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# A New Needle Driver for Minientry Coronary Artery Bypass

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## ABSTRACT

**Purpose:** This article describes our clinical experience with a new needle driver (Olympus, Tokyo, Japan), which we have produced to facilitate minithoracotomy or port-access coronary artery anastomosis with the running suture technique.

**Methods:** The needle driver is 21 cm long, weighs 38 g, and has a grip shaft 1.4 cm in diameter. The device is held like a pencil. A side lever and a revolving disk in the shaft are manipulated with the fingers; a fine needle with a 7-0/8-0 monofilament suture can be grasped/released and driven to penetrate the coronary arterial wall. This device was employed in 10 consecutive patients (8 men, 2 women, 73 ± 7.5 years old), and off-pump bypass to the left anterior descending artery was achieved using the left internal thoracic artery or vein via a minithoracotomy (4.2 ± 0.6 cm long).

**Results:** There was no instrument-related injury during each anastomosis. The mean sewing time per anastomosis was 12 minutes (range, 8-18 minutes). Angiography confirmed the patency of the graft in all cases.

**Conclusions:** Although our experience is limited, we consider the present needle driver to be a viable device for facilitating off-pump, minientry coronary artery anastomosis with the suturing technique.

## INTRODUCTION

Although its indications are limited, minimally invasive entry to perform coronary artery bypass eliminates the need for a full-sternotomy approach. It is technically cumbersome, however, to handle the standard needle holder for coronary anastomosis through the small entry. We have produced a needle driver (Olympus, Tokyo, Japan) that can be controlled easily via a minientry or port. This article introduces the instrument and discusses the early clinical results we have obtained.

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## MATERIALS AND METHODS

### *New Needle Driver*

The needle driver is 21 cm long, weighs 38 g, and has a grip shaft 1.4 cm in diameter. The device is held like a pencil (Figure 1). There is a small arm at the tip of the shaft, and a fine needle with a 7-0 or 8-0 monofilament suture can be grasped tightly in the groove of the arm. The needle is released (ie, the arm groove is widened) when the surgeon touches the side lever with an index finger. The shaft contains a small revolving disk, which is controlled with the thumb; the arm revolves around its long axis and the needle held in the arm accordingly moves around the holding point (Figure 1). With this simple turning motion, the needle can be driven to penetrate the coronary or graft wall (Figure 2). In an actual clinical setting, the surgeon held an endoscopic grasper/forceps in the other hand and used it to assist the needle driver, help to change the angle of the needle, and catch the needle released from the needle driver.

At this stage the device is a disposable product, and as of August 2004 it was still commercially unavailable.

### *Patients and Surgery*

After written informed consent had been obtained, the needle driver was used between September 2003 and April 2004 in 10 consecutive patients (8 men, 2 women, 73 ± 7.5 years old) who were scheduled for surgical treatment of coronary artery disease in the left anterior descending artery (LAD). In all cases, the operation was performed by a single surgeon. All the patients underwent off-pump, minithoracotomy coronary artery bypass to the LAD; the left internal thoracic artery (LITA) was used in 9 patients and the saphenous vein (SV) in 1 redo case. The LITA graft was thoracoscopically prepared and divided at its distal end, employing an ultrasonic coagulator [Ohtsuka 1997]. The SV graft was connected to the left axillary artery and thoracoscopically introduced into the left thoracic cavity. Then, the pericardium was opened, the LAD was identified, and a minithoracotomy was created just above the target portion of the LAD [Ohtsuka 2003].

After systemic heparinization, each anastomosis was implemented via the minithoracotomy. The LITA/SV-to-LAD anastomosis was performed with a running suture technique using a single piece of 8-0 monofilament suture. A reusable epicardial stabilizer was employed to immobilize the anastomosis site. The first 4 or 5 running stitches were

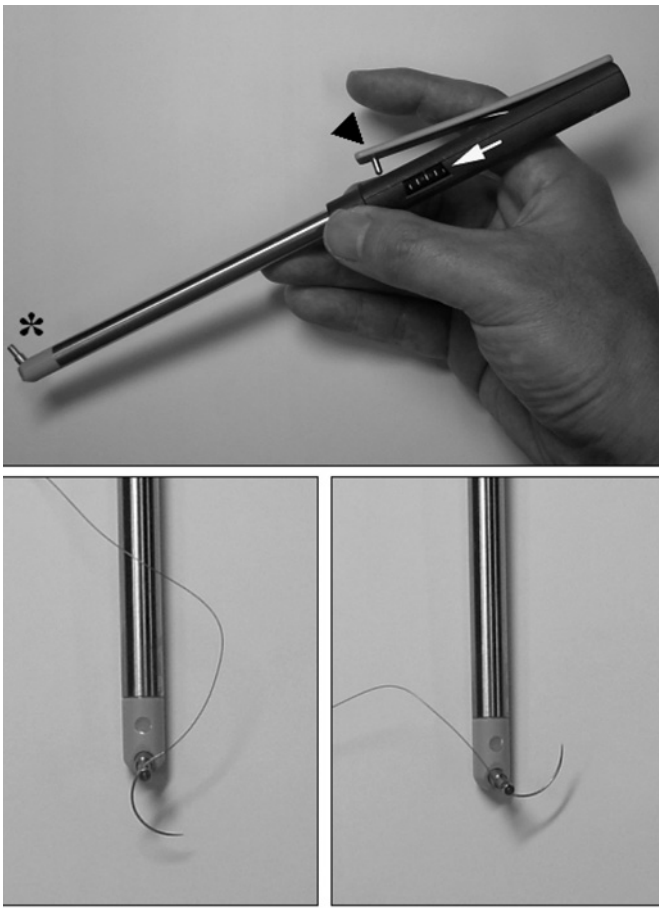

Figure 1. Photographs of the needle driver (Olympus, Tokyo, Japan). A fine needle with a 7-0/8-0 monofilament suture is held at the small arm (*), and released by touching the side lever (arrowhead). Needle motion is controlled with a revolving disk in the shaft (arrow), and the grasped needle turns around the arm (left to right bottom pictures).

placed between the LAD, and the graft was suspended on the wound. Thereafter, the graft was approximated down to the LAD, and the anastomosis was completed with placement of approximately 10 running stitches though the graft to the LAD. The needle driver was employed for carrying out stitching around the LAD; the LAD wall (alone or together with the graft wall) was sewn through the minithoracotomy under direct vision.

## RESULTS

The minithoracotomy was 4.2 ± 0.6 cm long, ranging from 3.0 to 5.0 cm, and the wound was created precisely just above the LAD in each patient. There was no instrument-related injury during any anastomosis. The mean sewing time per anastomosis was 12 minutes (range, 8-18 minutes). There was no revision of running-suture anastomosis, although 1 additional stitch for hemostasis was placed in 3 cases. Angiography confirmed the patency of the graft in all cases.

## COMMENTS

Our clinical experience with the present needle driver technique showed that off-pump coronary anastomosis by the running suture technique could be carried out safely and successfully through a minithoracotomy approximately 4 cm long placed just above the LAD. The new device functioned effectively with only finger control.

A number of innovative tools are currently available to facilitate coronary artery anastomosis. The one-touch coronary anastomosis technique using a mechanical or magnetic connecter and the self-closing clip method have been used as alternatives to the standard suturing technique [Wolf 2003, Carrel 2004, Casselman 2004]. Although application of these new devices is limited to good-sized, noncalcified coronary arteries, and the long-term patency is unknown, these novel methods are promising and might facilitate minientry or port-access coronary anastomosis.

A machine assisted by robot technology has been developed and employed for totally endoscopic coronary artery bypass surgery [Bolton 2004]. The remote-controlled robot-hand has sophisticated motion and is therefore capable of coronary anastomosis by the standard sewing technique even in the closed chest cavity. The chief concept of our needle driver project is the same as the robot hand; the device can facilitate coronary suturing anastomosis in a limited space. However, the performance of the prototype needle driver is still primitive, and its function seems to be insufficient in more difficult situations, such as small coronary arteries located laterally or inferiorly. Therefore, further development is now under way to improve the device's performance.

In conclusion, although our experience is limited and further instrumental progress is required, the present needle

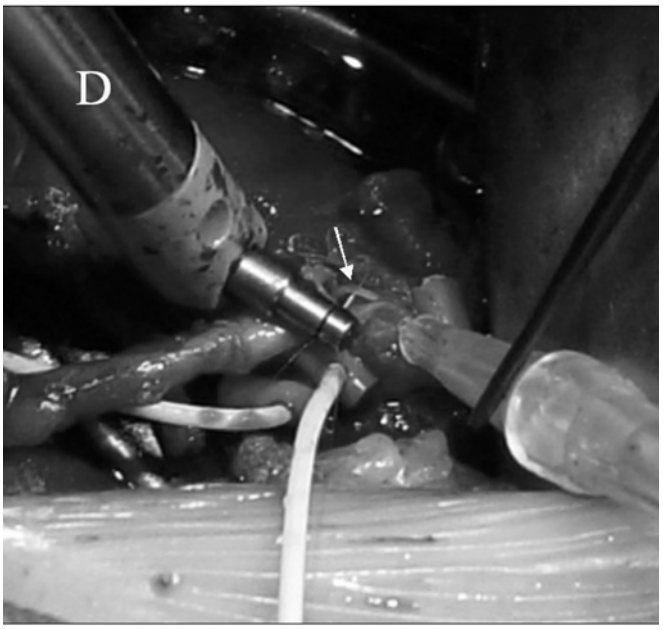


Figure 2. Photograph of the needle driver (D) sewing the left anterior descending artery (arrow) with an 8-0 monofilament suture.

driver is considered to be a viable device for facilitating off-pump, minientry coronary artery anastomosis with the suturing technique.

## REFERENCES

Bolton JW, Connally JE. 2004. Results of a phase one study on robotically assisted myocardial revascularization on the beating heart. Ann Thorac Surg 78:154-8.

Carrel T, Englberger L, Keller D, Windecker S, Meier B, Eckstein F. 2004. Clinical and angiographic results after mechanical connection for distal anastomosis in coronary surgery. J Thorac Cardiovasc Surg 127:1632-40.

Casselman FP, Meco M, Dom H, Foubert L, Van Praet F, Vanermen H. 2004. Multivessel distal sutureless off-pump coronary artery bypass grafting procedure using magnetic connectors. Ann Thorac Surg 78:E38-40.

Ohtsuka T, Ninomiya M, Maemura T, Takamoto S. 2003. Needle-guided mini-entry in video-assisted coronary artery bypass. Eur J Cardiothorac Surg 24:644-6.

Ohtsuka T, Wolf RK, Hiratzka LF, Wurnig P, Flege JB. 1997. Thoracoscopic internal mammary artery harvest for MICABG using the harmonic scalpel. Ann Thorac Surg 63:S107-9.

Wolf RK, Alderman EL, Caskey MP, et al. 2003. Clinical and six-month angiographic evaluation of coronary arterial graft interrupted anastomoses by use of a self-closing clip device: a multicenter prospective clinical trial. J Thorac Cardiovasc Surg 126:168-77.