

CJC 1295

Modified GRF (1-29) (same as CJC 1295 w/out DAC)

CJC 1295 + DAC

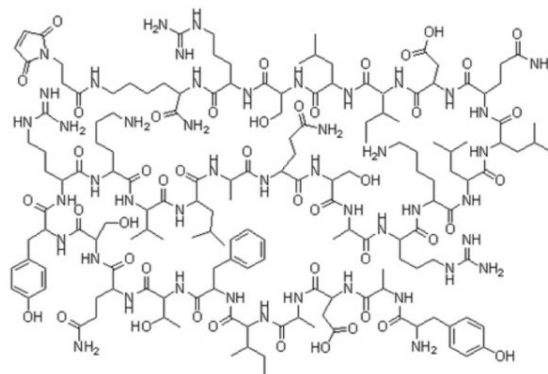
CJC 1295 w/out DAC + Ipamorelin

GROWTH HORMONE RELEASING HORMONE (GHRH) PEPTIDE

Sequence: Tyr-D-Ala-Asp-Ala-Ile-Phe-Thr-Gln-Ser-Tyr-Arg-Lys-Val-Leu-Ala-Gln-Leu-Ser-Ala-Arg-Lys-Leu-Leu-Gln-Asp-Ile-Leu-Ser-Arg-Lys

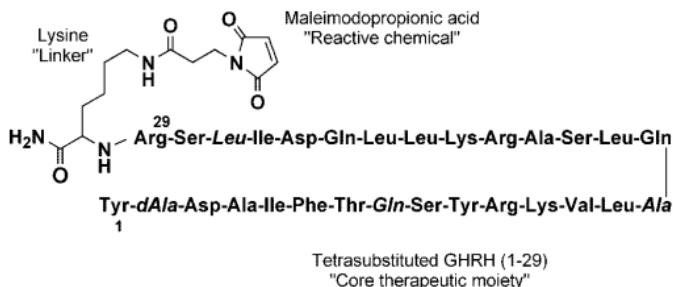
Molecular Weight: 3647.15

Molecular Formula : C₁₆₅H₂₆₉N₄₇O₄₆



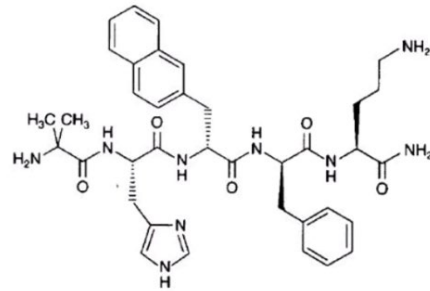
Most Frequent Uses:

- CJC 1295 is a growth hormone releasing hormone (GHRH) analogue = Growth hormone mimetic
- Similar effects as Sermorelin, but longer T-1/2 (see dosage)
- Stimulates pituitary endogenous GH (growth hormone)
- Increases endogenous IGF-1 (insulin-like growth factor-1)
 - Improved physical performance
 - Increased muscle mass
 - Weight loss support
 - Thermogenic – fat burning
 - Improved recovery from exercise and injury
 - Increased bone density
 - Cardiovascular support
 - Improved sex drive
 - Neuroprotection
 - Improved cognition and memory
- CJC 1295 + DAC
 - DAC = drug affinity complex; improves half life
- CJC 1295 + Ipamorelin
 - Synergistic effects on GH levels when Ipamorelin (GHRP) administered concurrently w/ CJC 1295 (GHRH)
 - Improves Growth Hormone levels w/ **minimal effects on ghrelin, prolactin, ACTH and cortisol**
 - **Increases IGF-1**



Drug Affinity Complex DAC-GRF (CJC-1295)

- Clinicians report that using CJC1295 + Ipamorelin concurrently results in improved weight loss and maintenance of muscle mass
- Energy levels also seem to be improved when using the combination.
- Helps promote deep wave sleep
- Similar cost to Sermorelin w/ approximately 3x better GH secretion
- Positive effects on GH are reported even after dosing is terminated (increases mRNA of hGH)



Ipamorelin Structure

Dosage(s):

- **CJC 1295 alone – no DAC**
 - Half-life = approx. 30 minutes
 - Supplied as 1mg per ml
 - Dosage = 0.05 ml to 0.1 ml QHS, 5 days out of the week.
 - It is best to dose CJC 1295 on an empty stomach, at least 2-3 hours after the last meal of the day.
- **CJC 1295 w/DAC**
 - Half-life = 6 days
 - Inject 600 mcg once weekly
 - It is best to dose CJC 1295 on an empty stomach, at least 2-3 hours after the last meal of the day.
- **CJC 1295 (w/o DAC) + Ipamorelin dosage**
 - Ipamorelin half-life = 120 minutes
 - Supplied as 1mg/1mg per ml (1mg CJC1295 + 1mg Ipamorelin per ml), 2mg/2mg per ml and 2mg/1mg per ml
 - Dosage = 0.05 ml to 0.1 ml QHS, 5 days out of the week.
 - It is best to dose on an empty stomach, at least 2-3 hours after the last meal of the day.
- A 12-week, Phase II clinical trial for CJC-1295 DAC in lipodystrophy in 192 HIV patients reported 1 death from a myocardial infarction. The deceased patient received the 11th weekly dose and approximately two hours later, the patient complained of chest discomfort and an ECG confirmed an acute myocardial infarction; death occurred approximately 1 hour later. The attending physician of the trial believed that the most likely explanation for the incident was that the patient had asymptomatic coronary artery disease with plaque rupture and occlusion, and that the occurrence was unrelated to treatment with CJC-1295.
- GH may be mitogenic; if patient prone to cancer or has cancer, use with caution
- GH may mask symptoms of hypothyroidism; make sure to test thyroid hormone levels (Free T3, free T4, TSH and thyroid antibodies)

- **Note** – CJC 1295 and CJC 1295 w/DAC are banned by WADA (World Anti-Doping Agency)

Safety and Potential Side Effects/Contraindications

- CJC-1295 is reported safe in recommended dosages.
 - As with all injections, redness, and pain at the site of injection may be present.
- **Note – CJC 1295, CJC 1295 w/DAC and Ipamorelin peptides are all banned by WADA (World Anti-Doping Agency) for use in sports**
- Most common SEs:
 - Flushing
 - Injection site erythema
 - Rash
 - Edema
 - Joint and muscle pain
 - Fatigue
- A 12-week, Phase II clinical trial for CJC-1295 DAC in lipodystrophy in 192 HIV patients reported 1 death from a myocardial infarction. The deceased patient received the 11th weekly dose and approximately two hours later, the patient complained of chest discomfort and an ECG confirmed an acute myocardial infarction; death occurred approximately 1 hour later. The attending physician of the trial believed that the most likely explanation for the incident was that the patient had asymptomatic coronary artery disease with plaque rupture and occlusion, and that the occurrence was unrelated to treatment with CJC-1295.
- GH may be mitogenic; if patient prone to cancer or has cancer, use with caution
- GH may mask symptoms of hypothyroidism; make sure to test thyroid hormone levels (Free and Total T3, T4, TSH and thyroid antibodies)
- Safety in pediatrics and in pregnancy has not been established.

Description

CJC 1295 is a synthetic analogue of growth hormone (hGH). It has 4 amino acid substitutions in GHRH (1-29) to enhance activity and render it resistant to degradation by proteolytic enzymes. Studies have reported that administering CJC 1295 once weekly helps to increase plasma GH concentrations (2-10 times more) for a period of up to 6 days after injection.¹ It also increases IGF-1 levels by 1.5 to 3 times, for a period of 9 to 11 days, with no reported adverse side effects.

CJC 1295 can be compounded in two forms (DAC and non-DAC). Drug affinity complex (DAC) is designed to prevent enzymatic degradation thus increasing the half-life. Consequently CJC 1295 - DAC is often prescribed by physicians to be dosed as a single weekly injection, but many clinicians wanting to improve GH prefer CJC 1295 w/out DAC and add ipamorelin (a GHRP) to the mix.

Administration of CJC 1295 plus DAC is designed to provide a GHRH-like stimulation around the clock. A potential drawback when using DAC (a weekly protocol) can be ineffective GHRH stimulation when the body is due for a GH spike (usually 1:00am). This is referred to as a GH-bleed and the overall result is inferior to using CJC 1295-NON-DAC daily for 5 days out of 7. Therefore, using CJC 1295- NON-DAC (and with Ipamorelin) daily (between 6-8pm) provides a more effective GH spike at 1:00am.

GHRH pulses generally last up to 30 minutes before the body has used out the potential for a single GH pulse. Using CJC 1295 w/o DAC allows for a more pulsatile release of GH daily (between 6-8pm) and provides a more effective GH spike at 1AM, more similar to that of endogenous GHRH.

A 2006 clinical study involving two randomized, placebo-controlled, double-blind, ascending dose trials with durations of 28 and 49 day in healthy subjects, ages 21-61 yr.² CJC-1295 or placebo was administered SQ in one of four ascending single doses in the first study and in two or three weekly or biweekly doses in the second study (see study for dosages³). The main outcome measures were peak concentrations and area under the curve of GH and IGF-I; standard pharmacokinetic parameters were used for CJC-1295.

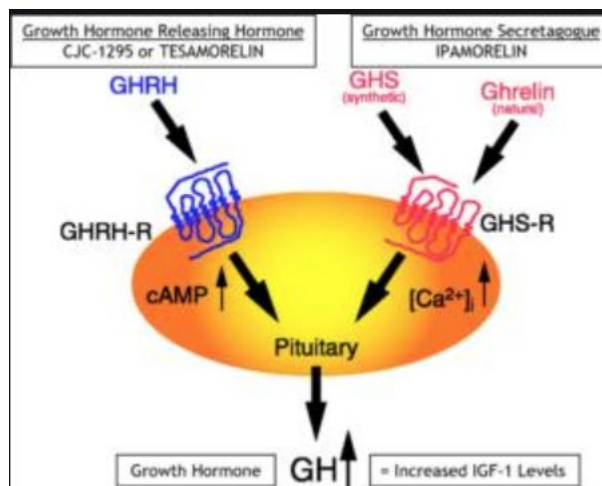
Results: After a single injection of CJC-1295, there were dose-dependent increases in mean plasma GH concentrations by 2- to 10-fold for 6 d or more and in mean plasma IGF-I concentrations by 1.5- to 3-fold for 9-11 d. The estimated half-life of CJC-1295 was 5.8-8.1 d. After multiple CJC-1295 doses, mean IGF-I levels remained above baseline for up to 28 d. No serious adverse reactions were reported. Subcutaneous administration of CJC-1295 resulted in sustained, dose-dependent increases in GH and IGF-I levels in healthy adults and was safe and relatively well tolerated. There was evidence of a cumulative effect after multiple doses.

Why Use CJC 1295 over Sermorelin

In comparative data, CJC 1295 was reported to be more effective at than Sermorelin, a popular GHRH. Sermorelin's binding time to GHRH receptors was reported to be **8-12 minutes**, compared to CJC 1295's binding time of **> 30 minutes**.⁴

Benefits of Combining CJC 1295 with Ipamorelin

Ipamorelin is a 3rd generation GHRP and selective agonist of the ghrelin/growth hormone secretagogue receptor (GHS) and a growth hormone secretagogue, are frequently combined in ergogenic and weight management protocols due to synergistic effects. Clinicians find that using CJC1295 and Ipamorelin together results in improved weight loss and maintenance of muscle mass. Energy levels seem to be improved also when using the combination.



CJC 1295 and Ipamorelin are generally combined to provide both a GHRH(amplifier) and a GHRP (or inducer). This combination will promote the increase of GH by both increasing the strength of the pulse of GH release along with increasing the number of cells that secrete GH (somatotrophs). This can help practitioners those who are looking to promote a steady and improved release of GH to get the benefits of increases in growth hormone and subsequently Insulin Like Growth Factor -1 (IGF-1), and with little or no side effects. This therapy is effectively used for anti-aging purposes as well as those with inflammatory conditions, disease or those who have low IGF-1 levels.

Compared to GHRP-6 and GHRP-2, Ipamorelin does not raise hormones of concern such as cortisol, prolactin or ghrelin.⁵ The benefits of CJC 1295 + Ipamorelin combination can include:

- Decreased body fat
- Increased muscle mass
- Increased strength
- Improved energy & strength
- Improved quality of sleep
- Helps combat insomnia
- Increased physical and mental performance
- Improved cognition/memory
- Enhanced calcium retention
- Bone density Improvement
- Improved immune function
- Improved thermogenesis
- Improved skin elasticity
- Improved connective tissue repair post injury – improved recovery
- Decreased aging

Clinical Research

IPS Level of Evidence

IPS Clinical Pharmacists have developed a method of ranking the studies so that the practitioner can easily discern the level of evidence this study provides to the topic. Levels 1-8 are listed below:

Level of Evidence	Description
Level 1	FDA Approved Drug studies
Level 2	Evidence obtained from systematic review and/or meta-analyses of studies including RCTs and other human studies

X	Level 3	Evidence obtained from a RCT
X	Level 4	Evidence obtained from a study without randomization
	Level 5	Evidence obtained from case reports
	Level 6	Evidence obtained from <i>in vitro</i> studies
X	Level 7	Evidence obtained from laboratory animal studies
X	Level 8	Evidence obtained from Opinions or Reviews

Teichman SL, et al. **Prolonged stimulation of growth hormone (GH) and insulin-like growth factor I secretion by CJC-1295, a long-acting analog of GH-releasing hormone, in healthy adults.** J Clin Endocrinol Metab. 2006;91(3):799-805.



Abstract - Context: Therapeutic use of GHRH to enhance GH secretion is limited by its short duration of action. **Objective:** The objective of this study was to examine the pharmacokinetic profile, pharmacodynamic effects, and safety of CJC-1295, a long-acting GHRH analog. **Design:** The study design was two randomized, placebo-controlled, double-blind, ascending dose trials with durations of 28 and 49 d. **Setting:** The study was performed at two investigational sites. **Participants:** Healthy subjects, ages 21-61 yr, were studied. **Interventions:** CJC-1295 or placebo was administered sc in one of four ascending single doses in the first study and in two or three weekly or biweekly doses in the second study. **Main outcome measures:** The main outcome measures were peak concentrations and area under the curve of GH and IGF-I; standard pharmacokinetic parameters were used for CJC-1295. **Results:** After a single injection of CJC-1295, there were dose-dependent increases in mean plasma GH concentrations by 2- to 10-fold for 6 d or more and in mean plasma IGF-I concentrations by 1.5- to 3-fold for 9-11 d. The estimated half-life of CJC-1295 was 5.8-8.1 d. After multiple CJC-1295 doses, mean IGF-I levels remained above baseline for up to 28 d. No serious adverse reactions were reported. **Conclusions:** Subcutaneous administration of CJC-1295 resulted in sustained, dose-dependent increases in GH and IGF-I levels in healthy adults and was safe and relatively well tolerated, particularly at doses of 30 or 60 microg/kg. There was evidence of a cumulative effect after multiple doses. These data support the potential utility of CJC-1295 as a therapeutic agent.



– Prolonged Stimulation of Growth Hormone (GH) and Insulin-Like Growth Factor I Secretion by CJC-1295, a Long-Acting Analog of GH-Releasing Hormone, in Healthy Adults

Ionescu M, et al. **Pulsatile Secretion of Growth Hormone (GH) Persists during Continuous Stimulation by CJC-1295, a Long Acting GH-Releasing Hormone Analog.** J Clin Endocrinol Metab. 2006;91(12):4792-97.

Abstract - Context: Pulsatile GH secretion is considered important for many of the hormone's physiological effects. Short-term GHRH infusions enhance GH pulsatility and increase IGF-I, but the short GHRH half-life limits its therapeutic use. A synthetic GHRH analog (CJC-1295) that binds permanently to endogenous albumin after injection (half-life = 8 d) stimulates GH and IGF-I secretion in several animal species and in normal human subjects and enhances growth in rats. **Objective:** Our objective was to assess GH pulsatility after a single injection of CJC-1295 and determine which GH secretion parameters correlated to the increase in IGF-I production. **Methods:** GH pulsatility was assessed by 20-min blood sampling during an overnight 12-h period in healthy 20- to 40-yr-old men before and 1 wk after injection of either 60 or 90 microg/kg CJC-1295. **Results:** GH secretion was increased after CJC-1295 administration with preserved pulsatility. The frequency and magnitude of GH secretory pulses were unaltered. However, basal (trough) GH levels were markedly increased (7.5-fold; $P < 0.0001$) and contributed to an overall increase in GH secretion (mean GH levels, 46%; $P < 0.01$) and IGF-I levels (45%; $P < 0.001$). No significant differences were observed between the responses to the two drug doses. The IGF-I increases did not correlate with any parameters of GH secretion. **Conclusions:** CJC-1295 increased trough and mean GH secretion and IGF-I production with preserved GH pulsatility. The marked enhancement of trough GH levels by continuous GHRH stimulation implicates the importance of this effect on increasing IGF-I. Long-acting GHRH preparations may have clinical utility in patients with intact pituitary GH secretory capability.

<https://sci-hub.se/10.1210/jc.2006-1702>

Sackmann-Sala L, et al. **Activation of the GH/IGF-1 axis by CJC-1295, a long-acting GHRH analog, results in serum protein profile changes in normal adult subjects.** Growth Horm IGF Res. 2009;19(6):471-7.

Abstract - Objective: To identify biomarkers of growth hormone (GH) and insulin-like growth factor 1 (IGF-1) action in human serum. **Background:** The search for new markers of GH activity has received extensive attention given that the current biomarkers (IGF-1, IGFBP-3 and collagen peptides) show substantial variability in the population, and are not reliably predictive of either the physiologic effects of GH therapy or the detection of GH abuse by athletes. GH releasing hormone (GHRH) is a polypeptide synthesized in the hypothalamus that binds to receptors on pituitary somatotropes to promote the synthesis and release of GH. Serum GH and IGF-1 levels have been shown to increase with administration of GHRH or CJC-1295, a long-acting GHRH analog. **Design:** Sera from 11 healthy young adult men before and one week after CJC-1295 injection were analyzed by two-dimensional gel electrophoresis for proteomic changes. Serum proteins displaying significant changes before and after treatment were subsequently identified using mass spectrometry. In addition, correlations between these proteins and GH or IGF-1 levels were evaluated. **Results:** Two protein spots that displayed decreased intensities after treatment were identified as an apolipoprotein A1 isoform and a transthyretin isoform. Three protein spots upregulated by CJC-1295 treatment included beta-hemoglobin, a C-terminal fragment of albumin, and a mix of an immunoglobulin fragment and another C-terminal albumin fragment. A linear relationship was found between the spot containing immunoglobulin and albumin fragments and IGF-1 levels. **Conclusions:** Although the molecular mechanisms linking the identified proteins to GH and IGF-1 biological activity remain to be clarified, the results suggest that they represent potential biomarkers of GH and/or IGF-1 action.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2787983/pdf/nihms102981.pdf>

Sato K, et al. **Synthetic Analogs Of Growth Hormone-releasing Factor With Antagonistic Activity In Vitro.** Biochem Biophys Res Commun. 1990;167(1):360-6.



Analogues of human and rat growth hormone-releasing factor (hGRF and rGRF), related to [D-Argz]hGRF(1-29)NH₂, were synthesized by solid phase methodology. Their capacity to inhibit growth hormone secretion stimulated by hGRF(1-44)NH₂ was tested on rat anterior pituitary cells in monolayer culture. Among the analogues of hGRF, [D-Arg^{2,29},Arg³⁰]hGRF(1-30)NH₂ showed the highest antagonistic potency of 3.64 relative to [DArgz] hGRF(1-29)NH₂ = 1. However, the most potent analogue synthesized thus far was [N-Ac-His*,D-Arg²,Ala¹⁵]rGRF(1-29)NH₂, which showed a relative potency of 27.7.



– Synthetic Analogs Of Growth Hormone-releasing Factor With Antagonistic Activity In Vitro

Jette L, et al. **Human growth hormone-releasing factor (hGRF)1-29-albumin bioconjugates activate the GRF receptor on the anterior pituitary in rats: identification of CJC-1295 as a long-lasting GRF analog.** *Endocrinol.* 2005;146(7):3052-8.



In vivo bioconjugation to the free thiol on Cys34 of serum albumin by a strategically placed reactive group on a bioactive peptide is a useful tool to extend plasma half-life. Three maleimido derivatives of human GH-releasing factor (hGRF)1–29 were synthesized and bioconjugated to human serum albumin ex vivo. All three human serum albumin conjugates showed enhanced in vitro stability against dipeptidylpeptidase-IV and were bioactive in a GH secretion assay in cultured rat anterior pituitary cells. When the maleimido derivatives were individually administered sc to normal male Sprague Dawley rats, an acute secretion of GH was measured in plasma. The best compound, CJC-1295, showed a 4-fold increase in GH area under the curve over a 2-h period compared with hGRF1–29. CJC-1295, a tetrasubstituted form of hGRF1–29 with an added N-3-maleimidopropionamide derivative of lysine at the C-terminus, was selected for further pharmacokinetic evaluation, where it was found to be present in plasma beyond 72 h. A Western blot analysis of the plasma of a rat injected with CJC-1295 showed the presence of a CJC-1295 immunoreactive species on the band corresponding to serum albumin, appearing after 15 min and remaining in circulation beyond 24 h. These results led to the identification of CJC-1295 as a stable and active hGRF1–29 analog with an extended plasma half-life.



- Human growth hormone-releasing factor (hGRF)1-29-albumin bioconjugates activate the GRF receptor on the anterior pituitary in rats: identification of CJC-1295 as a long-lasting GRF analog.

Alba M, et al. **Once-daily administration of CJC-1295, a long-acting growth hormone-releasing hormone (GHRH) analog, normalizes growth in the GHRH knockout mouse.** *Am J Physiol Endocrinol Metab.* 2006;291(6):E1290-4.



ABSTRACT: Once-daily administration of CJC-1295, a long-acting growth hormone-releasing hormone (GHRH) analog, normalizes growth in the GHRH knockout mouse. *Am J Physiol Endocrinol Metab* 291: E1290–E1294, 2006. First published July 5, 2006; doi:10.1152/ajpendo.00201.2006.— Although the majority of children with isolated growth hormone (GH) deficiency have a good growth response to GH-releasing hormone (GHRH), the use of this therapeutic agent is limited by its very short half-life. Indeed, we have shown that, in mice with GHRH gene ablation (GHRH knockout; GHRHKO), even twice-daily injections of a GHRH analog are unable to normalize growth. CJC-1295 is a synthetic GHRH analog that selectively and covalently binds to endogenous albumin after injection, thereby extending its

half-life and duration of action. We report the effects of CJC-1295 administration in GHRHKO animals. Three groups of 1-wk-old GHRHKO mice were treated for 5 wk with 2 g of CJC-1295 at intervals of 24, 48, and 72 h. Placebo-treated GHRHKO mice and mice heterozygous for the GHRHKO allele served as controls. GHRHKO animals receiving daily doses of CJC-1295 exhibited normal body weight and length. Mice treated every 48 and 72 h reached higher body weight and length than placebo-treated animals, without full growth normalization. Femur and tibia length remained normal in animals treated every 24 and 48 h. Relative lean mass and subcutaneous fat mass were normal in all treated groups. CJC-1295 caused an increase in total pituitary RNA and GH mRNA, suggesting that proliferation of somatotroph cells had occurred, as confirmed by immunohistochemistry images. These findings demonstrate that treatment with once-daily administration of CJC-1295 is able to maintain normal body composition and growth in GHRHKO mice. The same dose is less effective when administered every 48 or 72 h.



– Once-daily administration of CJC-1295, a long-acting growth hormone-releasing hormone (GHRH) analog, normalizes growth in the GHRH knockout mouse

Thomas MJ. **The Molecular Basis Of Growth Hormone Action.** Growth Horm and IGF Res. 1998;8:3-11.



Recent studies have begun to elucidate the molecular actions of growth hormone, a major regulator of somatic growth and metabolic functions. The cell surface growth hormone receptor, a member of the cytokine receptor superfamily, binds as a dimer to a single growth hormone molecule. Receptor dimerization precedes signal transduction, which is predominantly mediated by the non-receptor tyrosine kinase, Jak2. Activation of Jak2 leads to mitogenic proliferation, phosphorylation of intracellular proteins, MAP kinase activation, activation of Stats 1, 3, and 5, and induction of target gene expression. Specific cytoplasmic domains of the growth hormone receptor mediate Jak2 activation, metabolic actions of growth hormone, Stat activation, and calcium influx.



– The Molecular Basis Of Growth Hormone Action

Clemmons DR. **Long-Acting Forms of Growth Hormone-Releasing Hormone and Growth Hormone: Effects in Normal Volunteers and Adults with Growth Hormone Deficiency.** Horm Res. 2007;68 Suppl 5:178-81.



ABSTRACT: Background: Growth hormone (GH) replacement therapy in adults and children has found broad acceptance by endocrinologists and patients, but the need for daily injections remains a significant barrier to more widespread use. **Long-acting Formulations:** Several approaches have been taken to develop long-acting forms of GH and to extend the half-life of GH-releasing factor. Each of these preparations has been tested in experimental animal models and found to extend the half-life of GH and GH-releasing hormone (GHRH) and to increase mean daily GH levels. Frequent sampling following administration of long-acting GHRH showed that the greatest increases occurred in trough GH levels, which increased 7.8-fold. The extended GH half-life and increased trough levels resulted in increases in insulin-like growth factor I (IGF-I) levels, which increased 1.4- to 4.1-fold and extended the duration of the IGF-I increase from 7 to 14 days. These increases in GH and IGF-I levels allow these compounds to be administered much less frequently, and several studies have shown that IGF-I levels can be maintained in a therapeutically effective range with much less frequent GH administration. **Safety:** Complications other than those generally associated with GH therapy include nodule formation and lipoatrophy at the injection sites. One long-term study of a long-acting formulation demonstrated that growth could be effectively stimulated in GH-deficient children, but that the peak growth velocity was only about 80% of that seen following daily subcutaneous GH injections. Subcutaneous nodule formation in some patients may have contributed to noncompliance and thus to the difference in growth velocity. **Conclusions:** Different types of GH and GHRH formulations have been developed with extended half-lives. In general, these preparations are pharmacokinetically and pharmacodynamically effective, extend GH half-lives with longer sustained elevation of IGF-I and permit much less frequent GH administration. Thus, it may be possible to develop a therapeutically effective form of GH for use in long-term treatment. The precise efficacy and safety assessments to use in monitoring long-term GH administration have not been definitively established.



– Long-Acting Forms of Growth Hormone-Releasing Hormone and Growth Hormone: Effects in Normal Volunteers and Adults with Growth Hormone Deficiency

¹ Ionescu M, et al. Pulsatile secretion of growth hormone (GH) persists during continuous stimulation by CJC1295, a long-acting GH-releasing hormone analog. *J clin Endocrinol Metab.* 2006;91(12):4792-7.

² Teichman SL, et al. Prolonged stimulation of growth hormone (GH) an insulin-like growth factor-1 secretion by CJC 1295, a long-acting analog of GH-releasing hormone, in healthy adults. *J Clin Endocrinol Metab.* 2006;91(3):799-805.

³ Teichman SL, et al. Prolonged stimulation of growth hormone (GH) an insulin-like growth factor-1 secretion by CJC 1295, a long-acting analog of GH-releasing hormone, in healthy adults. *J Clin Endocrinol Metab.* 2006;91(3):799-805.

⁴ Walker RF. Sermorelin: a better approach to management of adult-onset growth hormone insufficiency? *Clin Interv Aging.* 2006;1(4):307-8.

⁵ Raun K, et al. Ipamorelin, the first selective growth hormone secretagogue. *Eur J Endocrinol.* 1998;139(5):552-61.