *Neurosci Res* 2016;113(37-47)

Agents: Chondroitinase ABC **Vehicle:** Not Stated; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2001; **Duration:** 7 days; **ALZET Comments:** Dose (40 U/200 ul); Controls received mp w/ vehicle and inactivated C-ABC; animal info (Adult female Sprague-Dawley rats weighing 200–220 g); behavioral testing (Open field hindlimb locomotor activity test); Chondroitinase-ABC is a CSPG-digesting enzyme; enzyme inhibitor (chondroitin sulfate proteoglycans); ALZET Rat Intrathecal Catheter used; spinal cord injury;

Q6662: J. Shen, *et al.* NMDA receptors participate in the progression of diabetic kidney disease by decreasing Cdc42-GTP activation in podocytes. *J Pathol* 2016;240(2):149-60

Agents: RNA, NR1-short hairpin **Vehicle:** Not Stated; **Route:** CSF/CNS (Intrathecal); **Species:** Mice; **Pump:** Intrathecal catheter; **Duration:** Not Stated; **ALZET Comments:** animal info (Diabetes-induced C57BL/6 J mice, 8 weeks of age); diabetes; ALZET intrathecal catheter used with another product

Q5186: U. N. Ramirez-Jarquín, *et al.* Neuropathological characterization of spinal motor neuron degeneration processes induced by acute and chronic excitotoxic stimulus in vivo. *Neuroscience* 2016;331(78-90)

Agents: AMPA **Vehicle:** Phosphate buffer; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2004; **Duration:** 5 days; **ALZET Comments:** Controls received mp w/ vehicle; animal info (male, Wistar, 270-300g); neurodegenerative (amyotrophic lateral sclerosis); post op. care (IM penicillin); behavioral testing (rotarod, paw grip endurance; stride analysis); AMPA aka a-amino-3- hydroxy-5-methyl-4-isoxazoleacetic acid; pumps primed for 48 hours in 37C saline; used surgical clips;

Q5052: G. Murlidharan, *et al.* CNS-restricted Transduction and CRISPR/Cas9-mediated Gene Deletion with an Engineered AAV Vector. *Mol Ther Nucleic Acids* 2016;5(7):

Agents: Viral vector, adeno-associated (AAV9, AAV2g0); Gene, CBh-ScGFP **Vehicle:** Not Stated; **Route:** CSF/CNS (intrathecal); **Species:** Mice; **Pump:** 2001D; **Duration:** 24 hrs; **ALZET Comments:** animal info (8 weeks old C57/Bl6 male mice); comparison of IT bolus injections vs mp; ALZET mouse intrathecal catheter used (lumbar cannulation); gene therapy;

Q6616: R. Matos, *et al.* Bladder pain induced by prolonged peripheral alpha 1A adrenoceptor stimulation involves the enhancement of transient receptor potential vanilloid 1 activity and an increase of urothelial adenosine triphosphate release. *Acta Physiologica* 2016;218(4):265-275

Agents: Phenylephrine **Vehicle:** Saline; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 1002; **Duration:** Not Stated; **ALZET Comments:** Dose (0.0498 mg/day); Controls received mp w/ vehicle; animal info (female Wistar rats); enzyme inhibitor (selective a1-adrenoceptor agonist); Therapeutic indication (chronic visceral pain);



Q4820: C. D. Luca, *et al.* Astrocytes and Microglia-Mediated Immune Response in Maladaptive Plasticity is Differently Modulated by NGF in the Ventral Horn of the Spinal Cord Following Peripheral Nerve Injury. *Cellular and Molecular Neurobiology* 2016;36):37-46

Agents: Nerve growth factor, b- **Vehicle:** CSF, artificial; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2001; **Duration:** 7 days;

ALZET Comments: Controls received mp w/ vehicle; animal info (male, Sprague Dawley, 250-300g); Cannula placement verified via induced lower body paralysis (IT lidocane injection); spared nerve injury; Dose (12 ug/kg/day);

Q6685: J. Y. Lee, *et al.* Jmjd3 mediates blood-spinal cord barrier disruption after spinal cord injury by regulating MMP-3 and MMP-9 expressions. *Neurobiol Dis* 2016;95(66-81

Agents: Virus, adeno-associated shjmd3 **Vehicle:** Not Stated; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 1003D; **Duration:** Not Stated;

ALZET Comments: Controls received mp w/ control adeno-associated virus; animal info (adult male Sprague-Dawley rats weighing 250-270g); spinal cord injury;

Q4843: B. Koenig, *et al.* Long term study of deoxyribozyme administration to XT-1 mRNA promotes corticospinal tract regeneration and improves behavioral outcome after spinal cord injury. *Experimental Neurology* 2016;276(51-58

Agents: DNAXT-1as **Vehicle:** Not Stated; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 1007D; **Duration:** 2 weeks;

ALZET Comments: Controls received mp w/ control enzyme or PBS; animal info (female, Wistar, 200-250g); pumps replaced every week; pumps replaced every week; spinal cord injury; post op. care (Baytril; manual bladder emptying; Rimadyl); behavioral testing (horizontal ladder task); used self-made intrathecal catheter from 32-gauge polyurethane; enzyme inhibitor (DNA enzyme of mRNA of xylosyltransferase-1);

Q5622: D. Kim. Anti-miR delivery strategies to bypass the blood-brain barrier in glioblastoma therapy. *Oncotarget* 2016;7(20):29400-11

Agents: Oligonucleotide, anti-miR, anti-let-7 **Vehicle:** Saline; **Route:** CSF/CNS (intrathecal); **Species:** Mice; **Pump:** 1004D; **Duration:** 7 days;

ALZET Comments: Controls received mp w/ vehicle; animal info (6-7 weeks); ALZET brain infusion kit 3 used; "Among them, the osmotic pump system is one of the most useful convection-enhanced delivery methods for delivering drugs to brain tumors and bypassing the BBB" pg 29408; Dose (20 µM, 50 µM); good figures (p29402);

Q4840: Z. Jiang, *et al.* Blocking mammalian target of rapamycin alleviates bone cancer pain and morphine tolerance via u-opioid receptor. *International Journal of Cancer* 2016;138(2013-2020

Agents: Rapamycin; CTOP; LY297002 **Vehicle:** DMSO; saline; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** Not Stated; **Duration:** 14 days;

ALZET Comments: Controls received mp w/ saline; animal info (Wistar, 200-250g); 50% DMSO used; cancer (breast; bone); dose-response (pg 2015); behavioral testing (hindpaw withdrawal latency); Rapamycin is an mTOR antagonist; CTOP is an MOR antagonist; LY297002 an a PI3K inhibitor;

Q6048: Y. Hayano, *et al.* Dorsal horn interneuron-derived Netrin-4 contributes to spinal sensitization in chronic pain via Unc5B. *J Exp Med* 2016;213(13):2949-2966

Agents: Netrin-4 **Vehicle:** Saline; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 1002; **Duration:** 28 days;

ALZET Comments: Controls received mp w/ vehicle; animal info (8-10 weeks old, Wistar; 200-280g); behavioral testing (von Frey filament test); Therapeutic indication (Chronic pain);

Q4825: P.-c. FU, *et al.* ROCK Inhibition with Fasudil Promotes Early Functional Recovery of Spinal Cord Injury in Rats by Enhancing Microglia Phagocytosis. *J Huazhong Univ Sci Technol [Med Sci]* 2016;36(1):31-36

Agents: Fasudil **Vehicle:** Saline; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 1007D; **Duration:** 3 days; 7 days; 14 days;

ALZET Comments: Controls received mp w/ vehicle; animal info (male, Dprague Dawley, adult, 260-300g); animal info (male, Dprague Dawley, adult, 260-300g); behavioral testing (BBB behaviorial testing); Dose (180 ug/day);



Q5348: J. D. Figueroa, *et al.* Fatty Acid Binding Protein 5 Modulates Docosahexaenoic Acid-Induced Recovery in Rats Undergoing Spinal Cord Injury. *J Neurotrauma* 2016;33(15):1436-49

Agents: Oligonucleotides, scramble nontargeting; siRNA **Vehicle:** Ethanol; **Route:** CSF/CNS (Intrathecal); **Species:** Rat; **Pump:** 2001; **Duration:** 7 days;

ALZET Comments: Controls received mp w/ vehicle; animal info (Young adult female Sprague-dawley rats); good methods (pg 1443); spinal cord injury; "Pumps were primed with DHA-albumin complex (DHA), FABP5 siRNA, and vehicle controls" (pg 1443); ALZET rat intrathecal catheter used;

Q4823: E. E. Ewan, *et al.* Intrathecal Acetyl-L-Carnitine Protects Tissue and Improves Function after a Mild Contusive Spinal Cord Injury in Rats. *Journal of Neurotrauma* 2016;33(269-277)

Agents: Carnitine, acetyl-L- **Vehicle:** PBS; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2001; **Duration:** 6 days;

ALZET Comments: animal info (female, Sprague Dawley, 200g); spinal cord injury; post op. care (wound rinsed in steril saline, bacitracin applied topically, gentamicin IM 0, 2 or 4 days later, buprenorphine IM every 12 hours, bladders manually expressed BID); behavioral testing (locomotor function, grid walking, open field); pumps primed overnight; pumps removed after 6 days; Dose (1 mg/day);

Q5767: S. A. Choi, *et al.* In vivo bioluminescence imaging for leptomeningeal dissemination of medulloblastoma in mouse models. *BMC Cancer* 2016;16(1):723

Agents: Not Stated **Vehicle:** Not Stated; **Route:** CSF/CNS (intrathecal); **Species:** Mice; **Pump:** Not Stated; **Duration:** Not Stated;

ALZET Comments: ALZET brain infusion kit 3 used;

Q5768: A. C. Choi. In vivo bioluminescence imaging for leptomeningeal dissemination of medulloblastoma in mouse models. *BMC CANCER* 2016;16(723):

Agents: Cells, MB-effLuc **Vehicle:** Not Stated; **Route:** CSF/CNS (Intrathecal); **Species:** Mice; **Pump:** Not Stated; **Duration:** Not Stated;

ALZET Comments: Mouse Intrathecal Catheter