Recent References on the Administration of Growth Hormones
Using ALZET® Osmotic Pumps

Bovine (2004-Present)

Q1384: M. Walser, *et al.* Peripheral administration of bovine GH regulates the expression of cerebrocortical beta-globin, GABAB receptor 1, and the Lissencephaly-1 protein (LIS-1) in adult hypophysectomized rats. GROWTH HORMONE & IGF RESEARCH 2011;21(1):16-24
Agents: Growth hormone, bovine recomb. **Vehicle:** Phosphate buffer; glycerol; sodium azide; **Route:** SC; **Species:** Rat; **Pump:** 2004; **Duration:** 6 days;
ALZET Comments: Animal info (female, Sprague Dawley, hx, normal); replacement therapy (hypophysectomized)

P8049: D. L. Kleinberg, *et al.* Insulin-like growth factor (IGF)-I controls prostate fibromuscular development: IGF-I inhibition prevents both fibromuscular and glandular development in eugonadal mice. Endocrinology 2007;148(3):1080-1088
Agents: Insulin-like growth factor I; growth hormone, bovine; insulin-like growth factor-1, binding protein **Vehicle:** Not Stated; **Route:** SC; **Species:** Mice; **Pump:** 1007D; **Duration:** 7 days;
ALZET Comments: Controls received mp w/ saline; peptides; animal info (ORX, 10 weeks old, male); drugs delivered alone or in combination

P8552: C. Gaelman, *et al.* Age-induced hypercholesterolemia in the rat relates to reduced elimination but not increased intestinal absorption of cholesterol. American Journal of Physiology Endocrinology and Metabolism 2007;293(3):E737-E742
Agents: Growth hormone, bovine **Vehicle:** Not Stated; **Route:** SC; **Species:** Rat; **Pump:** 2ML1; **Duration:** 1 week;
ALZET Comments: Controls received no treatment; peptides; animal info (male, Wistar-Hannover, 6, 18 months old); endocrinology

P8424: C. Gardmo, *et al.* In vivo transfection of rat liver discloses binding sites conveying GH-dependent and female-specific gene expression. Journal of Molecular Endocrinology 2006;37(3):433-441
Agents: Growth hormone, bovine **Vehicle:** Not Stated; **Route:** SC; **Species:** Rat; **Pump:** 2001; **Duration:** 6 days;
ALZET Comments: Peptides; animal info (Sprague-Dawley, 7 wks old, male)

P6387: M. Matasconi, *et al.* Pituitary control of lipoprotein and bile acid metabolism in male rats: growth hormone effects are not mediated by prolactin. American Journal of Physiology Endocrinology and Metabolism 2004;287(1):E114-E119
Agents: Growth hormone, human; growth hormone, bovine **Vehicle:** Not Stated; **Route:** SC; **Species:** Rat; **Pump:** 2001; **Duration:** 7 days;
ALZET Comments: Replacement therapy (hyphophysectomy); dose-response (p. E115)

P6852: P. Kotokorpi, *et al.* Activation of the glucocorticoid receptor or liver X receptors interferes with growth hormone-induced akr1b7 gene expression in rat hepatocytes. Endocrinology 2004;145(12):5704-5713
Agents: Growth hormone, bovine **Vehicle:** Not Stated; **Route:** Not Stated; **Species:** Rat; **Pump:** 2001; **Duration:** 6 days;
ALZET Comments: Replacement therapy (hypophysectomy); peptides

Chicken

P4547: C. G. Scanes, *et al.* Influence of continuous growth hormone or insulin-like growth factor I administration in adult female chickens. General and Comparative Endocrinology 1999;114(315-323
ALZET Comments: Growth hormone, chicken; Insulin-like growth factor I;; Saline; Albumin, bovine serum;; SC;; bird (chicken);; 2ML2;; 10 days;; controls received mp w/vehicle; functionality of mp verified by plasma levels; peptides; recomb. chicken growth hormone used;.

P1528: C. G. Scanes, *et al.* In vivo effects of biosynthetic chicken growth hormone in broiler-strain chickens. Growth Dev. Aging 1990;54(95-101
ALZET Comments: Growth hormone, chicken; Albumin, bovine serum; Saline; SC; bird (chicken); 2ML4; 3 weeks; pumps were siliconized (probably using Prosil) to decrease protein binding in pumps.

Human (2004-Present)

Q9442: S. Sanchez-Bezanilla, *et al.* Growth Hormone Promotes Motor Function after Experimental Stroke and Enhances Recovery-Promoting Mechanisms within the Peri-Infarct Area. International Journal of Molecular Sciences 2020;21(2):
Agents: Growth hormone, human recombinant **Vehicle:** Saline; **Route:** SC; **Species:** Mice; **Pump:** 2004; **Duration:** 28 days;
ALZET Comments: Dose (0.04 mg rhGH per day); Controls received mp w/ vehicle; animal info (Male C57BL/6 mice, 10 weeks old); behavioral testing (Motor test); Recombinant human growth hormone aka rhGH; replacement therapy (growth hormone);

Q5334: K. Wang, *et al.* Growth Hormone Mediates Its Protective Effect in Hepatic Apoptosis through Hnf6. PLoS One 2016;11(12):e0167085
Agents: Growth hormone, human recomb. **Vehicle:** Not Stated; **Route:** SC; **Species:** Mice; **Pump:** Not Stated; **Duration:** 7 days;
ALZET Comments: Controls received mp w/ PBS; animal info (male, Albumin-Cre); Therapeutic indication (Hepatic apoptosis); Dose (5 ug/h);

Q6633: H. Nishizawa, *et al.* IGF-I induces senescence of hepatic stellate cells and limits fibrosis in a p53-dependent manner. Sci Rep 2016;6(34605
Agents: Insulin-like Growth Factor 1, recomb.; Growth Hormone, human **Vehicle:** Saline; **Route:** SC; **Species:** Rat; Mice; **Pump:** 2004; **Duration:** 4 weeks; 6 weeks;
ALZET Comments: Dose (10 mg/mL); Controls received mp w/ vehicle; animal info (Eight-week-old male ICR mice, Sprague-Dawley (SD) rats; db/db mice with a C57BL/6 backgrounddb); Insulin-like Growth Factor aka IGF-I;

Q0858: C. Tateno, *et al.* Growth Hormone-Dependent Pathogenesis of Human Hepatic Steatosis in a Novel Mouse Model Bearing a Human Hepatocyte-Repopulated Liver. Endocrinology 2011;152(4):1479-1491
Agents: Growth hormone, human **Vehicle:** Not Stated; **Route:** SC; **Species:** Mice (transgenic/SCID); **Pump:** Not Stated; **Duration:** 2 weeks;
ALZET Comments: Animal info (uPA/SCID, 20-30 days old, chimeric)

Q1174: D. L. Kleinberg, *et al.* Pasireotide, an IGF-I action inhibitor, prevents growth hormone and estradiol-induced mammary hyperplasia. Pituitary 2011;14(1):44-52
Agents: Growth hormone, human **Vehicle:** Not Stated; **Route:** SC; **Species:** Rat; **Pump:** 1007D; **Duration:** Not Stated;
ALZET Comments: Animal info (CD-1, 42 days old); replacement therapy (hypophysectomy and oophorectomy)

P9566: E. F. Gevers, *et al.* Regulation of Rapid Signal Transducer and Activator of Transcription-5 Phosphorylation in the Resting Cells of the Growth Plate and in the Liver by Growth Hormone and Feeding. Endocrinology 2009;150(8):3627-3636
Agents: Growth hormone, human **Vehicle:** Saline; BSA; **Route:** SC; **Species:** Mice; **Pump:** 2001; **Duration:** 5 days;
ALZET Comments: Controls received sham surgery; animal info (dw/dw, 4-5 wks old)

P7492: M. Matasconi, *et al.* Pituitary control of cholesterol metabolism in normal and LDL receptor knock-out mice: Effects of hypophysectomy and growth hormone treatment. Biochimica et Biophysica Acta (BBA) - Molecular and Cell Biology of Lipids 2005;1736(3):221-227
Agents: Growth hormone, human **Vehicle:** Not Stated; **Route:** SC; **Species:** Mice; **Pump:** 2001; **Duration:** 7 days;
ALZET Comments: Controls received sham operation; replacement therapy (hypophysectomy); peptides; animal info (C57B1/6J, LDL R knockout, male)

P6387: M. Matasconi, *et al.* Pituitary control of lipoprotein and bile acid metabolism in male rats: growth hormone effects are not mediated by prolactin. American Journal of Physiology Endocrinology and Metabolism 2004;287(1):E114-E119
Agents: Growth hormone, human; growth hormone, bovine **Route:** SC; **Species:** Rat; **Pump:** 2001; **Duration:** 7 days;
ALZET Comments: Replacement therapy (hyphophysectomy); dose-response (p. E115)

P6639: R. K. Bains, *et al.* Visceral obesity without insulin resistance in late-onset obesity rats. Endocrinology 2004;145(6):2666-2679
Agents: Growth hormone, human **Vehicle:** Not Stated; **Route:** SC; **Species:** Rat; **Pump:** Not Stated; **Duration:** 4 weeks;
ALZET Comments: Controls received no treatment; replacement therapy (GH deficiency); pumps replaced on day 13; peptides

Ovine

P6300: S. D. McCormick. Effects of Growth Hormone and Insulin-like Growth Factor I on Salinity Tolerance and Gill Na^+, K^+-ATPase in Atlantic Salmon (Salmo salar): Interaction with Cortisol. General and Comparative Endocrinology 1996;101(3-11
Agents: Growth hormone, ovine; insulin-like growth factor I, recomb. ovine **Vehicle:** Ringer's solution; **Route:** Not Stated; **Species:** Fish (atlantic salmon); **Pump:** 1003D; **Duration:** 4-14 days;
ALZET Comments:

P3171: A. L. Albiston, *et al.* Sex- and tissue- specific regulation of 11B-hydroxysteroid dehydrogenase mRNA. Molec. and Cell. Endocrinol 1995;109(183-188
Agents: Growth hormone, ovine **Vehicle:** Not Stated; **Route:** Not Stated; **Species:** Rat; **Pump:** 2002; **Duration:** 4 days;
ALZET Comments: replacement therapy (hypophysectomy); peptides; infusion proved superior to injection; comparison of injections vs. mp

R0097: C. S. Nicoll, *et al.* Analysis of the role of hormones and growth factors in growth control and tissue differentiation using transplanted mammalian embryos and fetal structures. Growth Reg 1991;1(133-144
Agents: Antibody, anti-fibroblast growth factor; Antibody, anti-IGF I; Insulin; Growth hormone, ovine; Fibroblast growth factor; Epidermal growth factor; Insulin-like growth factor II; Antibody, anti-epidermal growth factor **Vehicle:** Not Stated; **Route:** IV (suprarenal); **Species:** Not Stated; **Pump:** Not Stated; **Duration:** no duration posted;
ALZET Comments: peptides

P1589: R. J. Madon, *et al.* Hypoinsulinaemia in the lactating rat is caused by a decreased glycaemic stimulus to the pancreas. J. Endocrinol 1990;125(81-88
Agents: Growth hormone, ovine; Prolactin, ovine **Vehicle:** Not Stated; **Route:** Not Stated; **Species:** Rat; **Pump:** 2001; **Duration:** 5 days;
ALZET Comments: functionality of mp verified by serum levels; replacement therapy (oviarectomy) in some of the prolactin-treated animals

P1177: D. R. Smith, *et al.* Hepatic estrogen and androgen receptors and binding proteins in streptozotocin-diabetic male wistar rats. Diabetologia 1987;30(957-962
Agents: Growth hormone, ovine **Vehicle:** Saline; **Route:** SC; **Species:** Rat; **Pump:** 2001; **Duration:** no duration posted;
ALZET Comments: streptozotocin induced diabetes; comparison of sc injections vs. mp infusion; peptides

Porcine (2014-Present)

Q9414: V. G. Piazza, *et al.* Exposure to growth hormone is associated with hepatic up-regulation of cPLA2alpha and COX. Molecular and Cellular Endocrinology 2020;509(110802
Agents: Growth hormone, porcine **Vehicle:** Saline; **Route:** SC; **Species:** Mice; **Pump:** 1007D; **Duration:** 5 days;
ALZET Comments: Dose (1 mg/kg of body weight per day); Controls received mp w/ vehicle; animal info (Adult (3–4 months old) Swiss-Webster female and male mice); Growth hormone, porcine aka GH; replacement therapy (Growth Hormone, Porcine);

Q7865: R. Sawa, *et al.* Growth hormone and Insulin-like growth factor-I (IGF-I) modulate the expression of L-type amino acid transporters in the muscles of spontaneous dwarf rats and L6 and C2C12 myocytes. Growth Horm IGF Res 2018;42-43(66-73
Agents: growth hormone, porcine **Vehicle:** Saline; **Route:** SC; **Species:** Rat; **Pump:** 2002; **Duration:** 14 days;
ALZET Comments: Dose (5 µg/h); Controls received mp w/ vehicle; animal info (6 weeks, SDR, 45-55g); dose of GH was selected to restore the GH and IGF-I levels to within the physiological ranges;

Q4548: H. Nishida, *et al.* Dexamethasone and BCAA Failed to Modulate Muscle Mass and mTOR Signaling in GH-Deficient Rats. PLoS One 2015;10(U459-U478
Agents: Growth hormone, porcine **Vehicle:** Not Stated; **Route:** SC; **Species:** Rat; **Pump:** 2002; **Duration:** 14 days;
ALZET Comments: Animal info (Sprague Dawley, 6 weeks old);

Q3456: M. E. Diaz, *et al.* GH administration patterns differently regulate epidermal growth factor signaling. Journal of Endocrinology 2014;221(309-323
Agents: Growth hormone, porcine **Vehicle:** Not Stated; **Route:** SC; **Species:** Mice; **Pump:** 1007D; **Duration:** 5 days;
ALZET Comments: Controls received mp w/ saline; animal info (Swiss-Webster, 3-4 months old, 26-30g); functionality of mp verified by plasma levels; comparison of SC injection BID vs mp; toxicology; "The results indicate that sustained delivery systems that allow continuous GH plasma patterns would be beneficial in terms of treatment safety with regard to the actions of GH on EGFR signaling and its promitogenic activity." pg 309

Rat (2009-Present)

Q7825: P. Hao, *et al.* Functional Roles of Sex-Biased, Growth Hormone-Regulated MicroRNAs miR-1948 and miR-802 in Young Adult Mouse Liver. Endocrinology 2018;159(3):1377-1392
Agents: growth hormone, recomb. rat **Vehicle:** Sodium bicarbonate; saline; albumin, buffered; **Route:** SC; **Species:** Mice; **Pump:** 1007D; **Duration:** 7 days;
ALZET Comments: Dose (20 ng/g body weight/hour); 30 mM NaHCO3 (pH 8.3) buffer containing 0.15 M NaCl and 100 mg/mL rat albumin used; Controls received sham surgery; animal info (8-10 weeks, male, CD1); "exogenous GH infusion using an ALZET osmotic minipump overrides the normal male plasma GH pulses and leads to downregulation of a large fraction of male-biased genes and upregulation of female-biased genes" p.1382;

Q1792: Y. J. Zhang, *et al.* Dynamic, Sex-Differential STAT5 and BCL6 Binding to Sex-Biased, Growth Hormone-Regulated Genes in Adult Mouse Liver. MOLECULAR AND CELLULAR BIOLOGY 2012;32(4):880-896
Agents: Growth hormone, rat, recomb. **Route:** Not Stated; **Species:** Mice; **Pump:** 1007D; **Duration:** 7 days;
ALZET Comments: Animal info (male, female, CD-1, 7-8 wks old)

P9969: T. J. Zhao, *et al.* Ghrelin O-acyltransferase (GOAT) is essential for growth hormone-mediated survival of calorie-restricted mice. PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA 2010;107(16):7467-7472
Agents: Ghrelin, recomb. rat; growth hormone, recomb. rat **Vehicle:** Saline; sodium bicarbonate; albumin, rat; **Route:** SC; **Species:** Mice; **Pump:** 1002; 2004; **Duration:** 10, 11 days;
ALZET Comments: Controls received mp w/ vehicle; peptides; animal info (male, wt, Goat-/-, 8 weeks old)

Q0258: P. Pathipati, *et al.* Delayed and chronic treatment with growth hormone after endothelin-induced stroke in the adult rat. Behavioural Brain Research 2009;204(1):93-101
Agents: Growth hormone, rat **Vehicle:** NaCl; tween 20; NaHCO3; Na2CO3; **Route:** CSF/CNS; **Species:** Rat; **Pump:** 2002; **Duration:** 6 weeks;
ALZET Comments: Controls received mp w/ vehicleanimal info (adult, male, Sprague-Dawley, 280-350 g); pumps replaced every 2 weeks; stability verified by for 2 weeks in vitro

Q0698: R. D. Meyer, *et al.* Male-Specific Hepatic Bcl6: Growth Hormone-Induced Block of Transcription Elongation in Females and Binding to Target Genes Inversely Coordinated with STAT5. MOLECULAR ENDOCRINOLOGY 2009;23(11):1914-1926
Agents: Growth hormone, recomb. rat, human **Vehicle:** Not Stated; **Species:** Rat; **Pump:** Not Stated; **Duration:** 7 days;
ALZET Comments: Controls were untreated; animal info (male, Fischer 344, 9-13 wks old); replacement therapy (hypophysectomy)

Releasing Factor (2005-Present)

Q4888: A. Veronique St-Onge, Alfonso Abizaid. Ghrelin enhances cue-induced bar pressing for high fat food. Horm. Behav 2016;78(141-149
Agents: Ghrelin; growth hormone-releasing peptide 6, [D-Lys-3] **Vehicle:** Saline; **Route:** CSF/CNS (ventral tegmental area); **Species:** Rat; **Pump:** 2002; **Duration:** 14 days;
ALZET Comments: Controls received mp w/ vehicle; animal info (male, Long evans, 216-375g); post op. care (SC injection of meloxicam; feed of mashed food); behavioral testing (food operant responses); used Plastics One cannula; obesity;

Q3886: C. Garcia-Caceres*, et al.* The Opposing Effects of Ghrelin on Hypothalamic and Systemic Inflammatory Processes Are Modulated by Its Acylation Status and Food Intake in Male Rats. Endocrinology 2014;155(2868-2880
Agents: Ghrelin, acylated; ghrelin, non-acylated; ghrelin mimetic growth hormone-releasing peptide-6 **Vehicle:** Saline; **Route:** CSF/CNS; **Species:** Rat; **Pump:** Not Stated; **Duration:** 14 days;
ALZET Comments: Controls received mp w/ vehicle; animal info (male, Wistar, 250g); immunology;

Q0371: S. Sheriff*, et al.* Ghrelin receptor agonist, GHRP-2, attenuates burn injury-induced MuRF-1 and MAFbx expression and muscle proteolysis in rats. Peptides 2009;30(10):1909-1913
Agents: Growth hormone-releasing peptide-2 **Vehicle:** Not Stated; **Route:** SC; **Species:** Rat; **Pump:** 2001D; **Duration:** 1 day;
ALZET Comments: Controls received mp w/ saline; animal info (male, Sprague Dawley, 50-70 g); peptides

P8904: M. L. Fiorotto*, et al.* Transplacental transfer of a growth hormone-releasing hormone peptide from mother to fetus in the rat. DNA and Cell Biology 2006;25(8):429-437
Agents: Growth hormone-releasing hormone; radio-isotopes 125_I tracer **Vehicle:** BSA; **Route:** SC; **Species:** Rat (pregnant); **Pump:** 1003D; **Duration:** 52-58 hours;
ALZET Comments: Controls received sham operation; functionality of mp verified by residual volume, total activity; no stress (see pg. 433); half-life (p. 432) 8 hours; teratology; peptides; animal info (female, Sprague Dawley, gd18)

P7613: L. M. Frago*, et al.* Growth hormone-releasing peptide-6 increases insulin-like growth factor-I mRNA levels and activates Akt in RCA-6 cells as a model of neuropeptide Y neurones. Journal of Neuroendocrinology 2005;17(11):701-710
Agents: Growth hormone-releasing peptide-6 **Vehicle:** Saline; **Route:** IV (jugular); **Species:** Rat; **Pump:** 2001; **Duration:** 7 days;
ALZET Comments: Controls received mp w/ vehicle; animal info (male, wistar 200-250 g); ghrelin receptor agonist; peptides