

Summary of Safety and Effectiveness Data

Tube and Bifurcated ANCURE™ Systems

Guidant Cardiac & Vascular Surgery Group

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Summary of Safety and Effectiveness Data

Tube and Bifurcated ANCURE™ Systems

Guidant Cardiac & Vascular Surgery Group

1. General Information

Device Generic Name: Endovascular Tube and Bifurcated Grafting Systems

Device Trade Name: Guidant ANCURE™ Tube System,
..... Guidant ANCURE™ Bifurcated System,
..... ANCURE™ Iliac Balloon Catheter

Applicant's Name and Address: Guidant Cardiac & Vascular Surgery Group
1525 O'Brien Drive
Menlo Park, CA 94025

PMA Application Number: P990017

Date of Panel Recommendation:..... June 23, 1999

Date of Notice of Approval to the Applicant:..... SEP 28 1999

2. Indications and Usage

The ANCURE™ Tube System is indicated for the endovascular treatment of infrarenal abdominal aortic aneurysms (AAA) in patients having:

- adequate iliac/femoral access,
- infrarenal non-aneurysmal neck length of at least 15 mm and a diameter of no greater than 26 mm,
- distal segment neck length of 12 mm and diameter of no greater than 26 mm, and
- morphology suitable for endovascular repair

The ANCURE™ Bifurcated System is indicated for the endovascular treatment of infrarenal abdominal aortic or aorto-iliac aneurysms in patients having:

- adequate iliac/femoral access,
- infrarenal non-aneurysmal neck length of at least 15 mm and a diameter of no greater than 26 mm,
- distal segment lengths of at least 20 mm and diameters no greater than 13.4 mm, and
- morphology suitable for endovascular repair.

3. Contraindications

There are no identified contraindications for these devices.

4. Warnings and Precautions

See Final Draft Labeling

5. Device Description

5.1 Guidant ANCURE™ System

The Guidant ANCURE™ System consists of an endograft, which is housed within a delivery catheter, a contralateral torque catheter, and a contralateral cutter. A separate component of the system is the ANCURE™ Iliac Balloon Catheter. The ANCURE™ System comes in two configurations: tube and bifurcated. The tube configuration contains a straight endograft, and the bifurcated configuration contains a bifurcated endograft. The endograft is a woven polyester vascular graft with attachment systems affixed to the ends. Each attachment system consists of angled metal attachment hooks and a self-expanding cylindrical metal frame. The attachment systems create an anastomosis between the graft and the vessel wall. Radiopaque markers on the endograft assist with the visualization under fluoroscopy. The attachment systems and radiopaque markers are made from metallic alloys.

An earlier version of the ANCURE System, called the EGS System, was used in some of the clinical trials to support this submission. The EGS and ANCURE endografts are identical except that the bifurcated ANCURE endograft has additional radiopaque markers to aid in implant visualization and both the tube and bifurcated ANCURE endografts have suture loops on the outside of the endograft at the level of the attachment system to accommodate the deployment mechanism of the ANCURE delivery catheter. Preclinical testing was used to qualify the new endograft design.

The delivery catheters house their respective compressed endografts and are used to deploy the endografts. All delivery catheters consist of 1) a multi-lumen balloon catheter that is used to guide the device over a guidewire and secure the attachment system, 2) a deployment system that controls deployment of the attachment systems, and 3) a jacket that houses the compressed endograft. See Figures 1 to 3 for depictions of the ANCURE delivery catheters.

Both the bifurcated EGS and bifurcated ANCURE delivery catheters contain a contralateral pull-wire assembly used to position the contralateral limb of the bifurcated endograft and a contralateral torque catheter used to manipulate the contralateral limb (see Figure 4). The bifurcated ANCURE System also features a contralateral cutter that is used to facilitate deployment (see Figure 5). These new features were qualified in the ANCURE clinical trial.

Both the tube and bifurcated endografts are provided in a range of lengths and diameters to accommodate variations in patient anatomy. Tables 1 and 2 list the sizes and model numbers available for the tube and bifurcated endograft devices, respectively.

Figure 1. ANCURE™ Delivery Catheter Handle (Tube and Bifurcated)

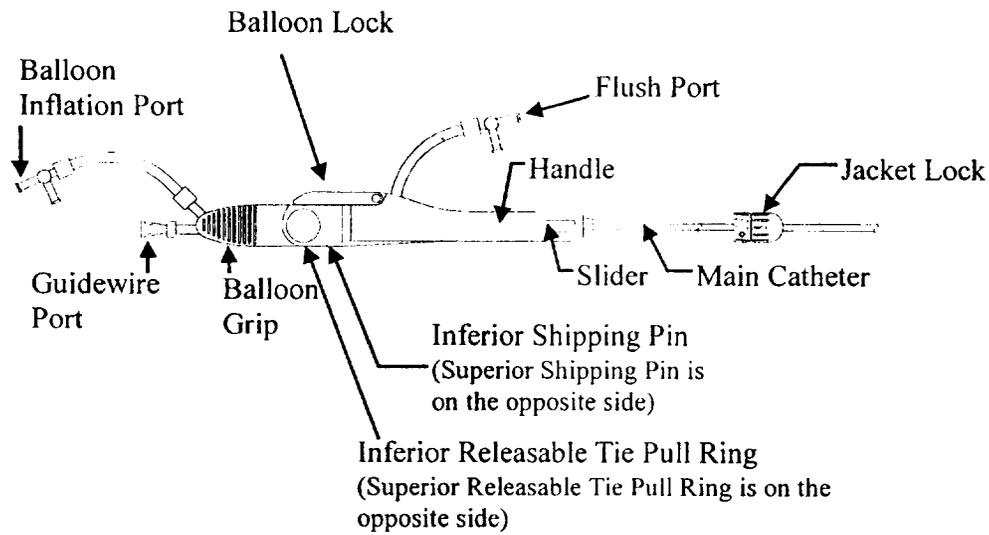


Figure 2. ANCURE™ Tube Delivery Catheter Jacket, Balloon, and Endograft

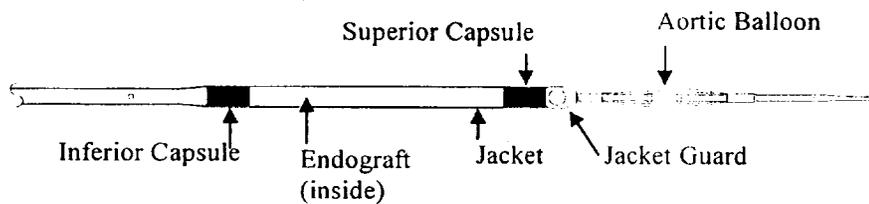


Figure 3. ANCURE™ Bifurcated Delivery Catheter Jacket, Balloon, Endograft, and Pull Wire

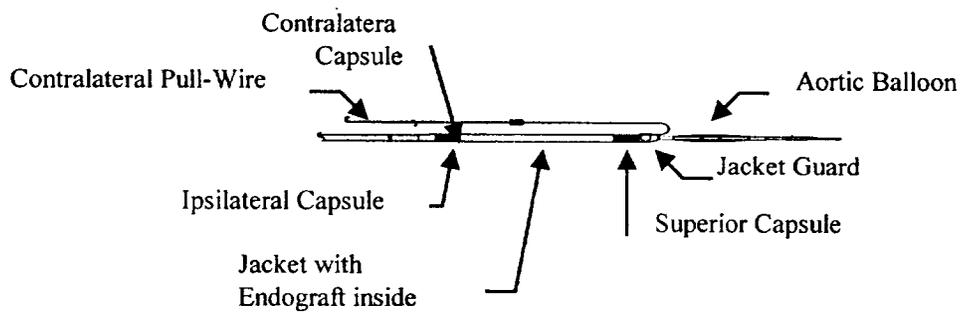


Table 1. ANCURE™ Tube System Model Numbers

DESCRIPTION	PART NUMBER	MODEL NUMBER	SIZE
TUBE	0305	2009	20x9
TUBE	0305	2010	20x10
TUBE	0305	2011	20x11
TUBE	0305	2012	20x12
TUBE	0305	2013	20x13
TUBE	0305	2014	20x14
TUBE	0305	2015	20x15
TUBE	0305	2016	20x16
TUBE	0305	2209	22x9
TUBE	0305	2210	22x10
TUBE	0305	2211	22x11
TUBE	0305	2212	22x12
TUBE	0305	2213	22x13
TUBE	0305	2214	22x14
TUBE	0305	2215	22x15
TUBE	0305	2216	22x16
TUBE	0305	2409	24x9
TUBE	0305	2410	24x10
TUBE	0305	2411	24x11
TUBE	0305	2412	24x12
TUBE	0305	2413	24x13
TUBE	0305	2414	24x14
TUBE	0305	2415	24x15
TUBE	0305	2416	24x16
TUBE	0305	2609	26x9
TUBE	0305	2610	26x10
TUBE	0305	2611	26x11
TUBE	0305	2612	26x12
TUBE	0305	2613	26x13
TUBE	0305	2614	26x14
TUBE	0305	2615	26x15
TUBE	0305	2616	26x16

Table 2. ANCURE™ Bifurcated System Model Numbers

DESCRIPTION	PART NUMBER	MODEL NUMBER	SIZE
BIFURCATED	0204	201210	20x12
BIFURCATED	0204	201310	20x13
BIFURCATED	0204	201410	20x14
BIFURCATED	0204	201510	20x15
BIFURCATED	0204	201610	20x16
BIFURCATED	0204	201710	20x17
BIFURCATED	0204	201810	20x18
BIFURCATED	0204	201910	20x19
BIFURCATED	0204	221211	22x12
BIFURCATED	0204	221311	22x13
BIFURCATED	0204	221411	22x14
BIFURCATED	0204	221511	22x15
BIFURCATED	0204	221611	22x16
BIFURCATED	0204	221711	22x17
BIFURCATED	0204	221811	22x18
BIFURCATED	0204	221911	22x19
BIFURCATED	0204	241212	24x12
BIFURCATED	0204	241312	24x13
BIFURCATED	0204	241412	24x14
BIFURCATED	0204	241512	24x15
BIFURCATED	0204	241612	24x16
BIFURCATED	0204	241712	24x17
BIFURCATED	0204	241812	24x18
BIFURCATED	0204	241912	24x19
BIFURCATED	0204	261213	26x12
BIFURCATED	0204	261313	26x13
BIFURCATED	0204	261413	26x14
BIFURCATED	0204	261513	26x15
BIFURCATED	0204	261613	26x16
BIFURCATED	0204	261713	26x17
BIFURCATED	0204	261813	26x18
BIFURCATED	0204	261913	26x19

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Figure 4. ANCURE™ Contralateral Torque Catheter

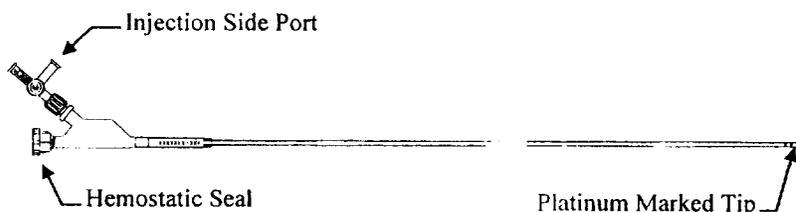
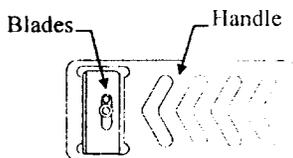


Figure 5. ANCURE™ Contralateral Cutter



5.2 ANCURE™ Iliac Balloon Catheter

The ANCURE Iliac Balloon Catheter is a balloon dilation catheter made up of a balloon at the distal end, catheter shaft, and an extension manifold at the proximal end. One lumen is used for inflation and deflation of the balloon. The other lumen accommodates a guidewire with a recommended diameter of 0.035” (0.89mm).

The ANCURE Iliac Balloon Catheter is available in a variety of sizes to accommodate various iliac diameters.

Table 3 lists the various sizes and model numbers.

Table 3. ANCURE™ Iliac Balloon Catheter Model Numbers

DESCRIPTION	PART NUMBER	SIZE
ILIAC BALLOON	1002820	9 mm
ILIAC BALLOON	1002821	10 mm
ILIAC BALLOON	1002822	11 mm
ILIAC BALLOON	1002823	12 mm
ILIAC BALLOON	1002824	13 mm
ILIAC BALLOON	1002825	14 mm

6. Alternative Practices or Procedures

Currently, the most widely accepted treatment for AAA repair is surgical repair utilizing aneurysmorrhaphy and prosthetic graft interposition through a transperitoneal or retroperitoneal incision.

7. Marketing History

The Ancure System has been commercially available in Australia, France, Germany, Italy, the Netherlands, the United Kingdom, Spain, and Greece. The Ancure System has not been withdrawn from marketing for any reason relating to the safety and effectiveness of the device.

8. Adverse Events

8.1 Observed Adverse Events

A total of 532 patients were enrolled in the EGS clinical study (153 tube, 268 bifurcated, and 111 control), and 89 patients were enrolled in the ANCURE clinical study (9 tube and 80 bifurcated). Both trials provide the basis for the observed event rates. Adverse event data are summarized in alphabetical order in Tables 4 and 5.

In the EGS clinical study, the operative mortality rate was less than three percent in all treatment groups (0.0% tube, 2.6% bifurcated, and 2.7% control subjects). For the bifurcated subjects, five of the seven deaths occurred early in the investigators' experience and two of the deaths occurred in subjects who required an intraoperative conversion. One bifurcated subject died of myocardial infarction following a second unrelated surgery for cancer. There were no deaths among the tube subjects. Three control patients died in the operative period.

In the Ancure clinical study, the operative mortality rate was virtually identical in the ANCURE and bifurcated EGS subjects (2.2% and 2.6% respectively). Two ANCURE bifurcated subjects expired in the early postoperative period. One died from a myocardial infarction on postoperative day two. The other, who required an intraoperative conversion, died from cardiovascular collapse on the sixth postoperative day. There were no deaths among the ANCURE tube subjects.

Table 4. Adverse Events ≤ 30 days (Listed Alphabetically)

Event	ANCURE (Tube & Bifurcated) ¹		Tube EGS		Bifurcated EGS		Control ²	
	%	(n/N)	%	(n/N)	%	(n/N)	%	(n/N)
Deaths – Operative	2.2%	(2/89)	0.0%	(0/153)	2.6%	(7/268)	2.7%	(3/111)
Other Adverse Events								
Arterial Trauma ³	13.5%	(12/89)	7.2%	(11/153)	16.0%	(43/268) ³	0.0%	(0/111)
Bleeding	12.4%	(11/89)	8.5%	(13/153)	15.7%	(42/268)	39.6%	(44/111)
Bowel	1.1%	(1/89)	5.2%	(8/153)	3.0%	(8/268)	8.1%	(9/111)
Cardiac	7.9%	(7/89)	10.5%	(16/153)	13.4%	(36/268)	20.7%	(23/111)
Coagulopathy	2.3%	(2/89)	0.7%	(1/153)	3.0%	(8/268)	4.5%	(5/111)
Conversions ⁴	3.4%	(3/89)	7.8%	(12/153)	9.7%	(26/268)	N/A	
Deep Vein Thrombosis	0.0%	(0/89)	0.7%	(1/153)	1.1%	(3/268)	0.9%	(1/111)
Embolism – Lower Extremity Ischemia	7.9%	(7/89)	3.9%	(6/153)	3.0%	(8/268)	0.9%	(1/111)
Hematoma	6.7%	(6/89)	10.5%	(16/153)	9.3%	(25/268)	1.8%	(2/111)
Impotence	0.0%	(0/89)	0.0%	(0/153)	0.0%	(0/268)	1.8%	(2/111)
Paraplegia/Paraparesis	0.0%	(0/89)	0.0%	(0/153)	0.4%	(1/268)	0.0%	(0/111)
Perigraft Flow, Discharge	19.3%	(16/83)	44.4%	(60/135)	48.4%	(106/219)	N/A	
Prosthetic Thrombosis	6.7%	(6/89)	0.0%	(0/153)	2.6%	(7/268)	0.0%	(0/111)
Reduced Limb Flow ⁵	37.7%	(29/77)	N/A		31.8%	(77/242)	N/A	
Renal Insufficiency	2.3%	(2/89)	3.3%	(5/153)	8.2%	(22/268)	1.8%	(2/111)
Respiratory	1.1%	(1/89)	7.2%	(11/153)	10.1%	(27/268)	22.5%	(25/111)
Stroke	3.4%	(3/89)	0.0%	(0/153)	0.7%	(2/268)	0.9%	(1/111)
TIA	0.0%	(0/89)	0.7%	(1/153)	0.7%	(2/268)	0.0%	(0/111)
Wound	3.4%	(3/89)	5.2%	(8/153)	3.4%	(9/268)	1.8%	(2/111)

1. Nine of the ANCURE subjects were tube subjects and 80 were bifurcated subjects.
2. 94 of the Control subjects were tube subjects and 17 were bifurcated subjects.
3. One bifurcated EGS arterial trauma resulted in limb amputation.
4. There were three conversions > 30 days postoperative (1 tube and 2 bifurcated patients)
5. The analyses included only implanted patients. An additional 16 bifurcated subjects experienced reduced limb flow > 30 days postoperatively.

Table 5. Adverse Event Rates at 12 months (Listed Alphabetically)

Event	Tube EGS (%) ¹	Bifurcated EGS (%) ¹	Control ² (%) ¹
Deaths	6.0%	7.1%	5.4%
Other Adverse Events			
Arterial Trauma	7.2%	16.1%	1.0%
Bleeding	8.5%	15.7%	39.6%
Bowel	5.9%	3.0%	11.0%
Cardiac	16.5%	22.3%	24.6%
Graft Migration ³	0.7%	0.4%	N/A
Perigraft Flow ³	25.0%	31.3%	N/A
Renal Insufficiency	4.7%	10.6%	1.8%
Respiratory	9.9%	16.3%	24.3%
Wound	5.9%	3.8%	1.9%

1. Event rates are based on Kaplan Meier methodology
2. 94 of the Control subjects were tube subjects and 17 were bifurcated subjects.
3. These events were assessed at discrete time points (discharge, 6 mos., 12 mos.) therefore Kaplan Meier estimates of the rates were not performed.

8.2 Potential Adverse Events

The following adverse events (in alphabetical order) may be associated with endovascular AAA repair:

Table 6. Potential Adverse Events

Acute myocardial infarction	Hypotension/Hypertension
Amputation	Impotence
Anastomotic false aneurysm	Infection and pain at insertion site
Arrhythmias	Infection
Arterial trauma/dissection	Lymphatic complications
Attachment system fractures	Paraplegia/paraparesis
Bleeding, requiring transfusion	Perforation
Bowel ischemia/bowel obstruction/adynamic ileus	Perigraft flow
Coagulopathy	Prosthesis extrusion/erosion
Congestive heart failure	Prosthetic infection
Conversion to standard AAA surgery	Pulmonary embolism
Death	Reduced limb flow
Deep vein thrombosis	Renal insufficiency/failure
Drug reactions to antiplatelet agents/contrast medium	Respiratory failure/atelectasis/pneumonia
Emboli, distal (air, tissue or thrombotic emboli)	Spasm
Fistula (aortoenteric, aortocaval)	Stroke/cerebrovascular event
Graft dilatation	TIA
Graft migration	Thrombosis/occlusion of graft
Hematoma	Wound dehiscence

9. Summary of Pre-Clinical Studies

9.1 Laboratory Studies

The tube and bifurcated ANCURE Systems (and the earlier version, the EGS System) were subjected to a comprehensive pre-clinical testing program in accordance with the FDA draft "Guidance for the Preparation of Research and Marketing Applications for Vascular Graft Prostheses". All test samples were prepared in the same manner as intended for clinical usage.

9.1.1 Biocompatibility, Immunology, and Toxicology Studies

Toxicity and biocompatibility studies were conducted for all endograft, delivery catheter, contralateral torque catheter, and iliac balloon catheter materials. The testing was conducted in accordance with Good Laboratory Practices per 21CFR 58 and ISO 10993. The endografts were classified by ISO 10993 as implant devices, blood contact, C - long-term. The delivery catheters, contralateral torque catheters, and iliac balloon catheters were classified as externally communicating devices with circulating blood contact and limited exposure of less than 24 hours. The results as shown in Table 7 supported the biocompatibility of the devices for their intended uses.

Table 7. Biocompatibility, Immunology, and Toxicology Studies

Test Performed	Extract(s)	Findings
Ames Salmonella/ Mammalian Microsome Mutagenicity Assay	0.9% USP Sodium Chloride for injection and DMSO extracts	Material is non-mutagenic.
Sister Chromatid Exchange	McCoy's 5A medium	Material is non-genotoxic.
Chromosomal Aberration	McCoy's 5A medium	Material is non-genotoxic.
<i>In Vitro</i> Hemolysis	0.9% Sodium Chloride USP	Material is non-hemolytic.
C3a Complement Activation	Normal Human Serum, NHS, certified HIV (1 & 2) and Hepatitis (B & C) negative	Test article represented activation at 18,472 ng/ml. The materials performed as anticipated.
Determination of Clotting Time using the Lee-White Method	Canis familiaris blood	Material did not have a significant effect on clotting time.
Cytotoxicity	Single strength MEM supplemented with 5% calf serum and 2% antibiotics	Material showed no evidence of cell lysis or toxicity to L-929 mouse fibroblast cells. The material was non-cytotoxic.
Acute Intracutaneous Reactivity Study in the Rabbit	0.9% Sodium Chloride USP Solution and Cottonseed Oil	The Primary Irritation Index Characterization was negligible. There was no evidence of significant irritation or toxicity.
Magnusson and Kligman Method Delayed Contact Sensitization Study in the Guinea Pig, Maximization	0.9% Sodium Chloride USP Solution and Cottonseed Oil	There was no evidence of causing delayed dermal contact sensitization in the guinea pig.
Magnusson and Kligman Method Delayed Contact Sensitization Study in the Guinea Pig, Maximization Method (Positive Control)	1-Chloro -2,4-Dinitrobenzene (DNCB)	The known sensitizer DNCB showed significant evidence of causing delayed dermal contact sensitization.
Rabbit Pyrogen	0.9% Sodium Chloride USP Solution	Material is non-pyrogenic.
USP Systemic Toxicity Study in the Mouse	0.9% Sodium Chloride USP Solution and Cottonseed Oil, NF (CSO)	There was no evidence of significant systemic toxicity.
Sub-Chronic (14 days) Intravenous Toxicity Study in the Rat	0.9% Sodium Chloride USP Solution	There was no evidence of significant systemic toxicity
Muscle Implantation Study in the rabbit with Histopathology (surgical method 13 weeks)	N/A	There was no evidence if material toxicity in the surrounding animal tissues.

9.1.2 Endograft Mechanical Testing

Mechanical tests were conducted on the EndoWeave-65 tube graft, as representative of both the tube and bifurcated endografts. Two sources for the Endo Weave-65 material were qualified. A summary of the mechanical testing conducted is presented in Table 8. The data demonstrates the mechanical properties of the endografts are equivalent, are suitable for their intended uses, and are within manufacturing capabilities.

Table 8. Endograft Mechanical Testing Summary

Attribute	Source A EndoWeave-65 Endograft Material	Source B EndoWeave-65 Endograft Material	Guidant Specification (EndoWeave-65)
Water Permeability (ml/cm ² /min)	Avg: 177 S.D.: 30.8	Avg.: 186 S.D.: 39.8	Average must be between 50 and 300 ml/cm ² /min
Modified Tensile Strength (lbs.)	Avg: 112.0 S.D.: 6.91	Avg.: 112.5 S.D.: 6.27	Average must be ≥95 lbs.
Balloon Burst Strength (Hoop Stress) (p.s.i.)	Avg: 9573 S.D.: 557	Avg.: 10199 S.D.: 665	≥5732 PSI
Compliance (%)	Avg: 0.0100 S.D.: 0.00145	Avg.: 0.0088 S.D.: 0.00121	0.00 – 0.03%
Longitudinal Tensile Strength (lb./inch)	Avg: 86.1 S.D.: 3.02	Avg.: 84.5 S.D.: 18.35	≥60 lb./in
Suture Retention Strength (grams-force)	Avg: 1682 S.D.: 366	Avg.: 2243 S.D.: 166	≥800 grams-force
Suture Hole Elongation (inches)	Avg: 0.006” S.D.: 0.0038	Avg.: 0.009” S.D.: 0.0038	≤0.039”
Kink Radius (inches)	Avg. Limbs: 0.234” S.D.: 0.010	Avg. Limbs: 0.235” S.D.: 0.005	<0.65”
Crush Resistance (grams)	Avg. Limbs: 52.5 S.D.: 2.5	Avg. Limbs: 78.3 S.D.: 12.5	≥50 grams-force
Usable Length (% elongation)	Avg. (100mm Hg): 18.6% S.D.: 3.60 Avg. (full): 22.3% S.D.: 3.28%	Avg. (100mm Hg):15.9% S.D.: 2.0% Avg. (full): 22.1% S.D.: 2.5%	8 – 20% at 100mm Hg 20 – 27% at full elongation

9.1.3 Endograft Durability Testing

Objective: Testing was conducted on the tube and bifurcated endograft material to evaluate the mechanical integrity of the endograft material.

Methods: Testing was completed on endograft material samples to an equivalent of 10 years or 400 million cycles. A modified tensile test was performed on one sample each following 100 million, 200 million, 300 million and 400 million cycles. Following cycling, the samples were cut into two pieces and pulled to failure.

Results: Durability results are shown in Table 9.

Table 9. Endograft Durability Testing Summary

Peak Tensile Force (lbf) after 100 Million Cycles (n=2)	Peak Tensile Force (lbf) after 200 Million Cycles (n=2)	Peak Tensile Force (lbf) after 300 Million Cycles (n=2)	Peak Tensile Force (lbf) after 400 Million Cycles (n=2)
113.2 ± 2.33	99.3 ± 7.92	102 ± 1.06	81.83 ± 16.65

Theoretical burst strength was calculated from the tensile force data. After the equivalent of 10 years *in vivo* the EndoWeave-65 graft material exhibited a theoretical burst strength of 106.5 psi, which far exceeds the estimated *in vivo* loads of 2 – 5 psi. The compliance of the Endo-Weave-65 graft material before and after 400 million cycles was 0.0100% and 0.0083%, respectively.

Conclusions: These data indicate the EndoWeave-65 graft material has sufficient strength and compliance for its intended use throughout its intended lifetime.

9.1.4 Tube Endograft Aortic Attachment System Studies

9.1.4.1 Estimation of In vivo Loads

Four estimation methods (clinical extrapolation, an *in vitro* flow model, a fluid mechanics model, and a computer model) were used to estimate tube endograft the axial loads.

Radial loads were estimated based on the cyclic diameter change experienced by the aorta. Cyclic diameter changes were estimated based on published literature. The estimates of radial and axial loads were employed to evaluate the mechanical integrity of the device.

9.1.4.2 Finite Element Analysis

Finite element analysis was used to estimate the *in vivo* stresses of the attachment system frame and V-hook. Both the attachment system frame model and the V-hook model showed stress as linearly proportional to the attachment system diameter change over the *in vivo* diameter range. Stresses were dominated by bending stresses. Axial and torsional stresses were low.

9.1.4.3 Fatigue Testing

Fatigue life was estimated through the use of Goodman fatigue diagrams.

Table 10. Tube Attachment System Fatigue Analyses

Test Performed	Methods	Findings
<i>In vivo</i> lifetime of the V-hook apex	The <i>in vivo</i> lifetime of the V-hook apex was estimated by applying cyclic displacement loading to test specimens representing the V-hook apex in a corrosive environment.	The V- hook apex was determined to meet the product requirement of a 15-year <i>in vivo</i> lifetime. The V-hook apex test specimens that failed did so at the top of the strut near the apex.
<i>In vivo</i> life of the V-hook tip	The effects of axial loading on the fatigue life of V-hook tips were also analyzed. Cyclic displacement loading in a corrosive environment was applied to the test specimen to estimate the <i>in vivo</i> life of the V-hook tip.	The V- hook tip was determined to meet the product requirement of a 15-year <i>in vivo</i> lifetime. The test specimens that failed did so at the tip.
Fatigue of aortic frame closure weld	Cyclic displacement at different loading was applied to test specimens in a corrosive environment using Cantilever Beam Equipment. Results were extrapolated to long term <i>in vivo</i> lifetimes.	The aortic frame closure weld was determined to meet the product criteria of a 15-year <i>in vivo</i> lifetime.

9.1.5 Bifurcated Endograft Attachment System Studies

9.1.5.1 Estimation of *In vivo* Loads

Three estimation methods (clinical extrapolation, a flow model, and a fluid mechanics model) were used to model the bifurcated endograft *in vivo* axial loads. Aortic axial loads experienced in a bifurcated endograft were found to be similar to axial loads in a tube endograft.

The iliac attachment system mean diameter *in vivo* was determined for all sizes of endograft diameters. Radial loads were estimated based on the cyclic diameter change experienced by the iliac arteries. The *in vivo* mean diameters and cyclic diameter changes were used in combination with finite element analysis to determine the *in vivo* mean and alternating stresses of the aortic and iliac attachment systems due to arterial diameter change loading.

9.1.5.2 Finite Element Analysis

Results from the finite element analysis for the tube EGS endograft attachment systems were used to represent the bifurcated EGS endograft aortic attachment system frame and V-hooks, since the aortic end of the bifurcated EGS endograft attachment system is identical to that of the tube EGS endograft attachment system.

Finite element analysis was used to estimate the *in vivo* mean and alternating stresses of the attachment system frame and V-hook. Two analyses were conducted to estimate hook stresses using elastic finite element analysis. In the first analysis, the iliac attachment system frame stresses were estimated using a radially loaded model that was compressed from a 15mm-free diameter to the estimated *in vivo* systolic and diastolic diameters. A second analysis was conducted to estimate hook stresses using a radially and axially loaded model that was compressed from a 15mm-free diameter to the estimated *in vivo* systolic and diastolic changes. The results for both analyses showed that stresses are linearly proportional to attachment system diameter changes over the *in vivo* diameter range. Stresses were dominated by bending stresses. Axial and torsional stresses were low. A similar analysis was performed on each diameter for iliac attachment systems yielding similar results.

9.1.5.3 Fatigue Testing

The estimated *in vivo* mean and alternating stresses and R-ratios in the aortic attachment systems and V-hooks for the tube endograft attachment systems were utilized to represent the bifurcated endograft aortic attachment system frame and V-hooks. These data were used in estimating fatigue life using the Goodman fatigue diagrams.

Table 11. Bifurcated Attachment System Fatigue Analyses

Test Performed	Methods	Findings
Fatigue lifetime of the iliac attachment system hook tip bend	Estimations by plotting alternating load versus cycles to failure at several different loads. Results were extrapolated from a fatigue curve and compared to the <i>in vivo</i> force.	The iliac hook tip bend was determined to meet the product requirement of a 15-year <i>in vivo</i> lifetime.
<i>In vivo</i> life of the iliac frame apex	Estimated using cyclic displacement loading applied to test specimens representing the iliac attachment frame apex in a corrosive environment. A fatigue curve was generated.	The iliac frame apex was determined to meet the product requirement of a 15-year <i>in vivo</i> lifetime.
<i>In vivo</i> life of the iliac hook weld	Estimated using cyclic displacement loading applied to test specimens representing the iliac attachment frame hook weld in a corrosive environment at three different test conditions. A fatigue curve was generated.	The iliac hook weld was determined to meet the product requirement of a 15-year <i>in vivo</i> lifetime.
Fatigue of aortic frame closure weld	Cyclic displacement at different loading was applied to test specimens in a corrosive environment using Cantilever Beam Equipment. Results were extrapolated to long term <i>in vivo</i> lifetimes.	The aortic frame closure weld was determined to meet the product criteria of a 15-year <i>in vivo</i> lifetime.
Fatigue of iliac frame closure weld	Cyclic displacement at different loading was applied to test specimens in a corrosive environment using Cantilever Beam Equipment. Results were extrapolated to long term <i>in vivo</i> lifetimes.	The iliac frame closure weld was determined to meet the product criteria of a 15-year <i>in vivo</i> lifetime.

9.1.6 Delivery System Mechanical Testing

Mechanical joint and component testing was conducted on the ANCURE delivery catheter. Deflation rate and burst testing was conducted for the balloons and balloon catheter components of the delivery catheters. The maximum anticipated *in vivo* loads for the delivery catheters were estimated and used as conservative design criteria for mechanical testing. The early estimates were found to be appropriate during the clinical trials.

All of the bonded joints and engagements were tested for the ANCURE delivery catheters. All results indicated that at a 95% confidence level that 99.9% of the bonded strength joints were greater than the expected maximum *in vivo* forces. The result of the balloon deflation rate testing indicated that for all balloon sizes 99.9% of the balloons had a deflation time less than 106 seconds at a 95% confidence level. The burst strength of the balloons was determined to be at least 51 psi, which compared favorably with the rated burst pressure of 30 psi.

9.2 Animal Studies

A series of animal studies were conducted to evaluate the tube and bifurcated EGS and ANCURE Systems. Both EGS and ANCURE animal data are presented since the EGS and ANCURE endografts are nearly identical in design making both relevant to an evaluation of the ANCURE endograft.

Table 12. Animal Studies Summary

Animal Study	No./Type Animals Studied	Test Article	Methods	Results/Conclusions
Acute and Chronic Study of Tube Endograft	19 sheep	Scaled-down tube EGS system consisting of a delivery catheter with a helically wound, longitudinal flexible capsule containing the compressed endograft.	Five animals each implanted for periods of 1, 2, and 6 months, at which time they were sacrificed. Four additional animals were later added to 6-month group. Implant sites were evaluated macro and microscopically.	All endografts successfully deployed. Endografts remained patent with no evidence of thrombosis, migration, twist, or compression. All animals displayed morphologic evidence of normal graft healing.
Acute Healing Study of Bifurcated Endograft	15 bovine	Full-scale EGS delivery catheters & EGS bifurcated endograft.	Fifteen animals assessed for delivery catheter deployment & acute implantation. Chronic evaluation was planned but terminated early due to animal model difficulties resulting from bovine vasculature. See next study for chronic healing.	Excellent acute results of the delivery catheter and endograft. All endografts were patent.
Chronic Healing Study of Bifurcated Endograft	7 sheep	Iliac portion of bifurcated EGS endograft	Two animals implanted with the bifurcated endograft with a shortened contralateral limb. Five animals were implanted bilaterally with a short tube with iliac attachment system using modified delivery catheters.	Acute implantation was successful in all animals. All grafts were patent with good distal perfusion. There were no signs of twisting, migration, kinks or longitudinal compression. Healing was normal and similar to those found in sheep at one month.
Acute Evaluation of Ancure System	5 bovine	Ancure delivery catheter w/ ANGIOSCALE catheter	Endografts were deployed using Ancure tube, bifurcated, and Aortoiliac delivery catheters. A necropsy was performed following animal sacrifice.	Acute implantation was successful and all grafts were patent, with no evidence of migration, twist, or compression. Minor technical issues encountered with the delivery catheter, which were corrected by subsequent device changes.

9.3 Additional Studies

This device contains no software or electrical components.

10. Summary of Clinical Studies

Two clinical studies were conducted. The first study, referred to as the EGS clinical study, was conducted at 22 investigational sites using the first generation EGS delivery catheter. This prospective, multi-center, non-randomized clinical study compared patients treated with the tube and bifurcated EGS Systems to a concurrent control group.

The second clinical study, referred to as the Ancure clinical study, was conducted at 16 investigational sites to compare patients treated with the new Ancure delivery system to patients previously treated in the EGS clinical study.

Vascular surgeons as well as an interventional radiologist served as principal investigators in the clinical studies. When the procedure was performed by the interventional radiologist, a vascular surgeon performed the cutdown and closure and was available during the procedure in the event that conversion to standard surgical repair was necessary.

10.1 Description of Patients and Gender Bias

Table 13. Demographics

Variable	ANCURE (Tube & Bifurcated) (N=89) ¹		Tube EGS (N=153)		Bifurcated EGS (N=268)		Control (N=111) ²	
	n	%	n	%	n	%	n	%
Male	81	(91.0%)	131	(85.6%)	240	(89.6%)	85	(76.6%)
Age (yrs) Mean ±SD	72.8 ± 7.8		73.8 ± 7.1		72.7 ± 7.7		71.6 ± 7.0	
Race (Caucasian)	87	(97.8%)	145	(94.8%)	254	(94.8%)	108	(97.3%)
CAD	45	(50.6%)	85	(55.6%)	165	(61.6%)	68	(61.3%)
MI	25	(28.1%)	45	(29.4%)	105	(39.2%)	43	(38.7%)
Arrhythmia	38	(42.7%)	40	(26.1%)	89	(33.2%)	21	(18.9%)
Valvular Heart Disease	8	(9.0%)	20	(13.1%)	32	(11.9%)	10	(9.0%)
CHF	9	(10.1%)	18	(11.8%)	35	(13.1%)	8	(7.2%)
Stroke	12	(13.5%)	24	(15.7%)	34	(12.7%)	13	(11.7%)
Hypertension	58	(65.2%)	91	(59.5%)	166	(61.9%)	79	(71.2%)
PAOD	6	(6.7%)	16	(10.5%)	37	(13.8%)	12	(10.8%)
COPD	19	(21.3%)	43	(28.1%)	77	(28.7%)	33	(29.7%)
Smoking	66	(74.2%)	117	(76.5%)	217	(81.0%)	100	(90.1%)
Diabetes	13	(14.6%)	18	(11.8%)	32	(11.9%)	11	(9.9%)
Anesthesia Risk								
I	1	(1.1%)	0	(0.0%)	1	(0.4%)	1	(0.9%)
II	10	(11.2%)	27	(17.9%)	36	(13.5%)	14	(12.6%)
III	64	(71.9%)	103	(68.2%)	175	(65.8%)	79	(71.2%)
IV	14	(15.7%)	21	(13.9%)	54	(20.3%)	17	(15.3%)

1. Nine of the ANCURE subjects were tube subjects and 80 were bifurcated subjects.
2. 94 of the Control subjects were tube subjects and 17 were bifurcated subjects.

10.1.1 Evaluation of Gender Bias

Study inclusion and exclusion criteria were designed and the study was conducted in a manner to avoid gender bias in the subject population. The selection criteria in the study were based on identifying subjects with the appropriate anatomy for endovascular surgery.

Table 14 displays the percentage of males and females in each study and the differences between groups. Overall, more men than women were enrolled in all studies. This finding reflects the actual incidence of AAA in the general population where men are more likely to have AAAs than women. However, enough women were enrolled and followed in each treatment group to analyze the effects of gender.

Table 14. Comparison of Gender Between the Tube EGS® and Control Groups , Bifurcated EGS® and Control Groups, and Bifurcated EGS® and Bifurcated ANCURE™ Groups

Treatment Group	Males		Females		Difference: [95% CI]
	(%)	n/N	(%)	n/N	
Tube EGS	(85.6%)	131/153	(14.4%)	22/153	9.0% [-0.6, 18.7]*
Bifurcated EGS	(89.6%)	240/268	(10.4%)	28/268	13.0% [4.3, 21.7]* †
Control	(76.6%)	85/111	(23.4%)	26/111	--
Bifurcated ANCURE	(92.5%)	74/80	(7.5%)	6/80	-2.9% [-9.8, 3.9]**

* Difference between EGS and control patients

** Difference between bifurcated EGS and bifurcated ANCURE

† p<0.01

A total of 58 women were enrolled in the combined EGS and ANCURE clinical studies. An analysis was conducted comparing clinical outcomes in women versus men. The most significant finding was that women had a higher rate of intraoperative conversion than men (25.9% vs. 5.8%). This is likely due to the fact that women have smaller access vasculature than men. Because of their higher rate of intraoperative conversions, women were more likely than men to experience a bleeding complication and arterial trauma.

10.1.2 Aneurysm Diameter Distribution

Table 15. Aneurysm Diameter Distribution

Diameter Range	ANCURE (Tube & Bifurcated) (N=88)		Tube EGS (N=152)		Bifurcated EGS (N=266)		Control (N=102)	
	n	%	n	%	n	%	n	%
< 30 mm	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
30 mm – 39 mm	1	(1.1%)	8	(5.3%)	7	(2.6%)	2	(2.0%)
40 mm – 49 mm	33	(37.5%)	60	(39.5%)	75	(28.2%)	28	(27.5%)
50 mm – 59 mm	41	(46.6%)	65	(42.8%)	116	(43.6%)	42	(41.2%)
60 mm – 69 mm	11	(12.5%)	13	(8.6%)	44	(16.5%)	21	(20.6%)
70 mm – 79 mm	2	(2.3%)	5	(3.3%)	19	(7.1%)	6	(5.9%)
80 mm – 89 mm	0	(0.0%)	1	(0.7%)	5	(1.9%)	3	(2.9%)
≥ 90 mm	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)

10.2 Summary of the EGS Studies

Purpose: This clinical study compared the rates of (proportions of patients with) major complications for patients treated with the Tube and Bifurcated EGS systems to the standard surgical treatment for AAA. Primary outcome measures were: 1) the rate of complications; 2) the length of hospital stay; and 3) the rate of aneurysm enlargement and rupture in the first 12 months.

Study Design: This prospective, multi-center, non-randomized clinical study compared patients treated with the Tube and Bifurcated EGS systems to a concurrent control group. All patients had a grade I (Tube) or II (Bifurcated) infrarenal AAA and were candidates for surgical treatment of AAA. The concurrent control group included patients whose vascular anatomy may not have been suitable for endovascular AAA repair based on arterial access size and proximal and distal neck lengths. Patients were followed at 6 weeks and 6 and 12 months from surgery. Aneurysm diameter changes and graft patency were evaluated by core laboratory assessment of contrast enhanced CT scans, abdominal ultrasounds, and x-rays. The study enrolled 268 Bifurcated, 153 Tube and 111 Control patients.

Table 16. Principle Safety and Effectiveness Results for EGS (Comparison Measures)

Outcome Measure	Treatment Group	%	(n/N)	EGS-Control ¹ Difference [95% CI]
Operative Mortality (≤ 30 days)	Tube	0.0%	(0/153)	-2.7% [-11.1, 2.0]
	Bifurcated	2.6%	(7/268)	-0.1% [-8.3, 4.6]
	Control	2.7%	(3/111)	--
Major Complications ² (≤ 30 days)	Tube	19.6%	(30/153)	-24.5% ⁴ [-35.7, -13.4]
	Bifurcated	28.7%	(77/268)	-15.4% ⁴ [-26.1, -4.7]
	Control	44.1%	(49/111)	--
Need for ICU Stay (%)	Tube	35.5%	(54/152)	-60.8% ⁴ [-70.5, -50.9]
	Bifurcated	39.1%	(102/261)	-57.2% ⁴ [-66.0, -48.6]
	Control	96.3%	(104/108)	--
Thrombosis/Occlusion	Tube	0.0%	(0/153)	0.0% [-6.6, 3.8]
	Bifurcated	2.6%	(7/268)	2.6% [-2.4, 7.5]
	Control	0.0%	(0/111)	--
		Median	(N)	
Hospital Stay (days)	Tube	2	(152)	-4.0 ⁴ [-4.0, -3.0]
	Bifurcated	3	(262)	-3.0 ⁴ [-4.0, -3.0]
	Control	6	(108)	--
ICU Stay (hours) ³	Tube	24.0	(54)	-3.0 ⁵ [-10.0, 0.0]
	Bifurcated	24.0	(101)	-3.0 ⁴ [-8.0, -1.0]
	Control	27.0	(104)	--
Operative Time (min)	Tube	159.5	(152)	-7.5 [-15.0, 10.0]
	Bifurcated	130.0	(266)	-37.0 ⁴ [-42.0, 19.0]
	Control	167.0	(111)	--
Operative Blood Loss (cc)	Tube	200	(151)	-600 ⁴ [-675, -500]
	Bifurcated	300	(268)	-500 ⁴ [-550, -350]
	Control	800	(111)	--

1. Confidence intervals for differences in percentages were calculated by the exact (binomial) method; confidence intervals for differences in medians center on the Hodges-Lehmann estimator.
2. Major Complications = significant respiratory, cardiac, bleeding, bowel, wound, renal, arterial trauma, neurological and ischemic complications, and death.
3. ICU Stay duration includes only subjects who went to the ICU.
4. p<0.01
5. p<0.05

Table 17. Principle Safety and Effectiveness Results for EGS (Other Measures)

Outcome Measure	Treatment Group	n/N	% [95% CI]
Intraop Conversions ¹	Tube	12/153	7.8% [17, 34]
	Bifurcated	26/268	9.7% [6.4, 14]
Postop Conversions	Tube	1/141	0.7% [0.2, 3.9]
	Bifurcated	2/235	0.9% [0.1, 3.0]
Aneurysm Rupture	Tube	0/141	0.0% [0, 1.9]
	Bifurcated	0/242	0.0% [0.1, 3.0]
Reduced Limb Flow ²	Tube	N/A	N/A
	Bifurcated	93/242	38.4% [32, 45]
Perigraft Flow, Discharge	Tube	60/135	44.4% [36, 53]
	Bifurcated	106/219	48.4% [42, 55]
Perigraft Flow, 12 mo	Tube	26/104	25.0% [17, 34]
	Bifurcated	40/128	31.3% [23, 40]
Increased Aneurysm Size (≥ 5 mm), 12 mo	Tube	6/103	5.8% [2.2, 12]
	Bifurcated	3/134	2.2% [0.5, 6.4]
Decreased Aneurysm Size, (≥ 5 mm), 12 mo	Tube	44/103	42.7% [33, 53]
	Bifurcated	64/134	47.8% [39, 57]
Graft Migration	Tube	1/141	0.7% [0.0, 3.9]
	Bifurcated	1/242	0.4% [0, 2.3]

1. Intraop Conversions = access failure or failure to deploy. Protocol required these subjects to undergo standard AAA repair.
2. Reduced Limb Flow = intraoperative or postoperative intervention during the first 12 mos. to treat reduced limb patency.

10.3 Summary of the Ancure Study

Purpose: The Ancure and EGS systems are different delivery systems that deploy the same Tube and Bifurcated endografts. The purpose of this clinical study was to evaluate the safety and efficacy of the Ancure delivery system in comparison to the EGS delivery system. The primary endpoint was to establish that the rate of intraoperative conversion to standard surgery was equivalent for the two delivery catheter designs.

Study Design: This prospective, multi-center clinical study compared patients treated with the Tube and Bifurcated Ancure systems to patients previously treated in the clinical study of the EGS system. All patients had a grade I (Tube) or II (Bifurcated) infrarenal AAA and were candidates for surgical treatment of AAA. Patients were followed at scheduled intervals from surgery up to twelve months, however, only endpoints captured in the first 30 days were compared. Efficacy was evaluated using contrast enhanced CT scans, abdominal ultrasounds, and x-rays. Safety was assessed by physical exams. The study enrolled 80 Bifurcated and 9 Tube patients.

Table 18. Comparison of ANCURE™ and EGS® Delivery Systems

Outcome Measure		ANCURE		EGS		EGS-ANCURE ¹ Difference [95% CI]
		%	(n/N)	%	(n/N)	
Operative Mortality (≤ 30 days)	Tube	0.0%	(0/9)	0.0%	(0/153)	0.0% [-46, 5]
	Bifurcated	2.5%	(2/80)	2.6%	(7/268)	0.1% [-8, 8]
Major Complications ² (≤ 30 days)	Tube	22.2%	(2/9)	19.6%	(30/153)	-2.6% [-48, 22]
	Bifurcated	28.8%	(23/80)	28.7%	(77/268)	-0.1% [-11, 11]
Need for ICU Stay (%)	Tube	0.0%	(0/9)	35.5%	(54/152)	35.5% [1, 49]
	Bifurcated	23.1%	(18/78)	39.1%	(102/261)	16.0% [4.9, 27.1]
Thrombosis/Occlusion	Tube	0.0%	(0/9)	0.0%	(0/153)	0.0% [-46.4, -4.6]
	Bifurcated	7.5%	(6/80)	2.6%	(7/268)	-4.9% [-15.7, 1.6]
Intraop Conversions ³	Tube	0.0%	(0/9)	7.8%	(12/153)	7.8% [-27, 18]
	Bifurcated	3.8%	(3/80)	9.7%	(26/268)	6.0% [-3, 17]
Postop Conversions	Tube	0.0%	(0/9)	0.7%	(1/141)	0.7% [-34, 7]
	Bifurcated	1.3%	(1/77)	0.9%	(2/235)	-0.4% [-9.7, 3.7]
Aneurysm Rupture	Tube	0.0%	(0/9)	0.0%	(0/141)	0.0% [-46, 5]
	Bifurcated	0.0%	(0/77)	0.0%	(0/242)	0.0% [-7.8, 2.5]
Reduced Limb Flow ⁴	Tube	N/A		N/A		N/A
	Bifurcated	37.7%	(29/77)	38.4%	(93/242)	0.8% [-12, 14]
Perigraft Flow, Discharge	Tube	37.5%	(3/8)	44.4%	(60/135)	6.9% [-29.3, 44.1]
	Bifurcated	40.6%	(28/69)	48.4%	(106/219)	7.8% [-5.9, 21.8]
Perigraft Flow, 12 mo	Tube	N/A		25%	(26/104)	N/A
	Bifurcated	N/A		31%	(40/128)	N/A
Increased Aneurysm Size (≥ 5 mm), 12 mo	Tube	N/A		5.8%	(6/103)	N/A
	Bifurcated	N/A		2.2%	(3/134)	N/A
Decreased Aneurysm Size (≥ 5 mm), 12 mo	Tube	N/A		42.7%	(44/103)	N/A
	Bifurcated	N/A		47.8%	(64/134)	N/A
Graft Migration	Tube	N/A ⁵		0.7%	(1/141)	N/A
	Bifurcated	N/A ⁵		0.4%	(1/242)	N/A
		Median	(N)	Median	(N)	
Hospital Stay (days)	Tube	2	(9)	2	(152)	0 [0, 1]
	Bifurcated	2	(78)	3	(262)	1 [0, 1]
ICU Stay (hours) ⁶	Tube	0.0	(0)	24.0	(54)	N/A
	Bifurcated	21.8	(18)	24.0	(101)	2.2 [-2.0, 7.0]
Operative Time (min)	Tube	160	(9)	159.5	(152)	-0.5 [-40, 35]
	Bifurcated	184.0	(80)	130.0	(266)	-54.0 [-68.0, -37.0]
Operative Blood Loss (cc)	Tube	300	(9)	200	(151)	-100 [-200, 0]
	Bifurcated	400	(79)	300	(268)	-100 [-100, 0]

1. Confidence intervals on percentages used exact binomial methods when required by small numbers of events; confidence intervals for differences in medians center on the Hodges-Lehmann estimator, which may differ from the observed differences between medians.
2. Major Complications = significant respiratory, cardiac, bleeding, bowel, wound, renal, arterial trauma, neurological and ischemic complications, and death.
3. Intraop Conversions = access failure or failure to deploy. Protocols required these subjects to undergo standard AAA repair.
4. Reduced Limb Flow = intraoperative or postoperative intervention during the first 12 mos. to treat reduced limb patency.
5. Graft migration was not evaluated in the ANCURE study
5. ICU Stay duration includes only subjects who went to the ICU.

10.4 Conversions for ANCURE and EGS

Table 19. Conversion to Standard Surgical Repair

Reason for Conversion	ANCURE ¹ Conversions (N=89)		Tube EGS Conversions (N=153)		Bifurcated EGS Conversions (N=268)	
	n	% [95% CI]	n	% [95% CI]	n	% [95% CI]
Conversion (Total)	3	3.4% [0.7, 9.5]	12	7.8% [4.1, 13.3]	26	9.7% [6.4, 13.9]
Failure to Access	1	1.1% [0, 6.1]	8	5.2% [2.3, 10]	11	4.1% [2.1, 7.2]
Failure to Accurately Place (Total)	2	2.2% [0.3, 7.9]	4	2.6% [0.7, 6.6]	15	5.6% [3.2, 9.1]
Arterial Trauma	0	0.0% [0, 3.3]	1	0.6% [0, 3.5]	4	1.5% [0.4, 3.8]
Failure to Retract Jacket	1	1.1% [0, 6.1]	0	0.0% [0, 1.9]	0	0.0% [0, 1.1]
Improper Graft Position	0	0.0% [0, 3.3]	3	2.0% [0.4, 5.6]	1	0.4% [0, 2.1]
Perigraft Flow	0	0.0% [0, 3.3]	0	0.0% [0, 1.9]	2	0.7% [0.1, 2.7]
Twist	1	1.1% [0, 6.1]	0	0.0% [0, 1.9]	3	1.1% [0.2, 3.2]
Unable to Remove Delivery Catheter	0	0.0% [0, 3.3]	0	0.0% [0, 1.9]	5	1.9% [0.6, 4.3]
Late Conversion (Total)	0	0.0% [0, 3.3]	1	0.6% [0, 3.5]	2	0.7% [0.1, 2.7]
Perigraft Flow and Aneurysm Enlargement	0	0.0% [0, 3.3]	1	0.6% [0, 3.5]	2	0.7% [0.1, 2.7]

1. Nine of the ANCURE subjects were tube subjects and 80 were bifurcated subjects.

10.5 Perigraft Flow for EGS

Table 20. Perigraft Flow for EGS[®] Subjects Over Time¹

	Discharge		6 Months		12 Months	
	n/N	% [95% CI]	n/N	% [95% CI]	n/N	% [95% CI]
Tube						
Attachment Site Flow	15/135	11.1% [6.4, 17.7]	9/123	7.3% [3.4, 13.4]	4/104	3.8% [1.1, 9.6]
Branch Flow	36/135	26.7% [19.4, 35]	21/123	17.1% [10.9, 24.9]	20/104	19.2% [12.2, 28.1]
Endograft Permeability	0/135	0.0% [0, 2.2]	0/123	0.0% [0.0, 2.4]	0/104	0.0% [0, 2.8]
Indeterminate	9/135	6.7% [3.1, 12.3]	1/123	0.8% [0.0, 4.4]	2/104	1.9% [0.2, 6.8]
Bifurcated						
Attachment Site Flow	11/219	5.0% [2.5, 8.8]	14/195	7.2% [4, 11.8]	3/128	2.3% [0.5, 6.7]
Branch Flow	78/219	35.6% [29.3, 42.4]	50/195	25.6% [19.7, 32.4]	34/128	26.6% [19.2, 35.1]
Endograft Permeability	0/219	0.0% [0, 1.4]	0/195	0.0% [0, 1.5]	0/128	0.0% [0, 2.3]
Indeterminate	17/219	7.8% [4.6, 12.1]	15/195	7.6% [4.4, 12.4]	3/128	2.3% [0.5, 6.7]

1. Includes implanted subjects eligible for follow-up at each time period.

10.6 Aneurysm Size Change for EGS

Table 21. Change in Aneurysm Diameter Between Discharge and 12 months¹

	Tube EGS (N=103)			Bifurcated EGS (N=134)		
	n	% [95% CI]	Mean Change (mm)	n	% [95% CI]	Mean Change (mm)
Increase (+ ≥5 mm)	6	5.8% [2.2, 12.2]	+ 7.85	3	2.2% [0.5, 6.4]	+ 7.10
No Change (± <5 mm)	53	51.5% [41.4, 61.4]	- 0.15	67 ²	50.0% [41.2, 58.8]	- 0.95
Decrease (- ≥5 mm)	44	42.7% [33, 52.8]	- 10.22	64	47.8% [39.1, 56.6]	- 10.04

1. Includes implanted subjects eligible for follow-up at each time period.

2. One subject experienced a decrease from discharge to six months, and an increase from six months to 12 months.

10.7 Perigraft Flow Status versus Aneurysm Size Change for EGS

Table 22. Aneurysm Diameter by Perigraft Flow Status at 12 months

Perigraft Flow Status	Aneurysm Diameter Change					
	Decrease (≥5 mm)		No Change (± <5 mm)		Increase (≥5 mm)	
	n/N	% [95% CI]	n/N	% [95% CI]	n/N	% [95% CI]
Tube EGS						
No Perigraft Flow at 12 months	40/76	52.6% [40.8, 64.2]	33/76	43.4% [32.1, 55.3]	3/76	4.0% [0.8, 11.1]
Perigraft Flow at 12 months	4/26	15.4% [4.4, 34.9]	19/26	73.1% [52.2, 88.4]	3/26	11.5% [2.4, 30.2]
Bifurcated EGS						
No Perigraft Flow at 12 months	47/85	55.3% [44.1, 66.1]	37/85	43.5% [32.8, 54.7]	1/85	1.2% [0, 6.4]
Perigraft Flow at 12 months	13/40	32.5% [18.6, 49.1]	25/40	62.5% [45.8, 77.3]	2/40	5.0% [0.6, 16.9]

10.8 Reduced Limb Flow for Bifurcated ANCURE and Bifurcated EGS

Table 23. Types of Interventions to Optimize Bifurcated Graft Limb Flow

	Intraoperative		Postoperative		Total	
	n/N	% [95% CI]	n/N	% [95% CI]	n/N	% [95% CI]
Bifurcated EGS						
Stent ¹	34/242	14.0% [9.9, 19.1]	19/242	7.8% [4.8, 12]	53/242	21.8% [16.9, 27.6]
PTA only	28/242	11.6% [7.8, 16.3]	0/242	0.0% [0, 1.2]	28/242	11.6% [7.8, 16.3]
Surgical ²	5/242	2.1% [0.7, 4.8]	4/242	1.6% [0.5, 4.2]	9/242	3.7% [1.7, 6.9]
Other ³	1/242	0.4% [0, 2.3]	2/242	0.8% [0.1, 3]	3/242	1.2% [0.3, 3.6]
(Total)	68/242	28.1%	25/242	10.3%	93/242	38.4%
Bifurcated ANCURE						
Stent ¹	17/77	22.1% [13.4, 33]	0/77	0.0% [0, 3.8]	17/77	22.1% [13.4, 33]
PTA only	6/77	7.8% [2.9, 16.2]	0/77	0.0% [0, 3.8]	6/77	7.8% [2.9, 16.2]
Surgical ²	3/77	3.9% [0.8, 11]	1 ⁴ /77	1.3% [0, 7]	3/77	3.9% [1.4, 12.8]
Other ³	1/77	1.3% [0, 7]	1/77	1.3% [0, 7]	3/77	3.9% [0.3, 9.1]
(Total)	27/77	35.1%	2/77	2.6%	29/77	37.7%

1. Includes some subjects who had PTA or thrombolysis and stent.
2. Includes Femoral-Femoral Bypass and surgical revision. Includes some patients who may have had stents, PTA, or other non-surgical interventions.
3. Includes thrombolysis, thrombectomy, and anticoagulants.
4. Patient was converted to standard surgery.

11. Conclusions Drawn from the Studies

The data establish that all delivery catheter components will withstand the expected *in vivo* loads and the implants have at least a 15-year useful life. The clinical benefits of these systems are the reduced risk of several serious complications including bleeding, cardiac, respiratory, and bowel, and the less invasive nature of the devices which lead to reduced need for post-operative care and shorter hospitalization. The risks include the increased risk of renal and arterial trauma complications and device-related phenomenon such as perigraft flow and increases in aneurysm size.

12. Panel Recommendation

At an advisory meeting held on June 23, 1999, the Circulatory Systems Devices Panel recommended that Guidant EndoVascular Technologies PMA for the tube and bifurcated ANCURE System (including the Guidant Contralateral Torque Catheter, Guidant Contralateral Cutter, and ANCURE Iliac Balloon Catheter) be approved subject to submission to, and approval by, the Center for Devices and Radiological Health (CDRH) of the following conditions:

1. Additional follow-up was requested for the original cohort of patients, with a recommended follow-up time of 5 years;
2. Additional clinical data on female subjects;
3. Revisions to the patient information booklet;
4. Include physician education and training; and
5. Revisions to the physician labeling were discussed.

13. FDA Decision

FDA reviewed portions of the pre-market application submission under the Modular PMA process (M980019). Acceptance letters for five of the modules were sent on December 29, 1998, January 22, 1999, and March 1, 1999. The remaining three modules were incorporated into the review of the PMA. The PMA was filed on March 15, 1999 and granted expedited review status.

FDA concurred with the Circulatory System Devices Panel's recommendation of June 23, 1999 and issued a post-panel status letter to Guidant EndoVascular Technologies on July 1, 1999, listing the panel conditions, above.

To address these conditions, Guidant submitted: 1) a patient information booklet that was reviewed and found acceptable by FDA; 2) a protocol for physician training that was reviewed and found acceptable by FDA; 3) modified labeling that addressed the panel's recommendations and other recommendations from FDA; and 4) an analysis of additional data gathered to date on female patients that, with appropriate labeling changes, addressed the panel's recommendations. Guidant also agreed to the post-approval condition to perform the 5-year follow-up study. Their

proposed protocol was reviewed and found acceptable by FDA. As an added condition, FDA requested that the sponsor annually report to FDA on the adequacy of the training program, and to notify FDA of changes made to the training program. The sponsor agreed to this post-approval condition.

CDRH made a decision to require tracking for endovascular grafting systems, in accordance with 21 CFR 821.

FDA inspected the manufacturing and sterilization facilities and determined that they were in compliance with the Quality Systems Regulation (21 CFR Part 820).

FDA determined that, based on the modified labeling and the physician-training plan, and the applicant's agreement to conduct the post-approval study and to report annually on changes to the physician training plan, the application was approvable without further conditions.

CDRH issued an approval order for the stated indication for the applicant's PMA, P990017, on September 28, 1999.

14. Approval Specifications

Directions for Use: See Final Draft Labeling (Information for Use)

Hazards to Health from Use of the Device: See INDICATIONS, CONTRAINDICATIONS, WARNINGS AND PRECAUTIONS, and ADVERSE EVENTS in the Final Draft Labeling (Information for Use).

Post-approval Requirements and Restrictions: See Approval Order