Recent References (2010-Present) on Opioid Receptor Research
Using ALZET® Osmotic Pumps


**Agents:** Methadone HCl; Buprenorphine HCl  
**Vehicle:** Water, Sterile;  
**Route:** SC;  
**Species:** Rat;  
**Pump:** 2ML4;  
**Duration:** 28 days;

**ALZET Comments:** Dose (10 mg/kg/day Methadone HCl; 1 mg/kg/day Buprenorphine HCl); Controls received mp w/ vehicle; animal info (Female Sprague–Dawley Rat); dependence;


**Agents:** Morphine  
**Vehicle:** Saline;  
**Route:** SC;  
**Species:** Mice;  
**Pump:** 2001;  
**Duration:** Not Stated;

**ALZET Comments:** Dose (24 or 48 mg/kg/day); 0.9% Saline used; Controls received mp w/ vehicle; animal info (C57BL6, 10-20 weeks old); dependence;


**Agents:** Nalmefene  
**Vehicle:** Saline;  
**Route:** SC;  
**Species:** Mice;  
**Pump:** 2004;  
**Duration:** 14 days;

**ALZET Comments:** Dose (5 mg/kg/day); Controls received mp w/ vehicle; animal info (Male and female C57BL/6J mice, 8 weeks old); behavioral testing (forced swim test, Conditioned place aversion, Marble burying, Dark-light emergence test); Nalmefene aka NMF; neurodegenerative (Depression);

Q8391: J. M. Bossert, et al. In a Rat Model of Opioid Maintenance, the G Protein-Biased Mu Opioid Receptor Agonist TRV130 Decreases Relapse to Oxycodone Seeking and Taking and Prevents Oxycodone-Induced Brain Hypoxia. Biological Psychiatry 2020;88(12):935-944

**Agents:** Buprenophrine; TRV130  
**Vehicle:** Not stated;  
**Route:** SC;  
**Species:** Rat;  
**Pump:** Not stated;  
**Duration:** 14 days;

**ALZET Comments:** Dose (0, 3, 6, or 9 mg/kg/day); Controls received mp w/ vehicle; animal info (Sprague Dawley rats, 250 to 350 g (males) or 175 to 225 g (females)); TRV130 aka G protein–biased mu opioid receptor agonist; dependence;


**Agents:** Fentanyl citrate; morphine sulphate salt pentahydrate  
**Vehicle:** PBS; water, sterile;  
**Route:** SC;  
**Species:** Mice (transgenic);  
**Pump:** 1007D;  
**Duration:** 7 days;

**ALZET Comments:** Dose (Fentanyl (2mg/kg/day); Morphine (17 mg/kg/day)); animal info (knock-in mice with 11S/T-A mutations (Oprm1tm3.1Shlz, MGI:6117673, 11S/T-A)); behavioral testing (hot plate test; open field locomotion test); dependence; “...we used subcutaneously implanted osmotic pumps to deliver opioids at a constant rate. This approach is a powerful means of assessing both tolerance and dependence in rodents” (p.5)


**Agents:** Morphine HCl  
**Vehicle:** Saline;  
**Route:** SC;  
**Species:** Rat;  
**Pump:** 2ML1;  
**Duration:** 5 days;

**ALZET Comments:** Dose (6 mg/kg); Controls received mp w/ vehicle; animal info (6-week-old Jcl Wistar male rats); dependence;

Q7450: J. Cunningham, et al. F160. Samidorphan, an Opioid Receptor Antagonist, Mitigates Olanzapine-Induced Metabolic Dysfunction in Female Rats. Biological Psychiatry 2019;85(10);

**Agents:** Olanzapine, Samidorphan  
**Vehicle:** Not stated;  
**Route:** SC;  
**Species:** Rat;  
**Pump:** Not Stated;  
**Duration:** 2 days;

**ALZET Comments:** animal info (Female,); Olanzapine aka OLZ, Samidorphan aka SAM; dependence;


**Agents:** Morphine Sulfate  
**Vehicle:** Not Stated;  
**Route:** SC;  
**Species:** Rat;  
**Pump:** 2ML1;  
**Duration:** Not Stated;

**ALZET Comments:** animal info (5-6 weeks old, Sprague Dawley, 180-300 g); dependence;

Agents: Morphine Sulfate Vehicle: Saline; Route: SC; Species: Rat; Pump: 2001; Duration: 7 days;
ALZET Comments: Dose (7.68 mg/kg/day); 0.9% Saline used; Controls received mp w/ vehicle; animal info (Male, Sprague Dawley, 175-200 g); post op. care (Gentamycin); neurodegenerative (Functional Pain Syndrome);


Agents: Morphine Sulfate Vehicle: Not stated; Route: SC; Species: Rat; Pump: 2ML1; Duration: 7 days;
ALZET Comments: Dose (50 mg/kg/day); animal info (Male, Sprague Dawley, 4-7 weeks old); dependence;


Agents: Morphine sulfate Vehicle: Water; Route: SC; Species: Rat; Pump: Not Stated; Duration: 6; 7 days;
ALZET Comments: Dose (80 mg/kg/day); Controls were untreated; animal info (5-6 weeks, male and female, Sprague-Dawley, 180-300g); dependence;


Agents: Sumatriptan Vehicle: Saline; Route: SC; Species: Rat; Pump: 2001; Duration: 7 days;
ALZET Comments: Controls received mp w/ vehicle; animal info (male, Sprague Dawley, 175-200g); post op. care (gentamicin 8 mg/kg SC); behavioral testing (von Frey filaments; tail flick test); Dose (0.6 mg/kg/day);


Agents: DAMGO Vehicle: Water, distilled; DMSO; saline; Route: CSF/CNS; Species: Mice; Pump: Not Stated; Duration: 5 Days;
ALZET Comments: Controls received mp w/ vehicle; animal info (male, C57BL6J or alpha2A-KO, 8-10 weeks old); ALZET brain infusion kit 3 used; Dose (DAMGO 4.7 nmol/day); used 7 day pump;


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 PI3K inhibitor;

Q4836: L. S. Hwa, et al. Dissociation of u-opioid receptor and CRF-R1 antagonist effects on escalated ethanol consumption and mPFC serotonin in C57BL/6J mice. Addiction Biology 2016;21(1):112-115

Agents: CP154526; naltrexone Vehicle: DMSO; CSF, artificial; Route: CSF/CNS; Species: Mice; Pump: 1002; Duration: 7 days;
ALZET Comments: Controls received mp w/ vehicle; animal info (male, C58BL6J or alpha2A-KO, 8-10 weeks old); ALZET brain infusion kit 3 used; 4% DMSO used; Cannula placement verified via Nissl staining;


Agents: Naloxone Vehicle: Saline, normal; Route: SC; Species: Mice; Pump: 1007D; Duration: 7 days;
ALZET Comments: Controls received mp w/ vehicle; animal info: obesity induced, C57black/6J male mice, 6 wks old; functionality of mp verified by lAA drinking test or morphine-sensitive tail withdrawal; ALZET brain infusion kit 3 used; 4% DMSO used; Cannula placement verified via Nissl staining;
**Agents:** Nicotine hydrogen tartrate salt **Vehicle:** Saline; **Route:** SC; **Species:** Mice; **Pump:** 2002; **Duration:** 14 days; 28 days; **ALZET Comments:** Controls received mp w/ vehicle; animal info (male, ICR, 8-10 weeks old); behavioral testing (elevated plus maze; hyperalgesia); dependence; Dose (24 mg/kg/day);

**Agents:** FSLLRY-NH2 **Vehicle:** Saline; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** Not Stated; **Duration:** 20 hours; **ALZET Comments:** Controls received mp w/ vehicle; animal info (Wistar 200-250g); cancer (bone); no stress (see pg. 1476); behavioral testing (mechanical paw withdrawal, thermal hyperalgesia); peptides;

**Agents:** Morphine; PD168,077; L745,870 **Vehicle:** DMSO; saline; **Route:** SC; **Species:** Rat; **Pump:** 2ML1; **Duration:** 6 days; **ALZET Comments:** Controls received mp w/ vehicle; animal info (adult male Sprague-dawley rats, 250-300g); 2% DMSO used; Combinational treatments; anesthesized with ketamine and medetomidine; PD168,077 is a dopamine D4 receptor agonist; L745,870 is a dopamine D4 receptor antagonist; Dose (morphine 20 mg/kg/day; PD168,077 1 mg/kg/day; L745,870 1 mg/kg/day);

**Agents:** Transforming growth factor-B1 **Vehicle:** HCl; albumin; **Route:** SC; **Species:** Mice (transgenic); **Pump:** 1002; **Duration:** 14 days; **ALZET Comments:** Controls received mp w/ vehicle; animal info (male, BAMBI-KO or WT, 14-18 weeks old); behavioral testing (von Frey monofiliments; formalin test); Transforming growth factor-B1 aka TGF-B1; sciatic nerve crush injury;

Q3152: M. Shaqura, et al. Reduced Number, G Protein Coupling, and Antinociceptive Efficacy of Spinal Mu-Opioid Receptors in Diabetic Rats Are Reversed by Nerve Growth Factor. JOURNAL OF PAIN 2013;14(7):720-730
**Agents:** Nerve growth factor **Vehicle:** CSF, artificial; rat serum albumin; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2001; **Duration:** 7 days; **ALZET Comments:** Controls received mp w/ vehicle; animal info (Wistar, male, STZ induced diabetes)

**Agents:** Naloxone; Naltrindole **Vehicle:** Saline; **Route:** SC; **Species:** Rat; **Pump:** 1007D; **Duration:** Not Stated; **ALZET Comments:** Control animals received mp w/ vehicle; animal info (Sprague Dawley, 250-350 g)

**Agents:** Nor-binaltorphimine; senktide **Vehicle:** Sodium bicarbonate; **Route:** IP; **Species:** Rat; **Pump:** 2002; **Duration:** 14 days; **ALZET Comments:** Controls received mp w/ vehicle; animal info (female, Wistar-Imamichi, 20 days old); Nor-binaltorphimine aka nor-BNI; Nor-binaltorphimine is a KOR agonist; senktide NK3R agonist;

**Agents:** Nerve growth factor, beta **Vehicle:** CSF, artificial; albumin, rat serum; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2001; **Duration:** 7 days; **ALZET Comments:** Control animals received mp w/ vehicle; animal info (Wistar, male, STZ induced diabetes)

**Agents:** Naltrexone HCl  
**Vehicle:** Saline;  
**Route:** CSF/CNS;  
**Species:** Rat;  
**Pump:** 1007D;  
**Duration:** 7 days;  
**ALZET Comments:** Animal info (male, Sprague Dawley, albino, 160-180g); ALZET brain infusion kit used; post op. care (ampicillin 100 mg/kg IM; meloxicam 2.0 mg/kg IM); behavioral testing (flexion reflex, flinch response, mechanical threshold pressure); Incision closed with wound clip


**Agents:** Morphine  
**Vehicle:** Saline;  
**Route:** SC;  
**Species:** Mice;  
**Pump:** 2001;  
**Duration:** 5 days;  
**ALZET Comments:** Controls received mp w/ saline; animal info (male, Swiss Webster, 20-35g); Pump not mentioned much only pg.473


**Agents:** Naltrexone  
**Vehicle:** Not Stated;  
**Route:** SC;  
**Species:** Rat;  
**Pump:** 2001;  
**Duration:** 7 days;  
**ALZET Comments:** Controls received mp w/ saline; animal info (Sprague Dawley, male, 250-300 g)


**Agents:** Nicotine  
**Vehicle:** Not Stated;  
**Route:** SC;  
**Species:** Rat;  
**Pump:** Not Stated;  
**Duration:** 14 days;  
**ALZET Comments:** Animal info (adolescent, adult, Wistar, male)


**Agents:** Fentanyl propionanilide; buprenorphine hydrochloride  
**Vehicle:** Saline, isotonic;  
**Route:** CSF/CNS (intrathecal);  
**Species:** Rat;  
**Pump:** Not Stated;  
**Duration:** 96 hours;  
**ALZET Comments:** Controls received mp w/ vehicle; animal info (male Wistar, 200-250 g); pain


**Agents:** Oligonucleotide, sense, JWA; oligonucleotide, antisense JWA  
**Vehicle:** CSF, artificial;  
**Route:** CSF/CNS;  
**Species:** Rat;  
**Pump:** Not Stated;  
**Duration:** Not Stated;  
**ALZET Comments:** Animal info (adult, male, Wistar, 190 g); antisense (JWA)

Q1406: Y. Wu, et al. JWA regulates chronic morphine dependence via the delta opioid receptor. Biochemical and Biophysical Research Communications 2011;409(3):520-525

**Agents:** Oligonucleotide, sense, JWA; oligonucleotide, antisense JWA  
**Vehicle:** CSF, artificial;  
**Route:** CSF/CNS;  
**Species:** Rat;  
**Pump:** Not Stated;  
**Duration:** Not Stated;  
**ALZET Comments:** Animal info (adult, male, Wistar, 190 g); antisense (JWA)


**Agents:** Morphine; methadone  
**Vehicle:** Water;  
**Route:** SC;  
**Species:** Rat;  
**Pump:** 2ML1;  
**Duration:** 6 days;  
**ALZET Comments:** Controls received mp w/ vehicle; tolerance; animal info (adult (150-250 g, male, Sprague Dawley)

**Agents:** Naloxone; BW373U86; U50,488H; morphine-6-glucuronide; morphine-3-glucuronide; wortmannin; PKI-(14-22)-amide

**Vehicle:** Not Stated; **Route:** SC; **Species:** Mice; **Pump:** 1007D; **Duration:** 5 days;

**ALZET Comments:** Animal info (7-12 wks old, C57/BL6, male); BW373U86 also known as (-)-4-[(R)-(2S,5R)-4-allyl-2,5-dimethyl-1-piperazinyl]-3-hydroxy-hydroxybenzyl]-N,N-diethylbenzamide is a delta opioid receptor selective agonist; U50,488H also known as trans-(-)-3,4-dichloro-N-methyl-N-(2-(1-pyrrolidin)cyclohexyl)-benzeneacetamide methane sulfonate hydrate is a kappa opioid selective receptor agonist


**Agents:** Naltrexone, methyl

**Vehicle:** Not Stated; **Route:** SC; **Species:** Mice; **Pump:** 1002; **Duration:** 12 days;

**ALZET Comments:** Controls received mp w/ PBS; animal info (MOR KO, C57BL/6 wt); cancer (lung); Methylnaltrexone (also known as MNTX) is a mu opioid receptor inhibitor


**Agents:** Morphine; fentanyl

**Vehicle:** Not Stated; **Route:** Not Stated; **Species:** Mice; **Pump:** 1003D; **Duration:** 3 days;

**ALZET Comments:** Controls received mp w/ saline; animal info (CD1 (ICR), 6-8 wks old)


**Agents:** Nicotine

**Vehicle:** Not Stated; **Route:** Not Stated; **Species:** Mice; **Pump:** 1007D; **Duration:** 7, 14 days;

**ALZET Comments:** Animal info (8-10 wks old, 20-25 g); 28-day pumps used; withdrawal

Q0746: R. J. Horvath, et al. Inhibition of microglial P2X(4) receptors attenuates morphine tolerance, Iba1, GFAP and &mu; opioid receptor protein expression while enhancing perivascular microglial ED2. Pain 2010;150(3):401-413

**Agents:** Morphine sulfate; naloxone

**Vehicle:** Not Stated; **Route:** SC; **Species:** Rat; **Pump:** 2ML1; **Duration:** 1, 4, 7 days;

**ALZET Comments:** Controls received mp w/ saline; animal info (male, Sprague-Dawley, 175-200 g); one pump contained morphine plus naloxone; "All morphine pumps were filled with 0.833 mg/kg/hr morphine to deliver the equivalent of twice daily 10 mg/kg injections over the course of 24 h" pg 402; tolerance