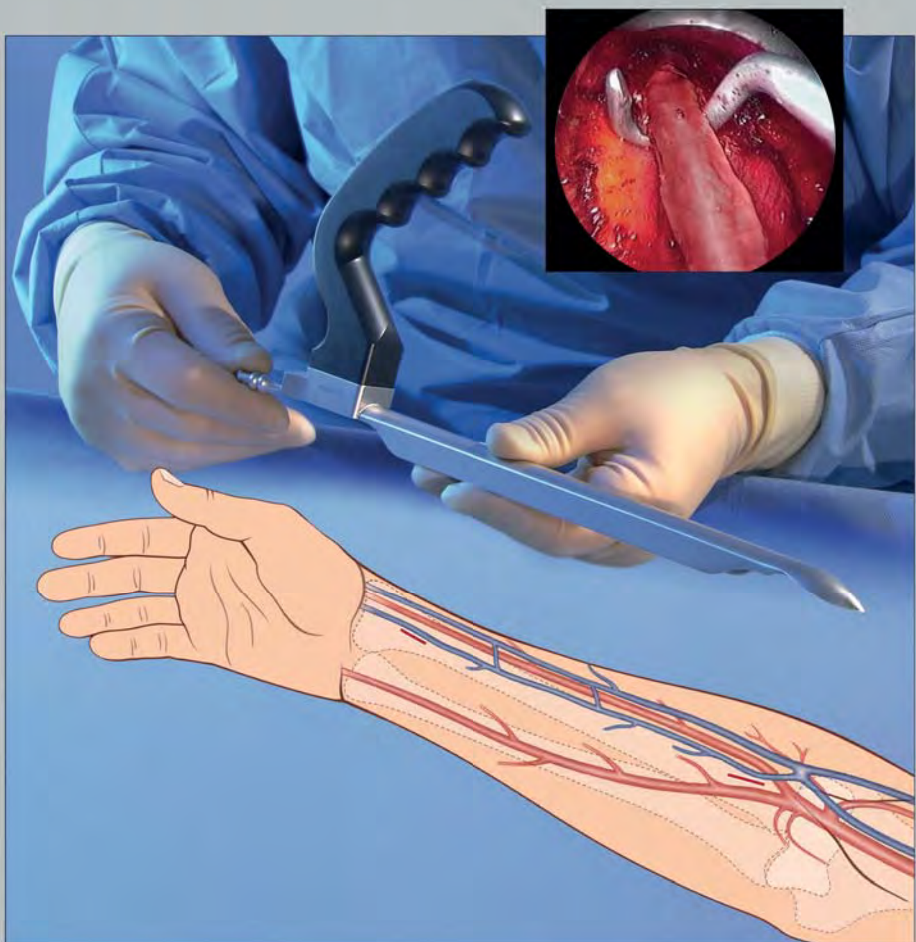
ENDOSCOPIC RADIAL ARTERY HARVESTING



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Attached to the inside back cover is the video DVD **KS 713** Endoscopic Radial Artery Harvesting, produced by the author of this booklet in cooperation with **KARL STORZ** MediaService. The video has been recorded in the Division of Cardiothoracic Surgery, Essex Cardiothoracic Centre, United Kingdom.

Hardware and software requirements:
PC with at least an 800 MHz processor and 64 MB of RAM, resolution 1024 x 768 with 24-bit color depth, Windows 98/NT/2000/XP, MPEG Player ActiveMovie (included on the CD-ROM), CD-ROM drive, sound card, speakers, mouse.

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Background

As the first so-called “alternative arterial conduit”, the radial artery was initially introduced by *Carpentier* and collaborators in 1972[4] and since then used at several sites in North America[6, 7]. Soon, after having been abandoned due to the concerns raised by the low patency rates at short-term, an upsurge in the use of the radial artery finally occurred in late Eighties, when conduit patency up to 15 to 18 years following grafting was demonstrated by *Carpentier's* group. This resulted in a steadily progressive reintroduction of the radial artery in the clinical scenario, with several studies supporting its routine use.[1, 3,12,14]

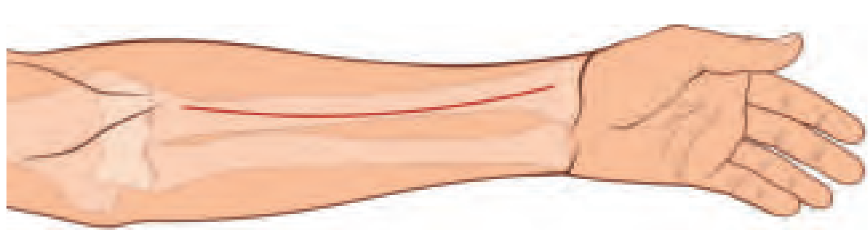
The reports by *Loop* and collaborators first[8] and then that by *Lytle* and collaborators[9] provided the foundation for the next logical step, i.e. the exclusive use of arterial conduits to achieve complete revascularization. Finally, the advent of the T-graft or Y-graft has allowed complete revascularization with only two conduits. By attaching the free conduit (ITA* or radial artery) to the mid-portion of the in situ left ITA, it is as though 10 cm is added to the length (compared with aortic anastomosis) of the free conduit, which enables it to reach most areas on the heart with sequential anastomoses.[10]

)* **I**nternal **T**horacic **A**rtery

Harvesting of the Radial Artery: Open Technique

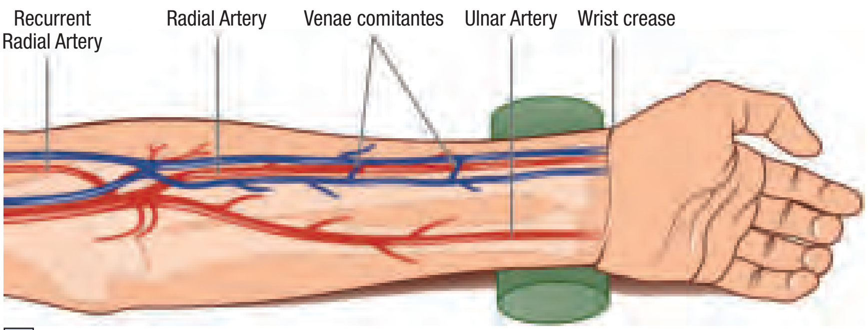
The conventional (open) approach for Radial Artery (RA) harvesting has been extensively described elsewhere in the literature[13], albeit several technical aspects are worthy to be analyzed in order to better understand the differences (not only in terms of aesthetics) when compared to the endoscopic technique.

Briefly, the patient's nondominant arm is prepped following adequate pre-operative assessment of collateral circulation (by means of an Allen test or other methods, e.g. Doppler ultrasound). The upper extremity is placed on an arm board perpendicular to the long axis of the operating table. A medially curved incision is made on the skin overlying the RA from a point 2 cm proximal to the styloid process of the radius to a point 2 cm distal to the elbow crease and 1 cm medial to the biceps tendon (**Fig. 1**).



1

Conventional technique: a 16–20 cm incision is performed.



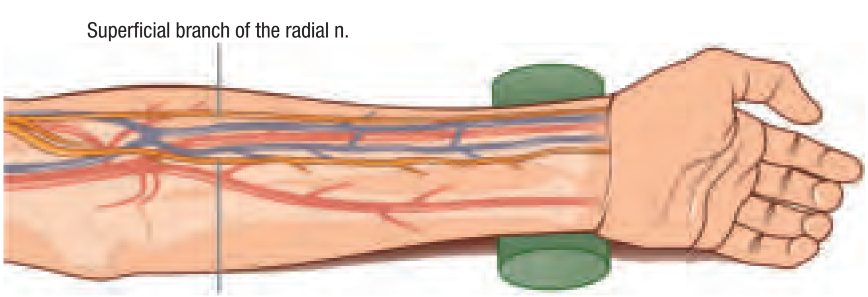
2

Surgical Anatomy of the radial artery.

The subcutaneous tissue is divided either with scissors or cautery. The dissection can be initiated at either end depending on the surgeons' preference, although most surgeons would start the dissection at the distal end. The deep fascia of the forearm is incised directly over the RA. The RA is harvested as a pedicle with minimal manipulation using sharp dissection, diathermy, or any other suitable vessel sealing system currently available. During harvesting, gentle retraction of the brachioradialis muscle is usually performed in order to further facilitate vessel exposure (**Fig. 2**).

Two nerves must be protected during RA dissection: first, the *lateral antebrachial cutaneous nerve* (LACN) lies superficial to the brachioradialis muscle and close to its medial border, making the nerve particularly prone to inadvertent injury if the skin incision is placed at this site. As a result of iatrogenic trauma, the patient will develop paresthesia and numbness of the radial aspect of the volar forearm. Second, please be well aware, that the superficial branch of the radial nerve (sRN) lies beneath the brachioradialis muscle in the proximal two-thirds of the forearm and runs parallel to the RA. Injury to the sRN will cause paresthesia and numbness of the thumb and the dorsum of the hand. Accordingly, the LACN should be spared by making sure, that no excessive lateral retraction is applied to the brachioradialis muscle.

Once the pedicle is free and systemic heparin has been administered, the artery is divided proximally and distally, and stored in a solution (usually containing heparinized arterial blood at room temperature, mixed with different anti-spastic drugs according to each center's own protocol). Next, hemostasis of the operative field is achieved and the arm is closed in multiple layers. A closed-suction drain may be placed to prevent seroma or hematoma formation. The arm is then secured to the table alongside the body.



3

Surgical anatomy of nerves during radial artery harvesting.

Harvesting of the Radial Artery: Endoscopic Technique

Endoscopic Harvesting of the Radial Artery (ERAH) has only recently been introduced in the clinical scenario, whilst endoscopic removal of the great saphenous vein is a well established technique during coronary artery bypass surgery and proved to offer significant advantages in terms of wound complications, reduced pain and aesthetics while yielding remarkable results with respect to the histological analysis of the harvested conduits.[2]

As a result, great interest was aroused in ERAH with the aim of providing the same clinical benefits as in endoscopic vein harvesting, which can also be attributed to advances made in the development of specialized medical devices for endoscopic visualization of the conduits and vessel sealing systems for completion of harvesting.

The pre-operative evaluation criteria (e.g. negative Allen test, choice of non-dominant arm, etc.) previously described for the open approach, are similarly adopted for the endoscopic technique.

The main steps required to perform endoscopic harvesting of the radial artery are outlined below. For further technical details, please refer to the DVD enclosed.

Surgical Equipment

Albeit different approaches have been described so far, the technique outlined in this manual allows a simplified approach for endoscopic harvesting of the radial artery to be performed using only a few specialized endoscopic devices mainly consisting of three components:

- BISLERI Endoscopic Radial Artery Retractor plus 45°-Hopkins® II Telescope
- Vessel sealing system
- Artery dissector

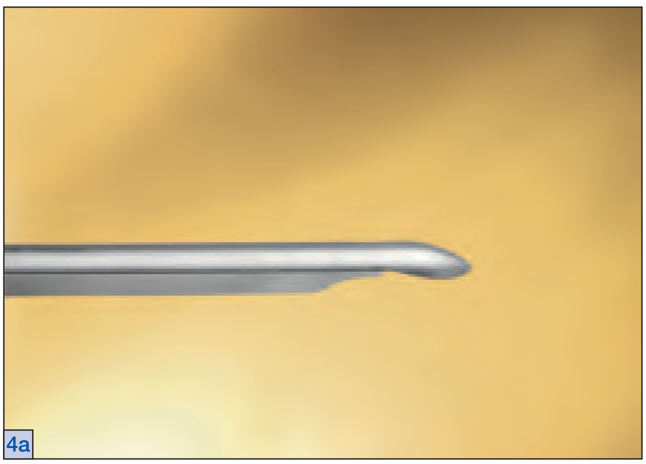
Moreover, the technique, as described in the following chapters, can be performed by a single surgeon (or physician assistant) without the routine need for another assistant, as in many other endoscopic procedures. Finally, the reported technique can be easily adopted even by those who do not have a background in endoscopic vein harvesting, which is not necessarily required for ERAH.

BISLERI Endoscopic Radial Artery Retractor

Despite the excellent performance of the Endoscopic Vein Retractor already available on the market, the different anatomical features of the radial artery – mainly the fact, that the great saphenous vein runs in the subcutaneous tissue while the radial artery lies mostly beneath the brachioradialis muscle – made the development of a novel retractor necessary.

Special Features of the BISLERI Endoscopic Radial Artery Retractor:

- Stainless steel, resterilizable device
- Hopkins® II rod-lens 45°-endoscope for optimal visualization of the operative field
- Ergonomic handle
- Improved design of the distal tip (**Fig. 4a**) and the proximal (**Fig. 4b**) part.
- Improved smoke evacuation due to a specific channel (**Fig. 5**)
- Tunnel-shaped design (**Fig. 6**).

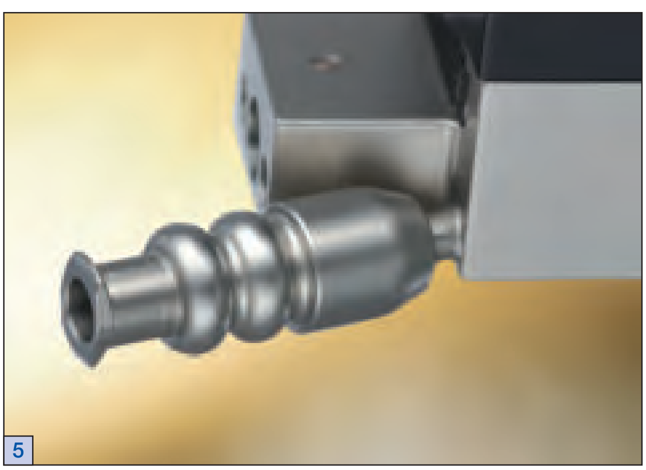


4a

Design of the distal tip.

4b

Design of the proximal part.



5

The additional channel can be used either connected to a suction device or to a CO_2 insufflator.

6

The tunnel-shaped design of retractor is clearly visible.

Vessel Sealing System

ERAH can be performed either with the use of a more traditional approach (e.g. using endoscopic clip appliers and scissors) or a vessel sealing system. As previously outlined, the use of a vessel sealing system yields considerable advantages during ERAH mainly in terms of time-effectiveness and simplification of the procedure, since it is routinely the only other instrument used by the operating surgeon (beside the BISLERI retractor), thus avoiding the potential need of an additional assistant.

The choice of the most appropriate vessel sealing system relies on each surgeon' preferences, and as such, it is not a matter of debate in the present manual. Conversely, the BISLERI retractor offers the added benefit that it can be combined with different vessel sealing systems: to date, the BISLERI retractor has been safely and effectively used in combination with the following devices:

- RoBi® Forceps and Metzenbaum Scissors (KARL STORZ, Germany)
- EnSeal™ endoscopic forceps (SurgRx®, Ethicon Endo-Surgery, USA)
- Starion endoscopic forceps (Starion Instruments, USA)
- Harmonic Scalpel / Ultracision (Ethicon Endosurgery, USA)

Moreover, considering that the existing armamentarium will be expanded by additional similar (in terms of dimensions) new devices, the BISLERI retractor stands a good chance of being used in conjunction with such tools.

Patient Selection

Endoscopic Radial Artery Harvesting can be performed in virtually all patients scheduled for Coronary Artery Bypass Grafting (CABG) surgery and selected for use of the radial artery.

Nevertheless, a careful selection of such candidates is strongly recommended during the initial phase (i.e. at the beginning of the learning curve) of the ERAH program, in order to avoid unnecessary discouragement and frustration of those surgeons involved in the endoscopic approach. It is particularly advisable to avoid patients with overdeveloped forearm (muscles or fat) at the beginning, unless the surgeon has already a consistent background in endoscopic procedures (preferably in endoscopic vein harvesting). Once the surgeon has completed the learning curve (usually 20 cases are the average required to reach the "plateau phase"), more heterogeneous patients could be included in the ERAH program.

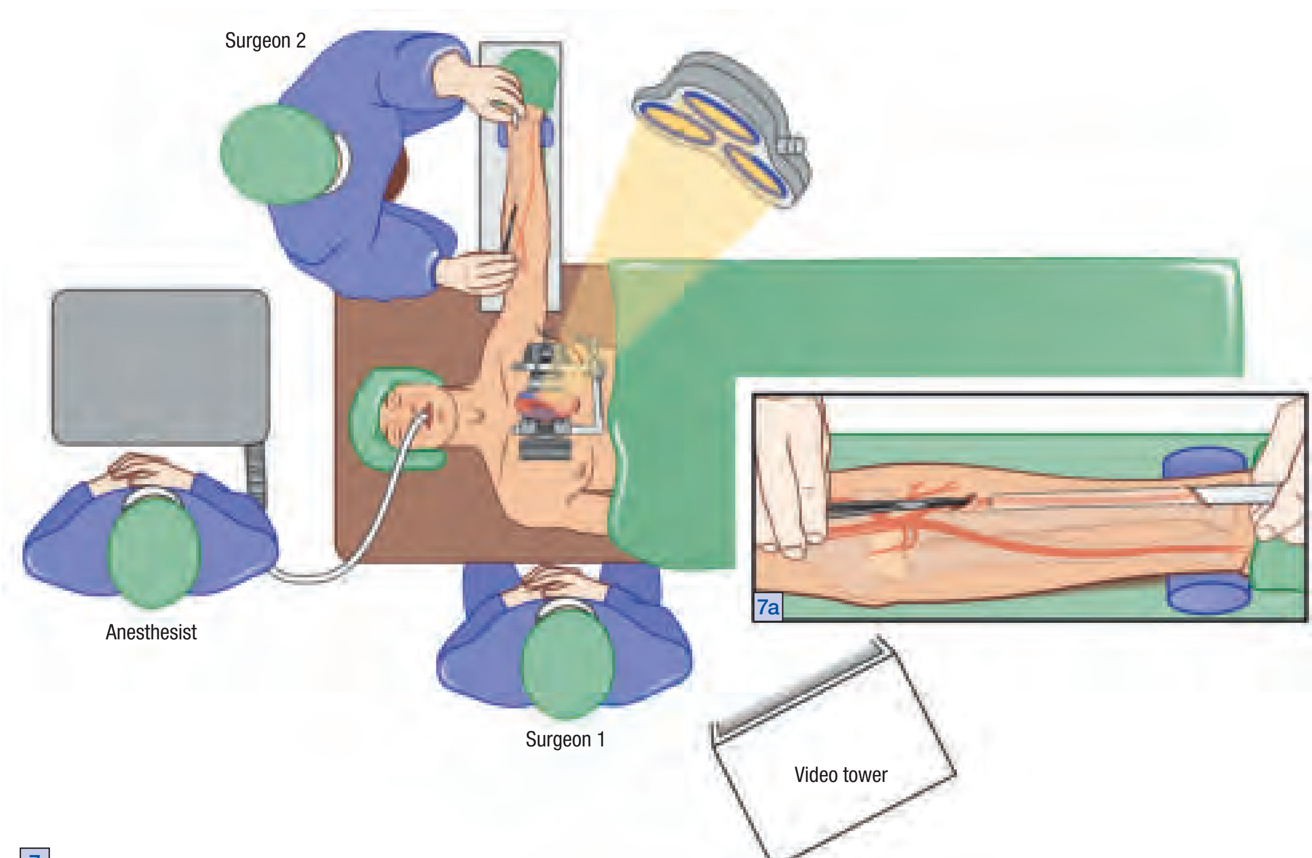
Arm Preparation

Procedural Steps

A schematic overview of the OR setting during endoscopic harvesting of the radial artery is depicted below (**Fig. 7**).

The upper extremity (usually the non-dominant arm) is prepped, draped and placed on an arm board perpendicular to the long axis of the operating table. The arm needs to be secured to the arm board (e.g. using adhesive tapes or towel clips) in order to provide an adequate setting for ERAH, especially in the initial steps. Moreover, a rolled pad below the wrist (allowing extension of the wrist) is fundamental to achieve a proper positioning of the forearm during ERAH, otherwise it will be extremely cumbersome to manoeuvre the BISLERI retractor and the vessel sealing system during the procedure (**Fig. 7a**).

Worthy of note, no tourniquet around the arm is used, as reported by other authors using different systems for ERAH: in fact, the pulsations of the radial artery can provide an important landmark especially in difficult cases when a clear and direct visualization of the radial artery cannot be achieved.



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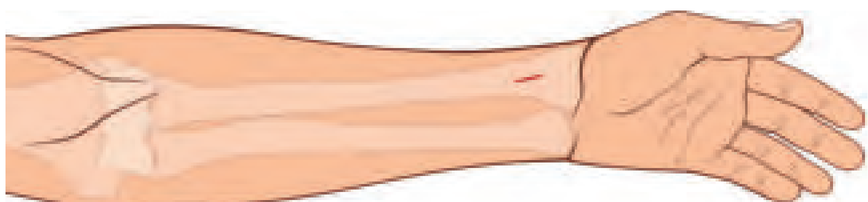
Operating room set-up and patient positioning during ERAH. It is of crucial importance that a rolled pad be placed below the wrist to establish a proper placement of the forearm, a preparatory measure that considerably facilitates maneuvering the BISLERI retractor and the vessel sealing system (**a**).

Step I

Exposure of the Radial Artery (Wrist Incision)

The very first step of ERAH is the exposure of the radial artery through an incision placed in the distal side, at the level of the wrist: this part of the procedure plays an essential role in preparation for the following "endoscopic" phase; therefore, the operating surgeon should exercise great care while performing this step to allow a simpler endoscopic step afterwards.

A 2- to 2.5-cm longitudinal incision of the volar surface of the forearm is performed beginning 1 cm proximal to the radial styloid prominence (**Figs. 8, 9**). The subcutaneous tissues are incised first. Next, the fascia between the brachioradialis and the flexor carpi radialis muscles is divided, and the radial artery is identified. Care is taken to separate the radial artery from the superficial radial nerve, which is one of the two nerves at risk during radial artery harvest.



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Endoscopic Technique: a 2-cm incision is performed at the level of the wrist.

Step II

Dissection of the Radial Artery Under Direct Vision

The radial artery is harvested as a pedicled graft. According to our protocol, the RA is first dissected from the surrounding tissues under direct vision with the aid of a vessel sealing system (**Fig. 10**). In the next steps of the procedure the endoscopic instruments should be advanced into the forearm for at least 3–4 cm. It is therefore highly advisable that dissection under direct vision be extended as proximally as possible (i.e., 3–4 cm) while lifting the self-retaining retractor. If this preliminary measure does not produce the anticipated effect, endoscopic-guided dissection of the distal part of the radial artery can become extremely cumbersome.

9

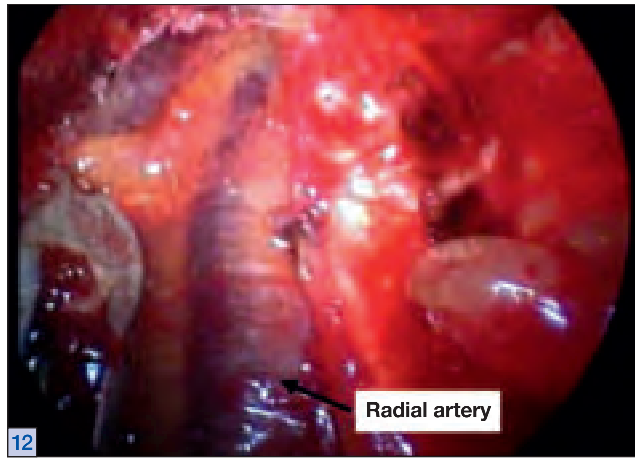
Exposure of the radial artery at the level of the wrist.

10

Dissection of the radial artery with the aid of a vessel sealing system under direct vision.

11

External view of the retractor following insertion in the forearm.



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Endoscopic view during opening of the fascia.

Fascia Opening

Step III

Once enough space has been created, the BISLERI Radial Artery Retractor and the vessel sealing system are advanced (**Fig. 11**) which allows the fascia between the brachioradialis and the flexor carpi muscles to be divided up to the antecubital fossa (**Fig. 12**). It is important to keep to a dissection plane immediately above the fascia and thus prevent any muscular structure from being divided (in particular the brachioradialis muscle) in an attempt to improve visualization of the radial artery. In fact, even in difficult cases, the BISLERI retractor can be advanced below muscular structures and the “tunnel-shaped” design allows to continue ERAH with enough comfort for the surgeon.

Dissection of the Brachioradialis Side of the Radial Artery

Step IV

The radial artery is then dissected off from side branches and the surrounding tissues on the brachioradialis side first (**Fig. 13**), otherwise the radial artery may become difficult to visualize as it can be obscured by the overlying brachioradialis muscle. Conversely, preserving the side branches and tissues on the flexor carpi radialis side pulls the radial artery towards the midline.

13

Dissection of the radial artery is started on the brachioradialis side.

Step V

Dissection of the Flexor Carpi Side of the Radial Artery

Similarly to the brachioradialis side, the flexor carpi side of the radial artery is dissected free up to the antecubital fossa (**Fig. 14**).

At any stage, either on the brachioradialis or flexor carpi side of the radial artery an inadvertent injury of a side branch may occur. In most of such instances, the injury is minor albeit the endoscopic view seems to magnify the amount of bleeding. It is therefore recommended either to remove the BISLERI Radial Artery Retractor with the coupled vessel sealing system from the forearm and perform compression from the outside. After a few minutes, bleeding usually resolves spontaneously; nevertheless, in those instances, once the radial artery is outside the forearm, it should be assessed in order to rule out potentially leaking side branches.

Step VI

Dissection of the Inferior Side of the Radial Artery

As the final step in the dissection of the radial artery from surrounding tissues, any residual side branches on the inferior aspect are divided (**Fig. 15**).

Step VII

Assessment of Residual Side Branches

Once the dissection has been completed, the hook-shaped artery dissector is used to confirm the absence of any residual side branches (**Fig. 16**).

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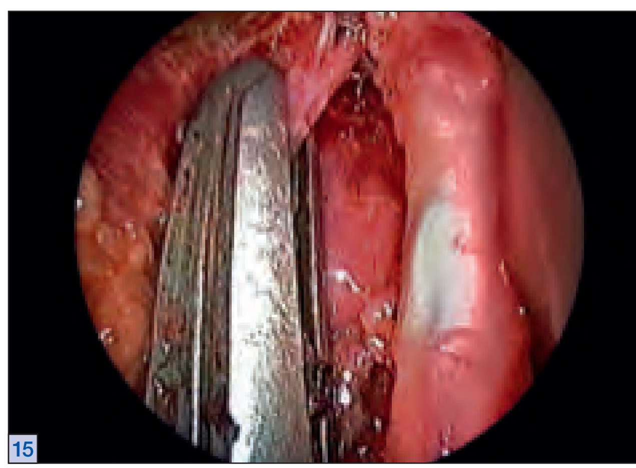
The flexor carpi side of the radial artery is dissected free.



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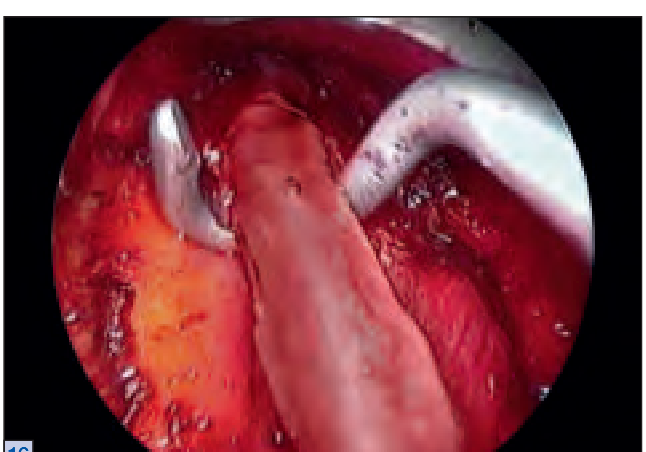
Dissection of the radial artery from surrounding tissues is completed by dividing any residual side branches on the inferior aspect.



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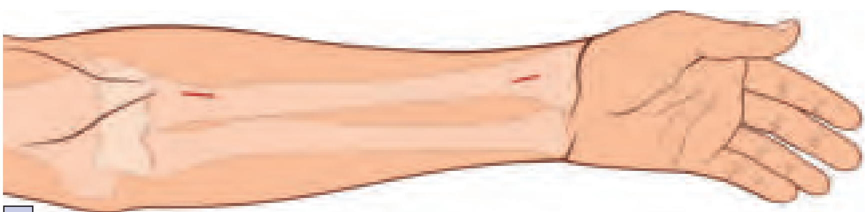
Absence of any residual side branches is confirmed by use of a hook-shaped artery dissector.

Proximal Incision of the Forearm

Step VIII

Finally, an additional 1.5-cm incision is performed near the antecubital space for proximal ligation (**Fig. 17**). A blunt tissue dissection is carried out under endoscopic control, using the tip of the dissector as a landmark (**Figs. 18, 19**). A tape is then looped around the radial artery and secured in a tourniquet, in case a residual side branch has been missed during final assessment (cf. step VII). This preventive step is to make sure that, once the radial artery has been divided distally following heparinization (prior to extraction from the forearm) division of any tissue remnant via the endoscopic route is still an available option. In such instance, the tourniquet can be snared down allowing to complete the residual tissue dissection.



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Drawing showing the wrist incision and the proximal incision made near the antecubital space.

19

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Once the proximal incision has been made, blunt dissection is performed under endoscopic control, using the tip of the dissector as a landmark.

Division of the Radial Artery

The radial artery is removed via the proximal incision (at the level of the antecubital fossa) and clipped at the distal end. The harvested graft is wrapped in prewarmed papaverine-soaked gauze outside the forearm, thus maintaining the radial artery perfused as much as possible. In case of need, the radial artery can be ligated proximally by means of an endoloop through the single, distal incision (**Fig. 20**).

20

The distal side of the radial artery is divided, but not the proximal side so as to preserve blood perfusion.

Conclusions

The growing popularity of endoscopic venous conduit harvest for CABG has led to the modification of this technique in order to harvest the radial artery via the endoscopic approach as well. Such a procedure can be completed with the simple use of two instruments, the BISLERI Endoscopic Radial Artery Retractor and a vessel sealing system. The use of the endoscopic approach for radial artery harvesting offers several advantages when compared to the open technique in terms of less neurological complications, wound complications, wound infections, hematomas, and improved aesthetics[5,11], findings similar to those reported previously by other authors. The advantages in terms of reduced neurological injuries are mostly related to the careful dissection of the distal part of the radial artery (which minimizes the trauma to the superficial branch of the radial nerve) and to the avoidance of manipulation to the lateral cutaneous antebrachial nerve (running along the brachioradialis nerve), due to the different route (below the brachioradialis muscle). Moreover, this technique allows reduced trauma and manipulation of the radial artery itself during harvesting, which is an important contributing factor to long-term conduit patency, i.e. preservation of the arterial wall and the endothelial morphology and function (**Table 1**).

	OPEN TECHNIQUE	ENDOSCOPIC TECHNIQUE
TISSUE DISSECTION	**MORE** likely to develop hematoma	**LESS** likely to develop hematoma
MUSCLE MANIPULATION	**MORE** likely to develop neurological injury	**LESS** likely to develop neurological injury
HARVESTING TIME	**FASTER** harvesting **LONGER** closure time	**LONGER** harvesting time **FASTER** closure time
INCISION	**WORSE** aesthetic results	**BETTER** aesthetic results
RADIAL ARTERY MANIPULATION	**MORE** manipulation ↓ **MORE** prone to spasm	**LESS** manipulation ↓ **LESS** prone to spasm

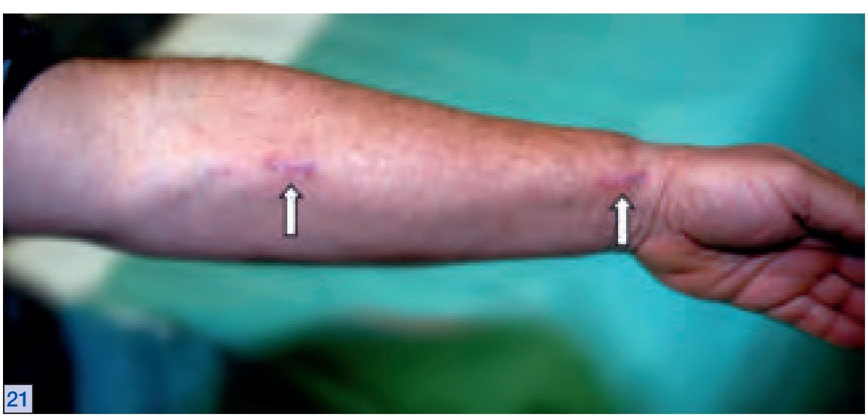
Table 1

Finally, the endoscopic technique provides ample patient satisfaction, especially in terms of length of the surgical incision when compared to the conventional approach. In patients with a normal postoperative course, the surgical scars are completely healed after 15 days with excellent aesthetic results. (**Fig. 21**)

The clinical experience with the BISLERI Endoscopic Radial Artery Retractor proved that this novel tool allowed endoscopic radial artery harvesting even in the most difficult cases (i.e. patients with a considerable amount of fat tissue in the subcutaneous layers or with a well-developed muscular forearm). Endoscopic radial artery harvesting can be performed concomitant to left internal mammary artery preparation, with a mean procedural time of 25–30 minutes, when performed by trained surgeons.

The BISLERI Endoscopic Radial Artery Retractor offers enhanced distension of the surrounding structures (due to the tunnel-shaped design of the device), improved positioning of the endoscopic instruments (once the vessel sealing system is inside the "tunnel", virtually no conflict with surrounding tissues has been detected, moreover the vessel sealing system always sits parallel to the radial artery, which minimizes the risk of inadvertent injury to the vessel during harvesting), less smoke production (the additional channel allows either to connect a suction device or employ low-flow carbon dioxide insufflation to clear the operative field from any excessive smoke produced during the use of the vessel sealing system. Finally, the previously outlined design features of the device provide improved comfort for the surgeon during the endoscopic harvesting of the radial artery.

As an increasing number of novel technologies for vessel sealing are becoming available on the market, it is the surgeon's choice which preferred energy source or system will be used along with the BISLERI Endoscopic Radial Artery Retractor. In conclusion, this novel tool offers a unique improved design for endoscopic radial artery harvesting and is extremely cost-effective (in that it allows the combined use of reusable instruments with disposable devices), thus meeting a definite demand in the field of minimally invasive conduit harvesting.



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Fifteen days after surgery, the scars are usually completely healed with excellent aesthetic results.

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Recommended Instrument Set for Endoscopic Radial Artery Harvesting

Instruments for Endoscopic Radial Artery Harvesting

49205 FCZ BISLERI **Endoscopic Artery Retractor,** for harvesting of the Arteria radialis, distal width 20 mm, working length 27.5 cm, with integrated U-shaped instrument guide and channel for smoke evacuation, with integrated routing of the fiber optic light cable inside the handle, **autoclavable,** for use with HOPKINS II® telescope 49205 FA, including cleaning adaptor 49205 FZ

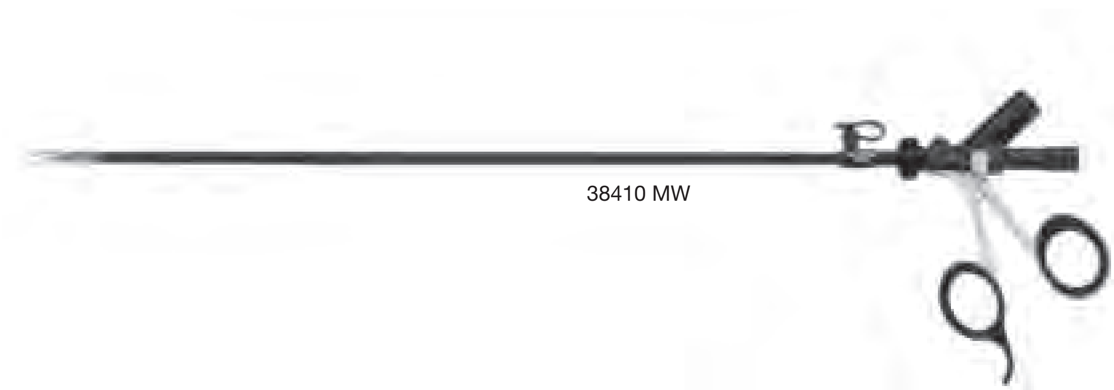
49205 FA HOPKINS II® **Forward Oblique Telescope 45°,** diameter 5 mm, length 29 cm, **autoclavable**, fiber optic light transmission incorporated, color code: black

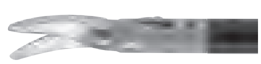
Adaptor for Cleaning, for use with Endoscopic Vein Retractor, FREIBURG Model 49205 FB and BISLERI Endoscopic Artery Retractor 49205 FC

49201 VR **Artery Dissector,** blunt, distal end **curved to right,** size 3 mm, working length 41 cm

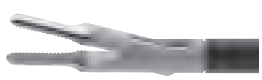
49201 VL **Artery Dissector,** blunt, distal end **curved to left,** size 3 mm, working length 41 cm

Dissecting and Ligating Instruments





38410 MW **RoBi® METZENBAUM Scissors Insert,**
CLERMONT-FERRAND Model, curved jaws, thinner scissor blades, double-action jaws, size 5 mm, length 43 cm



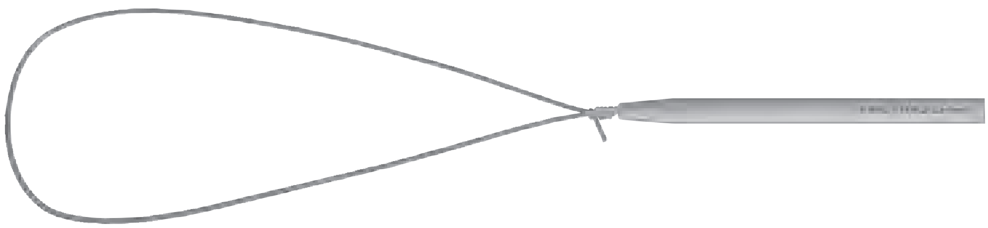
38410 CS **RoBi® Forceps Insert,**
CLERMONT-FERRAND Model, small jaws, for fine dissection and grasping, single-action jaws, size 5 mm, length 43 cm

RoBi® stands for “rotating bipolar instruments” and describes an innovative and compatible range of instruments that are distinguished by the following features:

- Jaws with robust hinge for optimized bipolar grasping
- Fully rotational 360° shaft
- Top-mounted 45° high frequency connector pin leads the cabel away from the operative field
- Can be completely disassembled into separate components:
  - Handle
  - Outer sheath
  - Working insert
- Cleaning port
- Autoclavable

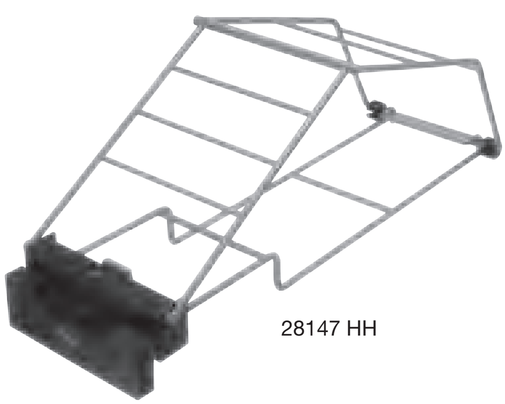
For further information please refer to our catalog LAPAROSCOPY.

Dissecting and Ligating Instruments



26172 AE **Endoloop Ligature** with ROEDER knot for bleeding stumps, disposable, with absorbable synthetic thread, sterile, packed, 12 pcs, USP 0

Additional Surgical Instrumentation



28147 HH

28147 HH GILBERT **Hand Holder,** for the fixation of the hand during carpal ligament release

Additional Surgical Instrumentation

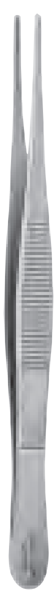
220211

208000

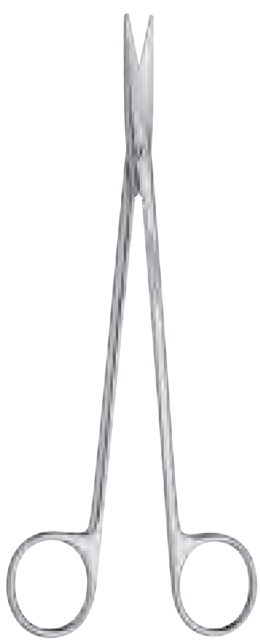
220211 PLESTER **Retractor,**
2x 2 teeth, length 11 cm

208000 **Surgical Handle,**
Fig. 3, length 12.5 cm,
for Blades 208010 – 19, 208210 – 19

208010 **Blade,**
Fig. 10, non-sterile, package of 100



530416



729071

530416 “ATRAUMA” **Atraumatic Tissue Forceps,**
length 16 cm

792071 TOENNIS **Dissecting Scissors,**
fine model, straight, blunt/blunt,
length 18 cm

KARL STORZ TELE PACK®

Special features:

The KARL STORZ TELE PACK™ consists of

- **Camera Control Unit**
- **Cold Light Fountain**
- **Documentation Module: storage capacity of up to 900 images**
- **Video monitor**
- **Keyboard for entering patient data**
- **Camera head**

20 0430 01-020 **TELE PACK™**, endoscopic video unit for use with all analog 1-Chip Camera Heads and KARL STORZ video endoscopes, incl. 24W Hi-Lux light source, integrated keyboard with US-english character set, integrated Image Processing Module, fix mounted folding 12“ LCD screen and PCMCIA memory module.
Color system **PAL**,
power supply: 100 – 240 VAC, 50/60 Hz or 12 VDC,
consisting of:

20 0430 20-020	**TELE PACK™ Control Unit**
20 2120 30	**TELECAM® 1-Chip Camera Head** with Parfocal-Zoom Lens, focal length f = 25 – 50 mm
400 A	**Mains Cord**
20 0410 32	**PCMCIA Memory Card**, 64 MB
536 MK	**BNC-Connecting Cable**, length 180 cm
547 S	**S-Video (Y/C) Connecting Cable**, length 180 cm

TELE PACK™ Set, Color Systems PAL/NTSC	**TELE PACK™ Control Unit** with Integrated Digital Image Processing Module	**Camera Head**		
		TELECAM® Par-focal Zoom Lens Camera Head	**TELECAM®** C-MOUNT Camera Head	**C-MOUNT Lens**, f = 30 mm
	20 0430 20-020 **PAL** **20** 0431 20-020 **NTSC**	**20** 2120 30 **PAL** **20** 2121 30 **NTSC**	**20** 2120 34 **PAL** **20** 2121 34 **NTSC**	**20** 2000 42
TELE PACK™ **20** 0430 01-020 **PAL** **20** 0431 01-020 **NTSC**	●	●	–	–
TELE PACK™ **20** 0430 02-020 **PAL** **20** 0431 02-020 **NTSC**	●	–	●	●

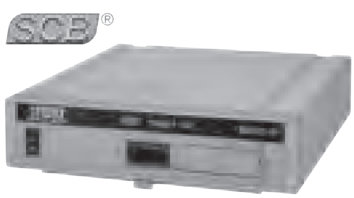
IMAGE 1 HUB™ HD

IMAGE 1 HUB™ HD Camera Control Unit

- **Genuine FULL HD (High Definition) is guaranteed by a maximum resolution and the consistent use of the native 16:9 aspect ratio throughout the entire image chain, from image capture, signal transmission to display**
- **HD-compatible endoscopic video camera systems must be equipped with three-CCD chips supporting the 16:9 input format and require that image capture is performed at a resolution of 1920 x 1080 pixels**

The benefits of FULL HD (High Definition) for medical applications are:

- **6 times higher input resolution of the camera delivers more detail and depth of field**
- **Using 16:9 format during image acquisition enlarges the field of view**
- **The 16:9/16:10 format of the widescreen monitor supports ergonomic viewing**
- **Enhanced color brilliance for optimal diagnosis**
- **Progressive scan technology provides a steady, flicker-free display and helps eliminate eyestrain and fatigue**



22 2010 11U102

22 2010 11U102 **IMAGE 1 HUB™ HD Camera Control Unit SCB, with SDI module**

for use with IMAGE 1™ HD and standard one- and three-chip camera heads, max. resolution 1920 x 1080 Pixels, with integrated **KARL STORZ-SCB®** and integrated digital Image Processing Module, color systems **PAL/NTSC,** power supply 100 – 240 VAC, 50/60 Hz

consisting of:

22 2010 20-102	**IMAGE 1 HUB™ HD Camera Control Unit SCB, with SDI module**
400 A	**Mains Cord**
400 B	**Mains Cord, US-version**
3 x 536 MK	**BNC/BNC Video Cable,** length 180 cm
547 S	**S-Video (Y/C) Connecting Cable,** length 180 cm
20 2032 70	**Special RGBS Connecting Cable,** length 180 cm
2x **20** 2210 70	**Connecting Cable,** for controlling peripheral units, length 180 cm
20 0400 89	**DVI-D Connecting Cable,** length 300 cm
20 0901 70	**SCB Connecting Cable,** length 100 cm
20 2002 31U	**Keyboard,** with US English character set

Specifications:

Signal-to-noise Ratio	AGC	Video Output	Input
IMAGE 1 HUB™ HD three-chip camera systems ≥ 60 dB	Microprocessor-controlled	- Composite signal to BNC socket - S-Video signal to 4-pin Mini-DIN socket (2x) - RGBS signal to D-Sub socket - SDI signal to BNC socket (only IMAGE 1 HUB™ HD with SDI module) (2x) - HD signal to DVI-D socket (2x)	Keyboard for title generator, 5-pin DIN socket

Control Output /Input	Dimensions w x h x d (mm)	Weight (kg)	Power supply	Certified to:
- KARL STORZ-SCB® at 6-pin Mini-DIN socket (2x) - 3.5 mm stereo jack plug (ACC 1, ACC 2), - Serial port at RJ-11	305 x 89 x 335	2.95	100-240 VAC, 50/60 Hz	IEC 601-1, 601-2-18, CSA 22.2 No. 601, UL 2601-1 and CE acc. to MDD, protection class 1/CF

IMAGE 1 HUB™ HD

HD Camera Head

22 2200 55-3

NEW **22** 2200 55-3 **50 Hz 60 Hz** **IMAGE 1™ H3-Z Three-Chip HD Camera Head**

max. resolution 1920 x 1080 pixels, progressive scan, soakable, gas-sterilizable, with integrated Parfocal Zoom Lens, focal length f = 15 – 31 mm (2x), 2 freely programmable camera head buttons

Specifications:

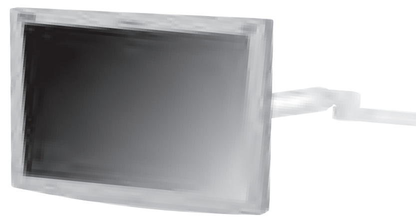
IMAGE 1™ HD Camera Heads	H3-Z
50 Hz/60 Hz	**22** 2200 55-3 (PAL/NTSC) (50/60 Hz)
Image Sensor	3x ⅓" CCD chip
Pixel Output Signal H x V	1920 x 1080
Dimensions	Diameter 32-44 mm, length 114 mm
Weight	246 g
Min. Sensitivity	F 1.4/1.17 Lux
Lens	Integrated Parfocal Zoom Lens, f = 15-31 mm
Grip Mechanism	Standard eyepiece adaptor
Cable	non-detachable
Cable Length	300 cm

Standard IMAGE 1™ camera heads may also be used with the IMAGE 1 HUB™ HD camera control unit.

IMAGE 1 HUB™ HD

HD Monitors

9524 N/NO
9526 N/NO



9524 NB/NBO
9526 NB/NBO

KARL STORZ HD Flat Screens	**24"**		**26"**	
Desktop with pedestal	9524 N	9524 NO	9526 N	9526 NO
Wall mounted with VESA 100-adaption	9524 NB	9524 NBO	9526 NB	9526 NBO
Inputs:				
SDI	●	●	●	●
HD-SDI	●	●	●	●
RGBS	●	●	●	●
S-Video	●	●	●	●
Composite	●	●	●	●
SOG	●	●	●	●
DVI-D	●	●	●	●
Fiber Optic	–	●	–	●
VGA	●	●	●	●

Specifications:

KARL STORZ HD Flat Screens	**24"**	**26"**
Desktop with pedestal	9524 N/NO	9526 N/NO
Wall mounted with VESA 100-adaption	9524 NB/NBO	9526 NB/NBO
Brightness	400 cd/m²	500 cd/m²
Max. Viewing Angle	178° vertical	178° vertical
Pixel Distance	0.270 mm	0.287 mm
Reaction Time	5-12 ms	5-12 ms
Contrast Ratio	1000:1	800:1
Adaption	100 mm VESA	100 mm VESA
Weight	7.3 kg	8.2 kg
Rated Power	115 Watt	115 Watt
Operating Conditions	0-40 °C	0-40 °C
Storage	-20-60 °C	-20-60 °C
Rel. Humidity	20-85%, non-condensing	20-85%, non-condensing
Dimensions in w x h x d	597 x 401 x 100 mm	627 x 427 x 100 mm
Power Supply	100-240 VAC	100-240 VAC
Certified to	EN 60601-1, protection class IPX1	EN 60601-1, protection class IPX1

IMAGE 1 HUB™ HD

HD and TFT Flat Screens

9524 NO **24" KARL STORZ HD Flat Screen**

Desktop with pedestal, color systems **PAL/NTSC,** max. screen resolution 1920 x 1200, image format 16:10, power supply 100 – 240 VAC, 50/60 Hz

consisting of:

9524 NBO **24" HD Flat Screen**
9419 NSF **Pedestal**

9524 NBO **24" KARL STORZ HD Flat Screen**

Wall mounted with VESA 100-adaption, color systems **PAL/NTSC,** max. screen resolution 1920 x 1200, image format 16:10, power supply 100 – 240 VAC, 50/60 Hz

consisting of:

9524 NGO **24" HD Flat Screen**
9523 PS **External 24VDC Power Supply**
400 A **Mains Cord**
Signal cables: S-Video, BNC, SXGA, DVI-D

9524 N **24" KARL STORZ HD Flat Screen**

Desktop with pedestal, color systems **PAL/NTSC,** max. screen resolution 1920 x 1200, image format 16:10, power supply 100 – 240 VAC, 50/60 Hz

consisting of:

9524 NB **24" HD Flat Screen**
9419 NSF **Pedestal**

9524 NB **24" KARL STORZ HD Flat Screen**

Wall mounted with VESA 100-adaption, color systems **PAL/NTSC,** max. screen resolution 1920 x 1200, image format 16:10, power supply 100 – 240 VAC, 50/60 Hz

consisting of:

9524 NG **24" HD Flat Screen**
9523 PS **External 24VDC Power Supply**
400 A **Mains Cord**
Signal cables: S-Video, BNC, SXGA, DVI-D

9526 NO **26" KARL STORZ HD Flat Screen**

Desktop with pedestal, color systems **PAL/NTSC,** max. screen resolution 1920 x 1200, image format 16:10, power supply 100 – 240 VAC, 50/60 Hz

consisting of:

9526 NBO **26" HD Flat Screen**
9526 SF **Pedestal**

9526 NBO **26" KARL STORZ HD Flat Screen**

Wall mounted with VESA 100-adaption, color systems **PAL/NTSC,** max. screen resolution 1920 x 1200, image format 16:10, power supply 100 – 240 VAC, 50/60 Hz

consisting of:

9526 NGO **26" HD Flat Screen**
9523 PS **External 24VDC Power Supply**
400 A **Mains Cord**
Signal cables: S-Video, BNC, SXGA, DVI-D

9526 N **26" KARL STORZ HD Flat Screen**

Desktop with pedestal, color systems **PAL/NTSC,** max. screen resolution 1920 x 1200, image format 16:10, power supply 100 – 240 VAC, 50/60 Hz

consisting of:

9526 NB **26" HD Flat Screen**
9526 SF **Pedestal**

9526 NB **26" KARL STORZ HD Flat Screen**

Wall mounted with VESA 100-adaption, color systems **PAL/NTSC,** max. screen resolution 1920 x 1200, image format 16:10, power supply 100 – 240 VAC, 50/60 Hz

consisting of:

9526 NG **26" HD Flat Screen**
9523 PS **External 24VDC Power Supply**
400 A **Mains Cord**
Signal cables: S-Video, BNC, SXGA, DVI-D

Cold Light Fountain XENON 300 ®

20 133101-1 **Cold Light Fountain XENON 300** ®
with built-in antifog air-pump, and integrated KARL STORZ Communication Bus System ®
power supply:
100 – 125 VAC/220 – 240 VAC, 50/60 Hz
including:

400 A	**Mains Cord**
610 AFT	**Silicone Tubing Set,** autoclavable, length 250 cm
20 0901 70	® **Connecting Cord,** length 100 cm

20 1330 27 **Spare Lamp Module XENON**
with heat sink, 300 watt, 15 volt

20 1330 28 **XENON Spare Lamp,** only,
300 watt, 15 volt

Fiber Optic Light Cable

495 NA **Fiber Optic Light Cable,**
with straight connector, diameter 3.5 mm,
length 230 cm

495 ND **Same,** length 300 cm

Electronic ENDOFLATOR®

26 4305 08-1 **Electronic ENDOFLATOR® Set** ®
operating voltage: 100-240 VAC, 50/60 Hz
consisting of:

26 430520-1	**Electronic Endoflator,** with integrated SCB ® Module
400 A	**Mains Cord**
20 400143	**Silicone tube,** sterilizable
20 400030	**Universal wrench**
20 090170	**SCB Connecting cable**
	Sterile filter, Package of 10 piece

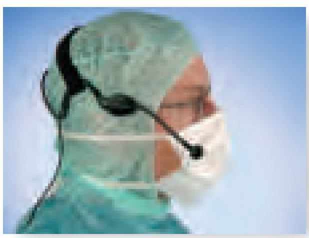
Subject to the customer's application-specific requirements additional accessories are available on request.

Please note: For fully utilizing maximum insufflation capacity of the **Electronic THERMOFLATOR® SCB®** and the **Electronic ENDOFLATOR®** the use of **KARL STORZ HiCap® Trocars** is recommended. For additional information see catalog LAPAROSCOPY.

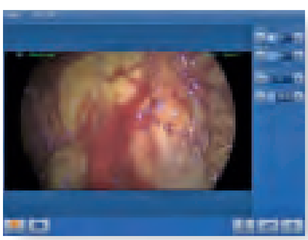
Data Management and Documentation

KARL STORZ AIDA® compact NEO (HD/SD)
Brilliance in documentation continues!

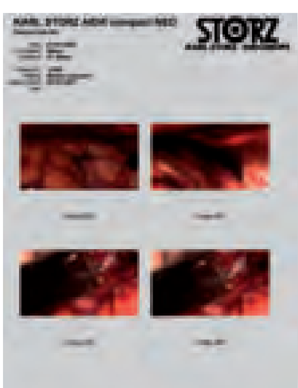
AIDA compact NEO from KARL STORZ combines all the required functions for integrated and precise documentation of endoscopic procedures and open surgeries in a single system.



AIDA compact NEO:
Voice control



AIDA compact NEO:
Review screen



***AIDA compact NEO:** Automatic creation of standard reports*

AIDA compact NEO:
Efficient archiving

Data Acquisition

Still images, video sequences and audio comments can be recorded easily during an examination or intervention on command by either pressing the on screen button, voice control, foot switch or pressing the camera head button. All captured images will be displayed on the right hand side as a "thumbnail" preview to ensure the still image has been generated.

The patient data can be entered by the on-screen keyboard or by a standard keyboard.

Flexible post editing and data storage

Captured still images or video files can be previewed before final storage or can be edited and deleted easily in the edit screen.

Reliable storage of data

- Digital saving of all image, video and audio fi les on DVD, CD-ROM, USB stick, external/internal hard-drive or to the central hospital storage possibilities over DICOM/HL7
- Buffering ensures data backup if saving is temporarily not possible
- Continuous availability of created image, video and sound material for procedure documentation and for research and teaching purposes.

Efficient data archiving

After a procedure has been completed, KARL STORZ AIDA® compact HD/SD saves all captured data efficiently on DVD, CD-ROM, USB stick, external hard-drive, internal hard-drive and/or the respective network on the FTP server. Furthermore the possibility exists to store the data directly on the PACS respective HIS server, over the interface package AIDA communication HL7/DICOM.
Data that could not be archived successfully remains in a special buffered procedure until it is finally saved. A two-line report header and a logo can be used by the user to meet his or her needs.

Multisession and Multipatient

Efficient data archiving is assured as several treatments can be saved on a DVD, CD-ROM or a USB stick.

Features and Benefits:

- Digital storage of still images with a resolution of 1920 x 1080 pixels, video sequences in 720p and audio fi les with AIDA compact NEO HD
- Optional interface package DICOM/HL7
- Sterile, ergonomic operation via touch screen, voice control, camera head buttons and/or foot switches
- Auto detection of the connected camera system on HD-SDI/SD-SDI input
- Efficient archiving on DVD, CD-ROM or USB stick, multi-session and multi-patient
- Network saving
- Automatic generation of standard reports
- Approved use of computers and monitors in the OR environment as per EN 60601-1
- Compatibility with the KARL STORZ Communication Bus (SCB) and with the KARL STORZ OR1™ AV NEO
- KARL STORZ AIDA® compact NEO HD/SD is an attractive, digital alternative to video printers, video recorders and dictaphones.

20 0409 10 **KARL STORZ AIDA® compact NEO SD**
Communication, documentation system for digital storage of still images, video sequences and audio files, power supply 115/230 VAC, 50/60 Hz

20 0409 11 **KARL STORZ AIDA® compact NEO HD**
Communication, documentation system for digital storage of still images, video sequences and audio files, power supply 115/230 VAC, 50/60 Hz

20 0406 10 **KARL STORZ AIDA® compact NEO SD,**
documentation system for digital storage of still images, video sequences and audio files, power supply 115/230 VAC, 50/60 Hz

20 0406 11 **KARL STORZ AIDA® compact NEO HD,**
documentation system for digital storage of still images, video sequences and audio files, power supply 115/230 VAC, 50/60 Hz

Specifications:

Video Systems	- PAL - NTSC
Signal Inputs	- S-Video (Y/C) - Composite - RGBS - SDI - HD-SDI - DVI
Image Formats	- JPG - BMP

Video Formats	- MPEG2
Audio Formats	- WAV
Storage Media	- DVD+R - DVD+RW - DVD-R - DVD-RW - CD-R - CD-RW - USB stick

AUTOCON® II 400 SCB®

20 5352 01-11x **AUTOCON® II 400** SCB®
consisting of:

20 5352 20-11x	**AUTOCON® II 400** with **KARL STORZ** SCB® power supply 230 VAC, 50/60 Hz
400 A	**Mains Cord**
20 090170	SCB® **Connecting Cable,** length 100 cm

20 5352 01-115 **AUTOCON® II 400** SCB® **High-End,**
power supply 230 VAC, 50/60 Hz,
HF connecting sockets:
2x bipolar standard, bipolar multifunction, unipolar 3-pin and Erbe, neutral electrode 6.3 mm jack, system requirements:
SCB R-UI Software Release 2009001-26,
consisting of:

20 5352 20-115	**AUTOCON® II 400,** with **KARL STORZ** SCB®
400 A	**Mains Cord**
20 0901 70	SCB® **Connecting Cable,** length 100 cm

Equipment Cart

29005 LAP

29005 LAP **Equipment Cart,**
rides on 4 antistatic dual wheels,
2 equipped with locking brakes,
3 fixed shelfs, one with handles, main switch at vertical beam, integrated cable conduits in vertical beams, drawer unit with lock,
3 horizontal cable conduits, one with cable winding, two with 4-times electrical sub-distributer,
1 set of non-sliding stands for units,
1 TFT-Monitor arm (VESA 75/100),
1 camera holder, 8 power cords (50 cm),
2 power cords (2 m), 2 equipment rails,
1 CO_2-bottle holder, max. diameter 155 mm,
Isolation transformer 230 VAC (50/60 Hz) with 8 sockets and earth potential and earth leakage monitor (2000 VA),
Dimensions:
Videocart 730 x 1470 x 716 mm (w x h x d),
shelf: 630 x 480 mm (w x d),
caster diameter: 150 mm

29005 SZ **TFT-Monitor arm,** height and side adjustable,
can be positioned at left/right side,
rotatable and inclinable,
turning radius approx. 180°,
load capacity max. 14 kg,
swivel length 600 mm, VESA 75/100-adaption,
for mobile videocart,
model 29005LAP/GU and 29003NE/NA

Notes:

Notes:

WITH COMPLIMENTS OF
KARL STORZ — ENDOSKOPE