



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

Baboon (2007-Present)

Q5859: P. B. Higgins, *et al.* Central GIP signaling stimulates peripheral GIP release and promotes insulin and pancreatic polypeptide secretion in nonhuman primates. *American Journal of Physiology Endocrinology and Metabolism* 2016;311(4):E661-E670

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

Q1517: N. S. Sunderland, *et al.* Tumor necrosis factor alpha induces a model of preeclampsia in pregnant baboons (*Papio hamadryas*). *Cytokine* 2011;56(2):192-199

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*)

Q1551: J. R. A. Sherwin, *et al.* The Endometrial Response to Chorionic Gonadotropin Is Blunted in a Baboon Model of Endometriosis. *Endocrinology* 2010;151(10):4982-4993

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

Q1005: J. J. Brosens, *et al.* Proteomic analysis of endometrium from fertile and infertile patients suggests a role for apolipoprotein A-I in embryo implantation failure and endometriosis. *MOLECULAR HUMAN REPRODUCTION* 2010;16(4):273-285

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)

Q0235: J. Evans, *et al.* Prokineticin 1 mediates fetal-maternal dialogue regulating endometrial leukemia inhibitory factor. *FASEB Journal* 2009;23(7):2165-2175

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

ALZET Comments: Animal info (*papio annubis*)

P8047: J. R. A. Sherwin, *et al.* Identification of novel genes regulated by chorionic gonadotropin in baboon endometrium during the window of implantation. *Endocrinology* 2007;148(2):618-626

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)

Q7744: D. Charvin, *et al.* An mGlu4-Positive Allosteric Modulator Alleviates Parkinsonism in Primates. *Mov Disord* 2018;33(10):1619-1631

Agents: 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

Agents: 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

Q3748: T. Negishi, *et al.* Altered social interactions in male juvenile cynomolgus monkeys prenatally exposed to bisphenol A. *NEUROTOXICOLOGY AND TERATOLOGY* 2014;44(46-52

Agents: 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

Q2632: N. Morin, *et al.* MPEP, an mGlu5 receptor antagonist, reduces the development of L-DOPA-induced motor complications in de novo parkinsonian monkeys: Biochemical correlates. *Neuropharmacology* 2013;66(:):355-364

Agents: MPTP **Vehicle:** Not Stated; **Route:** SC; **Species:** Monkey; **Pump:** Not Stated; **Duration:** Not Stated;

ALZET Comments: Animal info (female, cynomolgus, OVX); neurodegenerative (Parkinson's disease)

Q2945: L. Gregoire, *et al.* Safinamide reduces dyskinesias and prolongs L-DOPA antiparkinsonian effect in parkinsonian monkeys. *PARKINSONISM & RELATED DISORDERS* 2013;19(5):508-514

Agents: MPTP **Vehicle:** Not Stated; **Route:** SC; **Species:** Monkey (cynomolgus); **Pump:** Not Stated; **Duration:** Not Stated;

ALZET Comments: Animal info (ovariectomized cynomolgus, 2.8-4.4kg); neurodegenerative (Parkinson's disease)

Marmoset (2006-Present)

Q2105: K. Kitamura, *et al.* Human Hepatocyte Growth Factor Promotes Functional Recovery in Primates after Spinal Cord Injury. *PLoS One* 2011;6(11):U83-U95

Agents: 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

Q0075: K. A. Stockwell, *et al.* Continuous rotigotine administration reduces dyskinesia resulting from pulsatile treatment with rotigotine or L-DOPA in MPTP-treated common marmosets. *Experimental Neurology* 2010;221(1):79-85

Agents: 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



Q0515: T. E. Ziegler, *et al.* Prolactin's mediative role in male parenting in parentally experienced marmosets (*Callithrix jacchus*). *Hormones and Behavior* 2009;56(4):436-443

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

Q0449: K. A. Stockwell, *et al.* Continuous administration of rotigotine to MPTP-treated common marmosets enhances anti-parkinsonian activity and reduces dyskinesia induction. *Experimental Neurology* 2009;219(2):533-542

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):1765-1779

Agents: Pyridostigmine bromide **Vehicle:** Saline, sterile isotonic; **Route:** SC; **Species:** Marmoset; **Pump:** 2004; **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)

Q9136: F. Amargant, *et al.* Sphingosine-1-phosphate and its mimetic FTY720 do not protect against radiation-induced ovarian fibrosis in the nonhuman primate. *Biology of Reproduction* 2021;104(5):1058-1070

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

ALZET Comments: Dose (0); 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 rhesus 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);



Q8292: H. Nakagawa, *et al.* Treatment With the Neutralizing Antibody Against Repulsive Guidance Molecule-a Promotes Recovery From Impaired Manual Dexterity in a Primate Model of Spinal Cord Injury. *Cereb Cortex* 2019;29(2):561-572

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;

Q7118: J. M. Cline, *et al.* Post-Irradiation Treatment with a Superoxide Dismutase Mimic, MnTnHex-2-PyP(5+), Mitigates Radiation Injury in the Lungs of Non-Human Primates after Whole-Thorax Exposure to Ionizing Radiation. *Antioxidants (Basel)* 2018;7(3):

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;

Q6235: M. Pauthner, *et al.* Elicitation of Robust Tier 2 Neutralizing Antibody Responses in Nonhuman Primates by HIV Envelope Trimer Immunization Using Optimized Approaches. *Immunity* 2017;46(6):1073-1088 e6

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);

Q3984: J. O. Lo, *et al.* Vitamin C supplementation ameliorates the adverse effects of nicotine on placental hemodynamics and histology in nonhuman primates. *American Journal of Obstetrics & Gynecology* 2015;212(U271-U278)

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);

Q2568: P. Kievit, *et al.* Chronic Treatment With a Melanocortin-4 Receptor Agonist Causes Weight Loss, Reduces Insulin Resistance, and Improves Cardiovascular Function in Diet-Induced Obese Rhesus Macaques. *Diabetes* 2013;62(2):490-497

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;

Q2009: P. Poignard, *et al.* Protection against High-Dose Highly Pathogenic Mucosal SIV Challenge at Very Low Serum Neutralizing Titers of the Antibody-Like Molecule CD4-IgG2. *PLoS One* 2012;7(7):U1813-U1818

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)

Q9136: F. Amargant, *et al.* Sphingosine-1-phosphate and its mimetic FTY720 do not protect against radiation-induced ovarian fibrosis in the nonhuman primate. *Biology of Reproduction* 2021;104(5):1058-1070

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

ALZET Comments: Dose (0); 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;

Q9538: X. Wang, *et al.* Nogo receptor decoy promotes recovery and corticospinal growth in non-human primate spinal cord injury. *Brain* 2020;143(6):1697-1713

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;

Q10062: J. Savidan, *et al.* Cutaneous Inputs to Dorsal Column Nuclei in Adult Macaque Monkeys Subjected to Unilateral Lesion of the Primary Motor Cortex or of the Cervical Spinal Cord and Treatments Promoting Axonal Growth. *Neuroscience Insights* 2020;15(2633105520973991

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;

Q8626: C. Lecours, *et al.* Levodopa partially rescues microglial numerical, morphological, and phagolysosomal alterations in a monkey model of Parkinson's disease. *Brain, Behavior, and Immunity* 2020;90(81-96

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);

Q8477: R. P. Gale, *et al.* Use of molecularly-cloned haematopoietic growth factors in persons exposed to acute high-dose, high-dose rate whole-body ionizing radiations. *Blood Rev* 2020;100690

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;

Q8951: Y. Seita, *et al.* Comprehensive evaluation of ubiquitous promoters suitable for the generation of transgenic cynomolgus monkeys. *Biology of Reproduction* 2019;100(6):1440-1452

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;

Q8292: H. Nakagawa, *et al.* Treatment With the Neutralizing Antibody Against Repulsive Guidance Molecule-a Promotes Recovery From Impaired Manual Dexterity in a Primate Model of Spinal Cord Injury. *Cereb Cortex* 2019;29(2):561-572

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;

Q7118: J. M. Cline, *et al.* Post-Irradiation Treatment with a Superoxide Dismutase Mimic, MnTnHex-2-PyP(5+), Mitigates Radiation Injury in the Lungs of Non-Human Primates after Whole-Thorax Exposure to Ionizing Radiation. *Antioxidants (Basel)* 2018;7(3):

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