

GUIDANT

Physician's System Manual

**CONTAK CD® CRT-D
1823**

Cardiac Resynchronization Therapy Defibrillator

CARDIAC

RHYTHM

MANAGEMENT

RESTRICTED DEVICE: Federal law (USA) restricts this device to sale, distribution, and use by, or on the lawful order of a physician trained or experienced in device implant and follow-up procedures.

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Nominal Mechanical Specifications

	Dimensions W x H x D (cm)	Volume (cc)	Mass (g)	Maximum Shock Energy (J)	Connector Size ^{b, c}	Case Electrode Surface Area (mm ²)
CONTAK CD 1823 ^a	5.9 x 7.9 x 1.6	60	110	31	LV-1, IS-1, DF-1	9464

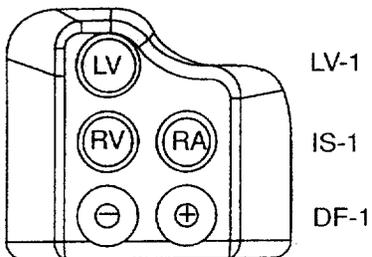
a. This model pulse generator uses its case as a defibrillating electrode.

b. For lead compatibility information, refer to Appendix C; and to the non-Guidant lead system warning on page 3.

c. LV-1 refers to the Guidant LV[®] proprietary connector. IS-1 refers to the international standard ISO 5841.3:1992. DF-1 refers to the international standard ISO 11318:1993.

Model 1823

Case material	Hermetically sealed titanium
Header material	Implantation-grade polymer
Power supply (WGL)	Two lithium-silver vanadium oxide cells



Chapter 1

DESCRIPTION AND USE

The Guidant CONTAK CD[®] cardiac resynchronization therapy defibrillator (CRT-D), Model 1823, provides ventricular tachyarrhythmia and cardiac resynchronization therapies. Ventricular tachyarrhythmia therapy is for the treatment of ventricular tachycardia (VT) and ventricular fibrillation (VF), rhythms that are associated with sudden cardiac death (SCD). Cardiac resynchronization therapy is for the treatment of heart failure (HF) and uses simultaneous biventricular electrical stimulation to synchronize ventricular contractions. The device also uses accelerometer-based adaptive-rate bradycardia therapy similar to Guidant's commercially available VENTAK[®] family of implantable cardioverter defibrillators (ICDs). The pulse generator, an atrial lead, and two ventricular leads connected in a parallel configuration constitute the implantable portion of the CRT-D system. The device accepts one IS-1¹ atrial lead, one LV-1 coronary venous pace/sense lead, and one DF-1/IS-1 cardioversion/defibrillation lead. Guidant recommends cardioversion/defibrillation leads with a pacing electrode tip surface area $\geq 8\text{mm}^2$ such as the ENDOTAK[®] ENDURANCE EZ[®] leads (Models 0154, 0155), or the ENDOTAK[®] DSP lead (Model 0125).

Cardioversion/defibrillation therapies include a range of low- and high-energy shocks using either a biphasic or monophasic waveform. The CONTAK CD device uses the Guidant TRIAD[®] electrode system for defibrillation energy delivery. By using the metallic housing of the pulse generator as an active electrode, combined with the Guidant ENDOTAK two-electrode defibrillation lead, energy is sent via a dual-current pathway from the distal shocking electrode to the proximal electrode and to the pulse generator case. The CONTAK CD device also offers a wide variety of antitachycardia pacing schemes to terminate slower, more stable ventricular tachyarrhythmias. Bradycardia pacing with cardiac resynchronization therapy, including adaptive-rate features, is available to detect and treat bradyarrhythmias and to support the cardiac rhythm after defibrillation therapy.

The ZOOM[®] Programming System, which includes the Model 2920 Programmer/Recorder/Monitor (PRM), the Model 2848 Software Application, and an accessory telemetry wand, constitutes the external portion of the CONTAK CD system. The external components allow interrogation and programming of the pulse generator as well as access to the device's diagnostic features. The CONTAK CD system can be programmed to provide a variety of therapy options. It also can provide noninvasive diagnostic testing and therapy history data.

Related Manuals and Information Tools

The Operator's Manual for the Guidant Programmer/Recorder/Monitor provides information specific to the programmer, such as setting up the system, maintenance, and handling. Physician's manuals for the leads provide specific information and instructions regarding the implanted leads.

1. Refer to the Nominal Mechanical Specifications table in the inside front cover of the manual for the defibrillating and pace/sense lead port dimensions; and refer to Appendix C for compatible Guidant leads.

Indications for Use

The CONTAK CD CRT-D is indicated for use in the following:

Patients who are at high risk of sudden cardiac death due to ventricular arrhythmias and who have moderate to severe heart failure (NYHA Class III/IV) including left ventricular dysfunction (EF \leq 35%) and QRS duration \geq 120 ms and remain symptomatic despite stable, optimal heart failure drug therapy.

Patient populations at high risk of sudden cardiac death due to ventricular arrhythmias include, but are not limited to, those with:

- Survival of at least one episode of cardiac arrest (manifested by the loss of consciousness) due to a ventricular tachyarrhythmia.
- Recurrent, poorly tolerated sustained ventricular tachycardia (VT).

NOTE: *The clinical outcome of hemodynamically stable, sustained-VT patients is not fully known. Safety and effectiveness studies have not been conducted.*

- Prior myocardial infarction, left ventricular ejection fraction of \leq 35%, and a documented episode of nonsustained VT, with an inducible ventricular tachyarrhythmia. Patients suppressible with IV procainamide or an equivalent antiarrhythmic (drug) have not been studied.

Contraindications

The CONTAK CD CRT-D is contraindicated for use in the following:

- Patients whose ventricular tachyarrhythmias may have reversible cause, such as 1) digitalis intoxication, 2) electrolyte imbalance, 3) hypoxia, or 4) sepsis, or
- Patients whose ventricular tachyarrhythmias may have a transient cause, such as 1) acute myocardial infarction, 2) electrocution, or 3) drowning.

Warnings

General

- **Labeling knowledge.** Read this manual thoroughly before implanting the pulse generator to avoid damage to the system. Such damage can result in injury to or death of the patient.
- **Avoid shock during handling.** Program the pulse generator Tachy Mode to Off during implant, explant, or postmortem procedures to avoid inadvertent high voltage shocks.
- **Defibrillator paddles.** Always have sterile external and internal defibrillator paddles or an equivalent (eg, R2² pads) immediately available during conversion testing. If not terminated in a timely fashion, an induced tachyarrhythmia can result in the patient's death.
- **Resuscitation availability.** Ensure that an external defibrillator and medical personnel skilled in cardiopulmonary resuscitation (CPR) are present during post-implant device testing should the patient require external rescue.
- **Magnetic resonance imaging (MRI) exposure.** Do not expose a patient to MRI device scanning. Strong magnetic fields may damage the device and cause injury to the patient.
- **Diathermy.** Do not subject a patient with an activated implanted pulse generator to diathermy since diathermy may damage the pulse generator.

Programming and Device Operation

- **Atrial tracking modes.** Do not use atrial tracking modes in patients with chronic refractory atrial tachyarrhythmias. Tracking of atrial arrhythmias could result in VT or VF.
- **Atrial only modes.** Do not use atrial only modes in patients with heart failure because such modes do not provide cardiac resynchronization therapy.

2. Trademark of R2 Corporation.

- **Hysteresis.** For heart failure patients, the use of hysteresis may not provide cardiac resynchronization therapy.
- **Ventricular sensing.** Left ventricular lead dislodgment to a position near the atria can result in atrial oversensing and ventricular inhibition. See Sensitivity Adjustment on page 157 for more information.
- **Slow VT.** Physicians should use medical discretion when implanting this device in patients who present with slow VT. Programming therapy for slow monomorphic VT may preclude CRT delivery at faster rates if these rates are in the tachyarrhythmia zones. See CRT Delivery Zone and Tachyarrhythmia Zones on page 48 for more information.

Implant Related

- **Lead system.** The use of non-Guidant lead systems may cause potential adverse consequences, such as undersensing cardiac activity and failure to deliver necessary therapy.
- **Patch leads.** Do not use defibrillation patch leads with the CONTAK CD system, or injury to the patient may occur.
- **Defibrillation leads.** Use cardioversion/defibrillation leads with a pacing electrode tip surface area $\geq 8\text{mm}^2$ such as the ENDOTAK[®] ENDURANCE EZ[®] leads (Models 0154, 0155), or the ENDOTAK[®] DSP lead (Model 0125); otherwise injury to the patient may occur.
- **Separate pacemaker.** Do not use the CRT-D with a separate pacemaker system. This combination could result in CRT-D/pacemaker interaction.
- **Emulator.** The emulator is not intended for use as a permanent lead electrode and must be removed from the patient. It is for one-time use only. Do not resterilize.

Precautions

Sterilization, Storage, and Handling

- **For single use only—do not resterilize devices.** Do not resterilize the device or the accessories packaged with it because Guidant cannot ensure that resterilization is effective.
- **If package is damaged.** Guidant sterilizes the pulse generator blister trays and contents with ethylene oxide gas before final packaging. When the pulse generator is received, it is sterile, provided the container is intact. If the packaging is wet, punctured, opened, or otherwise damaged, return the device to Guidant.
- **Storage temperature and equilibration.** Recommended storage temperatures are 0–50°C (32–122°F). Allow the device to reach room temperature before programming or implanting the device because temperature extremes may affect initial device function.
- **Device storage.** Store the pulse generator in a clean area, away from magnets, kits containing magnets, and sources of electromagnetic interference (EMI) to avoid device damage.
- **Use before date.** Do not implant the pulse generator after the USE BEFORE date (which appears on the device packaging) has passed because this date reflects a reasonable shelf life.

Implantation and Device Programming

- **STAT PACE settings.** Do not leave the device programmed in STAT PACE settings; these settings may significantly reduce the lifetime of the device due to the high output.
- **Drug-resistant SVTs.** Determine if the device and programmable options are appropriate for patients with drug-resistant supraventricular tachyarrhythmias (SVTs), because drug-resistant SVTs can initiate unwanted tachyarrhythmia therapy or can cause inhibition of cardiac resynchronization therapy.

- **AV Delay.** For delivery of cardiac resynchronization therapy, the programmed setting for the AV Delay must be less than the patient's intrinsic intracardiac AV interval.
- **Adaptive-rate pacing.** The clinical benefit of adaptive-rate pacing in heart failure patients has not been studied. The use of adaptive-rate pacing should be used with medical discretion if the patient develops an indication for rate-responsive pacing, such as chronotropic incompetence. Patients with heart failure may have hemodynamic compromise at rapid sensor-driven rates and the physician may wish to program less aggressive adaptive-rate parameters in accordance with patient condition.
- **Atrial Tachy Response (ATR).** ATR should be programmed Off unless the patient has a history of atrial tachyarrhythmias. The delivery of CRT is compromised because AV synchrony is disrupted.
- **Threshold test.** Backup VVI pacing is not available during a pacing threshold test.
- **Do not kink leads.** Kinking leads may cause additional stress on the leads, possibly resulting in lead fracture.
- **Do not bend the lead near the lead–header interface.** Improper insertion can cause insulation damage near the terminal ring that could result in lead failure.
- **Shock wave polarity.** Never change the shock waveform polarity by physically switching the lead anodes and cathodes in the pulse generator header—use the programmable Polarity feature. Device damage or nonconversion of the arrhythmia post-operatively may result if polarity is switched physically.
- **Absence of an LV-1 lead.** Absence of an LV-1 plug or an electrode in the unused lead port of an LV-1 header may affect device performance. If an electrode is not used, be sure to insert a plug.
- **Electrode rings.** The setscrews should be tightened onto the electrode rings of the pace/sense leads. If setscrews are tightened onto the silicone rubber insulation, permanent damage to the leads could occur.
- **Tachy Mode to Off.** Ensure that the pulse generator's Tachy Mode is Off when not in use, before handling it, and before using electrosurgery to prevent inappropriate shocks. For tachyarrhythmia therapy, verify that the Tachy Mode is on.
- **Atrial oversensing.** Care must be taken to ensure that artifacts from the ventricles are not present on the atrial channel or atrial oversensing may result. If ventricular artifacts are present in the atrial channel, the atrial lead may need to be repositioned to minimize its interaction.
- **Defibrillating lead impedance.** If a defibrillating lead impedance is less than 20 Ω , the defibrillating leads should be repositioned. The pulse generator should never be implanted with a lead system that has less than 15- Ω total lead impedance. Device damage may result.

Follow-up Testing

- **Conversion testing.** Successful conversion of ventricular fibrillation or ventricular tachycardia during arrhythmia conversion testing is no assurance that conversion will occur post-operatively. Be aware that changes in the patient's condition, drug regimen, and other factors may change the defibrillation threshold (DFT), which may result in nonconversion of the arrhythmia post-operatively.

Pulse Generator Explant and Disposal³

- **Incineration.** Be sure that the pulse generator is removed before cremation. Cremation and incineration temperatures might cause the pulse generator to explode.
- **Device handling.** Program the pulse generator Tachy Mode to Off, disable the magnet feature, and disable the Beep When ERI Is Reached beeper before explanting, cleaning, or shipping the device to prevent unwanted shocks, overwriting of important therapy history data, and audible tones.

3. Refer to the Explantation section in Chapter 11.

- Return all explanted pulse generators and leads to Guidant.

Environment and Medical Therapy Hazards

- **Avoiding EMI.** Advise patients to avoid sources of EMI (electromagnetic interference) because EMI may cause the pulse generator to deliver inappropriate therapy or inhibit appropriate therapy. Examples of EMI sources are: electrical power sources, arc welding equipment and robotic jacks, electrical smelting furnaces, large RF transmitters such as RADAR, radio transmitters including those used to control toys, electronic surveillance (anti-theft) devices, and an alternator on a car that is running.

Hospital and Medical Environments

- **Do not use internal defibrillation** paddles unless the pulse generator is disconnected from the leads because it may shunt energy causing injury to the patient, and may damage the pulse generator.
- **External defibrillation.** Use of external defibrillation can damage the pulse generator. To help prevent defibrillation damage to the pulse generator: position the defibrillation paddles as far from the pulse generator as possible, position the defibrillation paddles perpendicular to the implanted pulse generator–lead system, and set energy output of defibrillation equipment as low as clinically acceptable.

Following any external defibrillation episode, verify pulse generator function since external defibrillation may have damaged the pulse generator. To verify proper function: interrogate the device, perform a manual capacitor re-formation, verify battery status, check the shock counters, and ensure that programmable parameters did not change.

- **Electrical interference** or “noise” from devices such as electrosurgical and monitoring equipment may interfere with establishing or maintaining telemetry for interrogation or programming of the device. In the presence of such interference, move the programmer away from electrical devices and ensure that the wand cord and cables are not crossing one another.
- **Electrosurgical cautery.** Do not use electrosurgery devices until the pulse generator’s tachyarrhythmia therapy is deactivated. If active, the pulse generator may deliver an inappropriate shock to the patient. Remember to reactivate the pulse generator after turning off the electrosurgery equipment.
- **Ionizing radiation therapy may adversely affect device operation.** During ionizing radiation therapy (eg, radioactive cobalt, linear accelerators, and betatrons), the pulse generator must be shielded with a radiation-resistive material, regardless of the distance of the device to the radiation beam. Do not project the radiation port directly at the device. After waiting a minimum of one hour following radiation treatment (to allow for a device memory check to occur), always evaluate device operation including interrogation and sensing and pacing threshold testing. At the completion of the entire course of treatments, perform device interrogation and follow-up, including sensing and pacing threshold testing and capacitor re-formation.
- **Lithotripsy may damage the pulse generator.** If lithotripsy must be used, avoid focusing near the pulse generator site.
- **Therapeutic ultrasound energy may damage the pulse generator.** If therapeutic ultrasound energy must be used, avoid focusing near the pulse generator site.
- **Radio frequency ablation.** Exercise caution when performing radio frequency ablation procedures in device patients. If the pulse generator Tachy Mode is programmed On during the procedure, the device may inappropriately declare a tachycardia episode and deliver therapy, or may cause inhibition of pacing therapy. Minimize risks by following these steps:
 - Program the Tachy Mode to Off to avoid inadvertent tachycardia detection (sensing) or therapy.
 - Avoid direct contact between the ablation catheter and the implanted lead and pulse generator.

- Keep the current path (electrode tip to ground) as far away from the pulse generator and leads as possible.
- Have external defibrillation equipment available.
- Consider the use of external pacing support for pacemaker-dependent patients.

Home and Occupational Environments

- **Static magnetic fields.** Advise patients to avoid equipment or situations where they would have extended exposure to strong (>10 gauss or 1 mTesla) magnetic fields since the pulse generator mode could change. To prevent mode change in the presence of magnets, the Change Tachy Mode With Magnet feature may be programmed Off. Examples of magnetic sources are: industrial transformers and motors, magnetic resonance imaging (MRI) devices, large stereo speakers, telephone receivers if held within 0.5 inches (1.27 cm) of the pulse generator, and magnetic wands such as those used for airport security and in the game “Bingo.”

Electronic Article Surveillance (EAS)

- Advise patients to avoid lingering near anti-theft devices, such as those found in entrances and exits of department stores and public libraries, and to walk through them at a normal pace, because such devices may cause inappropriate pulse generator operation.

Cellular Phone

- Advise patients to hold cellular phones to the ear opposite the side of the implanted device. Patients should not carry a cellular phone in a breast pocket or on a belt over or within 6 inches (15 cm) of the implanted devices, since some cellular phones may cause the pulse generator to deliver inappropriate therapy or inhibit appropriate therapy.

ADVERSE EVENTS

Observed Adverse Events

The VENTAK[®] CHF/CONTAK CD[®]/EASYTRAK[®] Biventricular Pacing Study (hereafter referred to as the CONTAK CD Study) was a prospective, randomized, controlled, multicenter, double-blind study conducted at 47 sites in the United States and enrolled a total of 581 patients. Of these, 57 patients initially underwent a thoracotomy procedure to receive the Guidant Model 1822 VENTAK CHF AICD; 7 patients underwent a repeat procedure to receive an EASYTRAK lead. An additional 510 patients initially underwent an implant procedure to receive the Model 1823 CONTAK CD CRT-D along with the EASYTRAK (Models 4510/4511/4512/4513) coronary venous, single-electrode pace/sense lead for a total of 517 patients who underwent an EASYTRAK lead implant procedure. In 69 patients the EASYTRAK lead implant attempt was unsuccessful.

Table 1 provides information on all adverse events reported from implant through the randomization period in patients attempted or implanted with the EASYTRAK lead. During this period, a total of 765 events were reported in 310 patients. Of these, 155 were classified as complications, and 610 were classified as observations.

Table 1. Adverse Events Through the Randomization Period
(765 Events in 517 patients implanted or attempted with the EASYTRAK lead, 2559 total device months)

	# of Events (# of pts) ^a	% Complications (patients)	Complications per 100 Device Months (Events)	% Observations (patients)	Observations per 100 Device Months (Events)
Total Adverse Events	765 (310)	23.4 (121)	6.0 (155)	51.8 (268)	23.5 (610)
PG-Related Events					
Migration of device	1 (1)	0.0 (0)	0.0 (0)	0.2 (1)	0.0 (1)
Pacemaker mediated tachycardia (PMT)	3 (3)	0.0 (0)	0.0 (0)	0.6 (3)	0.1 (3)
Telemetry difficulty	1 (1)	0.2 (1)	0.0 (1)	0.0 (0)	0.0 (0)
LV Lead-Related Events					
Loss of capture	43 (41)	5.6 (29)	1.1 (29)	2.5 (13)	0.5 (14)
Inappropriate shock due to oversensing	1 (1)	0.0 (0)	0.0 (0)	0.2 (1)	0.0 (1)
Insulation breach observed	1 (1)	0.2 (1)	0.0 (1)	0.0 (0)	0.0 (0)
Multiple counting ^b	31 (22)	1.0 (5)	0.2 (5)	3.9 (20)	1.0 (26)
Phrenic nerve/diaphragm stimulation	15 (15)	0.4 (2)	0.1 (2)	2.5 (13)	0.5 (13)
RA Lead-Related Events					
Loss of capture	6 (6)	1.0 (5)	0.2 (5)	0.2 (1)	0.0 (1)
Oversensing	3 (3)	0.0 (0)	0.0 (0)	0.6 (3)	0.1 (3)
Undersensing	1 (1)	0.2 (1)	0.0 (1)	0.0 (0)	0.0 (0)
RV Lead-Related Events					
Loss of capture	10 (9)	0.6 (3)	0.1 (3)	1.2 (6)	0.3 (7)
Elevated DFTs	6 (6)	0.4 (2)	0.1 (2)	0.8 (4)	0.2 (4)
Inappropriate shock above rate cutoff	49 (38)	0.4 (2)	0.1 (2)	7.2 (37)	1.8 (47)
Inappropriate shock due to oversensing	5 (4)	0.0 (0)	0.0 (0)	0.8 (4)	0.2 (5)
Nonconversion of VF	1 (1)	0.2 (1)	0.0 (1)	0.0 (0)	0.0 (0)
Oversensing	2 (2)	0.0 (0)	0.0 (0)	0.4 (2)	0.1 (2)
Phantom shock	2 (2)	0.0 (0)	0.0 (0)	0.4 (2)	0.1 (2)
Phrenic nerve/diaphragm stimulation	5 (5)	0.4 (2)	0.1 (2)	0.6 (3)	0.1 (3)
Subtotal Device-Related Events	186 (135)	9.5 (49)	2.1 (54)	19.0 (98)	5.1 (132)
Procedure-Related Events					
AV Block	7 (7)	0.0 (0)	0.0 (0)	1.4 (7)	0.3 (7)
Coronary sinus dissection	5 (5)	0.0 (0)	0.0 (0)	1.0 (5)	0.2 (5)
Coronary venous perforation	5 (5)	0.2 (1)	0.0 (1)	0.8 (4)	0.2 (4)
Hematoma	11 (10)	0.8 (4)	0.2 (4)	1.2 (6)	0.3 (7)
Hypotension	7 (7)	0.0 (0)	0.0 (0)	1.4 (7)	0.3 (7)
Infection, post-operative wound	7 (7)	0.6 (3)	0.1 (3)	0.8 (4)	0.2 (4)
Pneumothorax	7 (7)	0.8 (4)	0.2 (4)	0.6 (3)	0.1 (3)
Post surgical wound discomfort	10 (9)	0.2 (1)	0.0 (1)	1.5 (8)	0.3 (9)
Renal failure	5 (5)	0.2 (1)	0.0 (1)	0.8 (4)	0.2 (4)

	# of Events (# of pts) ^a	% Complications (patients)	Complications per 100 Device Months (Events)	% Observations (patients)	Observations per 100 Device Months (Events)
Other ^c	18 (18)	1.2 (6)	0.2 (6)	2.3 (12)	0.5 (12)
Subtotal Procedure-Related Events	79 (71)	3.9 (20)	0.7 (17)	10.0 (51)	2.2 (56)
Cardiovascular-Related Events					
AV Block	3 (3)	0.0 (0)	0.0 (0)	0.6 (3)	0.1 (3)
Arrhythmia – SVT	49 (42)	0.2 (1)	0.0 (1)	7.9 (41)	1.8 (48)
Arrhythmia – VT	20 (17)	1.0 (5)	0.2 (5)	2.7 (14)	0.6 (15)
Arrhythmia – brady	16 (14)	0.2 (1)	0.0 (1)	2.5 (13)	0.6 (15)
Cardiac arrest	2 (2)	0.4 (2)	0.1 (2)	0.0 (0)	0.0 (0)
Chest pain	30 (20)	1.0 (5)	0.2 (5)	3.1 (16)	1.0 (25)
Coagulopathy	3 (3)	0.2 (1)	0.0 (1)	0.4 (2)	0.1 (2)
Congestive heart failure	140 (91)	3.5 (18)	0.7 (18)	16.1 (83)	4.7 (122)
Distal thromboemboli	3 (2)	0.0 (0)	0.0 (0)	0.4 (2)	0.1 (3)
Dizziness	17 (17)	0.0 (0)	0.0 (0)	3.3 (17)	0.7 (17)
Dyspnea (shortness of breath)	16 (13)	0.0 (0)	0.0 (0)	2.5 (13)	0.6 (16)
Fatigue	10 (10)	0.0 (0)	0.0 (0)	1.9 (10)	0.4 (10)
Hypertension	1 (1)	0.0 (0)	0.0 (0)	0.2 (1)	0.0 (1)
Hypotension	11 (9)	0.2 (1)	0.0 (1)	1.7 (9)	0.4 (10)
Myocardial infarction	2 (2)	0.0 (0)	0.0 (0)	0.4 (2)	0.1 (2)
Pacemaker syndrome	1 (1)	0.0 (0)	0.0 (0)	0.2 (1)	0.0 (1)
Palpitations	2 (2)	0.0 (0)	0.0 (0)	0.4 (2)	0.1 (2)
Pulmonary edema	6 (6)	0.4 (2)	0.1 (2)	0.8 (4)	0.2 (4)
Shock	4 (4)	0.2 (1)	0.0 (1)	0.6 (3)	0.1 (3)
Stroke syndrome or CVA	4 (4)	0.0 (0)	0.0 (0)	0.8 (4)	0.2 (4)
Syncope	9 (9)	0.0 (0)	0.0 (0)	1.7 (9)	0.3 (9)
Thrombosis	3 (3)	0.0 (0)	0.0 (0)	0.6 (3)	0.1 (3)
Vascular related	6 (6)	1.0 (5)	0.2 (5)	0.2 (1)	0.0 (1)
Subtotal Cardiovascular-Related Events	358 (200)	7.7 (40)	1.6 (42)	35.6 (184)	12.2 (316)
Total Noncardiovascular-Related Events	142 (92)	6.2 (32)	1.5 (39)	13.5 (70)	4.0 (103)

- a. The total number of patients for a given event represents the unique number of patients who experienced that event. The total may not be equal to the sum of patients with complications or observations because some patients experienced more than one event that fell into both categories.
- b. Sensing of the two ventricular intrinsic events when only one intrinsic event is present due to intraventricular conduction delay.
- c. Other procedure-related events occurred in three patients or fewer: Guide wire fracture (1), Hemorrhage (3), Finishing wire left in lead (1), Nonconversion of VF (1), Perforation, arterial (1), Perforation, cardiac (1), Perforation, venous (2), Pericardial effusion (3), Pericarditis (1), Physiological reaction (1).

A total of 109 deaths occurred during the study at any point in time. These deaths occurred during the study periods as shown in Table 2 along with the cause of death as adjudicated by an independent events committee.

Table 2. Deaths that Occurred During the Study
(All patients enrolled, N = 581)

Study Period	# of pt deaths	Cause of Death				
		Cardiac: Pump Failure	Cardiac: Arrhythmic	Cardiac: Other	Non-cardiac	Unknown
After unsuccessful implant procedure	2	1	1	0	0	0
Peri-operative (< = 30 days)	10	5	2	0	2	1
Randomized therapy phase ^a : No CRT	16	9	0	1	3	3
Randomized therapy phase ^a : CRT	11	4	1	2	2	2
Post-randomized therapy phase ^b	70	28	5	1	16	20
Total	109	47	9	4	23	26

a. Day 31 to 120 for Phase I patients, day 31 to 210 for Phase II patients.

b. Day 121 and beyond for Phase I patients, day 211 and beyond for Phase II patients.

Potential Adverse Events

Based on the literature and implantable cardioverter defibrillator (ICD) implant experience, the following alphabetical list includes potential adverse events associated with implantation of an ICD system:

- Acceleration of arrhythmias
- Air embolism
- Allergic reaction
- Bleeding
- Cardiac tamponade
- Chronic nerve damage
- Conductor coil fracture
- Death
- Elevated thresholds
- Erosion/extrusion
- Extracardiac stimulation (eg, phrenic, diaphragm, chest wall)
- Fibrotic tissue formation (eg, keloid formation)
- Fluid accumulation
- Formation of hematomas or cysts
- Heart block
- Inability to defibrillate or pace
- Inappropriate therapy (eg, shocks, ATP, pacing)
- Incomplete lead connection with pulse generator
- Infection
- Lead displacement/dislodgment
- Lead insulation breakage or abrasion
- Lead tip deformation and/or breakage
- Local tissue reaction
- Muscle and nerve stimulation
- Myocardial trauma (eg, cardiac perforation, irritability, injury)
- Myopotential sensing
- Oversensing/undersensing
- Pacemaker-mediated tachycardia
- Pericardial rub, effusion
- Pneumothorax
- Random component failures
- Shunting current or insulating myocardium during defibrillation with internal or external paddles
- Thrombosis/thromboemboli
- Valve damage
- Venous occlusion
- Venous trauma (eg, perforation, dissection, erosion)

Patients susceptible to frequent shocks despite antiarrhythmic medical management may develop psychologic intolerance to a implantable system that may include the following:

- Dependency
- Depression
- Fear of premature battery depletion
- Fear of shocking while conscious
- Fear that shocking capability may be lost
- Imagined shocking

In addition to the implantation of an ICD system, potential adverse events associated with implantation of a coronary venous lead system are listed below in alphabetical order:

- Allergic reaction to contrast media

- Breakage/failure of implant tools
- Coronary venous occlusion
- Coronary venous trauma (eg, perforation, dissection, erosion)
- Prolonged exposure to fluoroscopic radiation
- Renal failure from contrast media used to visualize coronary veins

SUMMARY OF CLINICAL STUDIES

Guidant conducted the CONTAK CD Study to demonstrate the safety and effectiveness of the CONTAK CD system and to demonstrate a reasonable assurance of the safety and effectiveness of biventricular stimulation, or cardiac resynchronization therapy (CRT), using the Guidant Model 1822 VENTAK CHF AICD and Model 1823 CONTAK CD CRT-D along with the EASYTRAK (Models 4510/4511/4512/4513) coronary venous, steroid-eluting, single-electrode pace/sense lead.

The CONTAK CD Study met the Lead and System Effectiveness endpoints as well as the Lead and System Safety Endpoints. In addition, some secondary CRT effectiveness endpoints related to functional capacity achieved nominal statistical significance. However, the primary CRT effectiveness endpoint did not achieve statistical significance, and the patient subgroup (NYHA Class III/IV) was not prospectively defined. Additional prospective data were requested by FDA to evaluate functional improvements in the patient population with NYHA Class III/IV heart failure.

Guidant subsequently submitted data from a Focused Confirmatory Study (FCS) that confirmed the CRT effectiveness results from the CONTAK CD Study. The study design and results of both studies are included in this section.

CONTAK CD Study

Study Design

The CONTAK CD study was a prospective, randomized, controlled, multicenter, double-blind study conducted at 47 sites in the United States and enrolled a total of 581 patients. All patients enrolled were intended to be implanted with a device capable of delivering both CRT and treating ventricular tachyarrhythmias. Patients were randomized to CRT Off (VVI lower rate 40) or CRT On (VDD). The study began as a crossover design (called "Phase I") and enrolled 248 patients with a primary endpoint of functional status with three months of follow-up. The study was later modified to a parallel design (called "Phase II") and enrolled 333 patients with a longer, six-month follow-up. The data from the first three months of the crossover phase were pooled with data obtained from the six-month parallel phase. The visit schedule and testing requirements remained the same. Additionally, while the study originally used the VENTAK CHF AICD in conjunction with epicardial leads placed via thoracotomy, the CONTAK CD CRT-D and EASYTRAK lead (placed transvenously) were added to the protocol later in the study.

Inclusion/Exclusion Criteria

Patients enrolled in the study were required to meet the following inclusion criteria:

- Meet the general indication for ICD implant
- Symptomatic heart failure despite optimal drug therapy (ACE inhibitors with diuretic and/or digoxin, as determined to be indicated and tolerated by the patient's physician-investigator)
- Left ventricular ejection fraction $\leq 35\%$
- QRS duration ≥ 120 ms
- Age ≥ 18 years
- Normal sinus node function

Patients were excluded from the investigation if they met any of the following criteria:

- Meet the general indications for permanent antibradycardia pacing, including pacemaker dependence

- Have chronic, medically refractory atrial tachyarrhythmias
- Require concomitant cardiac surgery
- Are unable to undergo device implant, including general anesthesia if required
- Are unable to comply with the protocol and follow-up requirements, including exercise testing
- Have a life expectancy of less than six months due to other medical conditions
- Have amyloid disease (amyloidosis)
- Have hypertrophic obstructive cardiomyopathy
- Require in-hospital continuous intravenous inotropes
- Have pre-existing cardioversion/defibrillation leads other than those specified in this investigational plan (unless the investigator intends to replace them with permitted cardioversion/defibrillation leads)
- Women who are pregnant or not using medically accepted birth control
- Have a mechanical tricuspid prosthesis
- Involved in other cardiovascular clinical investigations of active therapy or treatment

Follow-up Schedule

Pre-implant visit	Initial assessment of patient eligibility; taking of patient history.
Implant	Implant of investigational devices and acute device testing. Randomization status (CRT or No CRT) was assigned for implementation after a 30-day Recovery Period.
Recovery Period	Minimum 30-day period over which the patient recovered from the implant procedure and had his/her heart failure medications adjusted, but with no CRT, regardless of the randomization assignment.
Post-Recovery Visit	First visit after the Recovery Period in which patients underwent Special Testing* to establish their baseline condition, after which the randomization assignment was implemented (CRT or No CRT).
Three- and six-month visit	Evaluation of randomized therapy with Special Testing* and device function at three- and six-months after the Post-Recovery Visit.
Quarterly Visits	After the six-month visit, patients were seen for routine evaluation of device function and patient condition.

- * Special Testing included a Symptom-Limited Treadmill Test with measurement of oxygen uptake (Peak VO₂), a Six-Minute Walk, Echocardiography, Holter monitoring, blood chemistry testing, and a Quality of Life (QOL) questionnaire.

Patient Groups

The CONTAK CD Study included patients with symptomatic heart failure despite optimal drug therapy. The population included patients who were NYHA Class II/III/IV at the time of implant.

Based upon the clinical results from the covariate analyses in this study and the internal consistency of these clinical findings with those from other completed CRT studies, the patient subgroup with NYHA Class III/IV heart failure in this study was examined further.

Results indicate that patients with NYHA Class III/IV heart failure demonstrated the greatest improvement. Therefore, the CONTAK CD System indications for this PMA are for patients with NYHA Class III/IV heart failure.

- **All Patients:** All patients (NYHA Class II/III/IV at the time of implant) implanted with an investigational system (N = 501). Ten patients died and one withdrew before the post-recovery visit. Therefore, therapy effectiveness analyses used N = 490.
- **NYHA Class III/IV (Advanced Heart Failure):** This subgroup was defined as those patients with moderate to severe heart failure at the time of the Post-Recovery Visit

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(N = 227). The randomization assignment (CRT vs. No CRT) was initiated after baseline measurements were performed. This subgroup was determined from interaction analysis of preselected covariates with the functional status endpoints.

Endpoints

The CONTAK CD Study had three investigational elements consisting of:

CRT Effectiveness:

Primary: Composite endpoint consisting of all-cause mortality, hospitalization for heart failure, and ventricular tachyarrhythmia requiring device intervention.

Secondary: Peak VO₂ derived from a symptom-limited exercise test and Quality of Life as measured by the Minnesota Living with Heart Failure Questionnaire[®].

Additional: Six-Minute Walk, NYHA Class, Echocardiographic Analysis, Change in Norepinephrine, and Change in Heart Rate.

Lead and System Effectiveness:

Lead: Left ventricular pacing thresholds, biventricular sensing, biventricular lead impedance, and lead placement success rate.

System: VF detection time and biventricular antitachycardia pacing (ATP) efficacy.

Lead and System Safety:

Lead: Incidence of lead-related adverse events.

System: Incidence of severe, device-related adverse events and operative mortality.

Study Results

Patient Accountability

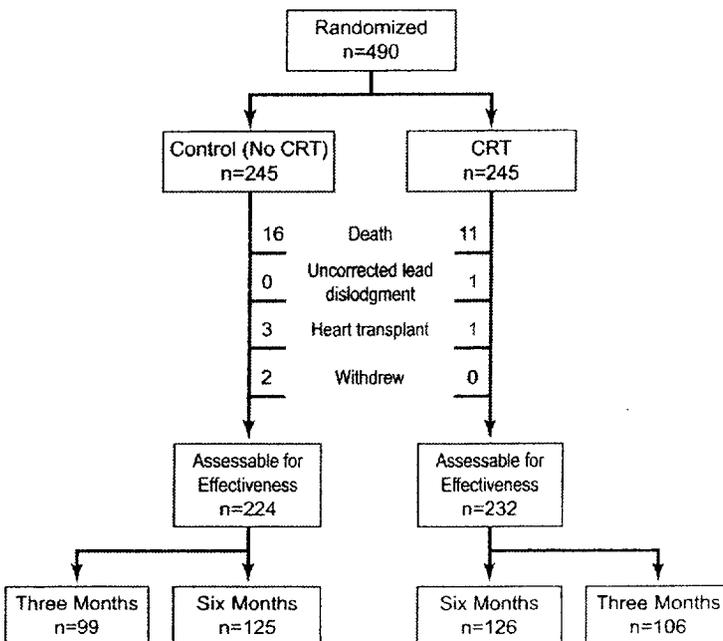


Figure 1. Enrollment and follow-up of randomized patients.

Baseline Characteristics

Table 3. Pre-implant Assessment
(All patients implanted, N = 501)

Characteristic		All Patients			NYHA Class III/IV		
		CRT (N=248)	No CRT (N=253)	P-val*	CRT (N=117)	No CRT (N=110)	P-val*
Age at Implant (years)	N	248	253		117	110	
	Mean +/- SD	66.0 +/- 10.5	66.3 +/- 10.5	0.73	66.1 +/- 10.5	65.8 +/- 10.5	0.80
	Range	26.1 - 82.6	29.5 - 86.3		26.1 - 82.5	38.3 - 85.3	
Gender [N (%)]	Male	210 (84.7)	211 (83.4)	0.70	90 (76.9)	86 (78.2)	0.82
	Female	38 (15.3)	42 (16.6)		27 (23.1)	24 (21.8)	
NYHA Class [N (%)]	II	80 (32.3)	83 (32.8)	0.66	20 (17.1)	11 (10.0)	0.08
	III	148 (59.7)	144 (56.9)		85 (72.6)	78 (70.9)	
	IV	20 (8.1)	26 (10.3)		12 (10.3)	21 (19.1)	
Concomitant Medications [N (%)]	ACE or ARB	212 (85.5)	224 (88.5)	0.31	95 (81.2)	98 (89.1)	0.19
	Beta Blocker	119 (48.0)	117 (46.2)	0.76	52 (44.4)	44 (40.0)	0.42
	Digoxin	172 (69.4)	171 (67.6)	0.67	84 (71.8)	75 (68.2)	0.55
	Diuretic	217 (87.5)	210 (83.0)	0.16	103 (87.2)	95 (86.4)	0.15
Qualifying LVEF (%)	N	248	253		117	110	
	Mean +/- SD	21.4 +/- 6.6	21.5 +/- 6.7	0.74	20.6 +/- 6.4	21.1 +/- 6.2	0.61
	Range	5.0 - 35.0	10.0 - 35.0		8.0 - 35.0	10.0 - 35.0	
PR Interval** (ms)	N	224	222		107	91	
	Mean +/- SD	205 +/- 42	202 +/- 49	0.44	204 +/- 41	200 +/- 54	0.60
	Range	88 - 336	104 - 400		136 - 336	110 - 400	
Qualifying QRS Duration** (ms)	N	226	224		109	93	
	Mean +/- SD	160 +/- 27	156 +/- 26	0.06	164 +/- 27	152 +/- 24	<0.01
	Range	120 - 240	120 - 264		120 - 240	120 - 222	
Resting Heart Rate (bpm)	N	248	253		117	110	
	Mean +/- SD	73 +/- 12	75 +/- 14	0.37	75 +/- 13	74 +/- 15	0.61
	Range	43 - 108	48 - 120		43 - 108	50 - 120	
Systolic Blood Pressure (mmHg)	N	247	253		116	110	
	Mean +/- SD	118 +/- 21	118 +/- 21	0.95	116 +/- 20	117 +/- 23	0.72
	Range	79 - 197	70 - 190		79 - 191	74 - 190	
Diastolic Blood Pressure (mmHg)	N	247	253		116	110	
	Mean +/- SD	67 +/- 12	69 +/- 12	0.27	68 +/- 12	67 +/- 14	0.85
	Range	31 - 100	40 - 109		31 - 100	40 - 109	

- * P-values for comparing means were calculated with Student's t-test; p-values for comparing proportions were calculated with Pearson's chi-squared test.
- ** PR interval and QRS duration were not obtained for thoracotomy patients.

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Table 4. Pre-implant History
(All patients implanted, N = 501)

Characteristics		All Patients			NYHA Class III/IV		
		CRT (N=248)	No CRT (N=253)	P-val ^a	CRT (N=117)	No CRT (N=110)	P-val ^a
Primary Tachyarrhythmia [N (%)]	Monomorphic VT (MVT)	148 (59.7)	136 (53.8)	0.44	72 (61.5)	48 (43.6)	0.03
	Polymorphic VT (PVT)	16 (6.5)	20 (7.9)		7 (6.0)	7 (6.4)	
	Nonsustained VT	58 (23.4)	63 (24.9)		30 (25.6)	35 (31.8)	
	Ventricular Fibrillation (VF)	26 (10.5)	32 (12.6)		8 (6.8)	18 (16.4)	
	Other	0 (0.0)	2 (0.8)		0 (0.0)	2 (1.8)	
Other Arrhythmias [N (%)]	Paroxysmal Atrial Fibrillation	43 (17.3)	62 (24.5)	0.05	21 (17.9)	29 (26.4)	0.13
	Atrial Flutter	10 (4.0)	13 (5.1)	0.55	3 (2.6)	7 (6.4)	0.16
Arrhythmia/ Conduction Disorder [N (%)]	LBBB	133 (53.6)	138 (54.5)	0.83	59 (50.4)	59 (53.6)	0.55
	RBBB	35 (14.1)	31 (12.3)		21 (17.9)	14 (12.7)	
	Non-Specific	80 (32.3)	84 (33.2)		37 (31.6)	37 (33.6)	
Etiology [N (%)]	Ischemic	167 (67.3)	178 (70.4)	0.47	76 (65.0)	78 (70.9)	0.34
	Non-Ischemic	81 (32.7)	75 (29.6)		41 (35.0)	32 (29.1)	

a. * P-values were calculated with Pearson's chi-squared test.

CRT Effectiveness

Heart Failure Progression (Composite Index)

The Composite Index (primary endpoint) is a combination of three events: all-cause mortality, hospitalization for heart failure, and VT/VF event requiring therapy (Table 5). A committee consisting of three heart failure specialists and an electrophysiologist reviewed and adjudicated all patient deaths and all hospitalizations, defined as an admission greater than 23 hours. Outpatient care, emergency room care, and clinic visits less than 23 hours were collected but not considered to be hospitalizations for the purposes of analysis.

Table 5. Composite Index

(All patients implanted and active 31 days post-implant)

Group	Heart Failure Mortality or Morbidity Event	CRT		No CRT		Relative Reduction with CRT
		N	%	N	%	
All Patients (N = 490)	Death from any cause	11	4.5	16	6.5	15% p = 0.35
	HF hospitalization	32	13.1	39	15.9	
	VT/VF	36	14.7	39	15.9	
NYHA III/IV (N = 227)	Death from any cause	11	9.4	11	10.0	22% p = 0.23
	HF hospitalization	23	19.7	27	24.5	
	VT/VF	21	17.9	22	20.0	

Twenty-seven patients died during the therapy phase. Mortality stratified by treatment group and cause, as adjudicated by the Events Committee, is shown in Table 6. The Kaplan-Meier curve, showing total survival by treatment group, is shown in Figure 2.

Table 6. Mortality Stratified by Treatment Group and Cause
(All patients implanted and active at 31 days post-implant, N = 490)

Deaths	Patients with CRT (N = 245)	Patients with No CRT (N = 245)
Cardiac, pump failure	4 (1.6%)	9 (3.7%)
Cardiac, arrhythmic	1 (0.4%)	0 (0.0%)
Cardiac, other	2 (0.8%)	1 (0.4%)
Noncardiac	2 (0.8%)	3 (1.2%)
Unknown	2 (0.8%)	3 (1.2%)
Total	11 (4.5%)	16 (6.5%)

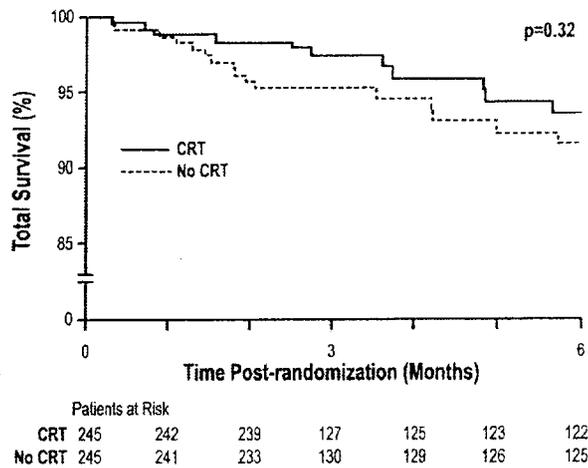


Figure 2. Kaplan-Meier curve.

Table 7 presents the reasons for hospitalization within the treatment period as determined by the Events Committee.

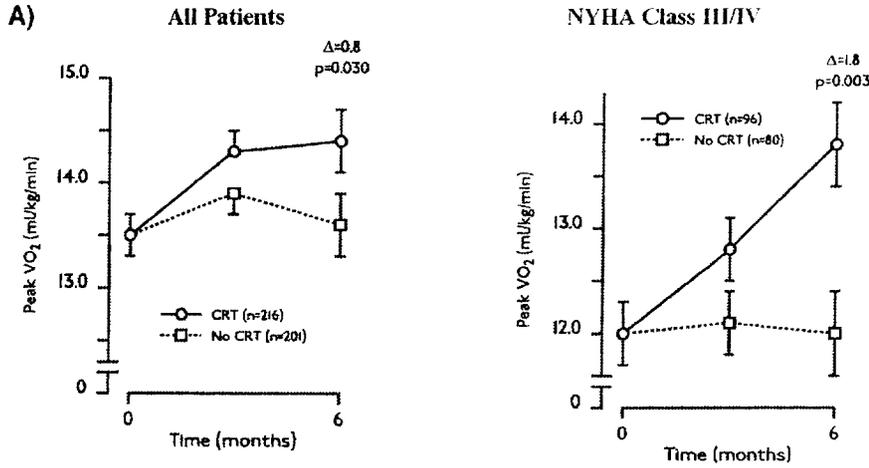
Table 7. Patients Hospitalized during Treatment Period^a
(All patients implanted and active at 31 days post-implant, N = 490)

Reason for Hospitalization	All Patients			NYHA Class III/IV		
	CRT (N = 245)	No CRT (N = 245)	Total (N = 490)	CRT (N = 117)	No CRT (N = 110)	Total (N = 227)
Heart Failure	32	39	71	23	27	50
Cardiac, other	20	25	45	14	14	28
Noncardiac	26	19	45	14	14	28
Total Hospitalizations	66	70	136	40	46	86

a. Represents number of patients with each category of hospitalization. Patients may have multiple hospitalizations that fall into different categories.

Peak VO₂

The Peak VO₂ was determined from a standardized protocol for exercise testing as a means of measuring a patient's capacity for performing physical activity. Figure 3 and the accompanying table provide the change in Peak VO₂.



B)

Peak VO ₂ (ml/kg/min)	All Patients			NYHA Class III/IV		
	CRT (N=216)	No CRT (N=201)	P-val ^a	CRT (N= 96)	No CRT (N= 80)	P-val ^a
Post-recovery Visit	13.5 +/- 0.2	13.5 +/- 0.2	-	12.0 +/- 0.3	12.0 +/- 0.3	-
3 Months	14.3 +/- 0.2	13.9 +/- 0.2	0.206	12.8 +/- 0.4	12.1 +/- 0.4	0.084
6 Months	14.4 +/- 0.3	13.6 +/- 0.3	0.030	13.8 +/- 0.5	12.0 +/- 0.5	0.003

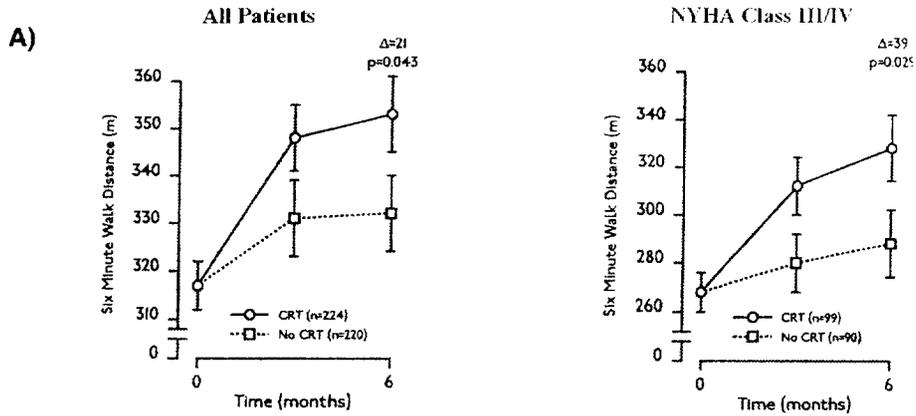
a. P-values reflect the between-group differences with respect to baseline.

Figure 3. Change in Peak VO₂ (A). Change in Peak VO₂ table (B).

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Six-Minute Walk

The Six-Minute Walk test is a measure of a patient's ability to sustain exercise during an activity similar to that which a patient may typically perform on a daily basis. For this test, patients are instructed to walk as far as possible in 6 minutes in a level corridor. Figure 4 and the accompanying table provide the change in Six-Minute Walk.



B)

Six Minute Walk Distance (meters)	All Patients			NYHA Class III/IV		
	CRT (N=224)	No CRT (N=220)	P-val ^a	CRT (N= 99)	No CRT (N= 90)	P-val ^a
Post-recovery Visit	317 +/- 5	317 +/- 5	-	268 +/- 9	268 +/- 9	-
3 Months	348 +/- 7	331 +/- 8	0.058	312 +/- 12	280 +/- 12	0.028
6 Months	353 +/- 8	332 +/- 8	0.043	327 +/- 14	288 +/- 15	0.029

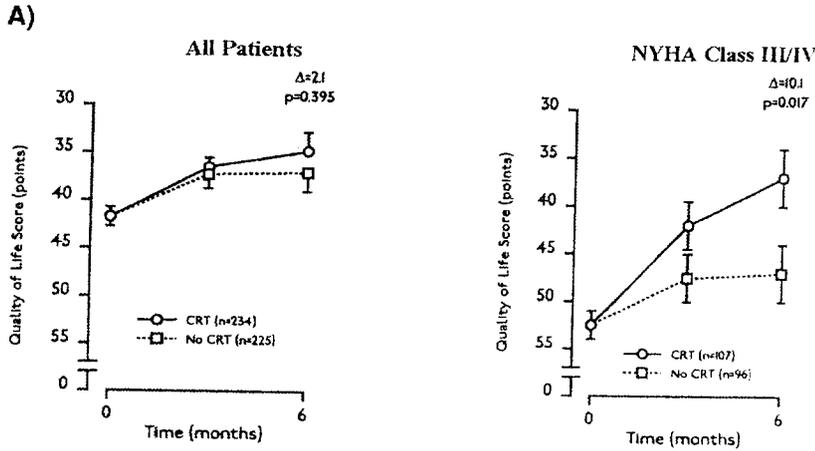
a. P-values reflect the between-group differences with respect to baseline.

Figure 4. Change in Six-Minute Walk (A). Change in Six-Minute Walk table (B).

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Quality of Life

Quality of Life (QOL) was assessed using the 21-question Minnesota Living with Heart Failure questionnaire. Each question is answered by the patient, ranking each item on a scale ranging from 0 to 5. A lower total score indicates an improved quality of life. Figure 5 and the accompanying table provide the change in Quality of Life.



B)

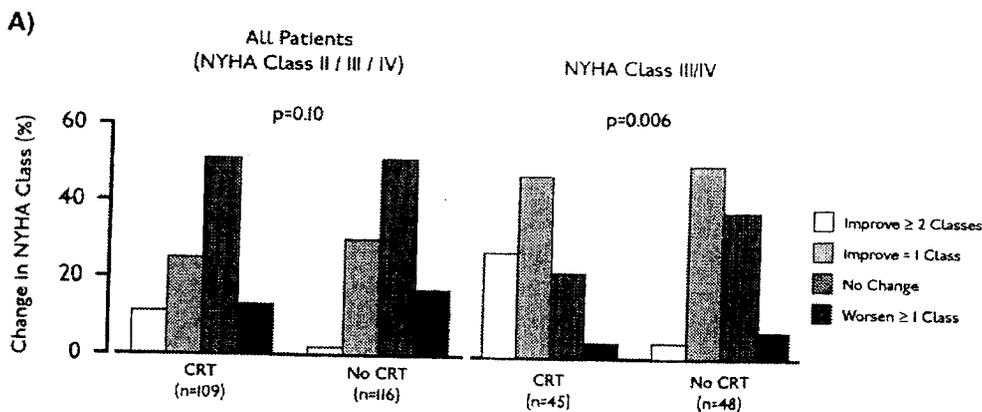
QOL (points)	All Patients			NYHA Class III/IV		
	CRT (N=234)	No CRT (N=225)	P-val ^a	CRT (N=107)	No CRT (N=96)	P-val ^a
Post-recovery Visit	41.8 +/- 1.1	41.8 +/- 1.1	-	52.7 +/- 1.5	52.7 +/- 1.5	-
3 Months	36.6 +/- 1.5	37.3 +/- 1.6	0.711	41.9 +/- 2.4	47.5 +/- 2.6	0.078
6 Months	34.8 +/- 1.8	36.9 +/- 1.8	0.395	37.2 +/- 3.1	47.3 +/- 3.2	0.017

a. P-values reflect the between-group differences with respect to baseline.

Figure 5. Change in Quality of Life (A). Change in Quality of Life table (B).

NYHA Class

The determination for New York Heart Association (NYHA) Class is based on mutual assessment by the patient and the patient's physician of the patient's heart failure symptoms both at rest and while performing ordinary physical activity. NYHA Class was determined at each follow-up visit by a physician who was blinded to the patient's randomized therapy. Figure 6 and the accompanying table provide the change in NYHA Class results.



B)

	All Patients					NYHA Class III/IV				
	CRT (N=109)		No CRT (N=116)		P-val ^a	CRT (N= 45)		No CRT (N= 48)		P-val ^a
Change in NYHA Class	N	%	N	%		N	%	N	%	
Improve 2 or More Classes	12	11.0	2	1.7	0.10	12	26.7	2	4.2	0.006
Improve 1 Class	27	24.8	35	30.2		21	46.7	24	50.0	
No Change	56	51.4	59	50.9		10	22.2	18	37.5	
Worsen 1 Class	13	11.9	19	16.4		2	4.4	4	8.3	
Worsen 2 or More Classes	1	0.9	1	0.9		0	0.0	0	0.0	

a. P-value was calculated from Mantel-Haenszel test and reflects the between-group differences with respect to baseline.
Figure 6. Change in NYHA Class (A). Change in NYHA Class table (B).

Echocardiography

Several echocardiography (echo) variables were identified to assist in measuring the possible hemodynamic impact of CRT as shown in Table 8. The limitation of this data is that patients are measured while at rest, and therefore, the data may not reflect any hemodynamic benefit that may be observed when patients are exercising and performing their daily activities.

Table 8. Echocardiography Results

Parameter	Timepoint	CRT		No CRT		Between Groups	
		N	Mean +/- SE	N	Mean +/- SE	Mean +/- SE	P-val
All Patients							
LVIDd (mm)	Post-recovery Visit	228	70.4 +/- 0.5	219	70.4 +/- 0.5	0	-
	Change at 6 Months	228	-3.4 +/- 0.6	219	-0.3 +/- 0.6	-3.1 +/- 0.9	<0.001
LVIDs (mm)	Post-recovery Visit	228	58.3 +/- 0.5	219	58.3 +/- 0.5	0	-
	Change at 6 Months	228	-4.0 +/- 0.7	219	-0.7 +/- 0.7	-3.3 +/- 0.9	<0.001
LVEF (%)	Post-recovery Visit	222	27.8 +/- 0.3	216	27.8 +/- 0.3	0	-
	Change at 6 Month	222	5.1 +/- 0.7	216	2.8 +/- 0.7	2.4 +/- 1.0	0.020
NYHA Class III/IV							
LVIDd (mm)	Post-recovery Visit	104	71.2 +/- 0.7	92	71.2 +/- 0.7	0	-
	Change at 6 Months	104	-4.9 +/- 1.0	92	-0.2 +/- 1.1	-4.7 +/- 1.5	0.001
LVIDs (mm)	Post-recovery Visit	104	59.2 +/- 0.7	92	59.2 +/- 0.7	0	-
	Change at 6 Months	104	-5.4 +/- 1.1	92	-0.6 +/- 1.1	-4.8 +/- 1.5	0.002
LVEF (%)	Post-recovery Visit	99	26.9 +/- 0.5	91	26.9 +/- 0.5	0	-
	Change at 6 Months	99	6.0 +/- 1.1	91	2.3 +/- 1.2	3.7 +/- 1.7	0.029

Measures of Sympathetic Tone

Mean Norepinephrine levels (Table 9) and Mean Heart Rate (Table 10) were examined as markers of how CRT may influence the excessive sympathetic drive associated with chronic heart failure.

Table 9. Mean Norepinephrine Results

Norepinephrine (pg/mL)	All Patients			NYHA Class III/IV		
	CRT (N=228)	No CRT (N=217)	P-val	CRT (N=104)	No CRT (N= 90)	P-val
Post-recovery Visit	663 +/- 19	663 +/- 19	-	720 +/- 31	720 +/- 31	-
3 Months	651 +/- 31	681 +/- 32	0.479	685 +/- 55	743 +/- 60	0.463
6 Months	658 +/- 40	738 +/- 41	0.143	681 +/- 75	827 +/- 79	0.163

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Table 10. Mean Heart Rate Results

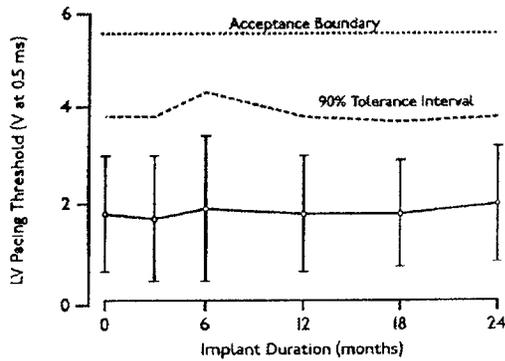
Heart Rate (bpm)	All Patients			NYHA Class III/IV		
	CRT (N=240)	No CRT (N=233)	P-val	CRT (N=113)	No CRT (N=101)	P-val
Post-recovery Visit	72.3 +/- 0.6	72.3 +/- 0.6	-	74.5 +/- 1.0	74.5 +/- 1.0	-
3 Months	70.8 +/- 0.8	72.1 +/- 0.8	0.20	74.1 +/- 1.2	73.9 +/- 1.3	0.94
6 Months	69.4 +/- 1.0	70.2 +/- 1.0	0.58	70.6 +/- 1.6	72.5 +/- 1.6	0.40

The stability of resting heart rate over time demonstrates that CRT did not increase sympathetic tone associated with advanced heart failure.

EASYTRAK Lead and System Effectiveness

A)

All patients implanted with an EASYTRAK lead at first implant, N=443



B)

Statistic	Implant	3 Months	6 Months	12 Months	18 Months	24 Months
N	435	347	330	233	103	25
Mean +/- SD	1.8 +/- 1.2	1.7 +/- 1.3	1.9 +/- 1.5	1.8 +/- 1.2	1.8 +/- 1.1	2.0 +/- 1.2
Range	0.2 - 7.5	0.2 - 7.5	0.2 - 7.5	0.4 - 7.5	0.6 - 7.5	0.6 - 5.0
Upper Tolerance Limit	3.8	3.8	4.3	3.8	3.7	3.9

* EASYTRAK lead models: 4511, 4512, and 4513

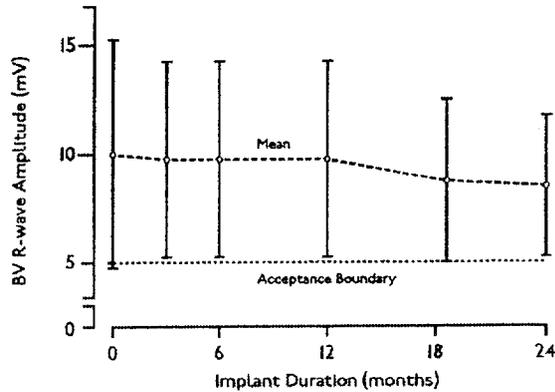
Figure 7. EASYTRAK lead threshold measurements (A). EASYTRAK lead threshold measurements table (B).*

It was hypothesized that the upper tolerance limit of the chronic left ventricular pacing threshold of the EASYTRAK lead be less than 5.5 V to ensure that an adequate safety margin exists. Chronic left ventricular pacing thresholds shown in Figure 7 are within this limit.

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A)

All patients implanted with an EASYTRAK lead at first implant, N=443



B)

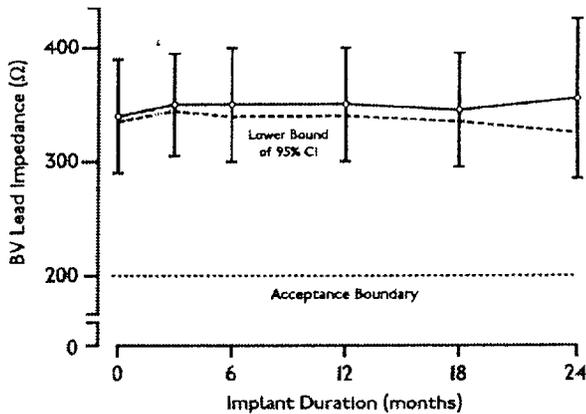
Statistic	Implant	3 Months	6 Months	12 Months	18 Months	24 Months
N	433	346	326	220	99	23
Mean +/- SD	10.0 +/- 5.2	9.9 +/- 4.4	9.9 +/- 4.5	9.8 +/- 4.4	8.9 +/- 3.5	8.5 +/- 3.3
Range	1.9 - 25.0	1.4 - 25.0	1.7 - 25.0	1.2 - 25.0	2.6 - 20.4	2.2 - 13.6

Figure 8. EASYTRAK biventricular sensed R-wave amplitude (A). EASYTRAK biventricular sensed R-wave amplitude table (B).

Mean chronic biventricular R-wave amplitudes are measured as a combination of the R-waves from both the right ventricle (commercially available ENDOTAK lead) and left ventricle (EASYTRAK lead). It was hypothesized that the mean biventricular R-wave amplitude be greater than 5 mV to ensure proper sensing. In Figure 8, the performance of the EASYTRAK lead system was significantly above this value ($p < 0.01$).

A)

All patients implanted with an EASYTRAK lead at first implant, N=443



B)

Statistic	Implant	3 Months	6 Months	12 Months	18 Months	24 Months
N	436	355	336	237	107	26
Mean +/- SD	340 +/- 46	352 +/- 47	349 +/- 50	351 +/- 51	347 +/- 46	356 +/- 67
Range	243 - 550	248 - 519	186 - 534	237 - 513	254 - 507	267 - 520
95% CI	(336, 344)	(347, 357)	(344, 355)	(345, 358)	(338, 356)	(329, 383)

Figure 9. EASYTRAK biventricular pacing impedance (A). EASYTRAK biventricular pacing impedance table (B).

The impedance measured by the CONTAK CD device is the parallel combination of the left ventricular (EASYTRAK) and right ventricular (ENDOTAK) leads simultaneously. Therefore, the biventricular lead impedance will be substantially less than that of either lead alone. It was hypothesized that the lower limit of the 95% confidence interval of the mean chronic biventricular lead impedance would be greater than 200 Ω to ensure proper pulse generator function. The lower limit of the 95% confidence interval of the chronic biventricular lead impedance exceeds this value (Figure 9).

EASYTRAK Lead Placement Success Rate

The EASYTRAK lead was implanted in 448/517 (87%) of patients who underwent the implant procedure. Table 11 shows the reasons for inability to place the EASYTRAK lead. Table 12 provides the EASYTRAK lead implant success rate.

Table 11. Reasons for Unsuccessful EASYTRAK Lead Implant
(Patients with unsuccessful attempt to implant EASYTRAK lead, N = 69)

Reason	# of pts	%
Inability to locate or cannulate the coronary sinus	29	42.0
Dislodgment of EASYTRAK lead while removing guide catheter	13	18.8
Inability to advance the lead to a stable position	11	15.9
Inability to obtain adequate pacing thresholds	6	8.7
Procedure stopped due to coronary sinus dissection or perforation	5	7.2
Procedure stopped due to transient AV block	1	1.4
Procedure stopped due to venous perforation during subclavian stick	1	1.4
Reason not stated	1	1.4
Extracardiac stimulation	1	1.4
Inability to place an atrial pace/sense lead	1	1.4
Total	69	100

Table 12. Lead Placement Success Rate
(All Patients implanted or attempted with EASYTRAK lead, N = 517)

Measurement	All Procedures
Number of patients implanted or attempted	517
Number of placements* of the EASYTRAK Lead	448
Rate	87%
95% CI	(84%, 90%)

* Defined as EASYTRAK implant procedure that is concluded with the implant of the investigational cardiac resynchronization system.

Although some situations such as patient anatomy and poor thresholds cannot be avoided, increased investigator experience with the EASYTRAK lead and accessories was associated with improved success, decreased total procedure time (measured skin-to-skin), and decreased fluoroscopy exposure time (Figure 10).

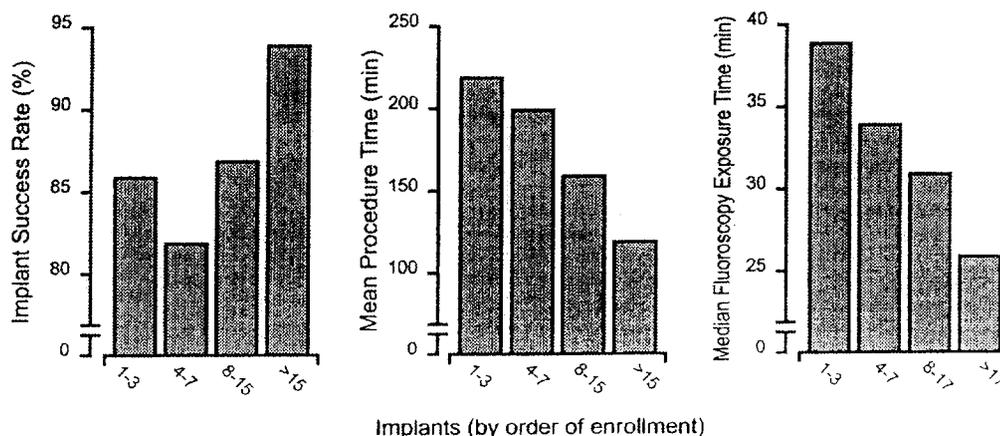


Figure 10. EASYTRAK success rate, procedure time, and fluoroscopy exposure time.

Biventricular Antitachycardia Pacing (ATP) Conversion Efficacy Performance

The conversion rate of induced monomorphic ventricular tachycardia (MVT) was 64% and that of spontaneous MVT was 88%.

Ventricular Tachyarrhythmia Detection Time

The VENTAK CHF and CONTAK CD devices sense events from both ventricles simultaneously. Ventricular tachyarrhythmia detection time was analyzed to determine if the additional lead had an adverse effect on sensing VT/VF. Guidant's ICDs typically have a detection time of two seconds. The VF detection time of 2.1 ± 0.6 seconds was statistically significantly lower than 6 seconds ($p < 0.01$), demonstrating that there was no statistically significant prolongation of induced VF detection times with the additional left ventricular lead. There were also no adverse events reported in which a VENTAK CHF or CONTAK CD device failed to detect a spontaneous ventricular tachyarrhythmia.

Lead and System Safety

EASYTRAK Lead Safety

Safety was established using the rate of adverse events that are either related to the EASYTRAK lead or to the implant procedure necessary to place the EASYTRAK lead.

An EASYTRAK lead implant procedure was performed in 517 patients with 448 patients (86.7%) being successfully implanted with the EASYTRAK lead.⁴ The upper boundary of the 95% confidence interval was hypothesized to be less than 23% at six months (Table 13).

Table 13. Lead-Related Adverse Events at Six Months

Patient Population	N	Event Rate (%)	95% CI
All Patients	517	12.2	(9.4, 15.0)
NYHA Class III/IV	201	17.4	(12.7, 22.7)

Fifty-three lead-related adverse events were reported during the clinical investigation of the EASYTRAK lead among the 448 patients who were implanted with an EASYTRAK lead. Twenty-seven procedure-related adverse events were reported among the 517 patients who underwent the implant procedure for an EASYTRAK lead. The overall lead-related adverse event rate was 14.5% [95% CI (11.5–17.5%)]. Table 14 reports lead-related adverse events observed during the CONTAK CD Study.

4. For purposes of defining event rates, a denominator of 448 will be used for those adverse events that pertain to chronically implanted EASYTRAK leads, and a denominator of 517 will be used for those adverse events that pertain to the implant procedure of the EASYTRAK lead.

Table 14. EASYTRAK Lead-Related Adverse Events Throughout the Study
(All patients implanted, N = 448; All patients attempted, N = 517)

Adverse Events	Total	% of pts (95% CI)
Lead-Related, N = 448		
Loss of capture/lead dislodgment	31 ^a	6.9 (4.6–9.3)
Ventricular oversensing	11	2.5 (1.0–3.9)
Extracardiac stimulation	9	2.0 (0.7–3.3)
Insulation breach	2	0.4 (0.0–1.1)
Procedure-Related, N = 517		
Transient AV block	6	1.2 (0.2–2.1)
Coronary venous dissection	5	1.0 (0.1–1.8)
Coronary venous perforation	5	1.0 (0.1–1.8)
Transient renal failure	5	1.0 (0.1–1.8)
Pericardial effusion	2	0.4 (0.0–0.9)
Finishing wire left in lead	1	0.2 (0.0–0.6)
Right ventricular lead dislodgment	1	0.2 (0.0–0.6)
Guide wire fracture	1	0.2 (0.0–0.6)
Hypotension due to blood loss	1	0.2 (0.0–0.6)
Total (unique patients)	75	14.5 (11.5–17.5)

a. Twenty-six events were successfully corrected in a repeat procedure.

The most common of the 53 lead-related adverse events (> 1% incidence) included loss of left ventricular capture (31 patients, 6.9%), ventricular oversensing (11 patients, 2.5%), and extracardiac stimulation (9 patients, 2.0%). These events were typically resolved with surgical intervention.

The most common of the 27 procedure-related adverse events (>1% incidence) included coronary venous trauma (10 patients, 2.0%), transient atrioventricular block (6 patients, 1.2%), and transient renal failure (5 patients, 1.0%). These events were typically resolved without intervention and no permanent long-term sequelae were reported.

Severe, Device-Related Adverse Events and Operative Mortality

Table 15. Adverse Events and Operative Mortality
(All patients attempted or implanted, N = 567)

Measurement	N	%	95% CI
Severe, Device-Related Adverse Events (Type I) ^a	7	1.2	(0.3, 2.1)
All-Cause Operative Mortality (<= 30 Days Post Implant)	12	2.1	(0.9, 3.3)

a. Percent is of patients with at least one event.

The incidence of severe, device-related events was reported in 7 of 567 patients (1.2%); this was significantly less than the hypothesized rate of 20% ($p < 0.01$) (Table 15). Table 16 reports system, device-related, severe adverse events observed during the CONTAK CD Study.

Table 16. System, Device-Related, Severe Adverse Events
(All patients attempted or implanted, N = 567)

Adverse Event	# of pts	% of pts (95% CI)
Telemetry difficulty; device explanted	2	0.4 (0.0–0.9)
Ventricular tachycardia during CPX testing	1	0.2 (0.0–0.5)
Coronary sinus perforation	1	0.2 (0.0–0.5)
Inappropriate shock due to oversensing	1	0.2 (0.0–0.5)
Lead dislodgment	1	0.2 (0.0–0.5)
Anaphylaxis in association with use of a pulmonary artery catheter	1	0.2 (0.0–0.5)

Operative mortality, defined as death from any cause within 30 days of implant, was reported in 12 of 567 patients (2.1%) undergoing the implant procedure. The outcome is significantly less than the hypothesized rate of 9% ($p < 0.01$). Table 17 reports the cause of death for operative mortality.

Table 17. Cause of Death for Operative Mortality
(All patients attempted or implanted, N = 567)

Cause of Death	Implants N = 501	Attempts N = 66	Total N = 567
Cardiac: Pump Failure	5	1	6
Cardiac: Arrhythmic	2	1	3
Noncardiac	2	0	2
Unknown	1	0	1
Total	10	2	12

System Safety Profile

Analysis of system safety was performed on the complication-free rate of device-related adverse events, regardless of whether or not they were related to the investigational device (Figure 11). Table 18 outlines the device-related complications. This study used an acceptance criterion such that the lower boundary of the 95% confidence interval could not be less than 70%.

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Table 18. Device-Related Complications^a
 (All patients implanted, N = 448; All patients attempted, N = 517)

Adverse Event	# of pts	% of pts
All patients implanted (N = 448)		
Loss of LV capture	31	6.9
Loss of right atrial capture	7	1.6
Ventricular oversensing	6	1.3
Extracardiac stimulation	5	1.1
All patients attempted or implanted (N = 517)		
Infections	7	1.4

a. This table represents patients attempted or implanted with the EASYTRAK lead, most common (> 1%) device-related complications reported.

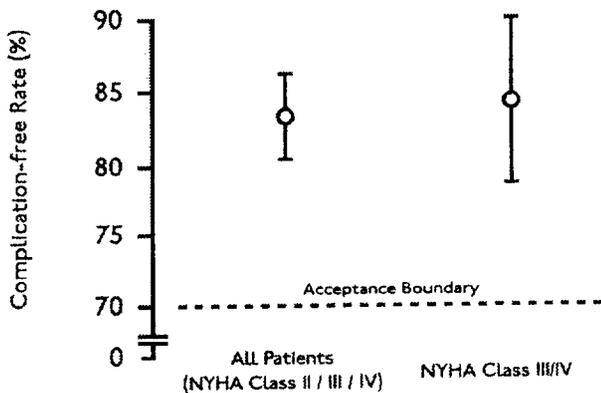


Figure 11. System safety.

System safety for the All Patients group and NYHA Class III/IV subgroup as determined by the device-related complication-free rate was within the 70% acceptance boundary for safety.

Verification of CRT Delivery

The delivery of biventricular pacing throughout the CONTAK CD Study was confirmed by comparing the programmed device output to the biventricular pacing threshold and demonstrating that capture was maintained in daily activities and during exercise.

The investigational plan recommended programming the device output to at least twice the biventricular pacing voltage threshold. Electrocardiograms (ECGs) from Holter Monitors during daily activities were received and analyzed to verify that total capture was maintained at the 3-month and 6-month visits and to ensure that the safety margin was adequate. Cardiopulmonary exercise tests (CPX) were performed on patients who were randomized to receive CRT therapy at 3- and 6- month visits.

- In 623 evaluations of safety margin at baseline, three-, and six-months, the device output was programmed to deliver a voltage approximately three times that necessary to stimulate both ventricles.
- A total of 1139 Holter monitors were placed throughout the study at baseline, three-, and six-months. The tests indicated only 4 instances (0.4%) of inappropriate pacing or sensing that were all corrected with device programming.
- A total of 316 CPX tests at the three- and six-month follow-up visits were performed in patients with CRT who also had interpretable ECG results. Of these, 277 (88%) had continuous CRT delivery throughout exercise. The remaining 39 patients (12%) had continuous CRT delivery until the sinus rate exceeded the maximum tracking rate (MTR).

These results demonstrated that investigators programmed devices in a manner appropriate to ensure the delivery of CRT and that CRT was maintained during daily activities and exercise.

Focused Confirmatory Study

Study Design

The Focused Confirmatory Study (FCS) was a prospective, multicenter, randomized study conducted in the United States in 127 patients who participated in an exercise performance study. The purpose of the FCS was:

- To establish primary endpoints to confirm effectiveness results related to functional capacity measures previously reported in the CONTAK CD Study.
- To prospectively define the indicated patient population (NYHA Class III/IV).

CRT was provided in the same manner for the FCS as for the CONTAK CD Study. The EASYTRAK lead, along with market approved right atrial and right ventricular leads, were used to provide biventricular stimulation.

Study Patients

The patients in the FCS had the same heart failure indications as the patients in the NYHA Class III/IV subgroup of the CONTAK CD Study; i.e., patient inclusion criteria included NYHA Class III or IV while on drug therapy, QRS duration ≥ 120 ms, and Left Ventricular Ejection Fraction (LVEF) $\leq 35\%$.

A baseline physical assessment and functional measures were performed prior to CRT system implant. Patients were eligible for participation in the study if they were capable of walking between 150 and 425 meters. In addition to a Six-Minute Walk test, other special tests were performed prior to implant consisting of a symptom-limited treadmill test and completion of the Minnesota Living with Heart Failure Questionnaire to assess Quality of Life. CRT therapy was enabled immediately upon device implant. Patients were followed at one week, one month, three months, and every three months thereafter for a routine physical assessment and device evaluation. Special testing as defined above was repeated at three months and six months post-implant.

Prior to study entry, patients were stable on optimal heart failure medications (ACE inhibitors or substitute > 1 month and beta blockers > 3 months). Patients were excluded if they were indicated for either a pacemaker or ICD or if they were hospitalized for heart failure in the month prior to enrollment.

Baseline Demographics

The patient characteristics at study entry are summarized in Table 19.

Table 19. Preimplant Characteristics of Study Patients (N = 127)

Characteristics	All Patients Receiving CRT	Characteristics	All Patients Receiving CRT	
Age (years)	61 \pm 12	QRS Width (ms)	159 \pm 27	
Male Gender (%)	69	LBBB/NSIVCD (%)	91%	
NYHA Class III (%)	94	Heart Failure Medications (%)		
Ischemic Etiology (%)	49		ACE Inhibitors or ARB	91
LVEF (%)	23 \pm 7		Beta Blockers	77
Resting Heart Rate (bpm)	73 \pm 12		Digoxin	76
		Diuretics	98	

Inclusion Criteria

Inclusion criteria included:

- Moderate or severe heart failure, defined as symptomatic heart failure for at least six months with NYHA Class III or IV symptoms at the time of enrollment, AND at least one of the following events in the previous 12 months:
 - Hospitalization for heart failure management
 - Outpatient visit in which intravenous (IV) inotropes or vasoactive infusion were administered continuously for at least 4 hours
 - Emergency room visit of at least twelve hours duration in which IV heart failure medications were administered (including diuretics)
- QRS \geq 120 ms and PR interval $>$ 150 ms from any two leads of a 12-lead ECG
- Left ventricular ejection fraction \leq 35%
- Left ventricular end diastolic dimension \geq 60 mm (required only if LVEF measured by echo)
- Age \geq 18 years
- Optimal pharmacologic therapy for heart failure
- Able to walk between 150 and 425 m in a Six-Minute Walk test

Major Differences Between CONTAK CD and Focused Confirmatory Study Patients

Some of the major differences between the study populations included:

- Patients were excluded from the FCS if they were indicated for either a pacemaker or implantable cardioverter defibrillator (ICD). Patients in the CONTAK CD Study were excluded if they met the indications for a pacemaker; however, they were required to meet the general indications for an ICD.
- Patients were excluded from the FCS if they were hospitalized for heart failure in the month prior to enrollment; whereas, there was no exclusion for hospitalization for heart failure in the month prior to enrollment for the CONTAK CD patients.
- Patients in the FCS must have been on stable, optimal heart failure medications, including beta blocker therapy for three months, prior to study entry. Patients in the CONTAK CD Study could be optimized on drug therapy between the time from device implant until the treatment phase (either CRT or No CRT) began.
- Patients in the FCS had baseline measurements performed prior to implant. Patients in the CONTAK CD Study had baseline measurements performed post-implant, but before programming of the randomized therapy.
- Seventy-seven percent (N = 127) of patients in the FCS were on beta blockers compared to 42% (N = 227) in the CONTAK CD Study.
- Forty-nine percent (N = 127) of the patients in the FCS had ischemic etiology compared to 68% (N = 227) in the CONTAK CD Study.

Endpoints

The primary endpoints of the study were Peak VO_2 and Six-Minute Walk distance. The study was designed to show a mean change of at least 1 ml/kg/min and a 95% lower confidence bound (LCB) at least 0.5 ml/kg/min. The study was also designed to detect a statistically significant improvement in the Six-Minute Walk distance at a one-sided significance level of 0.10. Additionally, two ancillary analyses of Quality of Life Score and NYHA Class had to demonstrate a change that was directionally favorable towards CRT using descriptive statistics.

Study Results

Peak VO_2

A statistically significant improvement from baseline of 0.94 ± 0.30 ml/kg/min ($p = 0.0008$) with a 95% LCB of 0.45 was observed after six months of CRT. The median change at six months

for patients completing the six-month testing was 1.1 ml/kg/min and the corresponding exact 95% LCB for the median change was 0.5 ml/kg/min.

Six-Minute Walk

Statistically significant improvements versus baseline were observed in Six-Minute Walk distance after six months of CR with an observed mean improvement of 50.9 ± 10.4 m ($p = 0.0003$). The median change at six months for patients completing six month testing was 49.8 m and the exact 90% LCB was 31.2 m.

Quality of Life

Consistent with the other analyses, a statistically significant improvement of 23.9 ± 2.6 points ($p < 0.0001$) was observed in the Quality of Life score after six months of CRT. The median change at six months for patients completing six-month testing was 18.0 points with an exact 95% LCB of 14.0 points.

New York Heart Association Class

After six months of CRT, a statistically significant improvement in NYHA Class was observed with 60.4% of patients ($p < 0.0001$) improving one or more NYHA Class.

GUIDANT

Physician's Manual

EASYTRAK®

**Coronary Venous
Steroid-Eluting
Single-Electrode
Pace/Sense Lead**

Models 4510/4511/4512/4513

GARDIAN

RHYTHM

MANAGEMENT

RESTRICTED DEVICE: Federal law (USA) restricts the sale, distribution, or use of this device to, by, or on the lawful order of a physician.

EASYTRAK® Lead
Models 4510/4511/4512/4513

Electrode → ← Steroid Collar



LV-1 Connector →

DEVICE DESCRIPTION

Guidant EASYTRAK® coronary venous, steroid-eluting, single-electrode pace/sense leads, Models 4510/4511/4512/4513, provide chronic pacing and sensing and are an over-the-wire design with a LV-1¹ connector. Placement is achieved by inserting the lead through the coronary sinus and placing it into a branch of the cardiac veins. The EASYTRAK lead is used in conjunction with a compatible Guidant cardiac resynchronization therapy (CRT) device.

Indications

The Guidant EASYTRAK coronary venous, steroid-eluting, single-electrode pace/sense leads, Models 4510/4511/4512/4513, are transvenous leads intended for chronic left ventricular pacing and sensing via the coronary veins when used in conjunction with a compatible Guidant cardiac resynchronization therapy (CRT) device.

Contraindications

Use of the EASYTRAK lead is contraindicated in patients with a hypersensitivity to a nominal single dose of 0.7 mg of dexamethasone acetate drug.

Warnings

- **Labeling knowledge.** Read this manual thoroughly before implanting the lead to avoid damage to the system. Such damage can result in injury to or death of the patient. Page 20
- When using a right ventricular (RV) pace/sense lead in conjunction with the EASYTRAK lead, it is recommended that a *polyurethane-insulated* lead be used. Failure to observe this warning could result in insulation damage of the RV lead, which can cause a periodic or continual loss of pacing, or sensing, or both.
- Lead fracture, dislodgment, abrasion, or an incomplete connection can cause a periodic or continual loss of pacing or sensing or both.

EASYTRAK® LEAD—DEVICE DESCRIPTION

- **Battery-powered equipment.** The use of battery-powered equipment is recommended during lead implantation and testing to protect against fibrillation that might be caused by leakage currents.
 - Line-powered equipment used in the vicinity of the patient must be properly grounded.
 - The lead connector must be insulated from any leakage currents that could arise from line-powered equipment.
- **Excessive flexing.** The lead is not designed to tolerate excessive flexing, bending, or tension. This could cause structural weakness, conductor discontinuity, or lead dislodgment (Page 22).

Precautions

In the following list of cautions, page numbers are indicated for those cautions that are specific to other areas of the manual. Refer to the indicated pages for information relevant to the caution. Failure to observe these cautions could result in incorrect lead implantation, lead damage/dislodgment, or harm to the patient.

Sterilization and Handling

- **For single use only—do not resterilize leads.** Do not resterilize the lead or the accessories packaged with it because Guidant cannot ensure that resterilization is effective. Do not reuse.
- **If package is damaged.** Guidant sterilizes the lead and accessories with ethylene oxide gas (EtO) before final packaging. When they are received, they are sterile and ready for use. If the container is wet, damaged, punctured, or if the seal is broken, return the lead to the nearest Guidant representative. Never attempt to resterilize the lead or accessories. Instead, return the lead to Guidant at the address on the back cover of this manual. Page 20
- **Use before date.** Do not implant the lead after the USE BEFORE date (which appears on the lead packaging) has passed because this date reflects a reasonable shelf life.
- **Lead compatibility.** Prior to implantation of this lead, confirm lead/pulse generator compatibility by calling Guidant

DEVICE DESCRIPTION—EASYTRAK® LEAD

Technical Services at the telephone number on the back cover of the manual.

- **Dexamethasone acetate.** It has not been determined whether the warnings, precautions, or complications usually associated with injectable dexamethasone acetate apply to the use of a low concentration, highly localized, controlled-release device. For a listing of potentially adverse effects, refer to the *Physician's Desk Reference*.
- **Defibrillating equipment.** Defibrillating equipment should be kept nearby for immediate use during the implantation procedure.

Lead Evaluation and Implantation Precautions

- **Vein pick.** The vein pick is not intended either for puncturing the vein or for dissecting tissue during a cutdown procedure. Page 22
- **Remove finishing wire.** The finishing wire MUST BE REMOVED before connecting the lead to the pulse generator. Page 22
- **Lead stabilizer.** Do not suture directly over the lead body, as this may cause structural damage. Use the suture sleeve to secure the lead at the venous entry site. Page 22
- **Do not wipe or immerse the distal lead tip in fluid prior to implant.** Such treatment will reduce the amount of steroid available when the lead is implanted. Page 22
- **Chronic repositioning.** Optimum threshold performance might not be achieved if the lead is chronically repositioned because the steroid can be depleted. Page 22
- **Protect from surface contamination.** The conductor insulation is silicone rubber, which can attract particulate matter, and therefore must always be protected from surface contamination. Page 23
- **Do not insert in medial one-third region of clavicle (subclavian puncture).** When attempting to implant the lead via a subclavian puncture, do not insert the lead under the medial one-third region of the clavicle. Damage or chronic dislodgment to the lead is possible if the lead is implanted in this manner. If implantation via the subclavian vein is desired, the lead must enter the subclavian vein

EASYTRAK® LEAD—DEVICE DESCRIPTION

near the lateral border of the first rib and must avoid penetrating the subclavius muscle. It is important to observe these implant precautions to avoid clavicle/first rib damage or chronic dislodgment to the lead. It has been established in the literature that lead fracture can be caused by lead entrapment in such soft tissue structures as the subclavius muscle, costocoracoid ligament, or the costoclavicular ligament.² Page 23

- **Strain relief.** When implanting the lead via a subclavian puncture, allow slack in the lead between the suture sleeve and the venous entry site. This will help minimize flexing at the suture sleeve and interaction with the clavicle/first rib region. Page 25
- **Contrast medium.** Risks associated with this procedure are similar to any other catheterization procedure in the coronary sinus. Some patients can have a physical intolerance to different types of contrast agents. If this is known in advance, the physician should select an appropriate agent. Page 27
- **Balloon catheter use.** At the physician's discretion an occlusion balloon catheter may be used. Inflate the balloon to the recommended volume. Inject the contrast medium through the injection port to opacify the sinus and the distal venous branches. Immediately deflate the balloon after the venogram is obtained. Page 27
- **Contrast medium.** The type, amount, and rate of injection of the contrast medium must be determined by the physician's medical judgment regarding the adequacy of the venogram obtained. Page 28
- **Guide wire prolapse.** Use fluoroscopy to verify the guide wire does not prolapse and catch on the distal tip of the lead. If this occurs, slowly extend the wire beyond the distal tip to free the guide wire and then retract it to reestablish movement of the guide wire. Page 29
- **Guide wire retraction.** If the guide wire cannot be retracted, withdraw the lead/guide wire assembly through the guiding catheter. Remove the guide wire through the distal tip of the lead and reintroduce the lead using a new

DEVICE DESCRIPTION—EASYTRAK® LEAD

guide wire. Follow the positioning procedures previously discussed. Page 29

- **Bending or rotating finishing wire.** Do not bend the finishing wire or rotate it counterclockwise in the lead. Counterclockwise rotations or bends in the finishing wire could lock it in the lead or damage the conductor coil. Page 30
- **Remove finishing wire.** If the finishing wire cannot be retracted from the lead, withdraw the lead and finishing wire together. Do not implant with the finishing wire inside the lead. Page 31
- **Avoid too tight ligature.** When ligating the vein, avoid too tight a ligature. A tight ligature might damage the silicone rubber insulation or sever the vein. Avoid dislodging the lead tip during the stabilizing procedure. Page 32
- **Do not kink leads.** Do not kink, twist, or braid the lead terminal with other leads, as doing so could cause lead insulation abrasion or conductor damage. Page 32
- **Do not bend the lead near the lead-header interface.** Insert the lead terminal straight into the lead port. Do not bend the lead near the lead-header interface. Improper insertion can cause insulation or connector damage. Page 32
- Return all explanted leads to Guidant. Page 33
- **Minimize dissection.** To minimize the possibility of dissection, it is recommended that a guide wire be used when advancing the guiding catheter through the venous system, right atrium, or coronary sinus.
- **Prevent renal failure.** To prevent renal failure associated with the use of contrast media, consider the patient's renal function prior to the implant procedure to determine the type, amount, and rate of injection of the contrast medium while performing a venogram.
- **Implant time.** The VENTAK CHF/CONTAK CD/EASYTRAK Biventricular Pacing Study data indicate that 80% of implants are completed within 4 hours; 90% are completed within 5 hours. Implants that extend beyond 5 hours are unlikely to have successful completion; the physician should consider terminating the procedure. The

EASYTRAK® LEAD—ADVERSE EVENTS

implant procedure may be reattempted at a later date, if feasible.

ADVERSE EVENTS

The VENTAK® CHF/CONTAK CD®/EASYTRAK Biventricular Pacing Study (hereafter referred to as the CONTAK CD Study) was a prospective, randomized, controlled, multicenter, double-blind study conducted at 47 sites in the United States and enrolled a total of 581 patients. Of these, 57 patients initially underwent a thoracotomy procedure to receive the Guidant Model 1822 VENTAK CHF AICD; 7 patients underwent a repeat procedure to receive an EASYTRAK lead. An additional 510 patients initially underwent an implant procedure to receive the Model 1823 CONTAK CD CRT-D along with the EASYTRAK (Models 4510/4511/4512/4513) coronary venous, single-electrode pace/sense lead for a total of 517 patients who underwent an EASYTRAK lead implant procedure. In 69 patients the EASYTRAK lead implant attempt was unsuccessful.

Observed Adverse Events

Table 1 provides information on all lead-related and procedure-related adverse events reported from implant through the randomization period in patients attempted or implanted with the EASYTRAK lead. During this period, a total of 765 events were reported in 310 patients. Of these, 155 were classified as complications, and 610 were classified as observations.

ADVERSE EVENTS—EASYTRAK® LEAD

Table 1. EASYTRAK Lead-related and Procedure-related Adverse Events Through the Randomization Period

Adverse Event	# of Events (# of pts) ¹	% Complications (Patients)	Complications per 100 Device Months (Events)	% Observations (Patients)	Observations per 100 Device Months (Events)
LV Lead-Related Events					
Loss of capture	43 (41)	5.6 (29)	1.1 (29)	2.5 (13)	0.5 (14)
Inappropriate shock due to oversensing	1 (1)	0.0 (0)	0.0 (0)	0.2 (1)	0.0 (1)
Insulation breach observed	1 (1)	0.2 (1)	0.0 (1)	0.0 (0)	0.0 (0)
Multiple counting ²	31 (22)	1.0 (5)	0.2 (5)	3.9 (20)	1.0 (26)
Phrenic nerve/diaphragm stimulation	15 (15)	0.4 (2)	0.1 (2)	2.5 (13)	0.5 (13)
Procedure-Related Events					
AV Block	7 (7)	0.0 (0)	0.0 (0)	1.4 (7)	0.3 (7)
Coronary sinus dissection	5 (5)	0.0 (0)	0.0 (0)	1.0 (5)	0.2 (5)
Coronary venous perforation	5 (5)	0.2 (1)	0.0 (1)	0.8 (4)	0.2 (4)
Renal failure	5 (5)	0.2 (1)	0.0 (1)	0.8 (4)	0.2 (4)
Other ³	18 (18)	1.2 (6)	0.2 (6)	2.3 (12)	0.5 (12)

1. The total number of patients for a given event represents the unique number of patients who experienced that event. The total may not be equal to the sum of patients with complications or observations because some patients experienced more than one event that fell into both categories.
2. Sensing of two ventricular intrinsic events when only one intrinsic event is present due to intraventricular conduction delay.
3. Other procedure related events occurred in three patients or fewer: Guide wire fracture (1), Finishing wire left in lead (1), Pericardial effusion (3), RV lead dislodgement (1), Hypotension due to blood loss (1)

A total of 109 deaths occurred during the study at any point in time. These deaths occurred during the study periods as shown in Table 2 along with the cause of death as adjudicated by an independent events committee.

EASYTRAK® LEAD—ADVERSE EVENTS

Table 2. Deaths that Occurred During the Study

All patients enrolled, N=581

Study Period	# of pt deaths	Cause of Death				
		Cardiac: Pump Failure	Cardiac: Arrhythmic	Cardiac: Other	Non-Cardiac	Unknown
After unsuccessful implant procedure	2	1	1	0	0	0
Peri-operative (<= 30 days)	10	5	2	0	2	1
Randomized therapy phase*, No CRT	16	9	6	1	2	5
Randomized therapy phase**, CRT	11	4	4	2	2	2
Post-randomized therapy phase**	70	26	7	2	19	24
Total	109	47	9	4	23	26

* Day 31 to 120 for Phase I patients, day 31 to 210 for Phase II patients

** Day 121 and beyond for Phase I patients, day 211 and beyond for Phase II patients

Potential Adverse Events

Based on the literature and lead implant experience, the following alphabetical list includes possible adverse events associated with implantation of an implantable cardioverter defibrillator lead system:

- Acceleration of arrhythmias
- Air embolism
- Allergic reaction
- Bleeding
- Cardiac tamponade
- Chronic nerve damage
- Conductor coil fracture
- Death
- Elevated thresholds
- Erosion/extrusion
- Extracardiac stimulation (eg, phrenic, diaphragm, chest wall)
- Fibrotic tissue formation (eg, keloid formation)
- Fluid accumulation
- Formation of hematomas or cysts
- Heart block
- Inappropriate therapy (eg, shocks, ATP, pacing)
- Incomplete lead connection with pulse generator
- Infection
- Lead displacement/dislodgment
- Lead insulation breakage or abrasion
- Lead tip deformation and/or breakage
- Local tissue reaction
- Muscle and nerve stimulation
- Myocardial trauma (eg, cardiac perforation, irritability, injury)
- Myopotential sensing
- Oversensing/undersensing
- Pacemaker-mediated tachycardia
- Pericardial rub, effusion
- Pneumothorax
- Random component failures
- Shunting current or insulating myocardium during defibrillation with internal or external paddles
- Thrombosis/thromboemboli
- Valve damage
- Venous occlusion
- Venous trauma (eg, perforation, dissection, erosion)

In addition to the implantation of an implantable cardioverter defibrillator lead system, possible adverse events associated

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with implantation of a coronary venous lead system are listed below in alphabetical order:

- Allergic reaction to contrast media
- Breakage/failure of implant tools
- Coronary venous occlusion
- Coronary venous trauma (eg, perforation, dissection, erosion)
- Prolonged exposure to fluoroscopic radiation
- Renal failure from contrast media used to visualize coronary veins

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The following is a summary of findings on the EASYTRAK lead observed during the VENTAK CHF/CONTAK CD/EASYTRAK Biventricular Pacing Study.

Study Design

The CONTAK CD study was a prospective randomized, controlled, multicenter, double-blind study conducted at 47 sites in the United States and enrolled a total of 581 patients. All patients enrolled were intended to be implanted with a device capable of delivering both CRT and treating ventricular tachyarrhythmias. Patients were randomized to CRT Off (VVI lower rate 40) or CRT On (VDD). The study began as a crossover design (called "Phase I") and enrolled 248 patients with a primary endpoint of functional status with three months of follow-up. The study was later modified to a parallel design (called "Phase II") and enrolled 333 patients with a longer, six-month follow-up. The data from the first three months of the crossover phase were pooled with data from the six-month parallel phase. The visit schedule and testing requirements remained the same. Additionally, while the study originally used the VENTAK CHF AICD in conjunction with epicardial leads placed via thoracotomy, the CONTAK CD CRT-D and EASYTRAK lead (placed transvenously) were added to the protocol later in the study.

Inclusion/Exclusion Criteria

Patients enrolled in the study were required to meet the following inclusion criteria:

- Meet the general indication for ICD implant

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- Symptomatic heart failure despite optimal drug therapy (ACE inhibitors with diuretic and/or digoxin, as determined to be indicated and tolerated by the patient's physician-investigator)
- Left ventricular ejection fraction $\leq 35\%$
- QRS duration ≥ 120 ms
- Age ≥ 18 years
- Normal sinus node function

Patients were excluded from the investigation if they met any of the following criteria:

- Meet the general indications for permanent antibradycardia pacing, including pacemaker dependence
- Have chronic, medically refractory atrial tachyarrhythmias
- Require concomitant cardiac surgery
- Are unable to undergo device implant, including general anesthesia if required
- Are unable to comply with the protocol and follow-up requirements, including exercise testing
- Have a life expectancy of less than six months due to other medical conditions
- Have amyloid disease (amyloidosis)
- Have hypertrophic obstructive cardiomyopathy
- Require in-hospital continuous intravenous inotropes
- Have pre-existing cardioversion/defibrillation leads other than those specified in the investigational plan (unless the investigator intends to replace them with permitted cardioversion/defibrillation leads)
- Women who are pregnant or not using medically accepted birth control
- Have a mechanical tricuspid prosthesis
- Involved in other cardiovascular clinical investigations of active therapy or treatment

Follow-Up Schedule

Pre-implant visit: Initial assessment of patient eligibility; taking of patient history.

Implant: Implant of investigational devices and acute device testing. Randomization status (CRT or No CRT) was assigned for

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implementation after a 30-day Recovery Period.

Recovery Period: Minimum 30-day period over which the patient recovered from the implant procedure and had his/her heart failure medications adjusted, but with no CRT regardless of the randomization assignment.

Post-Recovery Visit: First visit after the Recovery Period in which patients underwent Special Testing¹ to establish their baseline condition, after which the randomization assignment was implemented (CRT or No CRT).

Three- and six-month Visits: Evaluation of randomized therapy with Special Testing¹ and device function at three- and six-months after the Post-Recovery Visit.

Quarterly Visits: After the six-month visit, patients were seen for routine evaluation of device function and patient condition.

Patient Groups

The CONTAK CD Study included patients with symptomatic heart failure despite optimal drug therapy. This population included patients who were NYHA Class II/III/IV at the time of implant.

Based upon the clinical results from the covariate analyses in this study, and the internal consistency of these clinical findings with those from other completed CRT studies, the patient subgroup with NYHA Class III/IV heart failure in this study was examined further.

Results indicate that patients with NYHA Class III/IV heart failure demonstrated the greatest improvement. Therefore, the

1. Special Testing included a Symptom-Limited Treadmill Test with measurement of oxygen uptake (Peak VO₂), a Six-Minute Walk, Echocardiography, Holter monitoring, blood chemistry testing, and a Quality of Life (QOL) questionnaire.

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CONTAK CD system indications for this PMA are for patients with NYHA Class III/IV heart failure.

- **All Patients: All patients (NYHA Class II/III/IV at the time of implant)** implanted with an investigational system (N = 501). Ten patients died and one withdrew before the Post-Recovery Visit. Therefore, therapy effectiveness analyses used N = 490.
- **NYHA Class III/IV (Advanced Heart Failure):** This subgroup was defined as those patients with moderate to severe heart failure at the time of the Post-Recovery Visit (N = 227). The randomization assignment (CRT vs. No CRT) was initiated after baseline measurements were performed. This subgroup was determined from interaction analysis of pre-selected covariates with the functional status endpoints.

Lead Endpoints

Lead and System Effectiveness:

Lead: Left ventricular pacing thresholds, biventricular sensing, biventricular lead impedance, and lead placement success rate.

System: VF detection time, biventricular antitachycardia pacing (ATP) efficacy.

Lead and System Safety:

Lead: Incidence of lead-related adverse events.

System: Incidence of severe, device-related adverse events and operative mortality.

Implant Data

There were 517 patients enrolled in the VENTAK CHF/CONTAK CD/EASYTRAK Biventricular Pacing Study who underwent an implant procedure for an EASYTRAK coronary venous single-electrode pace/sense lead.

Clinical Investigation

The lead study was a nonrandomized study comparing the performance of the EASYTRAK lead to criteria established

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prospectively. The objective of this investigation was to demonstrate the safety and effectiveness of the EASYTRAK lead. The EASYTRAK lead was successfully implanted in 448/517 (86.7%) of patients in whom an EASYTRAK lead implant was attempted. The mean implant duration of the study in the 448 patients who received the EASYTRAK lead was 17.7 months (range: 0 to 29.5 months) with a cumulative implant duration of 623 patient-years. Demographic information on all 517 patients studied is shown in Table 3.

Table 3. Demographic information on all Patients (N = 517)

Characteristic	Patients	%
Gender		
Male	436	84%
Female	81	16%
Age at Implant (years)	66 ± 11	
Mean LVEF	21 ± 6	
Etiology of Cardiomyopathy		
Ischemic	355	69%
Non-ischemic	162	31%
NYHA Classification		
II	177	34%
III	296	58%
IV	44	9%

The EASYTRAK lead pacing threshold was measured with a CONTAK CD device at 0.5 ms pulse width. The EASYTRAK R-wave amplitudes and lead impedance were also measured with the CONTAK CD device in a biventricular lead configuration (from the EASYTRAK lead and right ventricular lead connected in parallel).

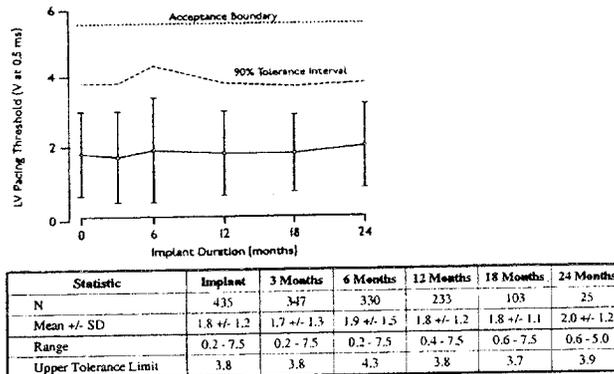
The mean chronic (> 12 months) pacing threshold (0.5 ms pulse width) of the EASYTRAK lead was 1.8 ± 1.2 V, mean chronic biventricular R-wave amplitude was 9.8 ± 4.4 mV, and mean chronic biventricular lead impedance was 351 ± 51 Ω .

Lead Effectiveness

The effectiveness of the EASYTRAK lead was determined with chronic left ventricular pacing thresholds, chronic biventricular sensed R-wave amplitudes, and chronic biventricular lead pacing impedances.

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All patients implanted with an EASYTRAK lead at first implant, N = 443



* EASYTRAK lead models 4511, 4512, and 4513

Figure 1. Threshold measurements.

It was hypothesized that the upper tolerance limit of the chronic left ventricular pacing threshold of the EASYTRAK lead be less than 5.5 V to ensure that an adequate safety margin exists. Chronic left ventricular pacing thresholds are within this limit.

All patients implanted with an EASYTRAK lead at first implant, N = 443

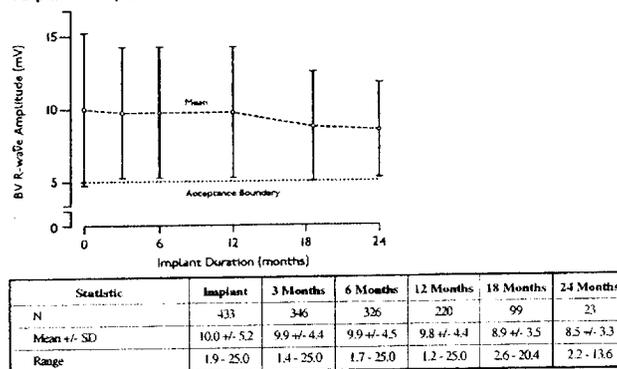


Figure 2. Biventricular sensed R-wave amplitude.

Mean chronic biventricular R-wave amplitudes are measured as a combination of the R-waves from both the right ventricle

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(commercially available ENDOTAK lead) and left ventricle (EASYTRAK lead). It was hypothesized that the mean biven- tricular R-wave amplitude be greater than 5 mV to ensure proper sensing. The performance of the EASYTRAK lead sys- tem was significantly above this value ($p < 0.01$).

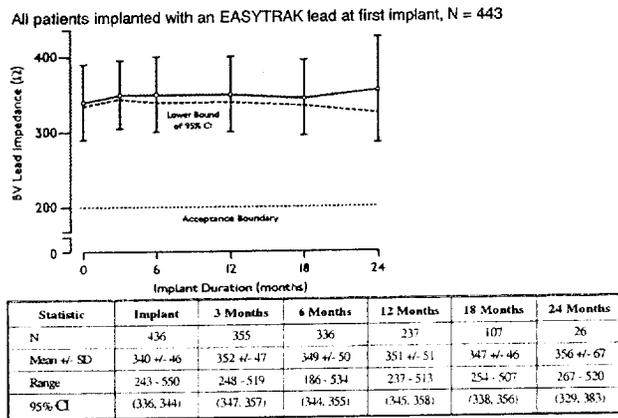


Figure 3. Biventricular pacing impedance.

The impedance measured by the CONTAK CD device is the parallel combination of the left ventricular (EASYTRAK) and right ventricular (ENDOTAK) leads simultaneously. Therefore, the biventricular lead impedance will be substantially less than that of either lead alone. The average measured beventricular R-wave amplitude is between 8 to 10 mV with the normal range typically between 5 and 20 mV. The average measured biventricular impedance is 350 Ω with the range typically between 250 and 500 ohms. It was hypothesized that the lower limit of the 95% confidence interval of the mean chronic biventricular lead impedance would be greater than 200 Ω to ensure proper pulse generator function. The lower limit of the 95% confidence interval of the chronic biventricular lead impedance exceeds this value (Figure 3).

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Lead Placement Success Rate

The EASYTRAK lead was implanted in 448/517 (87%) of patients who underwent the implant procedure. Table 4 shows the reasons for inability to place the EASYTRAK lead. Table 5 provides the EASYTRAK lead implant success rate.

Table 4. Reasons for Unsuccessful EASYTRAK Lead Implant

Patients with unsuccessful attempt to implant EASYTRAK lead (N=69)

Reason	# of pts	%
Inability to locate or cannulate the coronary sinus	29	42.0
Dislodgment of EASYTRAK lead while removing guide catheter	13	18.8
Inability to advance the lead to a stable position	11	15.9
Inability to obtain adequate pacing thresholds	6	8.7
Procedure stopped due to coronary sinus dissection or perforation	5	7.2
Procedure stopped due to transient AV block	1	1.4
Procedure stopped due to venous perforation during subclavian stick	1	1.4
Reason not stated	1	1.4
Extracardiac stimulation	1	1.4
Inability to place an atrial pace/sense lead	1	1.4
Total	69	100%

Table 5. EASYTRAK Lead Placement Success Rate

All patients implanted or attempted with EASYTRAK lead, N=517

Measurement	All Procedures
Number of patients implanted or attempted	517
Number of placements* of the EASYTRAK Lead	448
Rate	87%
95% CI	(84%, 90%)

*Defined an EASYTRAK implant procedure that is concluded with the implant of the investigational cardiac resynchronization system.

Although some situations such as patient anatomy and poor thresholds cannot be avoided, increased investigator experience with the EASYTRAK lead and accessories was associated with improved success, decreased total procedure time (measured skin-to-skin), and decreased fluoroscopy exposure time (Figure 4).

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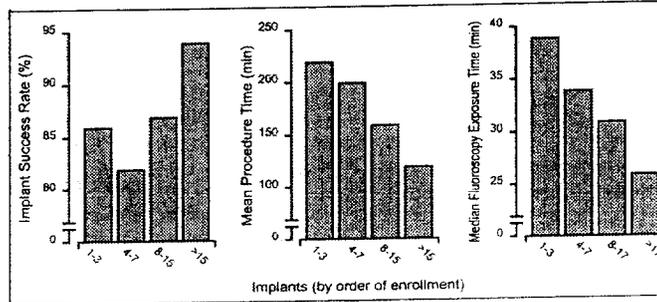


Figure 4. EASYTRAK Lead Success Rate, Procedure Time, Fluoroscopy Exposure Time.

Lead Safety

Safety was established using the rate of adverse events that are either related to the EASYTRAK lead or to the implant procedure necessary to place the EASYTRAK lead.

An EASYTRAK lead implant procedure was performed in 517 patients with 448 patients (86.7%) being successfully implanted with the EASYTRAK lead. The upper boundary of the 95% confidence interval was hypothesized to be less than 23% at six months (Table 6).

Table 6. Lead Related Adverse Events at Six Months

Patient Population	n	Event Rate (%)	95% Confidence Interval
All Patients	517	12.2	(9.4, 15.0)
NYHA Class III/IV	201	17.4	(12.7, 22.7)

Fifty-three lead-related adverse events were reported during the clinical investigation of the EASYTRAK coronary venous single-electrode pace/sense lead among the 448 patients who were implanted with an EASYTRAK lead. Twenty-seven procedure-related adverse events were reported among the 517 patients who underwent the implant procedure for an EASYTRAK lead. The overall lead-related adverse event rate was 14.5% [95% CI (11.5–17.5%)].

The most common of the 53 lead-related adverse events (> 1% incidence) included loss of left ventricular capture

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(31 patients, 6.9%), ventricular oversensing (11 patients, 2.5%), and extracardiac stimulation (9 patients, 2.0%). These events were typically resolved with surgical intervention.

The most common of the 27 procedure-related adverse events (> 1% incidence) included coronary venous trauma (10 patients, 2.0%), transient atrioventricular block (6 patients, 1.2%), and transient renal failure (5 patients, 1.0%). These events were typically resolved without intervention and no permanent long-term sequelae were reported.

Warranty

Guidant Corporation does not warrant or guarantee its EASYTRAK leads. Please see the enclosed Lead Information card for further information. For additional copies, please contact Guidant Corporation at the address on the back cover of this manual.

Refer to the Contraindications, Warnings, Precautions, and Adverse Events sections of this manual for information concerning the performance of this device.
