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Clinical Experience with the CorLink Device for Proximal Anastomosis of the Saphenous Vein to the Aorta: A Clinical, Prospective, and Randomized Study

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ABSTRACT

Background: Avoiding tangential clamping of the ascending aorta during coronary bypass operations reduces the trauma to the aorta and may avoid local particulate embolization.

Methods: From December 2000 to May 2001, 21 male patients, mean age 64.1 ± 7.2 years (range, 46-76 years), with coronary artery 2-vessel (n = 3) and 3-vessel (n = 18) disease were divided randomly into 2 groups and underwent myocardial revascularization. In 11 patients an aorta–saphenous vein graft anastomosis was performed with the CorLink device for anastomosis between the saphenous vein and the ascending aorta. Ten patients served as control subjects. In these patients the central bypass anastomosis was performed with a 6-0 running suture. Clinical follow-up was performed 1 month and 3 months postoperatively. Six months after surgery, multislice computed tomography was performed to evaluate bypass patency for all patients.

Results: Mean number of study vessels was 1.2 ± 0.4 in the CorLink group and 1.5 ± 0.5 in the control group. In the CorLink group, 13 additional arterial and vein grafts were performed, and in the suture control group 15 additional mammary artery grafts were carried out. No intraoperative complications occurred. In 2 CorLink anastomoses an additional stitch was necessary because of minor bleeding. Follow-up was carried out at 6 months with multislice computed tomography for all patients and showed only 1 study vessel occlusion in the CorLink group. All 62 other bypass grafts were revealed to be patent and had anastomoses of good quality.

Conclusion: Our experience suggests that the CorLink device is a safe and effective technique for anastomosis between saphenous vein grafts and the ascending aorta. The CorLink device could be used for totally endoscopic coronary bypass operations. Further randomized studies enrolling a larger number of patients are necessary to determine which patients may benefit the most from this procedure.

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INTRODUCTION

Cross-clamping and tangential clamping of the ascending aorta are generally used during coronary artery bypass operations with the use of the cardiopulmonary bypass (CPB). These manipulations to the ascending aorta may lead to aortic wall trauma, such as acute dissection [Ohashi 1993] and local particulate embolization [Barzilai 1989, Blauth 1992, Katz 1992, Wareing 1992, Roach 1996], and result in transient cerebral ischemia or stroke. To avoid these problems during CPB operations, the surgeon can perform proximal and distal anastomosis of the saphenous vein graft during a single episode of aortic cross-clamping [Salerno 1982]. During off-pump operations, however, this technique cannot be used. In these operations the risk of a local trauma to the ascending aorta is higher than for on-pump operations, because side-clamping has to be performed under higher arterial pressure [Chavanon 2001].

Early clinical experience with the new sutureless anastomotic device for proximal anastomosis of the saphenous vein to the aorta has been published by Calafiore and coworkers [Calafiore 2001]. These investigators concluded that this aortic anastomotic device allows a safe and effective sutureless anastomosis between the aorta and the saphenous vein graft.

We now report our experience of a clinical, prospective, and randomized study using the CorLink device (DAAD; ByPass Ltd, Herzelia, Israel) for proximal anastomosis of the saphenous vein to the ascending aorta.

MATERIALS AND METHODS

Patient Enrollment

The patients were accepted for this operative procedure according to a clinical protocol approved by the ethical

Table 1. Demographic Data of Patients Undergoing Coronary Artery Bypass Operations with or without the CorLink Device*

	Group A	Group B
CAD 2-vessel, n	2	1
CAD 3-vessel, n	9	9
CCS	2 ± 0.5	2 ± 0.9†
LVEF, %	63.8 ± 10.9 (41-77)	64.7 ± 10.5 (57-87)†
Smoker/ex-smoker, n	10	8
Diabetes mellitus, n	3	None
Hypertension, n	10	10
Family history, n	None	1
Previous QMI, n	5	None
Previous PTCA, n	2	None
Age, y	64.1 ± 5.2 (55-76)	64.1 ± 9.1 (46-76)†

*Group A used the CorLink device and group B used conventional suture; operations were carried out with 21 male patients from December 2000 to May 2001. CAD indicates coronary artery disease; CCS, Canadian Cardiovascular Society classification; LVEF, left ventricular ejection fraction; QMI, Q wave myocardial infarction; PTCA, percutaneous transluminal coronary angioplasty. Data are mean ± SD; ranges are indicated in parentheses.

†Differences between groups are not significant.

committee of the Aerztekammer Hamburg (approval date, November 15, 2000). The study was conducted according to the European standard EN 540 (Clinical Investigation of Medical Devices of Human Subjects) and the Declaration of Helsinki. Before being enrolled in the study, patients had to provide written consent after being informed of the purpose, rights, duties, strategies, and possible risks of the study. To be included, patients had to meet all inclusion criteria and none of the exclusion criteria.

Inclusion criteria were:

- Patients had to be scheduled for primary elective isolated coronary artery bypass grafting.
- Patients had to agree to attend the follow-up evaluation and to sign an informed consent form.

Exclusion criteria were:

- No saphenous vein graft available,
- History of bleeding diathesis,
- Graft vessel <2.0 mm or >6.0 mm,
- Probable inability to evert grafts,
- Calcification of the ascending aorta,
- Atherosclerosis of the deployment site,
- Aortic wall <1.5 mm or >5.0 mm,
- Signs of endothelial lesions in saphenous vein.

From December 2000 to May 2001, 21 male patients (mean age, 64.1 ± 7.2 years; range, 46-76 years) with coronary 2-vessel (n = 3) and 3-vessel (n = 18) disease were scheduled for myocardial revascularization and enrolled in this study. Demographic data are shown in Table 1. Concomitant diseases were present in 1 patient of group A (history of cerebral stroke and deep vein thrombosis) and 4 patients of group B (1 patient each with history of urinary bladder carcinoma, abdominal aortic aneurysm, pulmonary embolism, and atrial fibrillation).

Surgery

A median sternotomy and single or bilateral internal mammary artery preparations were performed in all patients. Saphenous vein harvesting was performed via direct access. Side branches of the saphenous vein were closed with 5-0 monofilament sutures.

All patients underwent operations that included CPB with aortic cross-clamping and cardioplegic arrest with modified blood cardioplegia. Intraoperatively, we looked for the quality of the saphenous vein and for calcification of the ascending aorta (exclusion criteria). All patients received heparin (400 IU/kg body weight) before the initiation of CPB procedures.

The principle of the CorLink technique is shown in Video 1.

Measuring Graft Vessel Size

Before CPB, the saphenous vein was loaded into the large vessel sizer tube (3.5-6.0 mm, color code grey; Video 2). If eversion was not possible, the vein was loaded into the small vessel sizer (color code blue). If eversion was not possible with the small sizer and without endothelial alterations, the CorLink device was not used.

DAAD Device

The DAAD is a self-expanding nitinol extraluminal device, which consists of a central cylindrical body made of interconnected elliptical arches and 2 sets of 5 pins (0.3 mm thick) radiating from each end. Two different sizes of the device are available. Technical data for the DAAD device are shown in Table 2. For patients in whom the CorLink device was used, the proximal anastomosis was carried out before the distal one.

Loading the Graft Vessel into the Inserter

First, additional adventitial tissue was removed from the end of the saphenous vein to be everted (Video 2). The graft vessel was carefully pulled through the inserter by means of a snare or a 4-0 suture fixed to the adventitial tissue of the vein. After removal of the Butterfly (Figure 1A ◎), a device to ensure smooth loading of the vein graft into the inserter, the proximal 2 to 3 mm of the vein graft was everted over the distal end of the delivery system (Figure 1B ◎).

The 5 intimal pins of the DAAD were deployed from the cartridge of the delivery system by fully moving the designated tab (Video 2). In no case did deployment result in all 5 pins completely penetrating the vein graft. With full penetration of the pins being a mandatory precondition for the success of the CorLink procedure, all pins were carefully

Table 2. Technical Data for the CorLink DAAD Device

	Large	Small
Extended outer diameter, mm	5.3	4.2
Extended inner diameter, mm	5.0	3.9
Punch diameter, mm	3.5	3.3
Diameter of graft vessel, mm	3.5-6.0	2.0-4.0
Length of eversion, mm	1, Minimum	1, Minimum

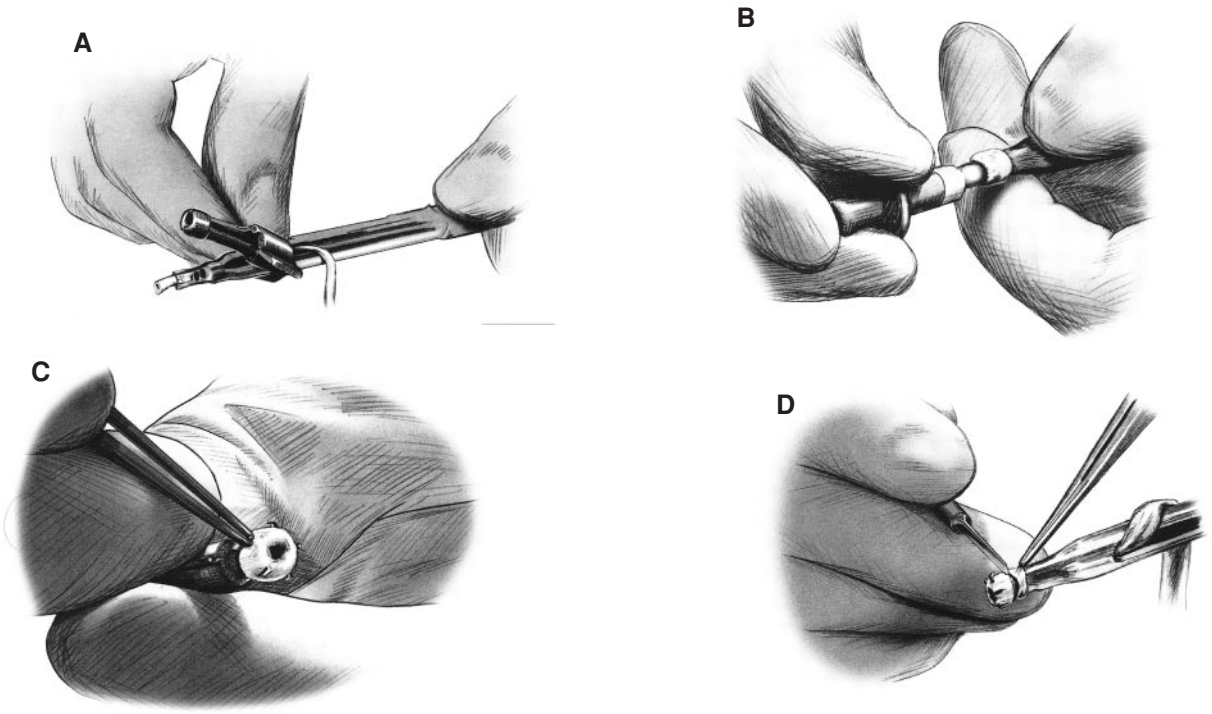

Figure 1. Technical system of DAAD device. The Butterfly, providing a smooth loading of the vein graft into the inserter, is removed as shown (A). Eversion of the distal part of the vein over the inserter's nozzle is accomplished by means of a special tool, the Everter (B). After intimal pin deployment, complete pin penetration is accomplished by means of pointed forceps (C). The everted part of the vein graft is shortened to 3 to 4 mm to avoid malfunction of the anastomotic device's adventitial pins (D).

manipulated through the vein graft tissue with a small forceps (Figure 1C ◎). After this step, the everted part of the vein was cut to a length of about 3 to 4 mm (Figure 1D ◎). A minimum of 1.0 mm had to be everted. It was important that the everted part of the vein not exceed 4 mm so as to allow the outer pins to have contact with the ascending aorta after DAAD deployment.

Punching and DAAD Delivery

The sites for the proximal vein anastomoses were chosen and marked with diathermy to ensure that the 90°-angle saphenous grafts after anastomosis were supported by the right ventricular outflow tract with respect to the pulmonary artery. The pulmonary artery or fatty tissue of the right outflow tract were withdrawn with a felt-armed 4-0 stay suture. Fatty tissue was removed from the ascending aorta at the site of anastomosis.

A special penetrating and punching device (Table 2) inserted through a guiding handle punched a hole in the unclamped aortic wall (Figures 2A and 2B ◎). To achieve a round hole, we performed the punching process in the CorLink group at a mean arterial pressure of approximately 60 mm Hg (Figure 3 ◎). Forceps for stabilizing the ascending aorta against the penetrating punch cone appeared to be helpful.

After punching, the punch cone was driven further into the aorta while the device was rotated 360° in both directions to ensure a complete punching of the adventitial tissue (Figure 2C ◎). After full insertion of the punch cone (the handle shoulders were in contact with the aortic wall), the punching device was withdrawn from the handle. Backflow from the aorta was prevented by a sealing gasket placed in the handle's overtube (Figure 2D ◎). Then, the delivery system loaded with the vein graft was advanced through the tubular guiding handle into the lumen of the aorta. It appeared to be important to penetrate the sealing gasket centrally.

Rotating the rear end of the inserter knob to the right resulted in withdrawal of the inserter and overtube from the DAAD lodged in the aortic wall (Figure 4A ◎). The DAAD's upper 5 pins were deployed in the process, and the inserter, together with the overtube, split open and released the anastomosed vein graft (Figure 4B ◎). The appearance of a metallic tip on the device's rear end indicated completion of the process (Figure 4A ◎).

The 5 intimal pins grabbed the aortic wall from the inside (Figure 5 ◎). By pressing down on the aortic adventitia, the outer pins held the DAAD device up. When released from its cartridge, the central cylindrical component of the DAAD device expanded, thus exerting radial pressure on the everted segment of the vein. By this means the vein was pressed to the rim of the punched hole in the aortic wall, sealing the hole circumferentially.

The angle that the saphenous vein graft formed with the ascending aorta was about 90°. A suitable length for the saphenous vein graft was estimated by fixing the distal end of the bypass graft with a 6-0 suture next to the site where the

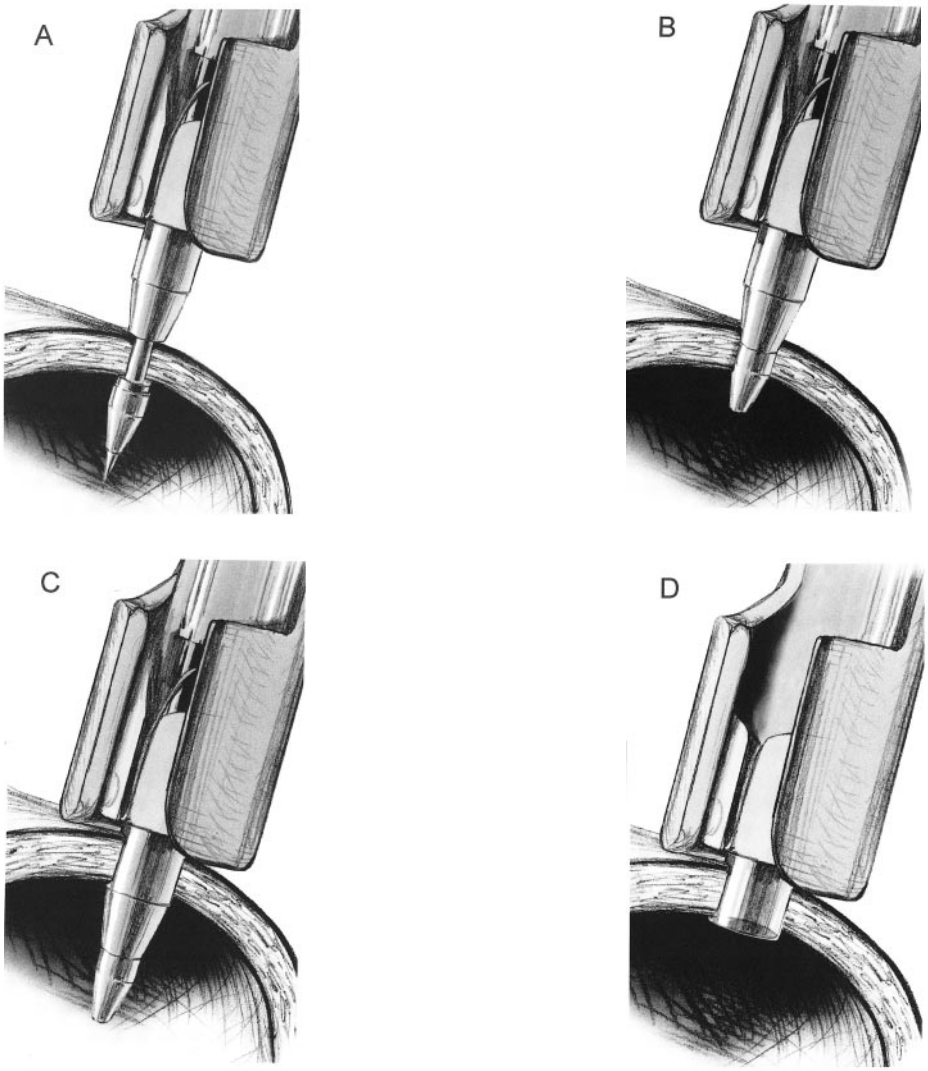

Figure 2. Technique of punching. After the puncture, the aortic wall is lodged in the punch cone's undercut space (A). The punch is closed, and the designated part of aortic wall is taken out (B). The punch cone is driven further into the aortic wall by rotating the device 360° in both directions until the handle shoulders press against aortic adventitia and the device's overtube is lodged in the hole in the aortic wall (C). The punching device is removed from the handle. A gasket in the device's overtube prevents blood from escaping the aorta (D).

coronary anastomosis was planned. Then the heart was released, and the graft was checked for kinking or traction. After initiation of the CPB, distal anastomoses of the study vessels as well as the additional arterial grafts were performed. In the control group (group B), the distal anastomoses of the saphenous vein grafts and the arterial grafts were performed first. Central venous anastomoses were performed by using tangential clamping of the ascending aorta and a monofilament 6-0 suture after releasing the aortic cross-clamp in the period of reperfusion.

All adverse events were documented during the entire study period. Intraoperative adverse events, such as bleeding before device deployment, leakage after device deployment, deployment failure, bypass vessel occlusion, back-wall perforation, aortic wall dissection, and embolization of aortic plaque, were documented. Furthermore, the total loss through the thoracic drainages and the amounts of red blood cell transfusion were measured, and the lengths of patient stays in the intensive care unit and in the hospital were recorded. Clinical follow-up was performed 1 month and 3 months postoperatively and included electrocardiograms and interviews with the patients regarding their clinical situations and stress-handling abilities. Defined end points of the study were (1) symptomatology class I-IV (class I, freedom from symptoms/angina; class II, angina during heavy exercise; class III, angina during moderate exercise; class IV, angina during low-level exercise or at rest), (2) restenosis requiring reintervention, and (3) myocardial infarction. At 6 months postoperative, we performed multislice computed tomography scans to evaluate the bypass patencies of all patients.

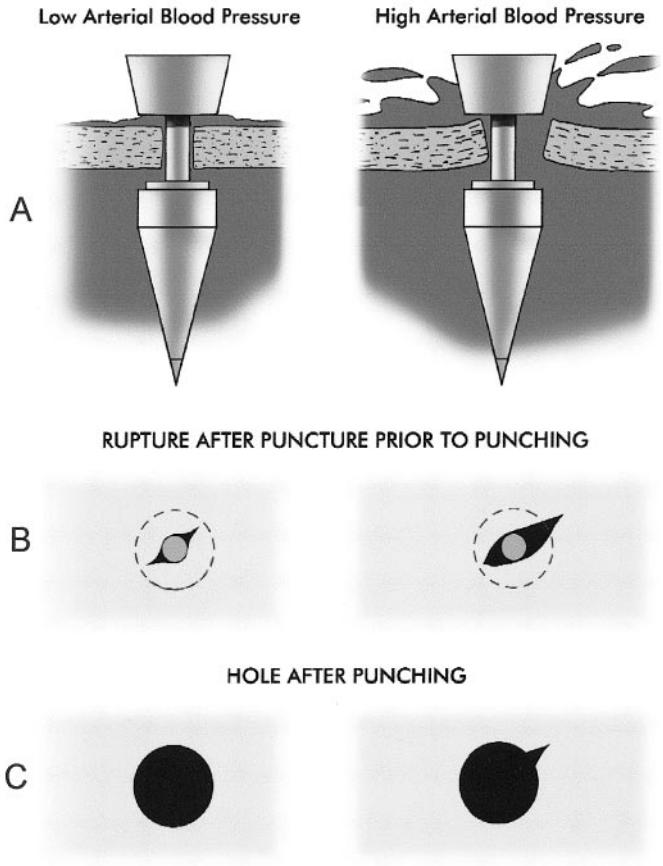

Figure 3. Illustration of the results of the punching process in relation to different aortic blood pressure conditions. Sectional drawings (A) of punch with its undercut space lodged in the aortic wall after puncture and prior to punching at low arterial pressure (left) and rupture in the aortic wall at high arterial pressure (right). Dotted line indicates area of aortic wall being taken out by the punch (B) and the resulting holes after punching (C).

Statistics

Data are presented as mean ± SD. Statistical analysis was carried out with the Student *t* test. Statistical significance of differences were presumed for $P < .05$, according to a reliability range of 90% (1.88 sigma) of all values.

RESULTS

Two patients enrolled in the study were excluded intraoperatively. One patient was excluded for calcification of the ascending aorta, and eversion of the vein was not possible for another patient. All operations were performed without intraoperative complications (Table 3). Two patients of the CorLink group demonstrated minor leakage from the central anastomosis, which was stopped with 6-0 single stitches. One other patient in the CorLink group developed an acute myocardial infarction with an increase of the myocardial band of creatine kinase to 96 U/L and had to undergo reoperation because of a kinking of the left internal mammary artery (LIMA) bypass, which was documented in the early postoperative angiogram. Skeletonizing the mammary artery pedicle prevented kinking. The remaining postoperative course of this patient was uneventful. No other patient required any reoperation or reintervention. Further intraoperative data are shown in Table 4. There were no statistical differences between the 2 groups. The number of study vessels performed in group B was slightly higher than in group A (Table 5), but this difference did not reach statistical significance. The total numbers of different grafts performed in both groups are shown in Table 5. In 2 cases, 1 stitch was necessary because of minor leakage. One patient developed postoperatively slight ST elevations without an increase in the myocardial band of creatine kinase or a significant increase in the levels of troponin I. Despite these findings, a coronary angiogram was performed and showed a patent LIMA graft, as well as patent study vessel grafts with widely open anastomoses (Video 3). In a postoperative coronary angiogram 6 months later, however, this particular patient

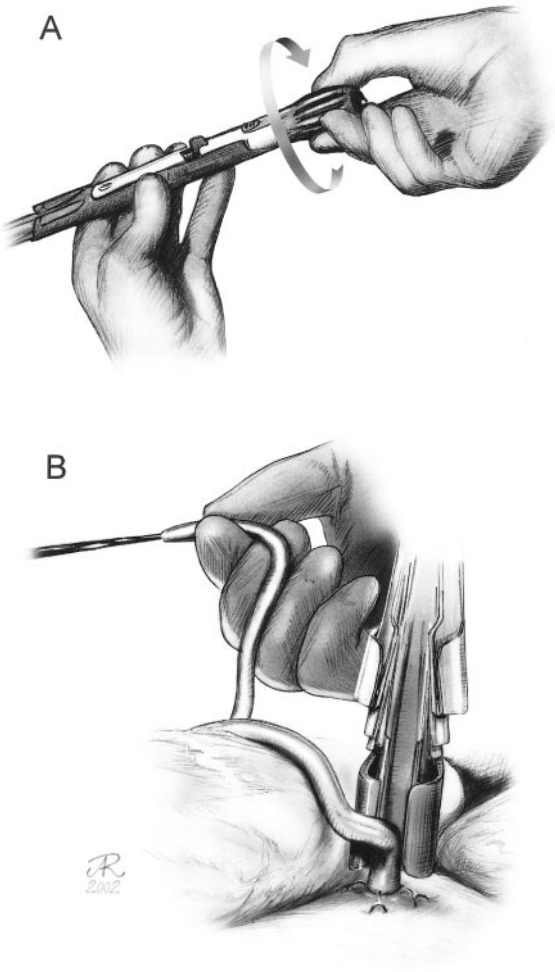

Figure 4. Rotation of the device's knob (A) splits the device, which releases the vein graft (B) in the process. After completion of anastomosis, free blood flow indicates patency.

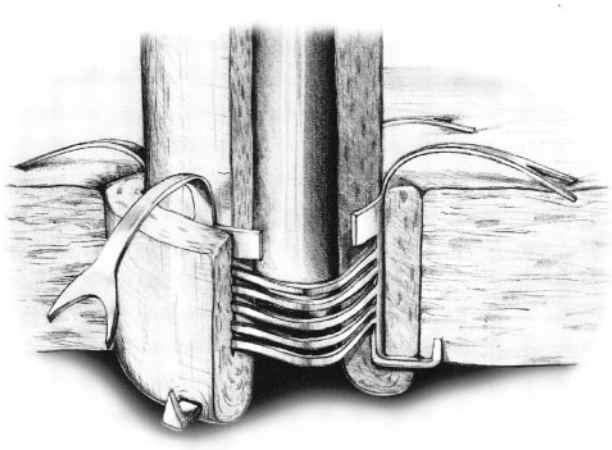

Figure 5. Architecture of proximal anastomosis with the CorLink nitinol anastomotic device.

showed for no obvious reasons a bypass occlusion of the study vessel to the right coronary artery (Table 6). All other study vessels, as well as additional arterial or saphenous vein grafts, proved to be patent by multislice computed tomography scans (Figure 6 ◎), which were performed for all cases half a year postoperatively, together with the last clinical follow-up examinations (Table 6). None of the patients had any symptoms of angina during the follow-up period with the exception of the patient with the study vessel occlusion to the right coronary artery and who demonstrated angina during intense exercise.

DISCUSSION

Aortic cross-clamping, as well as side-clamping of the ascending aorta, which is usually performed during coronary artery bypass grafting (CABG) operations, may result in injuries such as acute dissection of the aortic wall or injury of the vessel intima [Ohashi 1993]. In cases of calcification of the ascending aorta, cross-clamping and tangential clamping may induce particulate embolism and result in cerebral stroke or ischemic disease of other organs. [Barzilai 1989, Blauth 1992, Katz 1992, Wareing 1992, Roach 1996] One major advantage of anastomotic devices is that with use of such tools side-clamping and subsequent damage can be avoided. [Fokin 1998, Calafiore 2001, Eckstein 2001] Because off-pump techniques have become more common in CABG operations and have benefited patients [Ricci 2000, McKay 2001], there has been increased interest in using automatic mechanical anastomosis devices [Kirsch 2001, Niinami 2001, Tozzi 2001] instead of standard suture techniques. Side-clamping of the ascending aorta during off-pump operations has been supposed to increase the risk of damaging the ascending wall [Chavanon 2001], because clamping is usually performed under pulsatile blood pressure, whereas nonpulsatile blood pressure occurs during operations using CPB. Therefore, in off-pump surgery anastomotic devices may be helpful for avoiding tangential clamping.

Closed chest procedures using robotics for coronary artery bypass surgery are expensive procedures that require a long surgical learning curve because of the limited space in the operating field and the training required to carry out the technical manipulations [Boyd 2000, Kappert 2001, Mohr 2001]. In particular, using robotics in the sewing of the coronary artery anastomosis during closed chest CABG operations is still a challenging and time-consuming procedure. Again, the use of anastomotic devices may simplify the technique of creating an endoscopic anastomosis between a saphenous vein graft and the aorta [Calafiore 2001, Eckstein 2001, Filsoufi 2001].

Recently, initial clinical results with different anastomotic devices for the proximal anastomosis of the saphenous vein to the aorta have been reported [Calafiore 2001, Eckstein 2001]. The surgical characteristic of the DAAD device is that it creates an intima-to-intima anastomosis (Figure 5 ◎). Only 5 small inner pins made of nitinol (nickel-titanium), which serve as a fixation between the saphenous vein and the ascending aorta, are presented to the flowing blood. The stent is completely covered by the everted saphenous vein. Therefore, no intimal hyperplasia is expected, in contrast to the in-stent stenosis occurring after interventional cardiologic procedures that have, up to now, resulted in a considerable rate of in-stent stenoses [Berk 1995, Hamon 1995, Kornowski 1999]. Moreover, the inner pins of the DAAD device are fixed to the intima of the inner aortic wall and not within the proximal graft anastomosis (Figure 5 ◎).

We present our initial experience with the DAAD anastomotic device in this clinical, randomized, and prospective study. No device failure occurred, and there were no intraoperative

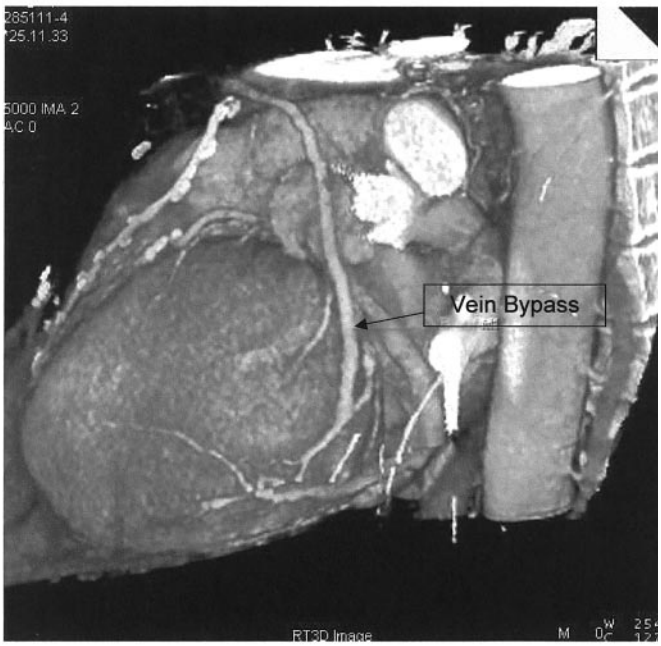

Figure 6. Fast computer tomography of a patient undergoing a coronary bypass operation using the CorLink device for central anastomosing of a saphenous vein graft to a marginal branch.

Table 3. Complications in Patients Undergoing Coronary Artery Bypass Operation with or without the CorLink Device*

	Group A	Group B
Intraoperative complications	None	None
Additional stitches at anastomosis site, n	2	None
Atrial fibrillation, n	4	3
Transient psychosyndrome, n	None	2
Rethoracotomy (LIMA kinking), n	1	None

*Group A used the CorLink device, and group B used conventional suture. LIMA indicates left internal mammary artery.

complications. One additional stitch was necessary in only 2 patients because of minor bleeding and was placed at the site of the DAAD anastomosis. Treatment was with additional superficial 6-0 single stitches to fix the everted vein to the adventitial tissue of the aortic wall (Figure 5 ◉). It is important that the suture not grab the stent in order to prevent a kinking of the stent that could result in graft vessel stenosis. No cerebral strokes occurred in patients in either group. Intraoperative transesophageal echocardiography/epiaortic ultrasonic assessment may be helpful in preventing particulate embolism during tangential clamping of the ascending aorta [Barzilai 1989, Dávila-Román 1996]. A follow-up at 6 months with multislice computed tomography revealed 1 occlusion of a study bypass in the CorLink group. This finding was confirmed by coronary angiogram. In this particular patient an early coronary angiogram was performed on the day of operation because of slight ST elevations. This angiogram demonstrated that all coronary artery bypass grafts, including the study vessels, were patent without any stenosis or kinking (Video 3). Because no flow measurement of the vein graft was performed intraoperatively, a low bypass runoff to the target vessel (right coronary artery) may be the reason for the observed midterm occlusion. Another reason may be an intima injury induced by the tip of the coronary catheter. All other study vessels, as well as all additional arterial mammaria grafts and saphenous vein grafts, were patent, and all anastomoses were of good quality. Multislice computed tomography was demonstrated to be an elegant noninvasive method of good quality for investigating bypass patency and anastomosis quality (Figure 6 ◉) [Cline 2000, Knez 2001, Kopp 2001]. No kinking of the central bypass anastomosis was observed, demonstrating that the 90° angle was supported effectively by the right outflow tract/right atrium or the pulmonary artery. In cases of insufficient support from the pulmonary artery or the right ventricular outflow tract, it is possible to put a piece of pericardium or muscle tissue below the vein graft in the area of the anastomosis.

An early rethoracotomy had to be performed in 1 patient of the CorLink group because of acute myocardial infarction (MI) with an increase of the myocardial band of creatine kinase to 96 U/L. The MI was attributable to a kinking of the LIMA bypass. This observation explains the fact that the mean level of creatine kinase MB isoenzyme was higher in group A than in group B. However, because the number of patients was small, this difference was not statistically significant.

Two different sizes of the DAAD device are now available, small and large. In 1 patient saphenous vein eversion was not possible using the large device, and the vein could not be brought through the inserter of the small device because the wall of the saphenous vein was relatively thick. An intermediate device size would be helpful.

It appears to be most important to avoid injury to the intima of the vein during the eversion. Intima lesions risk presenting the endothelial matrix, especially collagen, to the flowing blood, resulting in an activation of thrombocytes, which are linked via the von Willebrand factor to the endothelial lesion. This process may result in thrombus formation and, finally, in bypass occlusion.

The punching was performed at a mean arterial pressure of about 60 mm Hg to reduce stress to the wall of the ascending aorta. With high blood pressure, vigorously escaping blood widens the rupture caused by the puncture and increases the risk of the rupture extending from the area to be taken out with the punch. If this rupture occurs, the result

Table 4. Intraoperative and Postoperative Data for Patients Undergoing Coronary Artery Bypass Operation with or without the CorLink Device*

	Group A	Group B	*P*
Surgery time, min	229 ± 38 (150-290)	215 ± 59 (130-290)	NS
Perfusion time, min	80 ± 17 (47-103)	87 ± 26 (50-133)	NS
Aortic cross-clamp time, min	62 ± 15 (45-84)	62 ± 19 (30-87)	NS
Drainage loss, mL	1333 ± 530 (540-259)	1361 ± 493 (450-2030)	NS
Red cell transfusion, mL	386 ± 342 (0-750)	325 ± 334 (0-750)	NS
CKmax, U/L	397 ± 223 (154-545)	236 ± 148 (93-571)	NS, *P* = .059
CKMBmax, U/L	29 ± 25 (13-96)	11 ± 4 (8-12)	NS, *P* = .056
ICU stay, d	2.4 ± 1.1 (1-4)	2.1 ± 1.4 (1-5)	NS
Hospital stay, d	9.5 ± 1.5 (8-12)	9.1 ± 1.1 (7-11)	NS

*Group A used the CorLink device, and group B used conventional suture. NS indicates difference between groups is not significant; CKmax, maximum creatine kinase level; CKMBmax, maximum level creatine kinase, MB isoform; ICU, intensive care unit. Data are mean ± SD; data ranges are indicated in parentheses.

Table 5. Early Results with Patients Undergoing Coronary Bypass Operations with or without the CorLink Device*

	Group A	Group B
Study vessels (mean ± SD), n	13 (1.2 ± 0.4)	15 (1.5 ± 0.5)
Bypass length, mm	145 ± 21	134 ± 26
Bypass diameter, mm	5.1 ± 0.8	5.2 ± 1.0
AAD size	Small (n = 8)	—
	Large (n = 5)	—
Suture, central anastomosis	None	6-0 Prolene
Anastomosis time, min	<1, All cases	5.0 ± 1.2
Additional bypasses, n	LIMA, 11	LIMA, 10
	RIMA, 2	RIMA, 5
	ACVB, 7	ACVB, 0

*Group A used the CorLink device, and group B used conventional suture. AAD indicates acute aortic dissection; LIMA, left internal mammary artery; RIMA, right internal mammary artery; ACVB, aortocoronary venous bypass.

after punching is a hole with a broken rim (Figure 3 ◉). Thus, bringing more aortic wall tissue between the cutting knives of the punch leads to a rounder hole. Using excessively high arterial pressures during the punching process may induce a small slit and asymmetric holes, as has been observed in a wetlab pig model, and may result in bleeding from the proximal DAAD anastomosis (Figure 3 ◉).

The measurement of the correct bypass length is the crucial point of this technique, because the central anastomosis of the graft to the ascending aorta is performed first. For estimating the correct length, it appeared helpful to fix the adventitial tissue of the saphenous vein to the epicardium next to the site where the distal bypass anastomosis was planned. Then, we induced cardioplegia, and to estimate the correct length we filled the heart by reducing the saphenous backflow to the heart-lung machine.

Our experience suggests that the CorLink device is a safe and effective technique for anastomosis between the saphenous vein graft and the ascending aorta. The technique is performed rapidly, and the learning curve is short. The device is easy to handle, can be performed through small thoracic incisions, and can be used in a limited operative field. These characteristics seem to make it ideal for closed chest procedures. Further randomized studies that enroll a larger number of patients are necessary to determine which patients may benefit most from this procedure.

Table 6. Fast Computed Tomography Follow-up for Patients Undergoing Coronary Artery Bypass Operation with or without the CorLink Device*

	Group A	Group B
Study vessel patent, n	12/13	15/15
Additional arterial graft patent, n	13/13	15/15
Additional vein graft patent, n	7/7	None
Anastomosis of good quality, n	32/33	30/30

*Group A used the CorLink device, and group B used conventional suture; follow-up was conducted 6 months postoperatively for all 21 patients.

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