SIALENDOSCOPY
The Endoscopic Approach to Salivary Gland Ductal Pathologies

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Preface

Sialendoscopy is a prime example of the shifting paradigms in surgery which have irrevocably changed the landscape of our specialty. Other minimally invasive procedures such as: transoral CO₂ laser surgery of the larynx, endoscopic-assisted thyroid surgery, functional endoscopic sinus surgery, and robotic surgery have been made possible through the close co-operation between surgeons and industry. These remarkable advances in our specialty, driven by the development of innovative technology, have made minimally-invasive surgery readily available for the benefit of our patients.

The development of endoscopes, tiny enough to be inserted into salivary ducts, was pioneered by Karl Storz (1911–1996). Professor Francis Marchal, in close collaboration with KARL STORZ, developed a series of miniaturized instruments which can be inserted through the endoscope to accomplish a variety of important tasks, such as pulverizing calculi with a laser, retrieving calculi with a forceps or a basket, biopsy of lesions, removing granulation tissue, dilating stenotic ducts, and irrigating ducts clogged with mucous such as those that develop secondary to treatment.

The new paradigm in the management of sialadenitis and calculi has in large measure eliminated the need to remove salivary ductal stones or non-malignant salivary glands by open surgery. This new approach has modified our thinking about these problems and has resolved many of the complications inherent in the open approaches.

Successful application of sialendoscopy, as with all minimally invasive procedures, requires a well-organized training program. Surgeons from around the world have attended the many courses that Professor Marchal has organized in Geneva and many other countries around the world.

In these courses, didactic material is supplemented by a robust “hands-on” animal laboratory experience as well as observation of live surgery dispensed in 3D in the conference room. Such an intensive educational experience is necessary to assure a firm foundation for the surgeon wishing to perform sialendoscopy.

Research is another important element in this area of our specialty. The European Salivary Gland Society (ESGS) was formed to promote research in this area, and includes members from: Basic Sciences, Dental and Oral and Maxillofacial Surgery, Otolaryngology – Head and Neck Surgery, Pathology and Radiology all of whom have a particular interest in salivary gland disorders. The ESGS organizes courses and conferences, promotes teaching and designs consensus protocols for European Standards through multi-disciplinary efforts.

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1.0 Introduction

1.1 History

Salivary gland diseases were first described in ancient times by Hippocrates,29 460–370 BC. More than 1000 years later, Abulcasis,75 reported on a pioneering work and instrumentation for what later became known as otolaryngology, ophthalmology and neurosurgery. He described at that time the ranula and its treatment.

Further descriptions of salivary gland diseases focused on parotid tumors, although the humoral theory was developed already by Paulus Aeginata64 and by Ambroise Paré,63 a French surgeon of the 16th century.

The first description of the ductal system of a salivary gland appeared in the 17th century, with the pioneering work of Thomas Wharton, who published a monograph entitled, ‘Adenographia sive glandularum totius corporis descriptio’82 in 1659. Ever since, the duct has borne his name.

The anatomy of the parotid ductal system was discovered shortly thereafter in 1660 during an animal dissection by Nicolaus Stenonius. Van Horne of Leyden demonstrated the anatomy in public and named it after Stenon. Stenon’s main work, ‘De glandulis oris et novis earundem vasis. Observationes anatomicae in iclyta Lugdunensi Academia sub praesidio DD Johannis van Horne’76 was published in 1661, and the parotid duct also bears his name.

Casparus Bartholinus (1655–1738), professor of anatomy, first described the sublingual ductal system, which now bears his name.26

1.1.1 History of Endoscopy

The first endoscope, of a kind, was developed in 1806 by Philippe Bozzini but not introduced in a human until 1853. In 1911, a procedure termed ‘Laparothorakskopie’ was introduced. Its use in the abdomen was extended by Heinz Kalk in 1930. In 1953, Karl Storz (1911–1996) developed and produced the first endoscope. In January 1957, Basil Hirschowitz (*1925) invented the glass fiber for use in flexible and rigid scopes, and in this way pioneered flexible endoscopy. The first laparoscopic cholecystectomy was performed in 1984 and further generalized in the 90’s.

1.1.2 History of Sialendoscopy

The first attempts to perform salivary endoscopy in the early 1990’s by Katz25 and Gundlach25 were not followed by wider clinical applications, either on account of poor vision or due to lack of specific instrumentation. The first blind retrievals of salivary stones were performed by radiologists in submandibular (1990) and parotid (1994) glands. In 1994, Nahlili et al.61 reported on endoscope-assisted retrieval of stones using a hazel-type of scope. In the following period, dedicated instruments were simultaneously developed in two different centers (Marchal, Switzerland – Nahlili, Israel). Once feasibility of the technique was demonstrated,48, 59 and particularly after start-up of regular training programs at the European Sialendoscopy Training Center in 2002, physicians have been trained using the new method and members of ESTC began to adopt the technique, which is reflected in an abundance of literature.*
1.2 Disease Process of Sialadenitis

Salivary gland pathology can be divided into two categories: tumoral and ductal diseases. The latter is the predominant group comprising mainly stones, strictures, and polyps whereas salivary gland tumors are more rarely seen. The etiology of sialadenitis in case of stones remains unclear and various hypothesis have been described. Ductal strictures can be encountered mainly in juvenile recurrent parotitis, in Sjögren syndrome, or, in the absence of an underlying disease process, their cause remains unclear. Strictures can be localized, thin or thick or more generalized in the ductal tree.

1.3 History and Physical Examination of Sialadenitis

Stones and strictures do obstruct the salivary duct and patients present with recurrent glandular swellings during meals, which can remain transitory or be complicated by bacterial infections. In this case, patients occasionally have fever, complain of inappropriate taste in the mouth due to purulent discharge, often accompanied by continuous painful swelling of the gland. On physical examination, the gland is swollen and massage of the gland is painful and expresses thick saliva or pus through the papilla (Figs. 2, 3). Manual palpation of the submandibular gland is also painful and sometimes a stone can be palpated intraorally or, more rarely, in the parotid gland by bimanual or external palpation.

* Figs. 4a, b by courtesy of Prof Willy Lehmann, ORL Department, University of Geneva, Switzerland.
2.0 Standard Diagnostic Approaches

The classical investigation methods of salivary glands are radiography, including X-rays, ultrasound, CT scan and sialography, which up to now is considered as the gold standard for evaluation of the ductal system. Ultrasound remains an excellent primary diagnostic method for the detection of salivary stones, however calculi with a size of less than 3 mm cannot be visualized. Another non-invasive diagnostic option is nuclear magnetic resonance tomography, MR-sialography, which provides scans of the salivary ducts by opacification of the natural salivary pathways without the need for administration of contrast medium and without exerting the patient to ionizing irradiation.

As shown in the figures below, these procedures aim to visualize the ductal system for the diagnosis of obstructive pathologies, typically stones or other rarer diseases. New diagnostic options like 3D-sialography using the technique of cone beam CT with flat panel (CPCT) have been described recently, opening new vistas that certainly are of interest to the field.
3.0 Diagnostic Sialendoscopy

3.1 LSD Classification System

In recent years, sialendoscopy has gained in popularity, which is reflected by the increase of related publications (Table 1). The only existing classification was based on sialographic findings and did not include stones or dilatations. Therefore, the author and team felt the need to develop a classification of pathologies involving the salivary duct system. The acronym ‘LSD’ stands for ‘lithiasis’ (L), ‘stenosis’ (S) and ‘dilatation’ (D). The LSD classification system was approved by all members of the ESTC and further acknowledged by other sialendoscopists.12,58 * The classification system is based on endoscopic findings, which is why it can be applied for assessment purposes only after diagnostic sialendoscopy (see Tables 2–4).

* (Consensus Meeting on Salivary Gland Diseases, Paris, 2007)
3.2 Normal Anatomy of the Salivary Duct System

3.2.1 The Ductal System

The new endoscopic techniques described\(^4\) and the specific instrument set designed and developed by the author in close collaboration with KARL STORZ allow almost complete exploration of the ductal system of both the submandibular and parotid glands. The main duct of both glands, as well as secondary, tertiary, quaternary and even quinary branches, can be explored in a vast majority of cases. Rare limitations include convoluted sections that are impassable with a rigid endoscope. Mobility of the endoscope is also limited at the distal end of the gland due to the mouth opening. Sialendoscopy provides direct, reliable information about most pathologies and reduces the need for radiological investigations. In the author’s opinion, the bevelled-tip multi-purpose endoscope is extremely important as it facilitates exploration of smaller branches by smooth dilatation. The option of customizing the semi-rigid multi-purpose endoscope (at the risk of the user!) is a key feature, that has shown to be very helpful in exploring wide-angled ramifications. This is the reason why the ‘all-in-one scopes’ at our institution are of semi-rigid type.

▲ a
First centimeters of the Wharton’s duct.

▲ b
Endoscopic view as seen in Wharton’s duct when reaching the sublingual duct junction.

▲ c
Main duct.

▲ d
Primary branches.

▲ e
Secondary branches.

▲ f
Tertiary branches.

▲ g
Terminal branches (same endoscopic aspect in both the submandibular and the parotid gland).
3.2.2 Submandibular Sialendoscopy

10 Salivary duct probe in the papilla.
11 Salivary dilator inserted in the papilla.
12 Dilated papilla (🪄) of the left Wharton's duct.

3.2.3 Parotid Sialendoscopy

a The tip of the sialendoscope can be visualized in Stensen's duct due to transillumination.

3.2.4 Sialendoscopy in Case of Sialadenitis

a Endoscopic view of an inflamed ductal system during removal of a sialolith (which should be avoided, if possible).
3.3 Pathological Findings

3.3.1 Mucous Plugs

Unlike with urolithiasis and cholelithiasis, the etiology of sialolithiasis is unknown. Various hypotheses have been proposed. The first is based on the existence of intracellular micro-calculi, which when excreted in the canal, become a nidus for further calcification. The second theory supposes that ‘mucous plugs’ in the ductal system may represent the nidus. Both hypotheses suggest an initial organic nidus that progressively grows by deposition of layers of inorganic and organic substances.

Another hypothesis for the formation of sialolithiasis is that aliments, substances or bacteria within the oral cavity might migrate to the salivary ducts and stimulate further calcification. Mucous plugs are found in cases of sialolithiasis, but also in cases of Sjögren syndrome and in several cases of chronic parotitis in children.

Thick mucous plug floating in the main duct. Blurred image due to mucosal plug.

Extraction of this plug using a wire basket.

A mucous plug is attached to the stone which impairs intraductal vision. mp = mucous plug

The mucosal plug is mechanically detached by gently tapping on the stone with the laser fiber tip.

Mucous plug is detached from the stone...

... and ensuingly removed.
3.3.2 Sialolithiasis – Multiple Stones, Various Morphologies of Salivary Stones

According to past autopsy studies, sialolithiasis is supposed to affect 1% of salivary glands. However, its frequency is most probably underestimated due to the poor sensitivity of outdated detection methods and absence of treatment options for intraglandular stones, leading to more conservative approaches.

According to most published data, salivary stones are localized in the submandibular gland in 80% to 90% of cases. In our experience, parotid glands are affected more frequently (30% to 40%), a difference possibly explained by the sensitivity of the new detection methods.

Sialoliths are composed of organic and inorganic substances, in varying ratios. The organic substances are glycoproteins, muco-polysaccharides and cellular debris. The inorganic substances are mainly calcium carbonates and calcium phosphates. Salivary stones can be either solitary or multiple, particularly in the parotid gland. As seen before, their location can be proximal, distal or intraglandular. They vary in shape, being either round or irregular. The annual growth rate of established salivary stones has been estimated at 1 mm per year.

Depending on the size of the stones, they can either float (Fig. 16a) in the lumen, become partially fixed due to irregular shapes or even attach to the ductal wall. In some cases, they are trapped behind a bifurcation (Fig. 16c). Stone shapes vary between the parotid and submandibular glands: stones found in the parotid (Fig. 18a) are often smaller, longer and smoother than the more calcified submandibular stones (Fig. 18b).
3.3.3 Ductal Stenosis

According to the LSD classification, strictures can either be localized and thin, large or diffuse. These can be encountered in juvenile recurrent parotiditis, Sjögren syndrome, radiation-induced sialadenitis (either after external radiation therapy or as a sequel of radioactive iodine treatment for thyroid carcinoma and precipitating further salivary symptoms and strictures of one or multiple salivary glands).

3.3.4 Polyps and Tumors

Polyps and tumors of the ductal tree are of very rare occurrence. They can be benign or malignant. In case of malignant tumors, the prognosis is relatively poor and any suspicious sign on endoscopy eliciting doubts about the nature of the lesion should prompt the sialendoscopist to have histologic analysis be made of the collected specimen.
3.4 Classical Approach to Sialadenitis

3.4.1 Medical Treatment and External Surgery

Proximal stones close to the papilla are extracted, whereas glandular resection is indicated for deeply located stones (Fig. 4b).

In submandibular glands, sialolithiasis still represents 70 % to 90 % of all actual indications for glandular resection. Although resection of the submandibular gland is a frequent operation, several reports demonstrate a rather high rate of complications – up to 37 %. In rare cases, this may include neurological damage.

Parotidectomy is rarely performed for inflammatory conditions in parotid glands, because it remains a tedious procedure and is associated with a higher incidence of postoperative paresis. Because of this operation's higher morbidity, surgeons and, more often, patients are reluctant to proceed with surgery.

In case of strictures, usually no other treatments are applied than the medical therapy employed prior to sialendoscopy which consisted of anti-inflammatory medication, massages and administration of sialogogues.

One possible reason behind the high rate of submandibular resections may be the common opinion that submandibular glands with sialolithiasis (chronic infections) should be removed because they are non-functional.

In a clinical-histological study on 48 patients with sialolithiasis who were treated by resection of the submandibular gland, the clinical history was correlated with the histological alteration of the gland. The authors found out that up to one-half of the patients had subnormal histology patterns, and that there was no correlation between the number of infectious episodes and the alteration of the gland. Therefore, numerous infectious episodes or a long duration of symptoms cannot be used to predict the degree of glandular alteration, and thus a conservative attitude toward sialolithiasis appears justified.

3.4.2 Extracorporeal Lithotripsy

In search of conservative approaches toward the treatment of sialolithiasis, a new technique was developed in the 1990s, namely extracorporeal shock wave lithotripsy (e.g., by use of the extracorporeal lithotriptor MINILITH® SL; STORZ MEDICAL AG, Kreuzlingen, Switzerland). Success rates vary from 40 % to 75 % for the submandibular (Fig. 22) and parotid glands, respectively. Performed on an outpatient basis, this technique is now widely practiced but often requires multiple sessions. The main problem remains the clearance of fragments, which, if incomplete, can become the cause of recurrent sialolithiasis.

Interventional sialendoscopy allows to avoid these problems, as described hereafter.

Normal histological appearance of a submandibular gland specimen (a). Histologically confirmed alteration of glandular tissue (b).
4.0 Interventional Sialendoscopy

4.1 Stone Removal by use of a Wire Basket

Following diagnostic sialendoscopy and exposure of the sialolith, the adopted strategy is the same for the submandibular and parotid glands, although the diameter of the ductal system is smaller in the parotid duct. For small stones, less than 4 mm in diameter in submandibular cases and less than 3 mm in parotid cases, extraction is performed with wire baskets of various sizes. The basket is advanced through the working channel of the scope and opened behind the stone. It is then closed over the stone and basket and endoscope are removed altogether in one movement. Papillotomy is performed at the end of the procedure, and it should be kept as minimal as possible.

Wharton’s Duct
Stensen’s Duct

Stone extraction in Stensen’s duct (a–c).
4.2 Stone Removal by Use of a Wire Basket, preceded by Laser Fragmentation

In cases of bigger stones, prior fragmentation is necessary using a laser system. The first successful endoscopic-guided laser lithotripsy of salivary stones was reported by Gundlach in Germany, who, until now, uses two types of lasers for stone fragmentation with a success rate of above 90% for L2 stones of less than 10 mm. Limitations are stones that are only partially visible, or calculi too large in size.

Various types of laser systems are suited for laser lithotripsy of sialoliths: The Dye Laser at 350 nm is very useful, as well as the Holmium-YAG Laser at 2104 nm. Laser irradiation may inadvertently cause damage to ductal walls and hidden structures. Therefore, it is mandatory that the laser be operated only under clear vision, continuous flow irrigation and in close contact with the stone while carefully sparing the ductal walls.

![a-h](images)

**a–h** Laser fragmentation and extraction of stone debris by use of a wire basket through a minimal incision made in Wharton’s papilla, followed by complete clearance of the duct.

**NB:** Stone removal should only be performed after complete fragmentation of the sialolith. Attempting to retrieve large stone fragments poses the risk of wire basket entrapment, a situation that cannot be resolved by applying firm traction to the instrument, which – under any circumstances – must be avoided!
4.3 Sialendoscopic Treatment of Stenosis

Strictures are more common in the parotid than in the submandibular gland. The main issue with stricture treatment is the overall diameter of the duct, which is generally less than 1.5 mm. The best way to dilate the stricture is to choose the multi-purpose sialoscope. Following diagnostic sialendoscopy, a guide wire is first introduced through the channel of the scope. The shaft is then removed leaving the guide wire in the duct. The interventional sialendoscope is then passed over the guide wire allowing the scope to be securely advanced. Dilatation is accomplished by the beveled type of the scope without causing any trauma. In principle, the same technique can be applied via the guide wire when using the all-in-one scope, however, in order to achieve adequate dilatation, the surgeon needs to have available several scopes of increasing diameter. In clinical practice, we were frequently faced with difficulties to achieve dilatation, though using scopes of increasing diameter (because the all-in-one scope does not have a beveled tip).

Endoscopic view of the stenosis before...

... and after dilatation.

Close-up view of the completely filled balloon-tip at the catheter's distal end.

Bougies of various sizes for dilation of stenoses.
4.4 Combined Techniques

Large salivary stones or impassably dense strictures have always posed a therapeutic challenge that could not be solved by sialendoscopy alone. The advent of external lithotripsy in the early 1990’s opened up the prospects that all stones may become amenable to conservative treatment, however the relatively poor success rates in case of large stones were disappointing. The use of intraductal laser fragmentation had also its limitations in case of large stones. In all these cases, removal of the gland was the last-resort option, which as we all know, is associated with a significant rate of morbidity. Therefore, we proposed a new combined approach using both sialendoscopy and external surgery\textsuperscript{45} as described below. In close collaboration with KARL STORZ Tuttingen, Germany, the author has designed specific instruments for use in combined approaches. This set of instruments is currently in production and will be available soon.

4.4.1 Combined Techniques for the Submandibular Gland

The sialendoscope is positioned in front of the stricture / stone, which owing to the diaphanoscopic effect provides adequate orientation for the combined external-intraoral approach. First, an accurate mucosal incision is made with meticulous care, followed by a ductal incision, which enables careful dissection of the duct following visualization of the lingual nerve to remove the stone. Concurrent sialendoscopy of the distal part of the gland is extremely important and has proven useful in removing more distally located stones. At the end of the procedure, the duct is approximated by placing one or two nylon sutures. A stent may be introduced in the papilla in order to avoid improper scarring.

4.4.2 Combined Techniques for the Parotid Gland

At the author’s institution, sialendoscopy is also performed with the 1.3-mm all-in-one sialendoscope or the diagnostic multi-purpose scope. The sialendoscope is inserted in the duct, stabilized in a position proximal to the lesion, which may be a stricture or a stone. Throughout the next steps of the procedure, the scope may be fixed to the angle of the mouth. The patient is then prepared for a classical parotid approach. We commonly use a facelift approach assisted by intraoperative facial nerve monitoring\textsuperscript{45}, but as an alternative option, a ‘lazy-S’-shaped incision may also be used. The skin is then elevated and a SMAS\textsuperscript{*} flap raised and the U- or T-shaped SMAS flap is then created along the area defined by transillumination. The salivary tissue is then very carefully dissected free with the help of a binocular loupe or a microscope in order to expose Stensen’s duct. Constant awareness of proximity to the facial nerve branches is extremely important and particular care must be paid while cutting over the duct avoiding under any circumstances to cause iatrogenic damage to the nerve. Once the incision in the duct has been made, the stone may be removed and/or the stricture be treated by use of a venous patch. Constant irrigation of the duct is crucial to confirm patency of the ductal sutures. Following wound closure, a pressure dressing is applied.

\textsuperscript{*} Superficial Muscular Aponeurotic System
5.0 Technique of Sialendoscopy

5.1 Indications and Contraindications
The indications for sialendoscopy are all salivary gland swellings of unclear origin.\textsuperscript{55,60} There are no specific contraindications, mostly because sialendoscopy is a minimally invasive outpatient procedure performed under local anesthesia. Even elderly or unstable patients unable to undergo general anesthesia can benefit from this technique.

Despite its apparent simplicity, interventional sialendoscopy is a technically challenging procedure. Maneuvering the rigid sialendoscope is delicate, requires extensive experience and involves certain hazards due to the potential risks of causing perforation and vascular or neural damage. The sialendoscope should only be advanced under adequate vision. Perforations of iatrogenic origin can lead to diffuse swellings of the floor of the mouth. Meticulous attention has to be given to this anatomical area because of the potential risk of a life-threatening increase of the swellings.

The main technical limitations of interventional sialendoscopy at the present time are salivary stones in an extreme posterior location, or a fibrosed canal wall with a reduced diameter, which impedes advancement of the endoscope.

5.2 Operating Room Set-up
Sialendoscopy can be done as an outpatient procedure in the clinic with the patient sitting in a chair or partially recumbent.\textsuperscript{52} The author prefers the patient sitting in a chair or lying, which allows for better surgeon mobility. The disadvantage of a fully upright sitting position is that it is associated with an increased risk of vaso-vagal syncope. To be readily prepared for sensitive patients or the incidence of difficulties, an anesthesia unit should be kept available with the anesthetist on standby throughout the entire procedure. A mobile cart with connections for a video camera, video monitor, digital video recorder (DVR) and printer are on the opposite side of the patient, allowing for direct observation of the surgical procedure. An assistant (physician, nurse or technician) is located on that side and is responsible for performing the perioperative procedures.

5.3 Anesthetic Technique
Sialendoscopy generally requires local anesthesia of the papilla and the ductal system. A topical anesthetic paste or spray (10 or 20\%) is applied to either Stensen’s or Wharton’s papilla at the beginning of the procedure. After introduction of the sialendoscope, anesthesia of the ductal system is induced with an irrigation solution of Xylocain, Lidocain or Carbostesin 0.5\%. Depending on age and weight of the patient, the total amount infiltrated should not exceed 40 cc, because of absorption risks.

As a rule, diagnostic sialendoscopy can be performed under local anesthesia. Taking into account that interventional sialendoscopy is usually performed in the same setting, sedation or even general anesthesia can be applied by the anaesthesiologist. This largely depends on the level of difficulty of the individual case.

The patient can rest in a comfortable upright position during the whole course of treatment.
5.4 Step-by-Step Technique

5.4.1 Parotid Sialendoscopy
1. Local anesthesia of the papilla with an anesthetic paste or spray (10 or 20%).
2. Introduction of salivary probes of increasing diameter.
3. Introduction of the dilator.
4. Placement of dental tampons in the posterior aspect of the vestibule and gingivo-buccal sulcus. These will later be replaced with new dry ones during sialendoscopy.
5. Introduction of the sialendoscope.
6. Introduction of a guidewire in the working channel (this step is optional, depending on the experience of the surgeon. It facilitates reintroduction of the scope in the duct).
7. Interventional sialendoscopy involves the use of laser fibers, stone baskets or balloon dilators. The guidewire may be left in place in the duct throughout the procedure. By removing the endoscope and reintroducing the sialendoscope parallel to the guidewire the working channel can be kept open for the use of additional instruments. In view of the numerous ramifications, and the difficulty of inspecting sharply angulated distal parts of the gland, initial advancement of the guide wire in the branch that is difficult to access usually allows the endoscope to slip on the wire and explore the duct.

5.4.2 Submandibular Sialendoscopy
1. Local anesthesia of the papilla with an anesthetic paste or spray (10 or 20%).
2. Superficial infiltration of the papilla with a local anesthetic solution and adrenalin / epinephrine.
3. Introduction of salivary probes of increasing diameter.
4. Introduction of the dilator.
5. Placement of dental tampons in both sides of the lateral aspects of the floor of the mouth. These will later be replaced with new dry ones during sialendoscopy.
6. Introduction of the sialendoscope.
7. Introduction of a guidewire in the working channel. This step is optional – depending on the experience of the surgeon – and facilitates reintroduction of the scope in the duct.
8. Interventional sialendoscopy involves the use of laser fibers, stone baskets or balloon dilators. The guidewire may be left in place in the duct throughout the procedure. By removing the endoscope and reintroducing the sialendoscope parallel to the guidewire the working channel can be kept open for the use of additional instruments. In view of the numerous ramifications, and the difficulty of inspecting sharply angulated distal parts of the gland, initial advancement of the guide wire in the branch that is difficult to access usually allows the endoscope to slip on the wire and explore the duct.
5.5 Equipment

5.5.1 Salivary Probes
Access via the papilla may either involve initial marsupialization or by use of a non-traumatic approach. In order to systematically catheterize the papilla without causing any trauma, we developed a complete set of salivary probes which are made of various types of alloys with different levels of rigidity (the smaller diameters are more flexible and have a lower elastic modulus in order to prevent perforations).

5.5.2 Conic Dilator
This specially designed dilator should be used instead of a salivary probe for gentle dilation of the papilla without any hemorrhage or trauma.

5.5.3 Hollow Rigid Bougies
These bougies allow a blind dilatation of gross stenosis of the main duct, parotid or submandibular duct. The guidewire is inserted first under endoscopic control, traversing the stenotic process, and the sialendoscope removed after having marked the distance to the stenosis. The metallic bougie is then gently inserted, using increasing diameters.

5.5.4 Forceps
Custom-made forceps measuring 0.8 mm may also be used to retrieve small salivary stones (11538 TJ) or for taking biopsies in the salivary duct system. Care has to be taken when handling and maneuvering these instruments since they are small and fragile. Thus, very little pressure should be exerted when grasping the sialolith to avoid damage to the instrument.

5.5.5 Sialendoscopes
Two types of miniature endoscopes were developed for sialendoscopy. The first generation multi-purpose sialendoscopes comprised two scopes of different size, and various sheaths allowing for diagnostic and interventional sialendoscopy. The second generation sialendoscopes could be called ‘all-in-one endoscopes’ because they have an integrated irrigation channel that may also be used for introducing small-sized operating instruments.

Multi-Purpose Sialendoscopes
Diagnostic sialendoscopy requires that the miniature endoscope be available in two sizes, 0.75 mm and 1 mm in diameter, for pediatric or stenosed ducts, and adult/nonstenotic ducts, respectively. The irrigation channel is formed by the tiny gap between the scope and the lumen of the examination sheath (11576 KA and 11577 KA with outer diameters of 1 mm and 1.3 mm).

Interventional sialendoscopy requires that the examination sheath be replaced by a special operating sheath with irrigation channel and one integrated working channel. Operating sheaths are available in three sizes, with inner diameters of 0.65 mm, 0.9 mm, and 1.15 mm.

All-in-one Sialendoscopes
These endoscopes may be used for both diagnostic and interventional procedures eliminating the need for changing the instrument. They are available in 4 different diameters.

• the 0.89 mm-sialendoscope allows for exploration of small pediatric ducts, or fibrous/stenotic ducts. In the hands of the author the device is also used to perform dacryocystorhinostomies.
• the 1.1 mm-sialendoscope is suited for both diagnostic and interventional procedures with a working channel of 0.4 mm.
• the 1.3-mm-sialendoscope is the ‘universal’ sialendoscope, as its outer diameter is sized to allow for diagnostic and interventional sialendoscopy of the submandibular and parotid ducts. Its working channel of 0.6 mm allows the passage of baskets or laser fibers. However, the size of the working channel does not permit the use of balloon dilators or forceps.
• the 1.6 mm-sialendoscope allows the use of forceps. Its outer diameter is designed to allow for endoscopic inspection and treatment of the parotid and submandibular ducts. It is important to note that the lumen of affected ducts is often narrowed owing to inflammatory conditions, making the use of small-diameter sialendoscopes necessary. Therefore, the 1.6 mm-sialendoscope may not always be suitable in parotid cases due to the narrow lumen of Stensen’s duct.

5.5.6 Disposable Devices

Balloon Dilators
Disposable dilators allow for endoscopic-controlled dilatation of localized stenosis, mainly encountered in the parotid ductal system but also in the submandibular gland. In addition, we developed high-pressure balloon catheters designed to treat particularly dense strictures that are not amenable to dilatation when using low-pressure balloons. Great caution should be exercised while insufflating the balloon to prevent undue distension of the duct.

Stone Retrieval Baskets
The initial trials to remove salivary calculi were performed with dormia baskets designed for use in the field of urology, however this was fraught with the drawback that they did not fit into our scopes, which is why we decided to develop baskets of very thin diameter. Today, a wide range of special baskets are available in different sizes and with various numbers of strands. The latest model that has been developed is the tipless basket including a special handle that can be adapted to the ‘all-in-one’ sialendoscope.
5.6 Inherent Limitations of Sialendoscopy

The writhing course of the canal puts certain limitations on semi-rigid sialendoscopy, especially if sharply bent curvatures of the duct prevent the scope from being advanced. The main previously described limitation being the size of the sialendoscope has drastically changed since the development of the last generation ‘all-in-one’ sialendoscopes. The variety in sizes now allows for exploration of almost all salivary ducts.

Maneuvering within the narrow salivary ducts has to be absolutely atraumatic because of the risk of ductal perforation and unpredictable secondary consequences. Significant trauma to the ductal wall may result in latter stenosis.

5.6.1 Significance of the Tip Design

The small angulation, a distinguishing design feature of the tips of all Marchal sialendoscopes facilitates targeted catheterization of branches, whereas with a standard on-axis tip, difficulties may occur when advancing to the branch ahead. A minor deflection may also be given to the sheaths of sialendoscopes 11576 and 11577. After inserting the obturator, the tip may be bent very cautiously, providing the optimal curve. The endoscope must never be deflected. It usually follow the curve of the sheath and reverts to its former state after completion of the procedure.

5.6.2 Significance of the Bevelled Tip

Catheterization of the papilla is a challenging step of the procedure involving a relatively long learning curve. Once adequate dilatation has been achieved by use of bougies of varying sizes, introduction of the operating sialendoscope is considerably facilitated by the bevelled tip of the sheath since this design feature allows the tip to be used as a dilation probe.

5.6.3 Significance of Late Marsupialization

Marsupialization should be completely avoided, particularly at the beginning of the procedure. The irrigation liquid has a dilating effect that provides excellent vision of all ductal branches. Early marsupialization leads to poor visual conditions and makes the technique more difficult to master, because of the irrigation liquid escaping from the ductal system at its opening. Apart from that, marsupialization of the ductal papillae should either be completely avoided, or kept as small as possible to prevent retrograde passage of air and aliments.

5.7 Postoperative Care

Interventional sialendoscopic procedures are usually conducted under prophylactic antibiotic medication administered 48 hours or earlier prior to the procedure, depending on the individual case. Frequent self-massages of the gland are recommended. Clinical controls are performed directly after the intervention. Patients with ruptures of Wharton’s duct, or in cases of deliberately extended marsupialization of the latter, have to be subjected to careful clinical monitoring because of the risk of edema diffusion and/or infection of the floor of the mouth which poses the risk of developing into a life-threatening emergency.
6.0 Workflow

6.1 Decisional Algorithms

Diagram 1
Decisional algorithm of diagnostic and interventional sialendoscopy.

Diagram 2
Technical algorithms for selecting the appropriate sialendoscopic instrumentation.
6.2 Recommended Equipment for Beginners: Basic Set
The 1.3-mm MARCHAL Sialendoscope is the universal scope that may be used for diagnosis and treatment in the majority of patients undergoing outpatient sialendoscopy as well as for minor interventional procedures.

The Basic Set consists of a conic dilator, bougies of various sizes, and the universal 1.3 mm MARCHAL Sialendoscope. 
(Basic Set: see page 34)

6.3 Recommended Equipment: Advanced Set
The 0.75-mm sialendoscope in conjunction with various sheaths extends the technical options and may be applied in the entire field of interventional sialendoscopy:
- Optional custom-made bending of the scope at the risk of the user.
- Sialendoscopy under pediatric or stenotic conditions.
- Application of baskets, laser fibers, forceps and balloon-tipped dilators.
(Advanced Set: see page 35)
7.0 Training

7.1 Introduction
Since the initial development stage of sialendoscopy we have been convinced that the best way to popularize the technique is teaching. Since 2002, more than 600 physicians from 65 countries have been trained in the European Sialendoscopy Training Center (ESTC) in Geneva, Switzerland.

7.2 The European Sialendoscopy Training Center (ESTC)

7.2.1 Aims of the ESTC
The aims of the ESTC are:

- to train clinicians in the indications and procedures associated with diagnostic and therapeutic sialendoscopy,
- to organise and disseminate experience gained by clinicians in this field, and
- to conduct international courses and conferences as appropriate, to facilitate exchange of knowledge, experiences and advances gained by leading clinical physicians who focus on diseases and conditions of the salivary glands.

7.2.2 Hands-on Training
In Geneva, a specific training and demonstration model for sialendoscopy has been validated. The use of fresh pig heads has proven to be ideal, after extensive trials conducted with other animal models and human cadaveric specimen.

During each course, participants are paired and work on one fresh pig head. The lectures held during the hands-on course are divided into two sessions, one focusing on diagnostic and the other on interventional sialendoscopy.

7.2.3 Conferences
The international faculty addresses clinical, radiological, medical and surgical approaches to salivary gland pathologies. They explain and describe their techniques of sialendoscopy in a step-by-step fashion using a variety of videos and interactive presentations that allow for open discussion and comments.

Recent developments in new materials and designs combined with advances in instrumentation technology are presented during such conferences. Abstract sessions are an outstanding way to disseminate the results of clinical research or to present and discuss case histories. Round table format and informal discussions facilitate reporting on advances and prospects of research that address the management of salivary gland duct pathologies.
7.2.4 Live Surgery in 3D
Owing to the availability of an excellent video-conference system linking the operating room to the conference room, live surgeries can be viewed on a large central video screen. Participants are encouraged to ask questions and discuss with the surgeon during the operation. Through this real-time approach, the steps of the procedure, but also the risks and advantages are made tangible to the course participants. At the subsequent hands-on sessions surgical tricks and tips are demonstrated, expanded upon and taught. For a few years now, the courses are recorded with a 3D camera and transmitted to the auditorium.

7.2.5 Courses for Beginners and Advanced Courses
At the request of hundreds of participants, we started a few years ago to offer a beginners’ course and an advanced course in order to better cope with the individual needs at each level.

7.3 Course Evaluation
For retrospective evaluation of the courses held at the ESTC, questionnaires are distributed on a regular basis among the participants. As a result, 95% are satisfied with the theoretical part and 98% with the practical part of the course, underlining the importance of hands-on training with fresh pig heads. All participants agreed that the trickiest part of the procedure is the practical handling of the papilla in order to utilize the technique by ways of a truly minimally invasive approach. Based on the conclusions from this evaluation, we found out that the majority of participants (60%) requested an advanced course, so we decided to install both a beginners’ course and an advanced course, held annually in Geneva (www.sialendoscopy.com).

8.0 Conclusion
Taking into consideration differences in instrumentation and video-endoscopic equipment, as well as complexity, duration, and potential complications of the procedures, a distinction has to be made between diagnostic and interventional sialendoscopy.

Diagnostic sialendoscopy is a low-morbidity minimally invasive technique, which may become the investigational procedure of choice for salivary duct pathologies.

Interventional sialendoscopy allows for extraction and/or fragmentation in the majority of cases of sialolithiasis, and can therefore prevent salivary gland excisions.
Sialendoscopy – The Endoscopic Approach to Salivary Gland Ductal Pathologies

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Sialendoscopy – The Endoscopic Approach to Salivary Gland Ductal Pathologies

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Sialendoscopy Basic and Advanced Sets
for Diagnosis and Treatment of the
Parotid and Submandibular Glands
as recommended by Prof. MARCHAL
## Sialendoscopy Basic Set

for Diagnosis and Treatment of the Parotid and Submandibular Glands

as recommended by Prof. MARCHAL

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Specifications</th>
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<tbody>
<tr>
<td>11575 A</td>
<td><strong>Miniature Straight Forward Telescope 0°</strong>, O.D. 1.3 mm, semirigid, ** autoclavable**, 5° distal angulation, working channel I.D. 0.65 mm, irrigation channel I.D. 0.25 mm, working length 12 cm, length 100 cm, remote eyepiece, fiber optic light transmission incorporated, including protection cover 11570 P</td>
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<tr>
<td>11580 B</td>
<td><strong>Metal Tray</strong>, for Sterilization and Storage of a Miniature Straight Forward Telescope 11575 A, 11581 A – 11583 A, perforated, lid with silicone bridges, external dimensions (w x d x h): 275 x 178 x 35 mm</td>
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<tr>
<td>11575 K</td>
<td><strong>Stone Extractor</strong>, O.D. 0.6 mm, basket with 3 wires, sterile, for single use</td>
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<tr>
<td>11575 L</td>
<td><strong>Stone Extractor</strong>, O.D. 0.6 mm, basket with 6 wires, sterile, for single use</td>
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<tr>
<td>745847</td>
<td><strong>Salivary Duct Probe</strong>, size 0000</td>
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<td><strong>Salivary Duct Probe</strong>, size 00</td>
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<td><strong>Salivary Duct Probe</strong>, size 0</td>
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<td>745858</td>
<td><strong>Salivary Duct Probe</strong>, size 9</td>
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<td>11580 A</td>
<td><strong>Metal Tray</strong>, for sterilizing Salivary Duct Probes 745847 – 745858 and Dilator 745910, perforated, lid with silicone bridges, external dimensions (w x d x h): 178 x 178 x 35 mm</td>
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<td><strong>Dilator for salivary duct</strong>, length 14 cm</td>
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<td>745720</td>
<td><strong>Guide Wire</strong>, O.D. 0.6 mm, sterile, for single use, package of 10, for use with Bougies 745710–745713</td>
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<td>745715</td>
<td><strong>Forceps</strong>, angled, serrated, length 15 cm</td>
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<tr>
<td>745716</td>
<td><strong>Forceps</strong>, angled, with 1x 2 teeth, length 15 cm</td>
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<tr>
<td>745717</td>
<td><strong>Angled Scissors for Salivary Gland</strong>, with bulb, length 14 cm</td>
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<tr>
<td>27651 K2</td>
<td><strong>Cleaning Brush</strong>, for working channel diameter 0.6–0.8 mm, length 40 cm, for single use, package of 10</td>
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<tr>
<td>27651 K5</td>
<td><strong>Cleaning Brush</strong>, for working channel diameter 0.25–0.4 mm, length 40 cm, for single use, package of 10</td>
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It is recommended to check the suitability of the product for the intended procedure prior to use.
Sialendoscopy Advanced Set
for Diagnosis and Treatment of the Parotid and Submandibular Glands
as recommended by Prof. MARCHAL

<table>
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</tr>
<tr>
<td>11580 B</td>
<td>Metal Tray, for Sterilization and Storage of a Miniature Straight Forward Telescope 11575 A, 11581 A – 11583 A, perforated, lid with silicone bridges, external dimensions (w x d x h): 275 x 178 x 35 mm</td>
</tr>
<tr>
<td>11576 A</td>
<td>Miniature Straight Forward Telescope 0°, diameter 0.75 mm, working length 16 cm, semirigid, autoclavable, length 145 cm, with remote eyepiece and light connection, LUER-Lock adaptor, fiber optic light transmission incorporated, including Protective Tube 11576 P</td>
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<td>11580 C</td>
<td>Metal Tray, for Sterilization and Storage of a Miniature Straight Forward Telescope 11576 / 11577, perforated, lid with silicone bridges, external dimensions (w x d x h): 373 x 178 x 35 mm</td>
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<td>11576 KA</td>
<td>Examination Sheath, O.D. 1.1 mm, working length 16 cm, with blunt obturator, with lateral LUER-Lock adaptor for irrigation, for use with miniature telescope 11576</td>
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<tr>
<td>11576 KF</td>
<td>Operation Sheath, oval, O.D. 1.1 mm and 1.3 mm, working length 16 cm, telescope channel O.D. 0.9 mm, working channel O.D. 1.15 mm with 2 obturators, with lateral LUER-Lock adaptor for irrigation for use with miniature telescope 11576</td>
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<td>11576 KG</td>
<td>Operation Sheath, oval, O.D. 1.1 mm and 0.8 mm, working length 16 cm, telescope channel O.D. 0.9 mm, working channel 0.65 mm, with 2 obturators, with lateral LUER-Lock adaptor for irrigation for use with miniature telescope 11576</td>
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<td>11576 TJ</td>
<td>Foreign Body Forceps, double action jaws, flexible, O.D. 1 mm, working length 19 cm</td>
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<tr>
<td>11576 ZJ</td>
<td>Biopsy Forceps, double action jaws, flexible, O.D. 1 mm, working length 19 cm</td>
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<tr>
<td>11577 BP</td>
<td>Balloon Catheter, diameter 0.9 mm, sterile, single use, package of 10</td>
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<td>27651 K5</td>
<td>Cleaning Brush, for working channel diameter 0.25–0.4 mm, length 40 cm, for single use, package of 10</td>
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</table>
MARCHAL All-In-One Miniature Endoscopes for Diagnostic and Interventional Sialendoscopy

11581 A  **Miniature Straight Forward Telescope 0°**, O.D. 0.89 mm, semirigid, **autoclavable**, 5° distal angulation, irrigation channel I.D. 0.25 mm, working length 12 cm, length 100 cm, remote eyepiece, fiber optic light transmission incorporated, including protection cover 11520 P

11582 A  **Miniature Straight Forward Telescope 0°**, O.D. 1.1 mm, semirigid, autoclavable, 5° distal angulation, working channel I.D. 0.45 mm, irrigation channel I.D. 0.2 mm, working length 12 cm, length 100 cm, remote eyepiece, fiber optic light transmission incorporated, including protection cover 11520 P

**for use with:**
- Stone Extractor 11582 M
- Guide Wire 745725
- Laser Probe

11575 A  **Miniature Straight Forward Telescope 0°**, O.D. 1.3 mm, semirigid, **autoclavable**, 5° distal angulation, working channel I.D. 0.65 mm, irrigation channel I.D. 0.25 mm, working length 12 cm, length 100 cm, remote eyepiece, fiber optic light transmission incorporated, including protection cover 11570 P

**for use with:**
- Stone Extractor 11575 K / L
- Guide Wire 745720
- Laser Probe

11583 A  **Miniature Straight Forward Telescope 0°**, O.D. 1.6 mm, semirigid, **autoclavable**, 5° distal angulation, working channel I.D. 0.8 mm, irrigation channel I.D. 0.2 mm, working length 12 cm, length 100 cm remote eyepiece, fiber optic light transmission incorporated, including protection cover 11520 P,

**for use with:**
- Stone Extractor 11575 K / L
- Micro Burr 11574 MB
- Foreign Body Forceps 11583 TJ
- Biopsy Forceps 11583 ZJ
- Guide Wire 745720
- Laser Probe
Small-Size Miniature Endoscope for Diagnostic and Interventional Sialendoscopy

as recommended by Prof. MARCHAL

Ideal for assessment of stenotic ducts (juvenile recurrent parotitis, Sjögren, radio-iodine sialadenitis etc.)

11576 A  
Miniature Straight Forward Telescope 0°,
diameter 0.75 mm, working length 16 cm, semirigid, autoclavable, length 145 cm,
with remote eyepiece and light connection, Luer-Lock adaptor,
fiber optic light transmission incorporated,
including Protective Tube 11576 P

Sheath for Diagnostic Sialendoscopy

11576 KA  
Examination Sheath,
O.D. 1.1 mm, working length 16 cm, with blunt obturator,
with lateral Luer-Lock adaptor for irrigation,
for use with miniature telescope 11576
Sheath for Interventional Sialendoscopy

11576 KF

**Operation Sheath**, oval, O.D. 1.1 mm and 1.3 mm, working length 16 cm, telescope channel O.D. 0.9 mm, working channel O.D. 1.15 mm with 2 obturators, with lateral Luer-Lock adaptor for irrigation for use with miniature telescope 11576

**Operating instruments for use through the working channel of 11576 KF**
- Stone Extractor 11575 K
- Stone Extractor 11575 L
- Guide Wire 745720
- Balloon Catheter 11577 BP
- Grasping Forceps 11576 TJ
- Biopsy Forceps 11576 ZJ
- Laser Probe

11576 KG

**Operation Sheath**, oval, O.D. 1.1 mm and 0.8 mm, working length 16 cm, telescope channel O.D. 0.9 mm, working channel 0.65 mm, with 2 obturators, with lateral Luer-Lock adaptor for irrigation for use with miniature telescope 11576

**Operating instruments for use through the working channel of 11576 KG**
- Stone Extractor 11575 K
- Stone Extractor 11575 L
- Guide Wire 745720
- Laser Probe
Miniature Endoscopes for Diagnostic and Interventional Sialendoscopy

as recommended by Prof. MARCHAL

11577 A  **Miniature Straight Forward Telescope 0°**,
diameter 1 mm, working length 16 cm, semirigid,
**autoclavable**, length 145 cm,
with remote eyepiece and light connection, Luer-Lock adaptor,
fiber optic light transmission incorporated,
including Protective Tube 11576 P

Sheath for Diagnostic Sialendoscopy

11577 KA  **Examination Sheath**,
O.D. 1.3 mm, working length 16 cm, with blunt obturator,
with lateral Luer-Lock adaptor for irrigation,
for use with miniature telescope 11577
**Sheaths for Interventional Sialendoscopy**

**11577 KE**

**Operation Sheath**, oval, O.D. 1.3 mm and 1.3 mm, working length 16 cm, telescope channel O.D. 1.15 mm, working channel 1.15 mm, with 2 obturators, with lateral Luer-Lock adaptor for irrigation for use with miniature telescope 11577

**Operating instruments for use through the working channel of 11577 KE**
- Stone Extractor 11575 K
- Stone Extractor 11575 L
- Guide Wire 745720
- Ballon Catheter 11577 BP
- Grasping Forceps 11576 TJ
- Biopsy Forceps 11576 ZJ
- Laser Probe

**11577 KD**

**Operation Sheath**, oval, O.D. 1.3 mm and 0.8 mm, working length 16 cm, telescope channel O.D. 1.15 mm, working channel 0.65 mm, with 2 obturators, with lateral Luer-Lock adaptor for irrigation for use with miniature telescope 11577

**Operating instruments for use through the working channel of 11577 KD**
- Stone Extractor 11575 K
- Stone Extractor 11575 L
- Guide Wire 745720
- Laser Probe
Sialendoscopy – The Endoscopic Approach to Salivary Gland Ductal Pathologies

Additional Instruments
as recommended by Prof. MARCHAL

Set of Salivary Duct Probes
for Dilation of the Salivary Ducts

Set of MARCHAL Salivary Duct Probes,
745647 size 0000 745853 size 3
745648 size 000 745854 size 4
745649 size 00  745855 size 5
745850 size 0   745856 size 6
745851 size 1   745857 size 7
745852 size 2   745858 size 8

Bougies
for Elimination of Stenosis

745710
745708 MARCHAL Bougie diameter 1 mm, for use with guide wire 745725
745709 Same, diameter 1.5 mm, for use with guide wire 745725
745710 Same, diameter 2.0 mm, for use with guide wire 745725
745711 Same, diameter 2.5 mm, for use with guide wire 745725
745712 Same, diameter 3.0 mm, for use with guide wire 745725
745713 Same, diameter 3.5 mm, for use with guide wire 745725

Dilator

745910 Dilator, for salivary duct, length 14 cm
Stone Extractors, Ballon Catheter and Guide Wires

11582 M  **Stone Extractor**, O.D. 0.4 mm, basket with 4 wires, sterile, for single use

11573 T  **Stone Extractor**, diameter 0.6 mm, basket with 4 wires, tipless, handle for fixation to endoscope

11573 M  **Stone Extractor**, diameter 0.4 mm, basket with 4 wires, handle for fixation to endoscope

11575 K  **Stone Extractor**, O.D. 0.6 mm, basket with 3 wires, sterile, for single use

11575 L  **Stone Extractor**, O.D. 0.6 mm, basket with 6 wires, sterile, for single use

11577 BP  **Balloon Catheter**, diameter 0.9 mm, sterile, single use, package of 10

11583 BP  **Balloon Catheter**, diameter 0.7 mm, sterile, for single use, package of 10, for use with Telescopes 11574 A and 11583 A

745720  **Guide Wire**, O.D. 0.6 mm, sterile, for single use, package of 10, for use with Bougies 745710–745713

745725  **Guide Wire**, O.D. 0.4 mm, sterile, for single use, package of 10, for use with Bougies 745708–745713
Dissecting and Tissue Forceps, Scissors
Grasping and Biopsy Forceps

745715 Forceps, angled, serrated, length 15 cm
745716 Forceps, angled, with 1x 2 teeth, length 15 cm

745717 Angled Scissors for Salivary Gland, with bulb, length 14 cm

11576 TJ Foreign Body Forceps, double action jaws, flexible, O.D.1 mm, working length 19 cm
11576 ZJ Biopsy Forceps, double action jaws, flexible, O.D. 1 mm, working length 19 cm
11583 TJ Foreign Body Forceps, double action jaws, flexible, O.D. 0.8 mm, working length 26.5 cm
11583 ZJ Biopsy Forceps, double action jaws, flexible, O.D. 0.8 mm, working length 26.5 cm
Sterilizing and Storage Trays

11580 A  **Metal Tray**, for sterilizing Salivary Duct Probes 745847–745858 and Dilator 745910, perforated, lid with silicone bridges, external dimensions (w x d x h): 178 x 178 x 35 mm

11580 B  **Metal Tray**, for sterilization and storage of one Miniature Straight Forward Telescope 11575 A, 11581 A, 11582 A, 11583 A, 11578 A or 5800, perforated, lid with silicone bridges, with port for irrigation connector, external dimensions (w x d x h): 275 x 178 x 35 mm
Sterilizing and Storage Trays

11580 C  **Metal Tray**, for Sterilization and Storage of a Miniature Straight Forward Telescope 11576 / 11577, perforated, lid with silicone bridges, external dimensions (w x d x h): 373 x 178 x 35 mm

11580 D  **Metal Tray**, for Sterilization and Storage of a Miniature Straight Forward Telescope 11572 A – 11574 A, perforated, lid with silicone bridges, external dimensions (w x d x h): 275 x 175 x 37 mm

Cleaning

27651 K1  **Cleaning Brush**, round, flexible, for working channel diameter 0.4 – 0.6 mm, length 40 cm, for single use, package of 10

27651 K2  Same, for working channel diameter 0.6 – 0.8 mm

27651 K3  Same, for working channel diameter 0.8 – 1.4 mm

27651 K4  **Cleaning Brush**, for working channel diameter 0.2 – 0.25 mm, length 30 cm, for single use, package of 10

27651 K5  **Cleaning Brush**, round, flexible, for working channel diameter 0.25 – 0.4 mm, length 40 cm, for single use, package of 10
Unique benefits of the KARL STORZ TELE PACK X at a Glance

Crystal clear image
- 15" LCD monitor
- Rotatable image display
- 24 Bit color intensity for natural color rendition
- DVI video input for pristine picture quality
- DVI video output for connecting HD monitors

Flexible storage possibilities
- SD card-slot allows high storage capacity
- USB-slot for external HDDs and flash drives
- Picture gallery for records
- Playback of saved videos
- Print-ready patient report documentation

Natural illumination
- LED high-performance light source
- Natural colour rendition close to sunlight with a colour temperature of 6400 K
- Up to 30,000 hours lamp operating time

Easy control combined with highest safety
- Membrane keyboard approved for wipe disinfection
- Hot-Keys assuring fast and direct adjustment
- Arrow keys for intuitive control
- Pedal control available

Additional information
- Sturdy, portable casing
- Ergonomic design allows comfortable transport
- Universal power supply unit: 100 – 240 VAC, 50/60 Hz
- Measurement (H x W x D): 450 mm x 350 mm x 150 mm
- Weight: 7 kg

Ordering Information
TP100 EN TELE PACK X LED, endoscopic video unit for use with all KARL STORZ TELECAM one-chip camera heads and video endoscopes, incl. LED-light source on a similar niveau as the Power LED 175, with integrated digital Image Processing Module, 15" LCD monitor with LED backlight, USB/SD memory module, color systems PAL/NTSC, power supply 100–240 VAC, 50/60 Hz, including:
- USB Silicone Keyboard with Touchpad, with US character set

20212040 PAL TELECAM
20212140 NTSC One-Chip Camera Head
color system PAL, autoclavable, soakable, gas-sterilizable, with integrated Parfocal Zoom Lens, f = 14 – 28 mm (2x), 2 freely programmable camera head buttons, including plastic container 39301 ACT for sterilization
IMAGE1 S™ – A System for all Requirements

Connects all technologies
IMAGE1 S CONNECT™

10 mm 3D video laparoscope

4 mm 3D video endoscope

3D endoscopy IMAGE1 S D3-LINK™

Open to future technologies

e.g., 4K/UHD

Flexible video endoscopes

2D endoscopy IMAGE1 S™ X-LINK

2D endoscopy IMAGE1 S™ H3-LINK

3-chip camera heads

Near Infrared (NIR/ICG) 3-chip camera head FI

1-chip camera heads

PDD camera heads

Microscopy camera head
With the IMAGE1 S™ camera platform, KARL STORZ once again sets a new milestone in endoscopic imaging, consolidating their reputation as an innovative leader in minimally invasive surgery. The IMAGE1 S™ camera platform offers surgeons a single system for all applications. As a modular camera platform, IMAGE1 S™ combines various technologies (e.g., rigid, flexible and 3D endoscopy) in one system and can therefore be adapted to individual customer needs. Furthermore, near infrared (NIR/ICG) for fluorescence imaging, the integration of operating microscopes and the use of VITOM® 3D exoscopes is possible via the camera platform.

Brilliant imaging

- Versatile visualization options for diagnosis and therapy
- Innovative S-Technologies for easy differentiation of tissue structures
- Clear and razor-sharp imaging
- Natural color rendition
- Automatic light source control

* SPECTRA A: Not for sale in the U.S.
* SPECTRA B: Not for sale in the U.S.
**Innovative Design**

- Side-by-side View: Parallel display of standard image and visualization mode possible
- Multiple source management: Simultaneous control, display and documentation of two image sources possible (e.g., hybrid procedures)
- Intuitive user guidance (dashboard, live menu and setup menu)
- Intelligent icons display settings and status
- Individual presets possible
- 50 patient data records can be archived

**Economical and futureproof**

- Modular platform: Rigid, flexible and 3D technology can be selected according to individual preferences
- Easy integration of new technologies
- Forward and backward compatibility
- No additional equipment (e.g., special light sources) required for S-Technologies

*SPECTRA A: Not for sale in the U.S.*
*SPECTRA B: Not for sale in the U.S.*
IMAGE1 S™
As individual as your requirements

IMAGE1 S™ 3D
IMAGE1 S™ 3D is a further component in the IMAGE1 S™ camera platform. The 3D system provides surgeons with excellent depth perception. Furthermore, the 3D stereoscopic imaging system is particularly valuable for activities that demand a high degree of spatial perception. The 3D camera platform from KARL STORZ impresses with its wide range of applications – from laparoscopy, gynecology, ENT to microsurgical interventions.

Benefits of IMAGE1 S™ 3D
- Brilliant and razor-sharp imaging in 2D and 3D
- Switchover from 3D to 2D at the touch of a button
- Easy integration into the IMAGE1 S™ platform
- CLARA, CHROMA, SPECTRA* in 2D and 3D
- 3D system with video endoscopes with diameters of 10 mm and 4 mm as well as VITOM® 3D

Benefits of 3D integration into the IMAGE1 S™ camera platform
- Communication between all units
- One system for multiple applications
- Reduced space requirements
- One user interface for all applications
- Synergy effects between the OR workflow and financing

Available in 0°/30°
Autoclavable
Optimal sharpness in the working area

Easy switchover from 3D to 2D
Programmable camera head buttons
Lightweight and ergonomic design
CLARA, CHROMA, SPECTRA* in 2D and 3D
Easy documentation in 2D via USB flash drive

* SPECTRA: Not for sale in the U.S.
**IMAGE1 S™ Camera System**

TC 200EN* **IMAGE1 S CONNECT™**, connect module, for use with up to 3 link modules, resolution 1920 x 1080 pixels, with integrated KARL STORZ-SCB and digital Image Processing Module, power supply 100–120 VAC/200–240 VAC, 50/60 Hz including:

- **Mains Cord**, length 300 cm
- **DVI-D Connecting Cable**, length 300 cm
- **SCB Connecting Cable**, length 100 cm
- **USB Flash Drive**, 32 GB, USB silicone keyboard, with touchpad, US

*Available in the following languages: DE, ES, FR, IT, PT, RU

![TC 200EN](image1.png)

**Specifications:**

<table>
<thead>
<tr>
<th>Feature</th>
<th>TC 200EN</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD video outputs</td>
<td>- 2x DVI-D</td>
</tr>
<tr>
<td></td>
<td>- 1x 3G-SDI</td>
</tr>
<tr>
<td>Format signal outputs</td>
<td>1920 x 1080p, 50/60 Hz</td>
</tr>
<tr>
<td>LINK video inputs</td>
<td>3x</td>
</tr>
<tr>
<td>USB interface</td>
<td>4x USB, (2x front, 2x rear)</td>
</tr>
<tr>
<td>SCB interface</td>
<td>2x 6-pin mini-DIN</td>
</tr>
<tr>
<td>Power supply</td>
<td>100–120 VAC/200–240 VAC</td>
</tr>
<tr>
<td>Power frequency</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>Protection class</td>
<td>I, CF-Defib</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>305 x 54 x 320 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>2.1 kg</td>
</tr>
</tbody>
</table>

For use with **IMAGE1 S CONNECT™** Module TC 200EN

TC 300 **IMAGE1 S™ H3-LINK**, link module, for use with IMAGE1 FULL HD three-chip camera heads, power supply 100–120 VAC/200–240 VAC, 50/60 Hz, for use with **IMAGE1 S CONNECT™ TC 200EN** including:

- **Mains Cord**, length 300 cm
- **Link Cable**, length 20 cm

![TC 300](image2.png)

**Specifications:**

<table>
<thead>
<tr>
<th>Feature</th>
<th>TC 300 (H3-Link)</th>
</tr>
</thead>
</table>
| Supported camera heads/video endoscopes | TH 100, TH 101, TH 102, TH 103, TH 104, TH 106 (fully compatible with IMAGE1 S™)  
 **22220055-3, 22220056-3, 22220053-3, 22220060-3, 22220061-3, 22220054-3, 22220085-3** (compatible without IMAGE1 S™ technologies CLARA, CHROMA, SPECTRA*) |
| LINK video outputs              | 1x |
| Power supply                    | 100–120 VAC/200–240 VAC |
| Power frequency                 | 50/60 Hz |
| Protection class                | I, CF-Defib |
| Dimensions w x h x d            | 305 x 54 x 320 mm |
| Weight                          | 1.86 kg |

* **SPECTRA A:** Not for sale in the U.S.
** **SPECTRA B:** Not for sale in the U.S.
Sialendoscopy – The Endoscopic Approach to Salivary Gland Ductal Pathologies

IMAGE1 S Camera Heads

For use with IMAGE1 S Camera System
IMAGE1 S CONNECT Module TC 200EN, IMAGE1 S H3-LINK Module TC 300
and with all IMAGE1 HUB™ HD Camera Control Units

TH 100

IMAGE1 S H3-Z Three-Chip FULL HD Camera Head,
50/60 Hz, IMAGE1 S compatible, progressive scan, soakable, gas- and plasma-sterilizable, with integrated Parfocal Zoom Lens, focal length f = 15–31 mm (2x), 2 freely programmable camera head buttons, for use with IMAGE1 S and IMAGE1 HUB™ HD/HD

Specifications:

<table>
<thead>
<tr>
<th>IMAGE1 FULL HD Camera Heads</th>
<th>IMAGE1 S H3-Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product no.</td>
<td>TH 100</td>
</tr>
<tr>
<td>Image sensor</td>
<td>3x 1/3&quot; CCD chip</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>39 x 49 x 114 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>270 g</td>
</tr>
<tr>
<td>Optical interface</td>
<td>integrated Parfocal Zoom Lens, f = 15–31 mm (2x)</td>
</tr>
<tr>
<td>Min. sensitivity</td>
<td>F 1.4/1.17 Lux</td>
</tr>
<tr>
<td>Grip mechanism</td>
<td>standard eyepiece adaptor</td>
</tr>
<tr>
<td>Cable</td>
<td>non-detachable</td>
</tr>
<tr>
<td>Cable length</td>
<td>300 cm</td>
</tr>
</tbody>
</table>

TH 104

IMAGE1 S H3-ZA Three-Chip FULL HD Camera Head,
50/60 Hz, IMAGE1 S compatible, autoclavable, progressive scan, soakable, gas- and plasma-sterilizable, with integrated Parfocal Zoom Lens, focal length f = 15–31 mm (2x), 2 freely programmable camera head buttons, for use with IMAGE1 S and IMAGE1 HUB™ HD/HD

Specifications:

<table>
<thead>
<tr>
<th>IMAGE1 FULL HD Camera Heads</th>
<th>IMAGE1 S H3-ZA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product no.</td>
<td>TH 104</td>
</tr>
<tr>
<td>Image sensor</td>
<td>3x 1/3&quot; CCD chip</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>39 x 49 x 100 mm</td>
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<tr>
<td>Weight</td>
<td>299 g</td>
</tr>
<tr>
<td>Optical interface</td>
<td>integrated Parfocal Zoom Lens, f = 15–31 mm (2x)</td>
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<tr>
<td>Min. sensitivity</td>
<td>F 1.4/1.17 Lux</td>
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<tr>
<td>Grip mechanism</td>
<td>standard eyepiece adaptor</td>
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<tr>
<td>Cable</td>
<td>non-detachable</td>
</tr>
<tr>
<td>Cable length</td>
<td>300 cm</td>
</tr>
</tbody>
</table>
## Monitors

**9619 NB**

19" HD Monitor, color systems **PAL/NTSC**, max. screen resolution 1280 x 1024, image format 4:3, power supply 100–240 VAC, 50/60 Hz, wall-mounted with VESA 100 adaption, including:
- External 24 VDC Power Supply
- Mains Cord

**9826 NB**

26" FULL HD Monitor, wall-mounted with VESA 100 adaption, color systems **PAL/NTSC**, max. screen resolution 1920 x 1080, image format 16:9, power supply 100–240 VAC, 50/60 Hz including:
- External 24 VDC Power Supply
- Mains Cord
## Monitors

### KARL STORZ HD and FULL HD Monitors

<table>
<thead>
<tr>
<th>Wall-mounted with VESA 100 adaption</th>
<th>19&quot;</th>
<th>26&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitor no.</td>
<td>9619 NB</td>
<td>9826 NB</td>
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</table>

#### Inputs:

<table>
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<tr>
<th>Input</th>
<th>19&quot;</th>
<th>26&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>DVI-D</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Fibre Optic</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>3G-SDI</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>RGBS (VGA)</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>S-Video</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Composite/FBAS</td>
<td>●</td>
<td>●</td>
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</table>

#### Outputs:

<table>
<thead>
<tr>
<th>Output</th>
<th>19&quot;</th>
<th>26&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>DVI-D</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>S-Video</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Composite/FBAS</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>RGBS (VGA)</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>3G-SDI</td>
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<td>●</td>
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</table>

#### Signal Format Display:

<table>
<thead>
<tr>
<th>Format</th>
<th>19&quot;</th>
<th>26&quot;</th>
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<tbody>
<tr>
<td>4:3</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>5:4</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>16:9</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Picture-in-Picture</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>PAL/NTSC compatible</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

#### Optional accessories:

- 9826 SF [Pedestal, for monitor 9826 NB](#)
- 9626 SF [Pedestal, for monitor 9619 NB](#)

### Specifications:

<table>
<thead>
<tr>
<th>KARL STORZ HD and FULL HD Monitors</th>
<th>19&quot;</th>
<th>26&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desktop with pedestal</td>
<td>optional</td>
<td>optional</td>
</tr>
<tr>
<td>Product no.</td>
<td>9619 NB</td>
<td>9826 NB</td>
</tr>
<tr>
<td>Brightness</td>
<td>200 cd/m² (typ)</td>
<td>500 cd/m² (typ)</td>
</tr>
<tr>
<td>Max. viewing angle</td>
<td>178° vertical</td>
<td>178° vertical</td>
</tr>
<tr>
<td>Pixel distance</td>
<td>0.29 mm</td>
<td>0.3 mm</td>
</tr>
<tr>
<td>Reaction time</td>
<td>5 ms</td>
<td>8 ms</td>
</tr>
<tr>
<td>Contrast ratio</td>
<td>700:1</td>
<td>1400:1</td>
</tr>
<tr>
<td>Mount</td>
<td>100 mm VESA</td>
<td>100 mm VESA</td>
</tr>
<tr>
<td>Weight</td>
<td>7.6 kg</td>
<td>7.7 kg</td>
</tr>
<tr>
<td>Rated power</td>
<td>28 W</td>
<td>72 W</td>
</tr>
<tr>
<td>Operating conditions</td>
<td>0–40°C</td>
<td>5–35°C</td>
</tr>
<tr>
<td>Storage</td>
<td>-20–60°C</td>
<td>-20–60°C</td>
</tr>
<tr>
<td>Rel. humidity</td>
<td>max. 85%</td>
<td>max. 85%</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>469.5 x 416 x 75.5 mm</td>
<td>643 x 396 x 87 mm</td>
</tr>
<tr>
<td>Power supply</td>
<td>100–240 VAC</td>
<td>100–240 VAC</td>
</tr>
<tr>
<td>Certified to</td>
<td>EN 60601-1, protection class IPX0</td>
<td>EN 60601-1, UL 60601-1, MDD93/42/EEC, protection class IPX2</td>
</tr>
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</table>
### Cold Light Fountains and Accessories

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>495 NT</td>
<td>Fiber Optic Light Cable, with straight connector, diameter 2.5 mm, length 180 cm</td>
</tr>
<tr>
<td>495 NTW</td>
<td>Fiber Optic Light Cable, diameter 2.5 mm, length 180 cm with 90° deflection to the light source</td>
</tr>
<tr>
<td>495 NTX</td>
<td>Same, length 230 cm</td>
</tr>
</tbody>
</table>

**Cold Light Fountain XENON NOVA® 175**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>20134001</td>
<td>Cold Light Fountain XENON NOVA® 175, power supply: 100–125 VAC/220–240 VAC, 50/60 Hz including: Mains Cord</td>
</tr>
<tr>
<td>20132026</td>
<td>XENON Spare Lamp, only, 175 watt, 15 volt</td>
</tr>
</tbody>
</table>

**Cold Light Fountain HALOGEN 250 twin**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>20113320</td>
<td>Cold Light Fountain HALOGEN 250 twin, power supply: 100–240 VAC, 50/60 Hz including: Mains Cord</td>
</tr>
<tr>
<td>105</td>
<td>HALOGEN Spare Lamp, 250 watt, 24 volt</td>
</tr>
</tbody>
</table>

**Cold Light Fountain XENON 300 SCB**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>20133101-1</td>
<td>Cold Light Fountain XENON 300 SCB with built-in antigog air-pump, and integrated KARL STORZ Communication Bus System SCB power supply: 100–125 VAC/220–240 VAC, 50/60 Hz including: Mains Cord SCB Connecting Cord, length 100 cm</td>
</tr>
<tr>
<td>20133027</td>
<td>Spare Lamp Module XENON with heat sink, 300 watt, 15 volt</td>
</tr>
<tr>
<td>20133028</td>
<td>XENON Spare Lamp, only, 300 watt, 15 volt</td>
</tr>
</tbody>
</table>
Equipment Cart

Equipment Cart
- wide, high, rides on 4 antistatic dual wheels
- equipped with locking brakes
- 3 shelves
- mains switch on top cover
- central beam with integrated electrical subdistributors
- with 12 sockets, holder for power supplies, potential earth connectors and cable winding on the outside.

Dimensions:
- Equipment cart: 830 x 1474 x 730 mm (w x h x d),
- shelf: 630 x 510 mm (w x d),
- caster diameter: 150 mm

including:
- Base module equipment cart, wide
- Cover equipment, equipment cart wide
- Beam package equipment, equipment cart high
- 3x Shelf, wide
- Drawer unit with lock, wide
- 2x Equipment rail, long
- Camera holder

Monitor Swivel Arm,
- height and side adjustable,
- can be turned to the left or the right side,
- swivel range 180°,
- overhang 780 mm,
- overhang from centre 1170 mm,
- load capacity max. 15 kg,
- with monitor fixation VESA 5/100,
- for usage with equipment carts UG xxx
Recommended Accessories for Equipment Cart

**Isolation Transformer**,
200 V–240 V; 2000 VA with 3 special mains socket, expulsion fuses, 3 grounding plugs, dimensions: 330 x 90 x 495 mm (w x h x d), for usage with equipment carts UG xxx

**Earth Leakage Monitor**, 200 V–240 V, for mounting at equipment cart, control panel dimensions: 44 x 80 x 29 mm (w x h x d), for usage with isolation transformer UG 310

**Monitor Holding Arm**, height adjustable, inclinable, mountable on left or right, turning radius approx. 320°, overhang 530 mm, load capacity max. 15 kg, monitor fixation VESA 75/100, for usage with equipment carts UG xxx
Headlight KS60
with Cold Light Illumination

Special features:
- Luminous field can be focused – adjustable from 20 to 80 mm at a working distance of 40 cm – resulting in brightness of over 175,000 lux
- Double lens system provides outstanding illumination in the depths of the operating field
- Precise delineation and no luminous field color margins
- Homogeneous illumination of the luminous field without shadows
- Newly designed, lightweight headband provides improved comfort, also suitable for a small head size, can be adjusted both horizontally and vertically
- Sterilizable handle allows adjustment under sterile conditions, moveable and height adjustable
- Light cable is divided in the head area, ensuring even distribution of weight
- Extremely robust and flexible light cable due to special protective casing
- Convenient light cable length of 290 cm provides greater freedom of movement

Headlight KS60, with double lens system and Y-fiber optic light cable, >175,000 lux, illuminated area adjustable from 20–80 mm with 40 cm working distance, including:

- Headlight KS60, with removable and sterilizable Focus Handle 310065
- Headband, fully adjustable, with Forehead Cushion 078511, with cross band, including holder for Headlight 310063
- Y-Fiber Optic Light Cable, with special protective casing for Headlight 310063, length 290 cm
- Clip with Band, for attaching the fiber optic light cable to OR clothing

Same, including:

- Headlight KS60, with removeable and sterilizable Focus Handle 310065
- Headband, fully adjustable, with Forehead Cushion 078511, with cross band, including holder for Headlight 310063
- Y-Fiber Optic Light Cable, with special protective casing for Headlight 310063, with 90° deflection to the light source, length 290 cm
- Clip with Band, for attaching the fiber optic light cable to OR clothing
with the compliments of

KARL STORZ — ENDOSKOPE