Recent References on the Administration of Agents to Primates Using ALZET® Osmotic Pumps

Baboon (2007-Present)


**Agents:** Not Stated  **Vehicle:** CSF, artificial;  **Route:** CSF/CNS (ventricle);  **Species:** Monkey (baboon);  **Pump:** Not Stated;  **Duration:** 14 days, 2 weeks;

**ALZET Comments:** Controls received mp w/ vehicle; animal info (all animals were housed in social groups in outdoor enclosures) ; ALZET pumps used to maintain the patency of the ventricular infusion line and cannula before connection to the syringe pump infusion system


**Agents:** Tumor necrosis factor-alpha  **Vehicle:** PBS;  **Route:** IV (femoral);  **Species:** Monkey (pregnant, baboon);  **Pump:** 2ML4;  **Duration:** Not Stated;

**ALZET Comments:** Controls received mp w/ vehicle; animal info (female, baboon, Papio hamadryas)


**Agents:** Chorionic gonadotropin hormone, human recomb.  **Vehicle:** Saline;  **Route:** SC; intrauterine;  **Species:** Monkey (baboon);  **Pump:** 2ML1;  **Duration:** Not Stated;

**ALZET Comments:** Animal info (30 mo old, spontaneous endometriosis); tissue perfusion (oviductal lumen)

Q0042: Y. Fujimura, et al. Quantification of peripheral benzodiazepine receptors in human brain with 18F-PBR06. Journal of Cerebral Blood Flow and Metabolism 2010;29(S360-S375

**Agents:** Nicotine  **Vehicle:** Not Stated;  **Route:** Not Stated;  **Species:** Monkey (baboon);  **Pump:** Not Stated;  **Duration:** 6 months;

**ALZET Comments:** Long-term study; animal info (Papio anubis); functionality of mp verified by plasma nicotine concentration; pumps replaced at 15 days, 2, 3, 4 and 5 months


**Agents:** Chorionic gonadotropin hormone, human recomb.  **Vehicle:** Not Stated;  **Route:** Oviductal;  **Species:** Monkey (baboon);  **Pump:** Not Stated;  **Duration:** 5 days;

**ALZET Comments:** Animal info (cycling, female, 7-12 years old, 12-18 kg); tissue perfusion (oviduct)


**Agents:** Gonadotrophin, human chorionic  **Vehicle:** Not Stated;  **Route:** Oviductal;  **Species:** Monkey (baboon);  **Pump:** Not Stated;  **Duration:** 5 days;

**ALZET Comments:** Animal info (papio anubis)


**Agents:** Gonadotrophin, human chorionic  **Vehicle:** Not Stated;  **Route:** Oviductal;  **Species:** Monkey (baboon);  **Pump:** Not Stated;  **Duration:** 5 days;

**ALZET Comments:** Animal info (female, adult)
Cynomolgus (2013-Present)

Agent: tetrahydropyridine, 1-methyl-4-phenyl-1,2,3,6- Vehicle: Not Stated; Route: SC; Species: Monkey; Pump: Not Stated; Duration: 6 months;
ALZET Comments: Dose (0.5 mg/d); animal info (Cynomolgus); long-term study; 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (AKA MPTP) is used to induce Parkinsonism; neurodegenerative (); Pumps were used to induce advanced-stage Parkinsonism in macaques by continuous infusion of MPTP. Agents administered during test were administered orally, not through pump infusion.

Q6641: S. Petryszyn, et al. The number of striatal cholinergic interneurons expressing calretinin is increased in parkinsonian monkeys. Neurobiol Dis 2016;95(46-53
Agent: MPTP Vehicle: Not Stated; Route: SC; Species: Monkey; Pump: 2ML4; Duration: 2 weeks;
ALZET Comments: Dose (14mg); animal info (Eight, four-year-old, ovariectomized female cynomolgus monkeys); MPTP aka 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine

Agent: Bisphenol A Vehicle: DMA; PEG; Route: SC; Species: Monkey (Cynomolgus - pregnant); Pump: 2004; Duration: 28 days;
ALZET Comments: Control animals received mp w/ vehicle; animal info (cynomolgus, 2.5-4.0 kg, 5-13 years old, GD20); "We administered BPA in pregnant females on gestational day 20 at 10 µg/kg/day through pumps implanted to produce an exposure regimen with a steady level of circulating BPA without the stress of daily restraint essential for oral administration." pg 50; teratology; 50% DMA used; 50% PEG used

Marmoset (2006-Present)

Agent: Hepatocyte growth factor, recomb. human Vehicle: PBS; Route: CSF/CNS (intrathecal); Species: Monkey (marmoset); Pump: 2004; Duration: 4 weeks;
ALZET Comments: Controls received mp w/ vehicle; animal info (adult, female, common, 295-350 g); ALZET rat intrathecal catheter used

Agent: Rotigotine hydrochloride Vehicle: DMSO; Water, sterile; Route: SC; Species: Marmoset; Pump: 2004; Duration: 28 days;
ALZET Comments: Comparison of SC injections or PO administration vs. SC mp; animal info (adult, common, male, female, 2-7 years old, 350-500); 50% DMSO used; "These data suggest that dyskinesia induced by pulsatile drug treatment may be improved by switching to continuous rotigotine delivery." pg. 79; "...this study highlights the potential benefits of continuous drug delivery." pg 84

**Agents:** Prolactin, human, recomb. **Vehicle:** Glycerol, NaHCO3, NaCl; **Route:** SC; **Species:** Monkey (marmoset); **Pump:** 2004; **Duration:** Not Stated;

**ALZET Comments:** Controls received mp w/ saline; animal info (2.5-9 yrs old, male, parentally experienced); "... these pellets (from Innovative Research of America) did not raise the level of prolactin in the blood over the level of our control parentally experienced fathers... Therefore, we chose to use the osmotic minipump (Alzet, CA) for our test males." pg 439; "The position of the pumps on the lower area of a male's back precluded any interference with infant carrying since infant carrying occurs nearer the neck" pg 439; comparison of pellets vs mp


**Agents:** Rotigotine **Vehicle:** Saline, sterile; **Route:** SC; **Species:** Monkey (marmoset); **Pump:** 2004; **Duration:** 58 days;

**ALZET Comments:** Controls received mp w/ vehicle; animal info (adult common, male, female, 354 g); comparison of sc injections vs. mp; neurodegenerative (Parkinson's disease); post op. care (Rimadyl, Synulox); "pumps were removed... and replaced with new minipumps implanted into the opposite flank." pg 534; "These results demonstrate that the anti-parkinsonian benefits associated with a continuous infusion of rotigotine were more sustained compared to pulsatile rotigotine or L-DOPA treatment..." pg 541; long-term study

P8082: R. J. Hornby, et al. Multiple vaccine and pyridostigmine bromide interactions in the common marmoset Callithrix jacchus: Immunological and endocrinological effects. INTERNATIONAL IMMUNOPHARMACOLOGY 2006;6(12):1755-1779

**Agents:** Pyridostigmine bromide **Vehicle:** Saline, sterile isotonic; **Route:** SC; **Species:** Marmoset; **Pump:** Not Stated; **Duration:** 28 days;

**ALZET Comments:** Controls received mp w/ vehicle; no stress (see p.1776); immunology; animal info (female, vasectomized male, 331-565g, 2-5.5 yrs. old); mp primed 40 hours

P8143: G. D. Griffiths, et al. Development of methods to measure humoral immune responses against selected antigens in the common marmoset (Callithrix jacchus) and the effect of pyridostigmine bromide administration. INTERNATIONAL IMMUNOPHARMACOLOGY 2006;6(12):1755-1764

**Agents:** Pyridostigmine bromide **Vehicle:** Saline, sterile isotonic; **Route:** SC; **Species:** Marmoset; **Pump:** Not Stated; **Duration:** 28 days;

**ALZET Comments:** Controls received mp w/ vehicle; no stress (see p.1759,1762); immunology; animal info (male, female, 300-500g.); mp primed 40 hours; "delivery by pump ensured the animals would receive an appropriate dose of the drug over the desired time period.", oral delivery "would introduce unacceptable stress into the experiment and presentation in food was discounted because of difficulties in estimating the dose administered." (p.1757)

Rhesus (2012-Present)


**Agents:** Sphingosine-1-phosphate **Vehicle:** PEG; Ethanol; Tween 20; **Route:** SC; **Species:** Monkey; **Pump:** Not Stated; **Duration:** 4 weeks;

**ALZET Comments:** Dose (); 60% PEG; 30% Ethanol; 10% Tween 20 used; Controls received mp w/ vehicle; animal info (Adult female rhesus monkeys, 8-14 years); Sphingosine-1-phosphate aka S1P; cardiovascular;

Q8332: D. Alarcon-Aris, et al. Anti-alpha-synuclein ASO delivered to monoamine neurons prevents alpha-synuclein accumulation in a Parkinson's disease-like mouse model and in monkeys. EBioMedicine 2020;59(102944

**Agents:** Oligonucleotides, antisense **Vehicle:** CSF, artificial; **Route:** CNS/CSF (lateral ventricle); **Species:** Mice; Monkey (rhesus macaques); **Pump:** 1004; 2ML4; **Duration:** 28 days;

**ALZET Comments:** Dose (30 ug/day; 100 ug/day; 1 mg/day); Controls received mp w/ vehicle; animal info (Eight-week-old wild-type male C57BL/6J mice; male and female hesus macaques, 20 years or older); antisense oligonucleotides aka IND-ASO; ALZET brain infusion kit 3 used; Brain coordinates (antero-posterior -0.34, medial-lateral -1.0 and dorsal-ventral -2.2 in mm); neurodegenerative (Parkinson’s disease);
**Agents:** Angti-RGMa antibody  
**Vehicle:** Saline  
**Route:** CNS/CSF  
**Species:** Monkey  
**Pump:** 2ML4  
**Duration:** 4 weeks  
**ALZET Comments:** Dose (50 ug/kg/day); animal info (Rhesus, 3-5 years old, 2.8-5.4 kg); spinal cord injury;

**Agents:** mitochondrial superoxide dismutase mimetic (Hexyl)  
**Vehicle:** Saline  
**Route:** SC  
**Species:** Monkey  
**Pump:** Not Stated  
**Duration:** 6 weeks  
**ALZET Comments:** Dose (0.1 mg/kg/day); Controls received mp w/ vehicle; animal info (Rhesus monkeys); MnTnHex-2-PyP5+ aka hexyl; cardiovascular;

**Agents:** Antigen, BG505.v5.2 SOSIP  
**Vehicle:** ISCOMATRIX adjuvant  
**Route:** SC  
**Species:** Monkey (macaque)  
**Pump:** 2002  
**Duration:** 14 days  
**ALZET Comments:** Dose (50 ug); ISCOMATRIX adjuvant composed of cholesterol, phospholipid, and saponin in sterile PBS; animal info (3-4 year old Indian-origin rhesus macaques); Immunology (antigen immunization); “Pump delivery resulted in significantly higher nAb titers than conventional immunization, as well as shifted kinetics, after both the second and third immunizations (Figure 4G).” pg. 1081; Therapeutic indication (HIV);

**Agents:** Nicotine bitartrate  
**Vehicle:** Water, bacteriostatic  
**Route:** SC  
**Species:** Monkey (macaque, pregnant)  
**Pump:** 2ML4  
**Duration:** 134 days  
**ALZET Comments:** Controls received mp w/ vehicle; animal info (female, Rhesus, pregnant, GD26); functionality of mp verified by blood levels; pumps replaced every 3 weeks; post op. care (cefazolin 150 mg BID); long-term study; teratology; dependence;

Q4715: C. S. Cunningham, et al. The discriminative stimulus effects of mecamylamine in nicotine-treated and untreated rhesus monkeys  
1734. Behavioural Pharmacology 2014;25(296-305)  
**Agents:** Nicotine  
**Vehicle:** Saline  
**Route:** SC  
**Species:** Monkey (Rhesus)  
**Pump:** 2ML4  
**Duration:** Not Stated  
**ALZET Comments:** Controls received mp w/ vehicle; animal info (Macaca mulatta, rhesus monkey, adult); pumps replaced every 28 days; behavioral testing (stimulus-shock termination);

**Agents:** BIM-22493  
**Vehicle:** Saline; dimethylacetamide; serum, non-human primate  
**Route:** SC  
**Species:** Monkey (macaque)  
**Pump:** 2ML2  
**Duration:** 8 weeks  
**ALZET Comments:** Control animals received mp w/ vehicle; animal info (rhesus macaque, 9-11 years old, mature, adult, 9-19 kg); long-term study; pumps replaced biweekly; BIM-22493 is a novel MC4R, melanocortin 4 receptor, antagonist; 5% DMA used;

**Agents:** Immunoglobulin G2, CD4  
**Vehicle:** Not Stated  
**Route:** SC  
**Species:** Monkey (macaque)  
**Pump:** Not Stated  
**Duration:** 14 days  
**ALZET Comments:** Animal info (male, Indian, rhesus, macaques); CD4-IgG2 is an antibody-like molecule; “Owing to the relatively rapid decay of CD4-IgG2, we chose to deliver it subcutaneously and continuously by an osmotic pump” pg e42209
Monkey (2018-Present)


Agents: Sphingosine-1-phosphate Vehicle: PEG; Ethanol; Tween 20; Route: SC; Species: Monkey; Pump: Not Stated; Duration: 4 weeks;

ALZET Comments: Dose (); 60% PEG; 30% Ethanol; 10% Tween 20 used; Controls received mp w/ vehicle; animal info (Adult female rhesus monkeys, 8-14 years); Sphingosine-1-phosphate aka S1P; cardiovascular;


Agents: NgR1(310)–Fc Vehicle: Not Stated; Route: CSF/CNS (spinal cord); Species: Monkey; Pump: 2ML4; Duration: 4 months;

ALZET Comments: Dose (0.10-0.17 mg/kg/day); Controls received mp w/ vehicle; animal info (Adult African green monkeys (vervets, female, baseline body weight 4.2–7.2 kg)); pumps replaced every month; long-term study; NgR1(310)–Fc aka Nogo receptor decoy protein; spinal cord injury;


Agents: Antibody, anti Nogo-A monoclonal 11C7; Brain-derived neurotrophic factor Vehicle: Not stated; Route: CSF/CNS (spinal cord); Species: Monkey; Pump: 2ML2; Duration: 4 weeks;

ALZET Comments: Dose (14.8 mg anti Nogo-A monoclonal antibody 11C7; 1.4 mg Brain-derived neurotrophic factor); animal info (adult monkeys, 3.0 to 5.6 kg, 4 to 6 years old); Multiple pumps per animal (2 pumps); Brain-derived neurotrophic factor aka BDNF; spinal cord injury;


Agents: 1-Methyl-4-phenyl-1,2,3,6-tetrahydropyridine Vehicle: Saline; Route: SC; Species: Monkey; Duration: 2 weeks;

ALZET Comments: Dose (0.5 mg/day); animal info (adult female monkeys, 4 to 11 years old, 2.4 to 4.6 kg);

1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine aka MPTP; neurodegenerative (Parkinson’s Disease);


Agents: Granulocyte Macrophage Colony-Stimulating Factor, Recombinant Human Vehicle: Not stated; Route: SC; Species: Monkey; Pump: Not stated; Duration: 7 days;

ALZET Comments: Recombinant Human Granulocyte Macrophage Colony-Stimulating Factor aka rhG/M-CSF; dependence;


Agents: Human Follicle-Stimulating Hormone Vehicle: Not stated; Route: SC; Species: Monkey; Duration: 10 days;

ALZET Comments: Dose (15 IU/kg); animal info (Female, 4 years old, 2.0-3.8 kg); gene therapy;


Agents: Angti-RGMa antibody Vehicle: Saline; Route: CNS/CSF; Species: Monkey; Pump: 2ML4; Duration: 4 weeks;

ALZET Comments: Dose (50 ug/kg/day); animal info (Rhesus, 3-5 years old, 2.8-5.4 kg); spinal cord injury;


Agents: mitochondrial superoxide dismutase mimetic (Hexyl) Vehicle: Saline; Route: SC; Species: Monkey; Duration: 6 weeks;

ALZET Comments: Dose (0.1 mg/kg/day); Controls received mp w/ vehicle; animal info (Rhesus monkeys); MnTnHex-2-PyP5+ aka hexyl; cardiovascular