The INCRAFT® AAA Stent Graft System: Clinical Results and Experience

Prof. Giovanni Pratesi outlines the effectiveness of a new-generation device in expanding EVAR applicability using clinical evidence from trials and real-world experience.

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ADVANCED DESIGN AND TECHNOLOGY

The INCRAFT® AAA Stent Graft System (Cordis Corporation) is part of the latest generation in advanced endovascular aneurysm repair (EVAR) technology that combines and introduces unique features for the treatment of infrarenal abdominal aortic aneurysms (AAAs).[1]

The main body of the INCRAFT® Stent Graft is delivered through a flexible 14-F, ultra-low-profile delivery system,* allowing for proximal repositioning, and has a cap-free fixation release to assist with optimal placement accuracy. The iliac limb delivery system is equivalent to a 12-F sheath introducer.† Both the aortic bifurcation and the iliac limbs are constructed out of low-porosity polyester fabric with segmented endoskeletal nitinol stents. The stent graft design allows the highest amount of in situ sizing of all endografts currently on the market and, as such, provides a maximum level of customizability and conformability to address a wide range of AAA anatomies (Figure 1).

The current clinical data confirm excellent results with the INCRAFT® System, and a postmarket study is ongoing to verify the effectiveness of this system in the real-world setting.

INNOVATION TRIAL

The INNOVATION first-in-human feasibility study supporting the EU CE Mark approval was started in 2010 and enrolled 60 patients in two countries and six participating centers. With 14 patients treated, the Unit of Vascular Surgery, University of Florence (Florence, Italy) was among the highest enrollers in the study and built an extensive experience in the early developments of the device.

Based on the primary technical and safety endpoints at 1-month follow-up, the INCRAFT® Stent Graft System showed promising results despite a large number of patients with core lab–confirmed anatomic challenges. The most significant challenges were high infrarenal neck angulations (> 40° in 30% of patients), tight aortic bifurcations (< 18 mm in 33% of patients), and tight iliac access (< 7 mm in 45% of patients).[2]

The rate of technical success, defined as freedom from endoleaks, at 1 month was 97% (56/58 patients of the original 60 patients who were enrolled), with 100% of patients free from aneurysm enlargement and no type I or type III endoleaks in any patients at 2 years postprocedure.[3]

These favorable results were similar at 3-year follow-

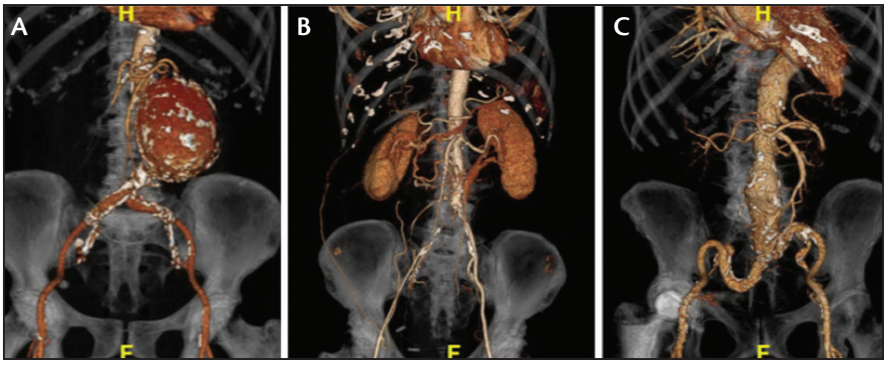

Figure 1. Examples of patients treated with the INCRAFT® System: small distal aorta and challenging neck (A), narrow or occluded iliac arteries and difficult access (B), and tortuous iliac arteries (C).

*For the prostheses diameter of 34 mm, the inner diameter of the integrated sheath introducer is 15 F (outer diameter of 16 F).
†The iliac limb delivery system has a 12-F outer diameter for prothesis diameters between 10 mm and 20 mm and the 13-F outer diameter for the 24-mm diameter prosthesis.

TABLE 1. PRIMARY TECHNICAL AND SAFETY ENDPOINTS OF THE INNOVATION TRIAL

Event	30 Days (N = 58)[a]	1 Year (N = 56)[a]	2 Years (N = 52)[a]	3 Years (N = 55)[a]
Freedom from endoleak (CEC adjudicated) Type Ia Type Ib Type III	 96.6%[b] 100% 100%	 100% 100% 100%	 100% 100% 100%	 100% 95.6% 100%
Stent graft patency	100%	100%	100%[c]	97.8%[d]
Freedom from migrations	N/A	100%	100%	100%[e]
Freedom from fracture	100%	100%	100%	97.7%[f]
Freedom from sac enlargement	N/A	100%	100%	95.6%
Freedom from MAE (death, QMI, CVA, renal failure)	100%	98.2%	88.5%	87.3%[g]

Abbreviations: CEC, Clinical Events Committee; CVA, cerebral vascular accident; MAE, major adverse event; N/A, not applicable; QMI, Q-wave myocardial infarction.
[a]Denominators vary based on the number of subjects who had imaging performed.
[b]Type I endoleak was present at 30-day follow-up and resolved after additional endovascular intervention on day 278.
[c]One patient developed a late graft thrombosis at day 666 due to sac contraction and limb and confirmation change.
[d]Endoleg nonpatency (ie, occlusion) occurred in one subject.
[e]Both aneurysm enlargement and stent graft migration are defined as being compared to the 30-day baseline CT assessment. One subject did not have 30-day CT and therefore could not be evaluated.
[f]Stent graft fracture is defined as stent skeleton fracture and barb separation and identified through radiograph. Fracture occurred in one subject.
[g]One death occurred within 1 year, five within 2 years, and one within 3 years; they were not AAA-related.

up, and despite two distal sealing leaks (one of which was potentially caused by insufficient oversizing and another that was secondary to a type II endoleak) and one non-aneurysm–related death, there was no other incidence of device-related endoleaks, major adverse events (death, Q-wave myocardial infarction, cerebrovascular accident, renal failure), or stent graft migrations (Table 1). A single patient presented with a proximal strut fracture identified by the core lab but without clinical sequelae. Two patients experienced aneurysm enlargement following type II endoleaks; however, an average sac regression of 6.8 mm was reported for the overall cohort.[4]

Despite the high number of patients with severe distal morphologies, no early limb occlusions were seen within 1-year follow-up, and overall stent graft patency was 97.8% within the 3-year follow-up period.

One of the most important features of the INCRAFT® System is the proximal and distal precision by which it is deployed. During the study, the mean proximal placement accuracy was 2 mm from the lowest renal artery, and due to the in situ sizing capabilities, the average iliac artery coverage was 79%, which assists with better long-term outcomes.

Another important design characteristic is graft conformability. Analysis of neck dilatation showed that, just as in surgical treatment, the aortic neck seems to dilate over time, which is likely related to the progression of the disease. Although the aortic neck enlargement was limited at the level of the lowest renal artery (mean increase, 1.2 mm ± 1.15 mm over 3 years), the effect was more significant at 15 mm below the lowest renal artery (mean increase, 2.6 mm ± 1.77 mm over 3 years). A similar effect was seen in the distal sealing area of the common iliac artery (mean increase, 2 mm ± 1.48 mm over 3 years). According to a preliminary analysis, this effect could not be attributed to stent graft oversizing. The nitinol-based configuration did however allow the device to adjust to the changes in anatomy (Figure 2).

In summary, the INNOVATION study has demonstrated outstanding clinical results, with 95% freedom from reinterventions at 3-year follow-up. These results are to be confirmed as the initial study patients return for 4-year follow-up at our center.

INSPIRATION TRIAL

Following the European clinical study, the INSPIRATION trial, which was initiated in 2012, enrolled a total of 190 patients in approximately 1 year and was the first AAA clinical trial to be conducted in parallel in the United States and Japan via the Harmonization by Doing program.

The objective of this study is to evaluate the safety and effectiveness of INCRAFT® in subjects with AAAs requiring endovascular repair. The primary safety end-

Neck diameter increase (Lowest renal vs 1-month CT)	6 Month	1 Year	2 Year	3 Year
Diameter, mm (mean ± SD)	22.3 ± 2.13	22.4 ± 2.18	23.2 ± 2.28	23.2 ± 2.14
Variation, mm (mean ± SD)	0.2 ± 0.78	0.5 ± 0.96	1.0 ± 1.11	1.2 ± 1.15

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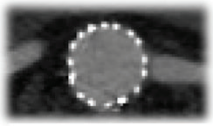
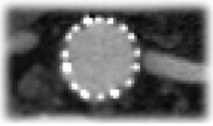
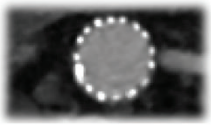


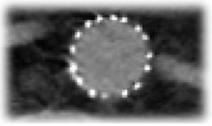
Aortic neck diameter (lowest renal): 6-mo FU = 19.4 mm



Aortic neck diameter (lowest renal): 1-y FU = 19.5 mm



Aortic neck diameter (lowest renal): 2-y FU = 19.5 mm



Aortic neck diameter (lowest renal): 3-y FU = 20 mm

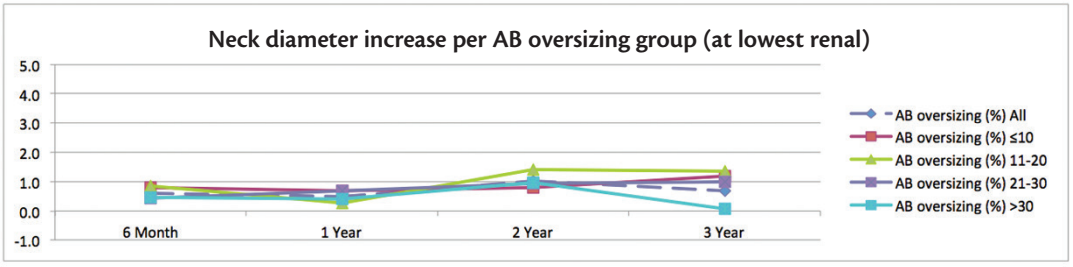


Figure 2. Neck compliance achieved in INNOVATION: 3-year evaluation of diameter increase at the lowest renal per oversizing group. Abbreviations: AB, aortic bifurcation; FU, follow-up.

point will look at a composite major adverse event rate at 30 days postprocedure, while the primary effectiveness endpoint will evaluate the acute technical success and absence of aneurysm enlargement, migrations, conversion to open surgery, sac rupture, type I/II endoleaks, or graft occlusions up to 1 year.

Results of the INSPIRATION study are currently under evaluation and are expected to be published in the very near future.

INSIGHT POSTMARKET STUDY

A postmarket study of the INCRAFT® Stent Graft System has recently commenced enrollment. The study will evaluate the safety and effectiveness of INCRAFT® System in patients with AAAs requiring endovascular repair in routine clinical practice. The first patient was enrolled on March 30, 2015, and the primary endpoint is the absence of major adverse events within 30 days postprocedure.

FROM CLINICAL TRIAL TO REAL WORLD

Based on the very promising results coming from international trials, the INCRAFT® Stent Graft System obtained CE Mark approval in August 2014. Since that time, we started to use the INCRAFT® Stent Graft System in our daily practice, and at present, 29 patients (24 males; mean age, 75 ± 5.7 years) have undergone elective EVAR with the INCRAFT® System at our institution. Case selection was mainly based on the innovative features of the INCRAFT® System, including ultra-low-profile delivery system, accuracy of placement, and in situ sizing customization to address more challenging anatomies[‡] in terms of access vessels and

TABLE 2. ANATOMIC CHARACTERISTICS OF PATIENTS WHO HAVE UNDERGONE EVAR WITH THE INCRAFT® SYSTEM IN OUR PRACTICE

	Mean	Range
Infrarenal angle	36.9°	5.9°–87.3°
Proximal neck diameter	23.1 mm	18.3–29.1 mm
Neck length	18.9 mm	8.7–35.5 mm
AAA maximum diameter	64.6 mm	48–93 mm
Minimum aortic bifurcation diameter	23.9 mm	12.3–50 mm
Right iliac seal zone diameter	14.9 mm	11.1–22.5 mm
Left iliac seal zone diameter	12.7 mm	8–19 mm
Right minimum access diameter	6.9 mm	2.1–10.3 mm
Left minimum access diameter	6.8 mm	5–10.8 mm

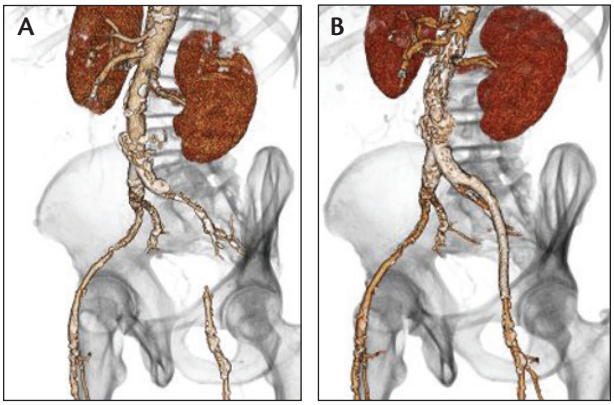


Figure 3. Pre- (A) and postoperative (B) CT angiograms of an AAA associated with extensive calcification and left external iliac artery occlusion treated with INCRAFT® Stent Graft System implantation and self-expanding stenting of the occluded vessel.

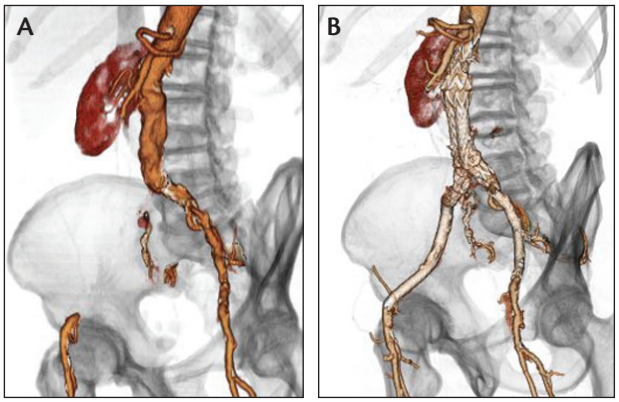


Figure 4. Pre- (A) and postoperative (B) CT angiograms of an AAA associated with right common and external iliac artery occlusion and severe stenosis of the left external iliac artery treated with INCRAFT® Stent Graft System implantation and self-expanding stenting of the access vessels.

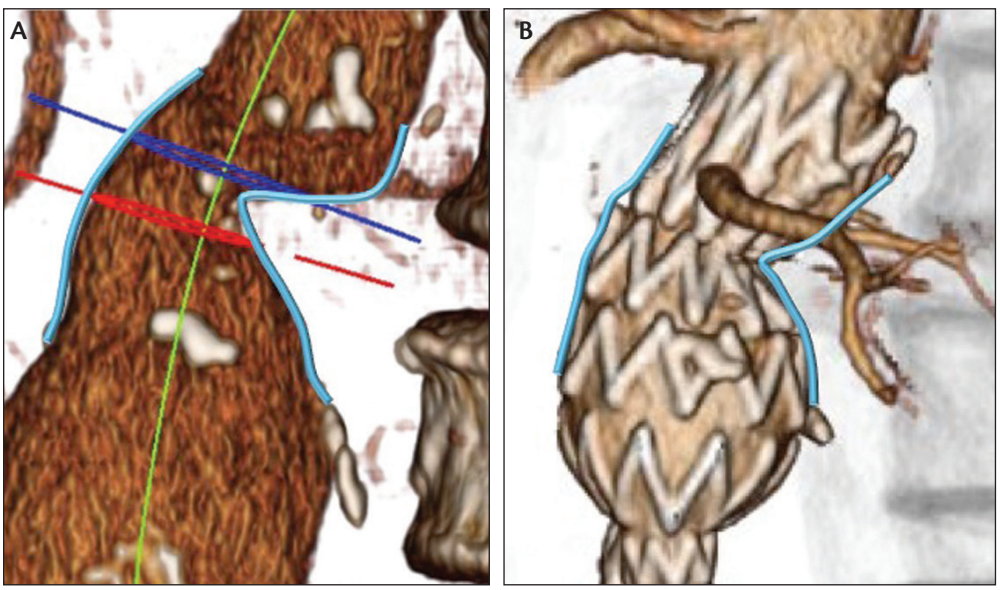


Figure 5. Preoperative CT angiogram of an AAA with an hourglass configuration of the proximal aortic neck (A); postoperative CT angiogram showing the excellent conformability of the INCRAFT® Stent Graft System to the native aorta anatomy (B).

proximal aortic neck and iliac arteries. In fact, when looking at the anatomic characteristics of our study group (Table 2), the median diameter of the access vessels was < 7 mm on both sites (range, 2.1–10.8 mm), the median neck length was 18.9 mm (range, 8.7–35.5 mm), median angulation was 36.9° (range, 5.9°–87.3°), and median aortic bifurcation diameter was 23.9 mm (range, 12.3–50 mm). Intraoperative technical success was obtained in 100% of the cases in absence of any major graft-related complications. Completion angiography showed the absence of endograft limb kinking and no reinforcing stenting was required. All operations were carried out under local anesthesia with bilateral percutaneous femoral access using only one Perclose ProGlide® (Abbott Vascular) either for the main body or the contralateral limb. Mean hospital stay was 3 ± 2.5 days. At 30 days, no type I or III endoleak, limb occlusion, or migration was observed. Four type II endoleaks were detected (13.8%), without aneurysm sac enlargement. One patient died of unrelated causes. Median follow-up was 4.3 ± 2.3 months (range, 1–6 months). During this time, there was one limb occlusion, which required a reintervention with thrombolysis and stenting, and no other graft-related complications in terms of type I and III endoleaks, migration, and aneurysm sac enlargement.

‡Exercise particular care in areas that are difficult to navigate, such as areas of stenosis, intravascular thrombus, calcification, or tortuosity, or where excessive resistance is experienced, as vessel or catheter damage could occur. Consider performing balloon angioplasty at the site of a narrowed or stenotic vessel, and then attempt to gently reintroduce the catheter delivery system. Also exercise care with device selection and correct placement/positioning of the device in the presence of anatomically challenging situations such as areas of significant stenosis, intravascular thrombus, calcification, tortuosity, and/or angulation, which can affect successful initial treatment of the aneurysm.

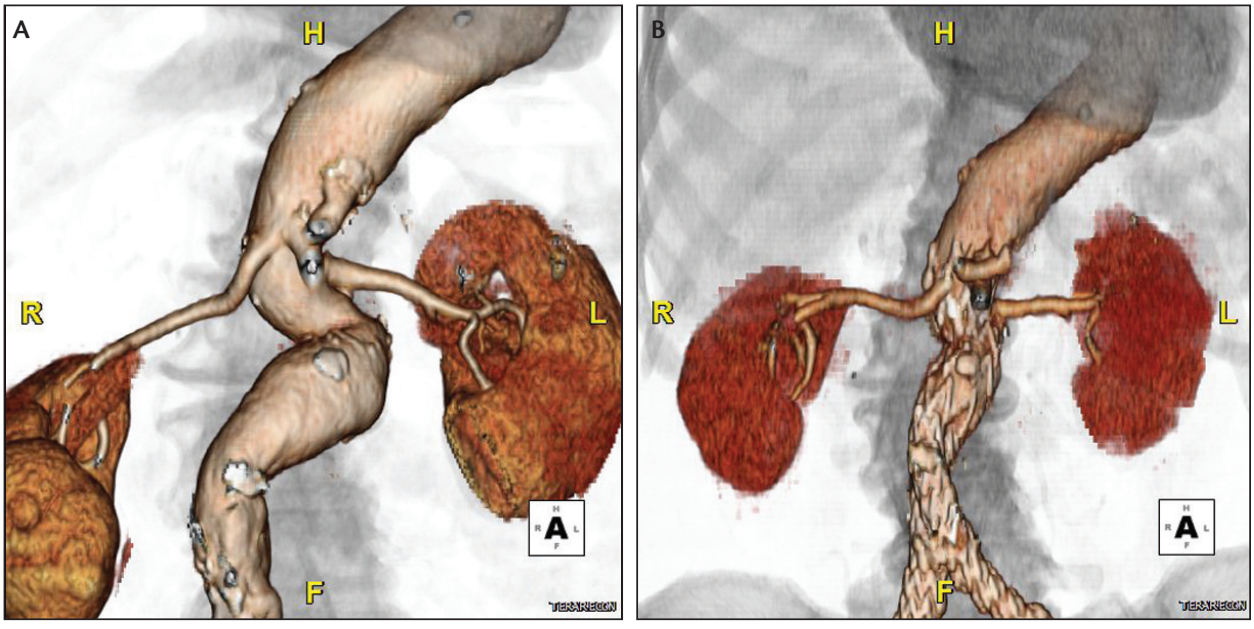


Figure 6. Preoperative CT angiogram of an AAA with a double severe angulation of the short proximal aortic neck (A); postoperative CT angiogram showing the precise deployment and the conformability of the INCRAFT® Stent Graft System to the tortuous anatomy (B).

The growing experience with the INCRAFT® System combined with its ease of use and clinical performance drove us to utilize it even in more challenging cases, additionally expanding the applicability of EVAR in our daily practice. Three patients in our practice presented with AAAs associated with iliac occlusion. In all of these cases, after recanalization of the occluded vessels (external iliac artery in two patients and common and external iliac artery in one patient), the graft was successfully advanced and deployed, and the procedure was concluded with stenting of the recanalized vessels (Figures 3 and 4). However, we did not focus only on challenging access vessels; we also addressed complex proximal aortic neck anatomy in terms of length, angulation, and shape. The INCRAFT® System confirmed its excellent precision in deployment and great conformability even in the presence of an hourglass proximal aortic neck configuration (Figure 5) and combination of severe supra- and infrarenal angulations (Figure 6).

This experience needs to be confirmed in a larger multicenter study with longer follow-up, but technical success in presence of such anatomies clearly represents a relevant step forward in the endovascular management of complex AAAs. ■

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