References on Pain Research
Using ALZET® Osmotic Pumps

**Agents:** Selective Calpain 2 Inhibitor  
**Vehicle:** Not stated;  
**Route:** CNS/CSF;  
**Species:** Mice;  
**Pump:** 2002;  
**Duration:** 10 days;  
**ALZET Comments:** Dose (0.3 mg/kg/day); Controls received mp w/ vehicle; animal info (C57Bl/6);

**Agents:** Rapamycin, LY294002, Interleukin-1Receptor antagonist, SC144, etanercept,  
**Vehicle:** CSF, artificial;  
**Route:** CSF/CNS (midbrain periaqueductal gray);  
**Species:** Rat;  
**Pump:** Not Stated;  
**Duration:** Not Stated;  
**ALZET Comments:** animal info (200-250 gr Wistar rats); ALZET brain infusion kit used; Brain coordinates (7.6 mm posterior to the bregma, 0.65mm lateral to the midline, and 4.2 mm ventral to the brain surface); Therapeutic indication (bone cancer pain);

**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, 200-250 g);

**Agents:** Glial cell line-derived neurotrophic factor, recomb. human  
**Vehicle:** Saline;  
**Route:** SC;  
**Species:** Rat;  
**Pump:** 2001;  
**Duration:** 7 days;  
**ALZET Comments:** Dose (0.5 mg/ml); Controls received mp w/ vehicle; animal info (adult male Sprague-Dawley rats weighing 210 to 240 g); Therapeutic indication (neuropathic pain);

**Agents:** Fentanyl  
**Vehicle:** Not Stated;  
**Route:** SC;  
**Species:** Rat;  
**Pump:** Not Stated;  
**Duration:** 28 days;  
**ALZET Comments:** Dose (0.01 mg/kg/hr); animal info (Male, Sprague Dawley); neurodegenerative (Chronic pain);

**Agents:** Sulfasalazine  
**Vehicle:** Ammonium Hydroxide;  
**Route:** IP;  
**Species:** Mice;  
**Pump:** 1002;  
**Duration:** 14 days;  
**ALZET Comments:** Dose (6.6 mg/kg/day); Controls received mp w/ vehicle; animal info (BALBI/c, 4-6 weeks old); behavioral testing (Nociception Test); cancer (Cancer-induced pain);

**Agents:** Selistate  
**Vehicle:** Not Stated;  
**Route:** SC;  
**Species:** Mice;  
**Pump:** 10074D;  
**Duration:** 1 week;  
**ALZET Comments:** Dose (0.5 lg/h); Controls received mp w/ vehicle; animal info (Male BALB/c mice (20–30 g)); Therapeutic indication (cancer-induced pain);

**Agents:** VEGF-A164 antibody  
**Vehicle:** Not stated;  
**Route:** SC;  
**Species:** Rat;  
**Pump:** 2001;  
**Duration:** 7 days;  
**ALZET Comments:** Dose (250 ng or 500 ng/day); Controls received mp w/ vehicle; animal info (Male, Sprague Dawley, 200-230 g); bilateral cannula used; neurodegenerative (Neuropathic pain);
Q8189: R. de la Puerta, et al. BMP-7 protects male and female rodents against neuropathic pain induced by nerve injury through a mechanism mediated by endogenous opioids. Pharmacol Res 2019;150(104470

**Agents:** recombinant BMP-7 **Vehicle:** CSF; **Route:** SC; **Species:** Mice; **Pump:** 1002; **Duration:** 14 days;

**ALZET Comments:** Dose (6μg/kg/day); Controls received mp w/ vehicle; animal info (8–10 weeks old wild type 3 (C57BL/6) and BMP-7+/- male and female mice); recombinant BMP-7 aka rBMP-7; neurodegenerative (BMP-7 and its type I receptors were detected in regions of the nervous system involved in pain transmission, processing, and modulation);


**Agents:** Transforming growth factor-b1 **Vehicle:** Hydrochloric acid; albumin; PBS; **Route:** Not Stated; **Species:** Mice (knockout); **Pump:** 1002; **Duration:** 14 days;

**ALZET Comments:** Dose (6.2 ng/hour); animal info (BAMBI-/- mice); Therapeutic indication (chronic pain);
**Agents:** Glucagon-like peptide-1, Dexamethasone **Vehicle:** Saline; **Route:** CSF/CNS; **Species:** Mice; **Pump:** 1002; **Duration:** 14 days;
**ALZET Comments:** Controls received mp w/ vehicle; Dose (GLP-1: 0.1 mg/24h; Dexa: 0.0219mg/ml); animal info (20 week-old male C57bl6j); post op. care (meloxicam for post-surgical pain (3 mg/kg); Brain coordinates (anteroposterior: 0.5 mm from bregma, lateral: +/-1.2 mm to bregma and dorsoventral: 2.1 mm below skull);

**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); Therapeutic indication (Pain, analgesia, electrophysiology);

**Agents:** Carbamazepine, baclofen, clomipramine **Vehicle:** DMSO, PEG, EtOH, Acetone; **Route:** SC; **Species:** Rat; **Pump:** 2ML1; **Duration:** 28 days;
**ALZET Comments:** Controls received mp w/ vehicle; animal info (7 weeks old); post op. care (morphine 5 mg/day); behavioral testing (Facial grooming); Therapeutic indication (Trigeminal neuralgia, neuropathic pain); Dose (30 mg/day carbamazepine (first-line drug treatment for trigeminal neuralgia), 1.06 mg/day baclofen, 4.18 mg/day clomipramine, and 5 mg/day morphine);

Q6006: K. T. Chang, et al. Leptin is essential for microglial activation and neuropathic pain after preganglionic cervical root avulsion. Life Sci 2017;187(31-41
**Agents:** Leptin **Vehicle:** PBS; **Route:** CSF/CNS (Cervical); **Species:** Mice; **Pump:** 2006; **Duration:** 28 days;
**ALZET Comments:** Controls received mp w/ vehicle; animal info (male and female, C57B/6 J (B6) and Ob); Therapeutic indication (Obesity, Neuropathic pain); Dose (1 ug/day);

**Agents:** Pseudosubstrate inhibitory peptide **Vehicle:** Saline; **Route:** CSF/CNS (anterior cingulate cortex); **Species:** Rat; **Pump:** 1007D; **Duration:** 7 days;
**ALZET Comments:** Controls received mp w/ vehicle; animal info (200-220g); ALZET brain infusion kit 1 used; Therapeutic indication (Neuropathic pain); Dose (10 nmol/ul);

**Agents:** NETA, progestin **Vehicle:** Propylene glycol; **Route:** Not Stated; **Species:** Rat; **Pump:** 2006; **Duration:** Not Stated;
**ALZET Comments:** Dose (20μg/day); Controls received mp w/ vehicle; animal info (twelve month old Fisher-344 female rats); post op. care (Rimadyl (5 mg/mL/kg) for pain and saline (2 mL) to prevent dehydration); replacement therapy (oophorectomy);

Q5165: P. Nardelli, et al. Reduced motor neuron excitability is an important contributor to weakness in a rat model of sepsis. Experimental Neurology 2016;282(1-8
**Agents:** Oxymorphine **Vehicle:** Not Stated; **Route:** IP; **Species:** Rat; **Pump:** 2ML; **Duration:** 5 days;
**ALZET Comments:** post op. care (buprenorphine SC 0.12 mg/kg; 5 ml SC saline; Baytril SC 10 mg/kg Q12H); pumps used for continuous pain relief in rat sepsis model; Dose (30 ug/kg/h);

**Agents:** Phenyplephrine **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); Therapeutic indication (chronic visceral pain);
Q5838: H. K. Kim, et al. Tempol Ameliorates and Prevents Mechanical Hyperalgesia in a Rat Model of Chemotherapy-Induced Neuropathic Pain. Front Pharmacol 2016;7(532)
Agents: Tempol Vehicle: Saline; Route: IP; Species: Rat; Pump: 2001; Duration: 7 days;
ALZET Comments: Controls received mp w/ vehicle; animal info (200-350 g); behavioral testing; Therapeutic indication (Pain study, chemotherapy-induced neuropathic pain); Dose (200 mg/kg);

Agents: Pentoxifylline Vehicle: Saline; Route: IP; Species: Rat; Pump: 2001; Duration: 7 days;
ALZET Comments: Controls receive mp w/vehicle; animal info (200-350g); Therapeutic indication (Chemo); Dose (.96 mg/day);

Agents: PD98059 Vehicle: DMSO, Ringer’s solution; Route: SC; Species: Rat; Pump: 2004; Duration: 28 days;
ALZET Comments: Controls underwent median nerve CCI; functionality of mp verified by residual volume; behavioral testing; Therapeutic indication (Neuropathic pain); Dose (2, 2.5, 3.0 mM);

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);

Q5815: S. Fuseya, et al. Systemic QX-314 Reduces Bone Cancer Pain through Selective Inhibition of Transient Receptor Potential Vanilloid Subfamily 1-expressing Primary Afferents in Mice. Anesthesiology 2016;125(1):204-18
Agents: QX-314 Vehicle: Saline; Route: SC; Species: Mice; Pump: 1003D; Duration: 14 days;
ALZET Comments: Controls received mp w/vehicle; animal info (20-25g); cancer; behavioral testing (pain related behavior); Therapeutic indication (Bone cancer, pain); Dose (3, 5 mg/kg);

Agents: RG108 Vehicle: Cyclodextrin, hydroxypropyl-β-; Route: CSF/CNS (dorsal striatum); Species: Rat; Pump: 2004; Duration: 14 days;
ALZET Comments: Controls received mp w/vehicle; animal info (male Sprague-dawley, 60 – 90 days old, 180-200 g); post op. care (7 days, buprenorphine, wound care); behavioral testing (femoral adjusting steps test); tissue perfusion (brain); delayed delivery “additional polyethylene tubing added to provide 14d prime of vehicle before RG-108 administration” (pg. 6515); Brain coordinates: anteroposterior, 0 from bregma, -3mm lateral from midline, and -3.5 mm from the dura; Dose (100 uM);

Agents: Loperamide, Prucalopride Vehicle: DMSO; Route: SC; Species: Rat; Pump: 2ML1; Duration: 7 days;
ALZET Comments: Controls received mp w/vehicle; animal info (18 months); half-life of Loperamide: 9-14hr. (p. ); post op. care (Lopaine 2% was given subcutaneously around the incision site to relieve discomfort.); “Continuous dosing was necessary to administer prucalopride because it is rapidly metabolized in rats... Slow release administration also avoided the stressful twice daily restraint and subcutaneous injection otherwise required for the rats dosed with loperamide (half-life 9–14 h).” pg. 1243; Therapeutic indication (Constipation, Colon transit); Dose (1, 2, 4 mg/kg/day);

Agents: Desipramine Vehicle: Saline; Route: SC; Species: Rat; Pump: 2ML2; Duration: 2 weeks;
ALZET Comments: Controls received mp w/vehicle; animal info (Adult male Harlan Sprague-Dawley rats, 200-250 g); functionality of mp verified by pain level measurements; functionality of mp verified by pain level measurements; Noradrenaline reuptake inhibitor; Chronic Constriction Injury (CCI); Therapeutic indication (Pain); Dose (10 mg/kg/d);
**Bibliography**


*Agents*: cAMP, BPY-DCA; *Vehicle*: PBS; *Route*: CSF/CNS (intrathecal); *Species*: Rat; *Pump*: 1007D, 2001, 2002; *Duration*: 1, 2 wk

*ALZET Comments*: Controls received mp w/ vehicle; animal info (female Wistar rats (200–250 g)); complete laminectomy of T8, T9, T11; post op. care (manual bladder emptying, antibiotics, pain relief); Individually housed until recovery from anesthesia; scar reduction; healing, recovery; Therapeutic indication (Spinal Cord Injury); Dose (cAMP 50, 100 ug/day; DFO 10, 50 ug/day; BPY-DCA 1.1, 7.8 ug/day);

**Q4690**: A. Okada-Ogawa, et al. Involvement of medullary GABAergic system in extraterritorial neuropathic pain mechanisms associated with inferior alveolar nerve transection. EXPERIMENTAL NEUROLOGY 2015;267(42-52

*Agents*: R-DIOA; *Vehicle*: DMSO; saline; *Route*: CSF/CNS (intrathecal); *Species*: Rat (transgenic); *Pump*: 2001; *Duration*: 7 days

*ALZET Comments*: Controls received mp w/ vehicle; animal info (male, VGAT-Venus Tg); 10% DMSO used; behavioral testing (von Frey filaments); used microsilicon tubing (0.8 mm in diameter) see pg. 44;


*Agents*: Buprenorphine; *Vehicle*: Not Stated; *Route*: SC; *Species*: Mice; *Pump*: 1007D; *Duration*: 7 days

*ALZET Comments*: Controls received mp w/ PBS; animal info (female, C57BL6, 8 weeks old); behavioral testing (pain score); “We observed strongly reduced pain scores in diseased mice receiving analgesics, whereas the immune response was not altered in these mice. Hence, our study offers a new treatment option to improve wellbeing of mice used to study LCMV-induced meningitis without grossly altering immune parameters” pg 184; “In this study, we subcutaneously implanted ALZET® osmotic pumps releasing the analgesic agent buprenorphine. Continuous delivery with osmotic pumps ensures constant compound levels for maximized therapeutic efficacy and reduced adverse effects. Additionally, unnecessary stressful animal handling due to repeated injection is not required.” pg 188; Dose (0.15 mg/kg/day);


*Agents*: Capsaicin; *Vehicle*: Saline, Tween 80, Ethanol; *Route*: CSF/CNS (intrathecal); *Species*: Rat; *Pump*: 2001D, 2001; *Duration*: 1 day, 3 days;

*ALZET Comments*: Controls received mp w/ vehicle; animal info ( Male adult Sprague Dawley rats, 250-300 g); 1.5% Ethanol, 1.5% Tween 80 used; good methods (pg 548, 549); ischemia (sciatic nerve); behavioral testing (Plantar Test, Von Frey Test); Ligature of the sciatic nerve (Chronic constriction injury of sciatic nerve); Therapeutic indication (Neuropathic Pain); Dose (1.5 ug/ul);


*Agents*: Pha1β; *Vehicle*: PBS; *Route*: CSF/CNS (intrathecal); *Species*: Rat; *Pump*: 2001; *Duration*: 7 days

*ALZET Comments*: Controls received sham surgery; animal info (adult male Wistar rats, 200-300 g); no stress, “No animal showed physical changes after surgical procedure” (see pg. 198); behavioral testing (paw withdrawal testing); Chronic constriction injury of sciatic nerve used as model of neuropathic pain; anesthetized with ketamine and xylazine; soft polyurethane catheter used (ALZET); Comparison of IT injection to IT infusion; Therapeutic indication (Neuropathic pain); Dose (60 pmol/ul/hour);


*Agents*: Muscimol; *Route*: CSF/CNS; *Species*: Rat; *Pump*: 1007D; 1002; 2002; *Duration*: 3 days; 7 days; 14 days

*ALZET Comments*: Controls received mp with saline or no mp; animal info (Sprague Dawley, 2 months old, 250-300g); ALZET brain infusion kit 1 used; dose-response (pg.21-25); good methods (Schematic of implant and cannula placement pg.20); ischemia (cardiac); no stress Thus, as in intact animals, vehicle infusion in the contralesional motor cortex with these methods does not affect behavior.” (see pg.21); post op. care (pain, anti-inflammatory and antibiotic medication); behavioral testing (Montoya staircase test, cylinder test); after 3 days, group 3D animals had pump and cannula cut and sealed;

**Agents:** Oligonucleotide, antisense; mismatch **Route:** CSF/CNS (intrathecal); **Species:** Mice; **Pump:** 1007D; **Duration:** 5 days;

**ALZET Comments:** Animal info (ICR, adult, male, 8 wks old); PE8 catheter used; antisense (TRAF6); neuropathic pain

Q3537: A. Koesters, et al. Decreased cardiac excitability secondary to reduction of sodium current may be a significant contributor to reduced contractility in a rat model of sepsis. Critical Care 2014;18(U3):U351-U357

**Agents:** Hydromorphone **Vehicle:** Not Stated; **Route:** IP; **Species:** Rat; **Pump:** 2ML; **Duration:** 24 hours;

**ALZET Comments:** Animal info (female, Wistar, adult, 250-300g); post op. care (buprenorphine 0.12 mg/kg SC injection);


**Agents:** Quinpirole hydrochloride **Vehicle:** Water, sterile; **Route:** SC; **Species:** Rat; **Pump:** 2ML1; **Duration:** 7 days;

**ALZET Comments:** Controls received sham mp; animal info (male, Sprague Dawley, adult, 250-300g); functionality of mp verified by incubating pumps after explantation in 37C saline and noted collected amount of fluid - post explantation in vitro testing; behavioral testing (tactile and cold allodynia); neuropathic pain; pumps primed in 37C saline for 2 hours;


**Agents:** Angiotensin II **Vehicle:** Not Stated; **Route:** IV (jugular); **Species:** Mice; **Pump:** 1004; 2004; **Duration:** 7, 14, 28 days;

**ALZET Comments:** Animal info (male info (male, adult, sprague dawley, 200g); behavioral testing (Rotarod test, Von Frey monofilaments, Hargreaves' method);


**Agents:** Quinpirole hydrochloride **Vehicle:** Water, sterile; **Route:** SC; **Species:** Rat; **Pump:** 2ML1; **Duration:** 7 days;

**ALZET Comments:** Controls received sham mp; animal info (male, Sprague Dawley, adult, 250-300g); functionality of mp verified by incubating pumps after explantation in 37C saline and noted collected amount of fluid - post explantation in vitro testing; behavioral testing (tactile and cold allodynia); neuropathic pain; pumps primed in 37C saline for 2 hours;


**Agents:** Vincristine **Vehicle:** Saline; **Route:** IV (jugular); **Species:** Rat; **Pump:** 2002; **Duration:** 14 days;

**ALZET Comments:** Controls received mp w/ vehicle; animal info (male, adult, sprague dawley, 200g); behavioral testing (Rotarod test, Von Frey monofilaments, Hargreaves’ method);


**Agents:** PD123319 **Vehicle:** Water, distilled; **Route:** IP; **Species:** Rat; **Pump:** 2001; **Duration:** 7 days;

**ALZET Comments:** Controls received mp w/ (DI water); animal info (female, 60 days, 190-200g); comparison of single IP injection vs mp; behavioral testing (Thermal sensitivity, mechanical sensitivity); PD123319 is an AT2 antagonist; Therapeutic indication (Inflammatory pain); Dose (5 mg/kg/d);


**Agents:** Allopregnanolone **Vehicle:** Captisol; **Route:** SC; **Species:** Mice; **Pump:** 1004; **Duration:** 4 weeks;

**ALZET Comments:** Dose (9.3 nmol/h); 60% Captisol (beta-cyclodextrin sulfobutyl ether) used; animal info (Swe/Arc and Swe/PS1 transgenic mice); post op. care (5.0 mg/kg carprofen for pain); behavioral testing (Morris water maze);


**Agents:** Allopregnanolone **Vehicle:** Captisol; **Route:** SC; **Species:** Mice (transgenic); **Pump:** 1004; **Duration:** 4 weeks;

**ALZET Comments:** Controls received mp w/ Captisol; 60% Captisol used; neurodegenerative (Alzheimer’s disease); post op. care (5.0 mg/kg carprofen (Rimadyel vet; Apoteket AB) for post surgery pain relief); behavioral testing (Morris Water Maze); Therapeutic indication (Alzheimer’s disease); Dose ( 9.3 nmol/h, 18.6 nmol/h);

**Agents:** Prolactin, ovine  
**Vehicle:** Not Stated;  
**Route:** SC;  
**Species:** Rat;  
**Pump:** Not Stated;  
**Duration:** 6 days; 21 days;  
**ALZET Comments:** Animal info (male, Sprague Dawley, 200-250g); functionality of mp verified by serum levels at 21 days; behavioral testing (hind paw pain); immunology.


**Agents:** QX-314; capsaicin  
**Vehicle:** DMSO; heparin; PBS;  
**Route:** CSF/CNS (intrathecal);  
**Species:** Rat;  
**Pump:** 2002;  
**Duration:** 14 days;  
**ALZET Comments:** Control animals received mp w/ vehicle; animal info (Sprague Dawley, male, 250-300 g); ALZET catheter used; pump replaced after 1 week; “Initially, the pump was filled with 5% heparin in PBS to prevent clots from forming in the catheter.” pg 367; 12.5% DMSO used; neuropathic pain.


**Agents:** Pregabalin, I125; pregabalin, unlabeled  
**Vehicle:** Not Stated;  
**Route:** CSF/CNS (intrathecal); CSF/CNS (sciatic nerve);  
**Species:** Rat;  
**Pump:** 2002;  
**Duration:** 72 hours;  
**ALZET Comments:** Controls received mp w/ saline; animal info (Sprague Dawley, male, 200-225 g); catheter patency and functionality of mp verified via pump infusion of india ink; neuropathic pain.


**Agents:** Inhibitor kapa beta kinase  
**Vehicle:** CSF/CNS (intrathecal); CSF/CNS (sciatic nerve);  
**Species:** Mice;  
**Pump:** 2004;  
**Duration:** 4 weeks;  
**ALZET Comments:** Controls received mp w/ vehicle; animal info (SNS-IKK beta -/-); catheter placement verified post mortem by stereomicroscopic inspection and flushing of the catheter with a blue dye; enzyme inhibitor (kapa beta kinase, IKK); behavioral testing (sensitivity to cold, pain); neuropathic pain.


**Agents:** Endotoxin, LPS  
**Vehicle:** CSF/CNS (fourth ventricle);  
**Species:** Rat;  
**Pump:** Not Stated;  
**Duration:** 4 weeks;  
**ALZET Comments:** Control animals received mp w/ aCSF; animal info (Wistar, male, 22 mo old); post op. care (bupivicaine on scalp for pain, sterile isotonic saline SC for dehydration); aCSF recipe.


**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:** SP600125  
**Vehicle:** DMSO;  
**Route:** CSF/CNS (intrathecal);  
**Species:** Rat;  
**Pump:** 2001;  
**Duration:** 7 days;  
**ALZET Comments:** animal info (male, Sprague–Dawley, 180–220 g); 1% DMSO used; enzyme inhibitor (JNK, janus kinase);


**Agents:** Naltrexone  
**Vehicle:** Saline;  
**Route:** SC;  
**Species:** Rat;  
**Pump:** 2006;  
**Duration:** 5 weeks;  
**ALZET Comments:** Controls received mp w/ vehicle; animal info (male, Sprague Dawley, 250-380 g); wound clips used;
ALZET Bibliography

Agents: Morphine Vehicle: Not Stated; Route: CSF/CNS (intrathecal); Species: Rat; Pump: 2001; Duration: 5 days;
ALZET Comments: Controls received mp w/ saline; animal info (male, Wistar, 300-350 g); two intrathecal catheters inserted caudally into the lumbar enlargement of the spinal cord; catheter was made by sealing PE-10 to silastic tubing with epoxy resin and silicone rubber; dead space of the catheter was about 8 ul; pain

Agents: WIN-55212-2; ACEA; AM1241 Vehicle: DMSO; Water; Route: SC; Species: Mice (nude); Pump: 2002; Duration: 2 weeks;
ALZET Comments: Animal info (Foxn1 nu, athymic, 4-5 wks old, 20-25 g); cancer (oral); behavioral testing (mechanical allodynia); 50% DMSO used; wound clips used; pain

Agents: Nicotine Vehicle: Saline; Route: CSF/CNS (intrathecal); Species: Rat; Pump: Not Stated; Duration: Not Stated;
ALZET Comments: Animal info (Sprague-Dawley, adult, male, 300-350 g); pain

Agents: A438079 hydrochloride 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, 200-250 g); neuropathic pain

Agents: Semaphorin 3A Vehicle: Saline; Albumin, rat serum; Route: CSF/CNS (intrathecal); Species: Rat; Pump: 2001; Duration: 7 days;
ALZET Comments: Controls received mp w/ vehicle; animal info (Sprague-Dawley, male, 220-300 g); neuropathic pain

Agents: Calpeptin Vehicle: DMSO; Route: IP; Species: Mice; Pump: 1004; Duration: 4 weeks; 72 hours;
ALZET Comments: Controls received mp w/ vehicle; animal info (adult, 3 mo old, wt, beta3 -/-); calpeptin is a specific inhibitor of calpain

Agents: SB203580; antibody, anti-NGF; oligodeoxynucleotide, antisense; oligodeoxynucleotide, missense; oligodeoxynucleotide, FITC-, antisense Vehicle: Saline; DMSO; Route: CSF/CNS (intrathecal); Species: Rat; Pump: 2001; Duration: 7 days;
ALZET Comments: Controls received mp w/ missense oligo; animal info (male, Sprague-Dawley, 200-250 g, SNL); antisense (TRPA1); enzyme inhibitor (p38 MAP kinase); 50% DMSO; behavioral testing (basal pain hypersensitivity, paw withdrawal latency, mechanical withdrawal threshold)

Agents: Propentofylline Vehicle: Not Stated; Route: CSF/CNS (intrathecal); Species: Rat; Pump: Not Stated; Duration: 7 days;
ALZET Comments: Controls received mp w/ saline; animal info (male, Sprague-Dawley, 160-180 g); behavioral testing (paw withdrawal testing); neuropathic pain

Agents: Substance P Vehicle: PBS; Route: CSF/CNS (rostral ventromedial medulla); Species: Rat; Pump: 1003D; Duration: 24h

ALZET Comments: Controls received mp w/ vehicle; animal info (male, Sprague-Dawley, 80-300 g); pain


Agents: Ketamine; Morphine Vehicle: Saline; Route: CSF/CNS (intrathecal); Species: Rat; Pump: 2ML4; Duration: 21 days;

ALZET Comments: Controls received mp w/ vehicle; tolerance; ALZET brain infusion kit used; half-life pg 477 (2.5 hrs in CSF (ketamine); 2.1 hrs (morphine)); animal info (Female, Lewis, 6-8 wks old, 160-180 g); dorsal laminectomy; behavioral testing (pain related behavior)


Agents: Anakinra Vehicle: Not Stated; Route: SC; Species: Rat; Pump: 2ML4; Duration: 28 days;

ALZET Comments: Controls received mp w/ sham surgery; animal info (adult, male, Sprague Dawley, 9 mo old); behavioral testing (mechanical allodynia); pain


Agents: Neramexane mesylate; memantine; gabapentin Vehicle: Saline, sterile; water; Route: SC; Species: Rat; Pump: 2ML2; Duration: 2 weeks;

ALZET Comments: Controls received mp w/ vehicle; animal info (male, 225-250 g, STZ induced diabetes); functionality of mp verified by plasma drug levels; post op. care (penicillin); wound clips used; neuropathic pain


Agents: Hydroxamic acid, suberoylanilide Vehicle: Cyclodextrin; PBS; Route: CSF/CNS (basolateral amygdala); Species: Mice; Pump: Not Stated; Duration: 14 days;

ALZET Comments: Controls received mp w/ vehicle; functionality of mp verified by examining the levels of acetylated histone H3 and H4; enzyme inhibitor (histone deacetylase); animal info (male, C57BL/6, 8 wks old); 5% cyclodextrin used; Plastics One bilateral cannula used; suberoylanilide hydroxamic acid also known as SAHA; behavioral testing (rotarod and locomotor activity, open-field test, elevated-plus maze, social interaction test; fear conditioning, pain sensitivity); bilateral infusion;


Agents: Morphine; Ketamine Vehicle: Not Stated; Route: SC; Species: Rat; Pump: 2ML1; Duration: 7 days;

ALZET Comments: Controls received mp w/ saline or no treatment; no stress (see pg. 683); tolerance; animal info (female, Sprague Dawley, 210-320); “No behavioral differences could be observed between groups, suggesting that the animals were not suffering significant distress due to the implantations + treatment.” (p. 683); pain


Agents: Phorbol 12, 13-didecanoate; Chelerythrine; Apamin; Iberiotoxin Vehicle: Not Stated; Route: CSF/CNS (thalamus); Species: Mice; Pump: Not Stated; Duration: Not Stated;

ALZET Comments: Controls received mp w/ vehicle; animal info (male, C57BL/6, 129S4/SvJae, wt, PLCB4 -/-); cannula position confirmed by post mortem histology; behavioral testing (visceral pain test)


Agents: Fractalkine Vehicle: Not Stated; Route: CSF/CNS (intrathecal, lumbar); Species: Rat; Pump: Not Stated;

ALZET Comments: Pain; animal info (male, Sprague-Dawley, 200-260 g); PE-5 tubing; agent is a chemokine (AKA, CXCL1)
Agents: Tetrodotoxin; Tetraethylammonium chloride; Pyridine, 4-amino-
Vehicle: CSF, artificial; Route: CSF/CNS (sciatic nerve);
Species: Rat; Pump: 2001; Duration: 7 days;
ALZET Comments: Controls received mp w/ vehicle, or contralateral uninjured nerve; targeted delivery (axotomy); animal info (female, Sprague-Dawley, 80-100g., sciatic nerve ligation/transection); mp primed 4 hrs in 37 celsius saline; chronic pain model

Agents: Insulin (Humulin R) Vehicle: Saline; Route: IV (jugular); Species: Rat; Pump: 2002; Duration: 10 days;
ALZET Comments: Controls received mp w/ vehicle; replacement therapy (STZ-induced diabetes); no stress (see pg. 797); peptides; post op. care (Ketoprofen); animal info (male, Sprague-Dawley, 300g); “The presence of an osmotic mini-pump at either site did not cause any obvious signs of pains or discomfort in the rats.” (p. 797); Humulin R U500 used

Agents: Tumor necrosis Factor-a, recomb. rat; tumor necrosis factor-a, recomb. rat, heat-inactivated Vehicle: CSF, artificial; Route: CSF/CNS; Species: Rat; Pump: Not Stated; Duration: 8 days;
ALZET Comments: Controls received mp w/ vehicle, or heat-inactivated rr-TNFa; comparison of ip injections vs. mp; peptides; animal info (male, Sprague-Dawley, 300-350g); chronic constriction injury to the right sciatic nerve; neuropathic pain

Agents: Uridine, bromodeoxy- Vehicle: Not Stated; Route: SC; Species: Mice; Pump: 1003D; Duration: 24 hours;
ALZET Comments: Animal info (C57BL/6J, 18-25g, male); bone; pain; labeling at the periosteum

Agents: Nicotine bitartrate Vehicle: Not Stated; Route: SC; Species: Rat; Pump: 2001; 2ML4; Duration: 14, 21 days;
ALZET Comments: Controls received mp w/ saline; dose-response (fig. 1, pg 56); pumps replaced; animal info (male, Sprague Dawley, 200-250 g.); “pumps were stabilized in 0.9% physiological saline for 24h at 37 degree C prior to implantation”; pain

Agents: Glutathione S-transferase; glutathione S-transferase-Nogo-66 Vehicle: Not Stated; Route: CSF/CNS (sciatic nerve); Species: Rat; Pump: 2002; Duration: 14 days;
ALZET Comments: Controls received mp w/ GST or no treatment; peptides; animal info (male, Sprague Dawley, 240-260g., Sciatic nerve transection); pain; silicon tube used

Agents: Tissue plasminogen activator inhibitor Vehicle: Saline; Route: CSF/CNS (intrathecal, subarachnoid space); Species: Rat; Pump: 2002; Duration: 5,11,15 days;
ALZET Comments: Controls received mp w/ vehicle; dose-response (fig. 5); animal info (male, Sprague-Dawley, 250-300g.); tPA-STOP; Radiculopathy pain model

Agents: Morphine; Naloxone Vehicle: Saline; Route: SC; Species: Mice; Pump: 1007D; Duration: 7 days;
ALZET Comments: Controls received mp w/ vehicle; dose-response (p. 157, 159); no stress (see pg. 155); cancer (bone); multiple pumps per animal (2); animal info (20-25g, male, adult, C3H/HeJ); pain
**Agents:** Fasudil hydrochloride hydrate  
**Vehicle:** Not Stated  
**Route:** CSF/CNS (intrathecal)  
**Species:** Rat  
**Pump:** 2002  
**Duration:** 14 days  
**ALZET Comments:** Enzyme inhibitor (Rho-kinase); animal info (6 week, male, Sprague-Dawley, 200-250g); pain; silastic tubing

**P8728:** G. Gradl, *et al.* Continuous intra-arterial application of substance P induces signs and symptoms of experimental complex regional pain syndrome (CRPS) such as edema, inflammation and mechanical pain but no thermal pain. Neuroscience 2007;148(3):757-765  
**Agents:** Substance P  
**Vehicle:** Saline; Heparin  
**Route:** IA (femoral)  
**Species:** Rat  
**Pump:** 2001D  
**Duration:** 24 hours  
**ALZET Comments:** Controls received mp w/ vehicle; good methods (p. 758); animal info (male, Sprague-Dawley, 225-250g);

**P3582:** M. Clark, *et al.* Chronic low dose ovine corticotropin releasing factor or urocortin II into the rostral dorsal raphe alters exploratory behavior and serotonergic gene expression in specific subregions of the dorsal raphe. Neuroscience 2007;146(4):1888-1905  
**Agents:** Urocortin II, Corticotropin releasing factor, ovine  
**Vehicle:** CSF, artificial  
**Route:** CSF/CNS  
**Species:** Rat  
**Pump:** 1007D  
**Duration:** 6 days  
**ALZET Comments:** Dose: ovine CRF (100ng/hr), urocortin II (2ng/μL); Controls received mp w/ vehicle; animal info (male Sprague-Dawley rats (250 g)); post op. care (surgical methylacrylate glue (VetBond) used to close incision, 25 ug of buprenorphine once after surgery for pain control); functionality of mp verified by determining residual volume in the pump at the termination of the experiment; stability verified by HPLC HPLC analysis of samples taken at filing and after 6 days; peptides; Brain coordinates (AP −7.5, lateral −0.2, and depth −6.4);

**Agents:** Vincristine sulfate  
**Vehicle:** Not Stated  
**Route:** IV (jugular)  
**Species:** Rat  
**Pump:** 2002  
**Duration:** 14 days  
**ALZET Comments:** Animal info (male, Sprague-Dawley, 200-300g.); mp primed overnight; chemotherapy-induced neuropathic pain model

**Agents:** Epinephrine bitartrate  
**Vehicle:** Saline; Ascorbic acid  
**Route:** SC  
**Species:** Rat  
**Pump:** 1007D  
**Duration:** 7 days  
**ALZET Comments:** Controls received no treatment; animal info (male, Sprague-Dawley 250-380 g); pain

**P6954:** J. F. Harrington, *et al.* Physiological and behavioral evidence for focal nociception induced by epidural glutamate infusion in rats. Spine 2005;30(6):606-612  
**Agents:** Glutamate  
**Vehicle:** Saline  
**Route:** CSF/CNS (intrathecal, lumbar)  
**Species:** Rat  
**Pump:** 1003D  
**Duration:** 72 hours  
**ALZET Comments:** Behavioral study; pain; lumbar catheterization (L5) using PE-10

**Agents:** Buprenorphine  
**Vehicle:** Not Stated  
**Route:** SC  
**Species:** Mice  
**Pump:** Not Stated  
**Duration:** 12 hours  
**ALZET Comments:** Pain treatment

**P7174:** N. Bizat, *et al.* Neuroprotective effect of zVAD against the neurotoxin 3-nitropropionic acid involves inhibition of calpain. Neuropharmacology 2005;49(5):695-702  
**Agents:** Nitropropionic acid, 3-; zVAD  
**Vehicle:** Saline; DMSO  
**Route:** SC, CSF/CNS  
**Species:** Rat  
**Pump:** 2001; 2ML1  
**Duration:** 5 days  
**ALZET Comments:** Controls received mp w/ vehicle sham operation; enzyme inhibitor (caspase, calpain), multiple pumps per animal (2); 40% DMSO

**Agents:** Leupeptin; MDL 28170  
**Vehicle:** Saline, sterile; DMSO; cyclodextrin  
**Route:** CSF/CNS  
**Species:** Rat  
**Pump:** Not Stated  
**Duration:** 5 days  
**ALZET Comments:** Controls received mp w/ vehicle; replacement therapy (axotomy); enzyme inhibitor (calpain); 2% DMSO; mp primed overnight at 37 degree Celsius; 10% cyclodextrin used


**Agents:** Morphine sulfate; Fentanyl  
**Vehicle:** Saline  
**Route:** SC  
**Species:** Rat  
**Pump:** 2ML1  
**Duration:** 7 days  
**ALZET Comments:** Controls received mp w/ vehicle; comparison of pellets vs. mp; tolerance; mp primed overnight in saline at room temperature; pain; animal info (225-250 grams)


**Agents:** Vincristine  
**Vehicle:** Saline  
**Route:** IV (Jugular)  
**Species:** Rat  
**Pump:** 2002  
**Duration:** Not Stated  
**ALZET Comments:** animal info (Sprague-Dawley); good methods (pg. 93); no stress (see pg. 96); behavioral testing (pain response testing); Therapeutic indication (neuropathic pain); Dose (0.75 ug/ul)


**Agents:** RNA, small interfering; oligonucleotide, antisense  
**Vehicle:** Saline  
**Route:** CSF/CNS (intrathecal)  
**Species:** Rat  
**Pump:** Not Stated  
**Duration:** 6-7 days  
**ALZET Comments:** Controls received mp w/ missense siRNA; no stress (see pg. 4); antisense (P2X3); gene therapy; siRNA (P2X3); pain research


**Agents:** F13640  
**Vehicle:** Not Stated  
**Route:** SC  
**Species:** Rat  
**Pump:** 2ML4  
**Duration:** 56 days  
**ALZET Comments:** Controls received mp w/ saline; functionality of mp verified by plasma levels; long-term study; pumps replaced at day 28; 5-HT1A receptor agonist; spinal cord injury; pain


**Agents:** Buprenorphine HCl  
**Vehicle:** Sodium citrate  
**Route:** SC; bone (tibia)  
**Species:** Rabbit  
**Pump:** 2ML1  
**Duration:** 5-7 days  
**ALZET Comments:** “The implanted pump provided pain control for 5-7 days without having to administer multiple injections.” (p.67)


**Agents:** Fibroblast growth factor, recomb. human; dihydrotestosterone  
**Vehicle:** Sodium citrate  
**Route:** SC; bone (tibia)  
**Species:** Rat  
**Pump:** 1007D; 1002; 2002  
**Duration:** 7, 14 days  
**ALZET Comments:** Functionality of mp verified by residual volume; comparison of injections vs. mp; post op. care (heated cage/analgescics); pumps used for systemic or targeted delivery; silastic tubing used; “The pumps were well tolerated without inflammatory reaction, infection, or pain.” (p. 273); picture of pump and catheter (radiograph image) p. 277, fig 10A-8; animal info (Sprague-Dawley)


**Agents:** MDL 28170  
**Vehicle:** Ringer’s solution; cyclodextrins; DMSO  
**Route:** CSF/CNS  
**Species:** Mice  
**Pump:** 1007D  
**Duration:** Not Stated  
**ALZET Comments:** Neurodegenerative (Parkinson’s disease); MDL-28170 is a calpain inhibitor
ALZET® Bibliography

**Agents:** Nitropropionic acid, 3-; calpain inhibitor I  **Vehicle:** DMSO; PBS  **Route:** SC; CSF/CNS  **Species:** Rat  **Pump:** 2001; 2ML1  **Duration:** 1.5 days;
**ALZET Comments:** Controls received mp w/ vehicle or sham operation; enzyme inhibitor (succinate dehydrogenase); ALZET brain infusion kit used; multiple pumps per animal (2); 40% DMSO used for calpain inhibitor I; neurodegenerative (Huntington’s disease)

**Agents:** Calpastatin, synthetic  **Vehicle:** CSF, artifical;  **Route:** CSF/CNS (hippocampus);  **Species:** Mice (transgenic)  **Pump:** 1007D  **Duration:** 7 days;
**ALZET Comments:** Peptides; bilateral stainless steel guide cannula used; calpastatin is a calpain inhibitor; timeline schematic (p. 442); bilateral infusion;

**Agents:** F13640; morphine HCL; imipramine HCl; ketamine HCl; gabapentin  **Vehicle:** Water, double distilled;  **Route:** SC;  **Species:** Rat;  **Pump:** 2ML2  **Duration:** 14 days;
**ALZET Comments:** Controls received mp w/ saline; dose-response (fig. 3); comparison of IP & SC injections vs. mp; tolerance; dependence; “Continuous F 13640 infusion uniquely produced profound analgesia in this model of severe, chronic pain.”

**Agents:** Buprenorphine  **Vehicle:** Not Stated;  **Route:** SC;  **Species:** Mice;  **Pump:** Not Stated;  **Duration:** Not Stated;
**ALZET Comments:** Pain control

**Agents:** Morphine  **Vehicle:** Saline;  **Route:** SC;  **Species:** Rat;  **Pump:** 2001;  **Duration:** 7 days;
**ALZET Comments:** Controls received mp w/ vehicle; comparison of pellets vs. mp; also used morphine pellets; pain

**Agents:** Leupeptin  **Vehicle:** Hank’s solution;  **Route:** Ear (round window);  **Species:** Guinea pig;  **Pump:** 2002;  **Duration:** 8 weeks;
**ALZET Comments:** Controls received mp w/ vehicle; tissue perfusion (bulla); long-term study, pumps replaced every 13 days; IntraEAR catheter used; Leupeptin is a potent calpain inhibitor; neuroprotection; buprenorphine given as postoperative analgesic; chloramphenicol given as prophlactic antibiotic

**Agents:** Galanin; AR-M1896; AR-M1961;  **Vehicle:** Saline; Albumin, rat serum; Ampicillin;  **Route:** CSF/CNS (intrathecal);  **Species:** Rat;  **Pump:** 2002;  **Duration:** 14 days;
**ALZET Comments:** peptides; galanin is a 29-aa neuropeptide with a role in pain processing; dissolved in rat serum albumin vehicle; Ampicillin dissolved in saline; AR-M1896 and AR-M961 are Gal R1 and R2 receptor agonists; catheter location examined by lidocaine injection to verify receptor blockade

**Agents:** Oxymorphone HCl  **Vehicle:** Not Stated;  **Route:** IP;  **Species:** Rat;  **Pump:** Not Stated;  **Duration:** 32 hours;
**ALZET Comments:** functionality of mp verified by pain relief indicators - posture, physical condition, behavior; comparison of iv infusions vs mp; compared bolus iv infusion, continuous iv infusion, osmotic pump.

**Agents:** Naloxone; Naloxone methiodide  
**Vehicle:** Saline;  
**Route:** SC;  
**Species:** Rat;  
**Pump:** 2001;  
**Duration:** 3 days;  
**ALZET Comments:** Dose (3 mg/kg/day); Controls received mp w/vehicle; animal info (polyarthritic male sprawg dawley rats, 6 weeks old); behavioral testing (foot withdrawal (pain)); Therapeutic indication (Rheumatoid arthritis);

P4328: S. R. Thornton, et al. Fentanyl self-administration in juvenile rats that were tolerant and dependent to fentanyl as infants. Pharmacology Biochemistry and Behavior 2000;65(3):563-570

**Agents:** Fentanyl HCl  
**Vehicle:** Saline, pyrogen-free isotonic;  
**Route:** SC;  
**Species:** Rat (neonate);  
**Pump:** 1003D;  
**Duration:** 3,5 day;  
**ALZET Comments:** Controls received mp with saline; tolerance; dependence; pain


**Agents:** Antibody, nerve growth factor; Antibody, NT-3; Immunoglobulin, normal sheep  
**Vehicle:** Not Stated;  
**Route:** CSF/CNS (dorsal root ganglia);  
**Species:** Rat;  
**Pump:** Not Stated;  
**Duration:** 2 weeks;  
**ALZET Comments:** Tissue perfusion (DRG via lesioned L5 spinal nerve); peptides; diagram of experimental model (p. 1712)


**Agents:** Nerve growth factor  
**Route:** CSF/CNS (sciatic nerve);  
**Species:** Rat;  
**Pump:** 2002;  
**Duration:** 12 days;  
**ALZET Comments:** Controls received mp with normal saline; peptides; recomb. human NGF used; pain; tissue perfusion


**Agents:** Antibody, monochlonal hamster anti-murine TNFalpha; Antibody, polyclonal rabbit anti-mouse TNFa; Tumor necrosis factor-a  
**Vehicle:** CSF, artificial; Gentamycin; Albumin, rat;  
**Route:** CSF/CNS;  
**Species:** Rat;  
**Pump:** 2002;  
**Duration:** 14 days;  
**ALZET Comments:** Controls received mp with aCSF, normal rabbit serum or Armenian hamster IgG isotype control antibody; stability of each antibody, control, and rrTNFa verified by bioassay following 14 days of incubation in aCSF at 37ºC; peptides; ALZET brain infusion kit used; pain


**Agents:** Retinoic acid; Quinacrine; Dipyridamole  
**Vehicle:** PBS; Ethanol;  
**Route:** Injury site;  
**Species:** Rabbit;  
**Pump:** 2ML1;  
**Duration:** 1, 2, 3, 7 days;  
**ALZET Comments:** Controls received mp w/vehicle; tissue perfusion (surgical injury site); animals given morphine i.m. for post-operative pain; catheter stabilized in sidewall w/suture; in some studies, catheter tubing was disconnected to halt flow at specific times; immunology


**Agents:** Glial-derived neurotrophic factor; Nerve growth factor;  
**Vehicle:** Saline; Albumin, rat serum;  
**Route:** CSF/CNS (intrathecal);  
**Species:** Rat;  
**Pump:** 2002;  
**Duration:** Not Stated;  
**ALZET Comments:** Controls received mp with vehicle; peptides; recomb. human GDNF and NGF used; pain; silastic tubing used for IT delivery


**Agents:** Oligodeoxynucleotide, antisense  
**Vehicle:** Saline;  
**Route:** CSF/CNS;  
**Species:** Rat;  
**Pump:** 2ML4;  
**Duration:** 21 days;  
**ALZET Comments:** Dependence; antisense; pain
Agents: MK-801; Enkaphalin analog ST-91 Vehicle: Saline, sterile normal; Route: CSF/CNS (intrathecal); Species: Rat; Pump: 2001; Duration: 7 days;
ALZET Comments: Controls received mp with vehicle; no stress (see pg. 1221); tolerance; agents infused singly and concomitantly; pain; PE-10 tubing externalized through the top of the skull to allow discontinuation of infusion, and conduit for external drug dosing;

Agents: Hirudin, recomb. analog Vehicle: Not Stated; Route: Injury site; Species: Rabbit; Pump: 2ML1; Duration: 7 days;
ALZET Comments: Controls received mp w/ PBS; tissue perfusion (injury site); immunology; peptides; rabbits were given IM morphine for postoperative pain

Agents: L-NAME Vehicle: NaCl; Route: SC; Species: Rat; Pump: 2002; Duration: 10 days;
ALZET Comments: functionality of mp verified by hypertension after 5 days; dose response (see pg. 62); bupivacaine HCl given to minimize post-operative pain

Agents: Hydromorphone Vehicle: Not Stated; Route: SC; Species: Rabbit; Pump: 2ML4; Duration: 4 weeks;
ALZET Comments: Functionality of mp verified by blood sample assays; comparison of IV bolus administration vs. EVA polymer drug delivery vs. mp; pain; cancer;

Agents: Butorphanol tartrate; Morphine HCl Vehicle: Saline; Route: CSF/CNS; Species: Rat; Pump: 2001; Duration: 3 days;
ALZET Comments: controls received mp w/saline; dependence; animals allowed 1 week recovery after cannulae placement-stylet maintained cannulae patency; bupivacaine given for post-operative pain relief

Agents: Morphin; Naloxone Vehicle: Saline; Route: CSF/CNS (intrathecal); Species: Rat; Pump: 2001; Duration: 7 days;
ALZET Comments: controls received mp w/saline; tolerance; medical category:pain/analgiesia;skc

Agents: Morphin; Sufentanil; Enkephalin Vehicle: Saline; Route: IV; CSF/CNS (intrathecal); CSF/CNS; Species: Rat; Pump: Not Stated; Duration: 7 days;
ALZET Comments: controls received mp w/vehicle; dose-response (p. 163); tolerance; pain; reference of mp pump study on pp. 162-164

Agents: Fentanyl dihydrogencitrate Vehicle: Saline; Route: SC; Species: Guinea pig; Pump: 2001; Duration: 6 days;
ALZET Comments: pain