A Novel Port for Single Portal Laparoscopic Surgery
S-Portal – Single Portal Laparoscopic Surgery

Single Portal (S-PORTAL) Laparoscopic Surgery is the natural extension of traditional multi-incision laparoscopic surgery in the quest for reduction of surgical trauma and residual scarring to the patient. It also represents an alternative approach to Natural Orifice Translumenal Endoscopic Surgery (NOTES) over which it has certain important and practical advantages:

- Surgeons are more familiar with the technique as it differs little for the traditional multi-port laparoscopic surgery
- The technologies required for the S-PORTAL approach including rigid telescopes and instruments with minor modification are available
- The S-PORTAL approach enables execution of operations in the various specialties: general surgery, gynecology and urology
- The S-PORTAL approach enables execution of major intra-abdominal operations, e.g., liver resections, colonic resections, splenectomies, pancreatic resections, nephrectomies, hysterectomies etc.
The idea of S-PORTAL through a single dedicated port is not new since it was first introduced and practiced by the late Austrian endoscopic surgeon R. Wittmoser in the 1970s for operative thoracoscopic interventions on the autonomic nervous system. Unfortunately, this development has been marred by a lack of an agreed scientific nomenclature with a resulting profusion of terms/acronyms, e.g., Laparo-Endoscopic Single Site (LESS) Surgery, One Port Umbilical Surgery (OPUS), Natural Orifice Trans-Umbilical Surgery (NOTUS), trans-umbilical E-NOTES etc., none of which are semantically accurate.

Despite potential advantages, the S-Portal technique imposes major ergonomic restrictions and limitations such that the level of difficulty of executing laparoscopic procedures through this approach is much higher and the surgeon needs to be experienced in traditional multi-port laparoscopic surgery.

The ENDOCON® S-Portal system (Fig. 1) was developed as a holistic solution (port-instruments-retraction system) for S-Portal to overcome these problems and to facilitate the execution of operations by this approach.

The use of proximally deviating curved coaxial instruments increases the operative space between the surgeon’s hands during SPLS and facilitates the performance of various surgical procedures, e.g., cholecystectomy, colectomy, nephrectomy etc. (Fig. 2).
Materials

Although standard 10 mm 30° scopes can be used, the recommended extra-long 5 mm telescope (Fig. 3) or the ENDOCAMELEON (Fig. 4) are reducing the risk of instrument collisions and creates the perfect conditions for an optimal image quality and ergonomic working conditions.

The associated 90° light cable connector helps to reduce clashing between the operating instruments and the light cable.

Whereas standard laparoscopic units might be used for Single Portal Surgery we recommend the use of an Image 1 HD system due to the brilliant image quality and the wide screen picture which is extremely helpful for Single Portal Surgery.

Fig 3: Extra-long 5 mm 30° endoscope

Fig 4: The ENDOCAMELEON (variable direction of view, 0° – 120°)

Fig. 5: S-Portal equipment mounted on a videocart
The DUNDEE ENDOCONE®

All the available S-PORTAL access port devices are disposable being constructed from flaccid polymers. The DUNDEE Group developed the only reusable operating system, the ENDOCONE® system, manufactured from stainless steel with a design that facilitates both insertion and retention within the anterior abdominal wall. Additionally the system includes coaxially curved instruments designed to facilitate triangulation, provide traction and counter-traction during dissection of tissue planes and maximize their range of motion within the operating space.

The ENDOCONE® was designed to enable instrument triangulation, albeit reduced from the ideal 60° to 30° because of the imposed restricted space imposed by the access port. To achieve this, the shape of the port is complex and consists of a proximal section (cone) leading to a short cylindrical section for negotiation through the abdominal wall and having an outer diameter of 35 mm. This cylindrical section has a protruding rim feature of sufficient width which aids insertion of the ENDOCONE® (by a clockwise movement) and ensures secure retention within the abdominal wall (Figure 6).

Figure 6: DUNDEE ENDOCONE® showing protruding rim feature which aids insertion and retention of the device.
The actual insertion is accomplished by placing the leading edge of the thread through the umbilical wound and turning through one clockwise revolution, after which the complete lip will have negotiated the full thickness of the abdominal wall into the peritoneal cavity. The proximal conical section of the ENDOCONE® is capped with a separate seal cap (bulkhead) which houses 8 valved instrument seals (Fig. 7a): two along large midline (for instruments up to 15 mm in diameter) and 6 (three on either side) for instruments up to 5 mm in diameter.

The seal cap is removed by an anti-clockwise movement from the ENDOCONE® for extraction of specimen.
The CUSCHIERI Coaxial Deviating Instruments

The CUSCHIERI coaxial deviating instruments (Fig.8, 9) are specifically designed to be used during S-Portal with the ENDOCONE® port.

The ENDOCONE® S-PORTAL Operating system comes with a basis set of curved instruments. In addition a supplemental set of instruments is available for execution of major operations with the ENDOCONE® S-PORTAL approach.

Fig 8: The CUSCHIERI coaxial deviating instruments
These are based on the Cuschieri’s coaxial curved instruments but have been specifically modified for use during S-PORTAL with the ENDOCON® port. Their main characteristics are:

- Straight ergonomic axial handle with integrated mono-polar energy connection that allows ergonomic manipulation of the instruments following insertion, thus reducing surgeon’s discomfort
- Distal and proximal curvatures: the former enhances internal manipulations and the latter increases the operative space between the surgeon’s hands
- The curve design allows the surgeon to achieve acceptable intracorporeal triangulation and a comfortable, ergonomic position without intrusion into the operating work space of the camera person.

By virtue of the cut out by the leading flange of the screw, the surgeon can increase the excursion of the operating and assisting instruments by rotation of the ENDOCON® so that one instrument can be accommodated in the notch during manipulation (Fig. 9).

Fig. 9: Illustration of how the surgeon can increase the distance between two operating instruments by rotation of ENDOCON® so that one instrument is accommodated in notch. Another way is to use a crossed instrument configuration with the instruments crossing each other inside the port.
Insertion of the ENDOCONE®

The pneumoperitoneum can be induced by either the closed (Veress needle) or open technique according to surgeon’s preferences. A 5 or 10 mm port is inserted through a vertical mid-line incision at the upper margin of the umbilicus and the peritoneal cavity is explored to evaluate the feasibility of S-Portal approach.

If this is the case, the incision is enlarged up to 30 – 35 mm along the midline through the umbilicus into the peritoneal cavity. We recommend the insertion of a plastic wound protector through the incision as this improves the stability of the ENDOCONE® and provides wound protection during the extraction of large specimens (Fig. 10).

Fig. 10: Introduction of a wound protector through a 30 mm incision
The ENDOCONER® can now be inserted using a “corkscrew”-clockwise movement (Fig. 11).

Afterwards, the abdomen is insufflated through the dedicated stopcock on the port and the instruments are inserted. It is recommended that the stopcock value should be at the 9 o’clock position at the start of the operation. The visual position of the stopcock also helps to identify the intraabdominal position of the leading flanche.
Insertion of Telescopes and Instruments

The ENDOCONE® allows the insertion of either a 5 or 10 mm laparoscope together with up to 3 working straight or coaxial curved instruments simultaneously; furthermore the two central (upper and lower) 10–13 mm valves also allow the insertion of endoscopic surgical staplers (Fig. 12).

Fig. 12: Insertion of instruments through the ENDOCONE®
The introduction of curved instruments is facilitated by a gentle rotational clockwise movement for negotiating passage through ENDOCONE®. The curved instruments should slide into the abdominal cavity with this technique. At no point must the curved instruments be forced through when passage is prevented by impingement on the walls of the ENDOCONE® as such force will damage the insulation of the instruments. All the surgeon has to do in this situation is to rotate the instrument clockwise or anti-clockwise during gentle pushing, when the instrument will glide through the ENDOCONE® without sustaining any damage.
Use of Coaxial Deviating Instruments

The instrument sets for ENDOCONE® S-Portal are available as a basic set but can be customized by a supplementary instrument list in accordance with the surgeon’s personal preferences and needs. Nevertheless, the use of coaxial proximally deviating instruments allows the surgeon to achieve acceptable triangulation which is not possible with other devices for single port surgery, especially when straight instruments are used. Indeed, according to the specific procedures and situations as well as surgeon’s preferences, a combination of curved and straight shaft may be the correct choice.

Fig. 14: Told’s fascia blunt dissection during S-Portal right hemicolecctomy using two coaxial curved forceps. Note how the curvature of the shafts enables good triangulation and optimal viewing.

The curvature can also be used to arch over foreground structures to reach the desired anatomical structure, to lift and tent tissues, obtain triangulation and the back of the curvature for atraumatic blunt dissection of tissue planes (Fig. 14 – 16).
Fig. 15: Mobilization of the right colon using curved instruments

Fig. 16: Dissection round the renal artery (a) and vein (b) during single port right nephrectomy
End of the Procedure and Removal of the ENDOCONE®

Once the procedure is completed the cap valve of the ENDOCONE® is unscrewed and the specimen (if small) extracted, using the cone itself as wound protector (Fig. 17). However if the specimen is bulky, it is best to remove the ENDOCONE® by an anti-clockwise rotation leaving the wound protector in-situ. In this case, the ENDOCONE® is re-inserted and abdomen insufflated to enable final check of the operative field.

Fig. 17: Removal of the cap and extraction of the specimen

At the end of the procedure the peritoneal, musculofascial and skin layers are closed, using non-absorbable sutures for the fascial layer. Because of the natural shape of the umbilical pit, the cosmetic results are excellent (Fig. 18)

Fig. 18: Final cosmetic results after S-Portal in case of right hemicolecotomy (Fig. 18 a,b) and Splenectomy (Fig. 18c)
Conclusion

Single Portal Laparoscopic Surgery represents an additional challenge to surgeons and requires dedicated technology which reduces the risk of instruments clashing and restores the ergonomic working conditions of standard multi-port laparoscopic surgery. The ENDOCONE® system with its dedicated set of coaxially curved instruments greatly facilitates the safe execution of operations by the S-Portal approach.

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Ospedale di Circolo di Varese  
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References

1. HANNA GB, SHIMI S, CUSCHIERI A:  
   Influence of direction of view, target-to-endoscope distance and manipulation angle on endoscopic knot tying.  

2. CUSCHIERI A, SHIMI S, BANTING G, VANDER-VELPEN G, DUNKLEY P:  
   Coaxial curved instruments for minimal access surgery.  
Instrumentation

HOPKINS Telescope

26048 BA  HOPKINS® Forward-Oblique Telescope 30°, diameter 5.5 mm, length 50 cm, autoclavable

495 EW  Light Adapter, diameter 4.8 mm, 90° angled, free rotatable, to connect with standard scopes

Wound Protector-Retractor (e.g. Alexis/Applied Medical)

Single Port Access System

23010 PA  ENDOCONE® Single Portal Surgery Access System
(size 34 mm)
consisting of:
23010 P  Port, size 34 mm
23010 SA  Gasket, with 1 x 10 mm,
           1 x 10-15 mm and 6 x 3-5 mm ports
23001 DB  Reducer, 13/ 5 mm and 11/ 5 mm
23005 ID  LUER-Lock-Connector
           with stopcock for insufflation and desufflation
Instruments

Set of standard straight 5 mm KARL STORZ Instruments (with insulated handles with connector pin for unipolar coagulation: No. 33127, including:

- **34327 MS** CLICK\textsuperscript{line} METZENBAUM Scissors, rotating, curved, length of blades 12 mm, size 5 mm, length 36 cm, double action jaws

- **33327 ON** CLICK\textsuperscript{line} Grasping Forceps, rotating, size 5 mm, length 36 cm, atraumatic, fenestrated, single action jaws

- **33327 CC** CLICK\textsuperscript{line} CROCE-OLMI Grasping Forceps, rotating, size 5 mm, length 36 cm, atraumatic, fenestrated, curved, single action jaws

- **33327 A** CLICK\textsuperscript{line} BABCOCK Grasping Forceps, rotating, size 5 mm, length 36 cm, double action jaws

- **33327 C** CLICK\textsuperscript{line} Bowel Grasper, rotating, size 5 mm, length 36 cm, fenestrated, double action jaws

- **33327 ML** CLICK\textsuperscript{line} KELLY Dissecting and Grasping Forceps, long, rotating, size 5 mm, length 36 cm, double action jaws

- **33327 R** CLICK\textsuperscript{line} Dissecting and Grasping Forceps, rotating, size 5 mm, length 36 cm, right angled, double action jaws

- **26775 UF** Coagulating and Dissecting Electrode, L-shaped, size 5 mm, working length 36 cm
Set of co-axial 5 mm KARL STORZ Instruments (with insulated handles with connector pin for unipolar coagulation No. 33127 P, including:

- 23262 MSA CLICKliné METZENBAUM Scissor, curved, length of blades 12 mm, double action jaws, sheath bending according to CUSCHIERI, size 5 mm, working length 36 cm
- 23162 ONA CLICKliné Grasping Forceps, fenestrated, with especially fine atraumatic serration, single action jaws, sheath bending according to CUSCHIERI, size 5 mm, working length 36 cm
- 23162 DFA CLICKliné Dissecting and Grasping Forceps, atraumatic, double action jaws, sheath bending according to CUSCHIERI, size 5 mm, working length 36 cm
- 23162 CCA CLICKliné CROCE-OLMI Grasping Forceps, atraumatic, fenestrated, curved, single action jaws, sheath bending according to CUSCHIERI, size 5 mm, working length 36 cm
- 23162 AA CLICKliné BABCOCK Grasping Forceps, atraumatic, fenestrated, double action jaws, sheath bending according to CUSCHIERI, size 5 mm, working length 36 cm
- 23162 MLA CLICKliné KELLY Dissecting and Grasping Forceps, long, double action jaws, sheath bending according to CUSCHIERI, size 5 mm, working length 36 cm
- 23162 RA CLICKliné Dissecting and Grasping Forceps, right angled, double action jaws, sheath bending according to CUSCHIERI, size 5 mm, working length 36 cm
- 23870 UFA Coagulating and Dissecting Electrode, L-shaped tip, sheath bending according to CUSCHIERI, size 5 mm, working length 36 cm
23262 MSI  **CLICKline METZENBAUM Scissor**, curved, length of blades 12 mm, double action jaws, sheath bending according to CUSCHIERI, size 5 mm, working length 43 cm

23162 DFI  **CLICKline Dissecting and Grasping Forceps**, atraumatic, double action jaws, sheath bending according to CUSCHIERI, size 5 mm, working length 43 cm

23162 MLI  **CLICKline KELLY Dissecting and Grasping Forceps**, long, double action jaws, sheath bending according to CUSCHIERI, size 5 mm, working length 43 cm

23162 RI  **CLICKline Dissecting and Grasping Forceps**, right angled, double action jaws, sheath bending according to CUSCHIERI, size 5 mm, working length 43 cm

23162 BAI  **CLICKline BABCOCK Grasping Forceps**, atraumatic, jaws with multiple teeth, single action jaws, sheath bending according to CUSCHIERI, size 5 mm, working length 43 cm

23870 UFI  **Coagulating and Dissecting Electrode**, L-shaped tip, sheath bending according to CUSCHIERI, size 5 mm, working length 43 cm
KARL STORZ AIDA® compact NEO (HD/SD)
Brilliance in documentation continues!

Features and Benefits
- Digital storage of still images with a resolution of 1920 x 1080 pixels, video sequences in 720p and audio files 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.

Specifications:

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**IMAGE 1™ HD**

**HD hub Camera Control Unit**

- Maximum resolution and the consistent use of the 16:9 aspect ratio guarantee FULL HD

- Endoscopic camera systems have to be equipped with three-CCD chips that support the 16:9 input format as well as capturing images with a resolution of 1920 x 1080 pixels

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

- Up to 6 times* higher input resolution of the camera delivers more detail and depth of focus

- Using 16:9 format during image acquisition enlarges the field of vision and supports ergonomic viewing

- The brilliance of color enables optimal diagnosis

- Lateral view is enhanced by 32% when the endoscope is withdrawn slightly, providing the same image enhancement as a standard system. Any vertical information loss is restored and the lens remains clean

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### Specifications:

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<th>Signal-to-noise ratio</th>
<th>AGC</th>
<th>Video output</th>
<th>Input</th>
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| **IMAGE 1 HUB™ HD** Three-chip camera systems ≥ 60 dB | Micro-processor-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))  
- HDTV signal to DVI-D socket (2x) | Keyboard for title generator, 5-pin DIN socket |

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<tr>
<th>Control output / input</th>
<th>Dimensions w x h x d (mm)</th>
<th>Weight (kg)</th>
<th>Power supply</th>
<th>Certified to:</th>
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| - 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  
- USB port (only IMAGE 1 HUB™ HD with ICM) (2x) | 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 |

**SDI – Serial Digital Interface:** optimized to display medical images on Flat Screens, Routing with OR1™ and digital recording with AIDA-DVD-M

**ICM:** USB-connector for recording video streams and stills on USB storage media or for connection of USB printers for direct printing of the recorded stills
**IMAGE 1™ HD**

**HD Camera Head**

**222200 55-3**

- **max. resolution 1920 x 1080 pixels, progressive scan, soakable, gas and plasmasterilizable, with integrated Parfocal Zoom Lens, focal length f = 15 – 31 mm (2x), 2 freely programmable camera head buttons, for use with color system PAL/NTSC**

**Specifications:**

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<td>Cable</td>
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**KARL STORZ**

**HD Flat Screens**

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**The following accessories are included:**

- 400 A **Mains Cord**
- 9523 PS **External 24VDC Power Supply**
- 9419 SF **Pedestal**