Aesculap® Endoscopic Thyroid Surgery

Methods, Indications, Instrumentation

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Aesculap Endoscopic Technology

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1. Preface

Operations on the thyroid are among the most frequent interventions in general surgery. As a rule, thyroid resections are performed via a six to ten centimeter long incision in the neck. This Kocher's incision, as it is called, is regarded as the gold standard and has characterized the cosmetic appearance after struma operations from more than a hundred years. For the surgeon, Kocher's incision represents a good approach to the thyroid gland, for the patient it means a lifelong scar.

The neck has a particular significance in cosmetic terms because scars in this position can hardly be permanently hidden and are visible to everyone. Especially where wound healing is disturbed or keloids form, the patient is left with a cosmetically unfavourable situation. Thus, ugly scars can also become a psychological problem. In recent years, efforts have been made worldwide to remove above all small thyroid nodules using approaches that are more advantageous cosmetically. With the help of endoscopic techniques, large incisions can be avoided and the formation of scars can be much more favourably managed. The objective is to achieve a significant improvement in the cosmetic outcome through minimizing the length of the incision and relocating the scar to a cosmetically more favourable position.

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1.1 Minimally Invasive Thyroid Surgery

The approach via the Kocher's incision is regarded as the gold standard. In recent years, increasing efforts have been made to improve the postoperative cosmetic outcome by adapting the incision length to the thyroid tissue that is to be removed. Thus nodules situated in the anterior thyroid area can be removed via minimally invasive open approaches. Video-assisted techniques also make it possible to remove thyroid lobes with small nodules via incisions up to 3 cm in length; however, the disadvantageous position of the scar remains unchanged.

Objectives for significantly improving the cosmetic outcome are to minimize the length of the incision and to relocate the scar to a more favourable position cosmetically. The endoscopic methods use various different approaches in order to meet these objectives.

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1.2 Endoscopic Thyroid Surgery

Development

Laparoscopic techniques have become increasingly widespread since the early 1990s. Endoscopic surgery on the neck, however, is a new area of minimally invasive surgery that has not so far achieved any notable importance. First indications concerning endoscopic parathyroid surgery appear in the literature in 1996 (Gagner et al). The first endoscopic removal of a thyroid lobe was reported in 1997 (Hüscher et al). This late and hesitant application can be attributed to several factors. In contrast to endoscopic interventions in the abdominal or thoracic cavity, dissection takes place in a secondary space which, although embryologically predefined, still has to be artificially created for the intervention in the shifting layers between the individual fasciae of the neck. In minimally invasive surgery, these layers are regarded as a "no man's land", and there is still no clear idea of how they can be used for endoscopic dissection. Scepticism exists in particular about whether cosmetic advantages justify a more complicated dissection procedure.

Because of the limited space and the necessary subtle exposure of epithelial corpuscles and the vocal cord nerve, this procedure can very well be described as microsurgical. This circumstance, combined with the high demands placed on the motor coordination skills of the surgeon, increases the difficulty of the operation. To perform it safely requires on the one hand sufficient experience in open thyroid surgery, especially with regard to sparing the nerves to the vocal cords, and on the other knowledge of and practice in other minimally invasive operating methods (e.g. laparoscopic gallbladder, large bowel and hernia surgery).

The structures that appear on the monitor are greatly magnified. Despite the initially unaccustomed view of the anatomical details, this almost microscopic depiction on the screen makes it possible to operate very precisely. The instrument configuration must be adapted to the small dissection space. Only endoscopic mini-instruments permit both minimal incisions with cosmetic advantages and safe and precise dissection of the structures that have to be spared.

Endoscopic surgery is justified if cosmetic and/or functional advantages can be achieved. Moreover, it must be possible to perform it safely and less invasively, and to achieve the same surgical outcome as the adequate open procedure.
A new method is only accepted if it offers a clear improvement on the conventional technique.
In endoscopic operations on the neck, this lies in the more advantageous cosmetic result.

2. Variations of Minimally Invasive Thyroid Surgery

At present, endoscopic operations on the thyroid are only offered by a few surgeons worldwide. Above all, colleagues in Japan and Italy have taken on this subject, and there are already more than 20 centres in Japan working with the new technique. Although they are using different surgical approaches, it is possible to identify a common goal of minimizing the incision length and relocating the incision to a more favourable position cosmetically. Endoscopic operations in the neck are classified into two types:

❶ Purely endoscopic operations, characterized in most cases by three mini-incisions, the use of trocars and CO_2 insufflation, and

❷ Procedures using video-assisted gasless techniques

Each of these methods offers advantages and disadvantages. From the cosmetic point of view, the endoscopic procedures are superior to the video-assisted ones, because they allow small incisions in far away or cosmetically more favourable positions. In the gasless, video-assisted procedures, it is attempted to keep the approach smaller than in the conventional operation using videoscopic vision and microsurgical instruments. However, the scar is still located in the very visible area on the neck. Furthermore, this method requires two or three assistants to set up the operating area.

As a rule, the endoscopic techniques use CO_2 insufflation to create a suitable space for dissection. It is here that the widest spectrum of approaches can be found. In addition to the obvious cervical approach, there are reports, above all from Asia, of axillary, transmammary and subclavicular approaches. The latter certainly offer scar-free conditions in the neck, but have the disadvantage of extensive long range tunneling in order to be able to operate on the target organ at all. If endoscopic dissection proves unsuccessful, the probability is that these procedures culminate in multiple incisions. Moreover, the question arises whether these techniques satisfy the requirements of minimally invasive surgery at all.

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2. Variations of Minimally Invasive Thyroid Surgery

Method	Approach	Incisions/ trocars	Insufflation	Cosmetic advantage	Switch to alternative procedure possible
Mini-incision, open	cervical central	one (3 – 5 cm)	No	+	++++
Videoassisted	cervical central	one (up to 3 cm)	No	++	++++
	submandi-bular	one (up to 3 cm)	No	++	++
Endoscopic	cervical central	3 – 4 trocars	Yes	+++	++
	thoracic	3 – 4 trocars	Yes	+++	+
	axillary	3 trocars	Yes	++++	0
	mammary	3 trocars	Yes	++++	0

3. Endoscopic Cervical Thyroid Surgery: Methods

3.1. Endoscopic lobectomy, endoscopic resection:

The operation is performed entirely endoscopically, the dissected tissue is recovered through the lateral incision with the help of a recovery bag.

3.2 Endoscopically assisted lateral approach:

3.2.1. Endoscopic phase: Mobilization of the lower and upper pole is performed endoscopically, as is the dissection of the dorsal area, as far as this is possible without increased risk.

3.2.2. Open phase: Luxation of the mobilized thyroid lobe through the slightly extended lateral incision; the operation is completed with dissection of the dorsal area and the recurrent nerve via the mini-incision.

4. Operation Technique

A transverse 7 mm incision is made in the jugular region for the first 5 mm trocar. This is followed by insertion of the 5 mm trocar and CO_2 insufflation up to 6 mm Hg. This trocar serves as an access for the 5 mm 30° scope throughout the operation. With the help of the scope, further blunt dissection is performed cranially and laterally by pushing away the connective tissue. After obtaining sufficient space between the fascia and the musculature, a second 5 mm access is made laterally under visual control on the anterior margin of the sternocleidomastoid muscle in the region of a neck fold. A 3.5 mm access is then placed between the two 5 mm accesses (Fig. 1). After the linea alba colli has been opened, the musculature is pushed away from the thyroid lobe. The isthmus is dissected and cut (e.g. using the bipolar technique). With the thyroid lobe mobilized in a medial direction, the branches of the inferior thyroid artery that radiate into the thyroid are exposed for dissection. They are cut only after the recurrent nerve has been unambiguously identified (Fig. 2). If the position is suitable, the lower parathyroid gland is seen during this dissection stage (Fig. 3). The upper pole is dissected under caudal tension. After being freed laterally, dorsally and medially, the branches of the superior thyroid artery are dissected and cut close to the capsule between clips (Fig. 4). The further mobilization of the cranial pole follows, with dissection of the upper parathyroid glands. It is only after the upper pole has been mobilized that the thyroid lobe can be ideally luxated in a medial direction and the dorsal area can be dissected, with a clear view being provided by applying appropriate tension to the tissue. If, owing to difficult conditions, it can be foreseen that the operating time will become excessive or the risk is too great, the operation is ended under endoscopic assistance. The lateral 5 mm incision is extended by 2.5 cm on average and the mobilized thyroid lobe is luxated through it. The lobectomy is completed via the mini-incision. Otherwise, with the recurrent nerve precisely exposed and spared, the upper branches of the inferior thyroid artery are cut and the thyroid lobe is dissected away from the trachea.

Fig. 1

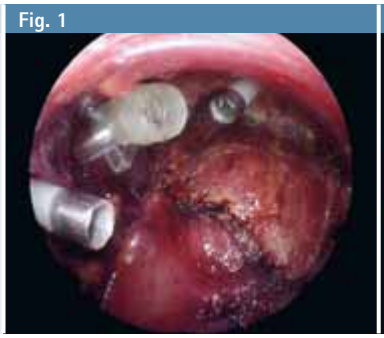


Fig. 2

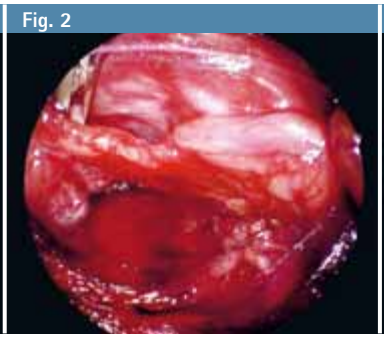


Fig. 3

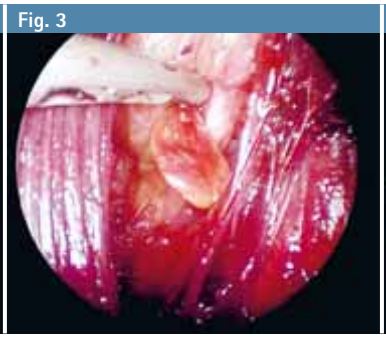
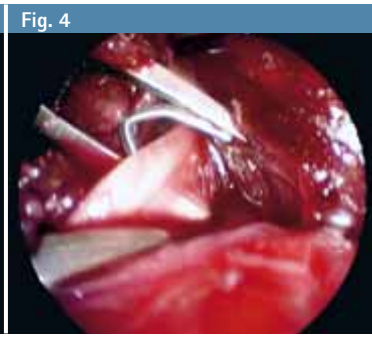


Fig. 4



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5. Instrumentation

5.1. Endoscopy unit

As an endoscopic operating technique, the procedure requires the corresponding special equipment and instruments. An endoscopy unit is available in every operating theatre nowadays, and the surgical staff are conversant with its use. Handling the camera, light source, insufflator and monitor is now part of the daily routine. Essentially, the same procedure applies as for laparoscopic operations. The only differences are the use of a (short) 5 mm 30° scope and a reduction in insufflation pressure to 6 mm Hg. Special attention should be paid to the arrangement of the camera cable, light guide cable and gas insufflation tube, since connections that are too loose or too taut can hinder the movements of the camera in the small operating field and thus become a disturbing factor.

The arrangement of the surgical team around the operating table makes the use of a second monitor essential.

5.2. Mini instruments

For cosmetic reasons, one of the usual three accesses is placed as a 3.5 mm access. Surgery through this incision is performed using corresponding instruments from paediatric surgery. Two endoscopic mini forceps and a scissor, each 20 cm long, are used here. These instruments are reusable and can be sterilized.

5.3. Bleeding control, vessel treatment

5.3.1. Titanium clips:
Since the method makes it impossible to use ligatures, vessels are closed with small-medium sized titanium clips. The applicator (Challenger Ti-P, SM) is sterilizable and compatible with 5 mm trocars. At 20 cm, its length conforms to the other instruments used.

5.3.2. Thermal haemostasis:
The most important group of instruments, without which an operation of this kind is impossible, consists of instruments for thermal tissue sealing using the bipolar technique. Ultrasound technology can be used as an alternative.

5.4. Additional instruments

A 5 mm endoscopic dissection probe is used for blunt dissection and for mobilizing the thyroid. If necessary, an endoscopic irrigation and suction unit is used. Elements from conventional instrumentation are also used, principally at the beginning and end of the operation.

6. Patient Position

6.1. Open procedure

The position is significantly different from the open procedure. Depending on the individual department and surgeon, conventional operations on the thyroid are performed with the patient in a half sitting to lying position. In this position the head is over-extended in the region of the neck in order to make the operating area less deep and thus more accessible. As a rule the left arm is positioned away from the body, and a neck roll is obligatory.

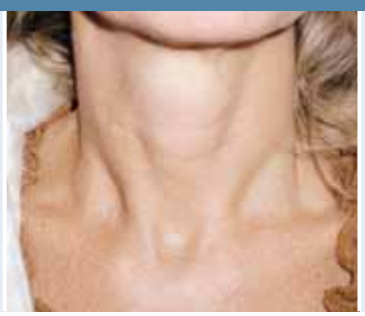
6.2. Endoscopic procedure

In the endoscopic procedure, the position of the patient differs in comparison with conventional operating methods in that over-extension of the head in the neck area is not necessary. Indeed, it would even represent an obstacle for the expansion of the connective tissue layers during insufflation. The increased tension in the musculature of the neck during over-extension would prevent the formation of a sufficiently large dissection space. One positive effect for the patients of this altered basic position is that they are to a large extent free from postoperative neck pain. Which arm can be positioned away from the body depends on the side to be operated on. Since the surgeon always stands on this side and also needs some room towards the patient's head because of the length of the endoscopic instruments, the opposite arm is always placed away from the body and the arm on the same side as the surgeon is laid against the body.

Cosmetic outcome

Open technique,
3 days postoperative

Endoscopic technique,
3 days postoperative



Endoscopic technique,
3 weeks postoperative

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7. Patients

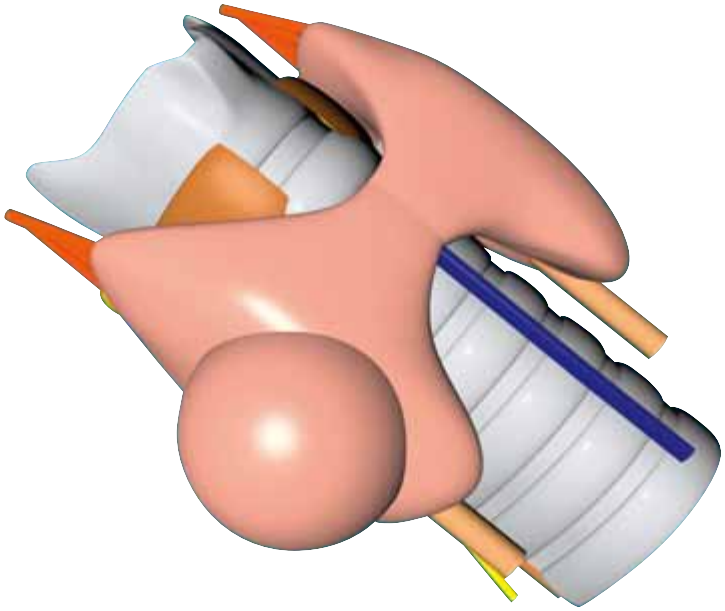
Between March 2001 and October 2010, 203 patients were operated on endoscopically in the Surgery Department at Schwarzach using a minimally invasive cervical approach. The average volume of the resected thyroid lobes was 15.6 ml (11 – 30 ml). The average size of the nodules removed was 23 mm (15 – 30 mm). Where the indication was for unilateral resection with nodules < 30 mm we offered this method after full and careful explanation. All patients to whom we suggested this procedure consented.

The duration of the surgery initially was 130 min on average (60 – 240 min) and decreased significantly over time, in line with increasing experience and better instrument equipment. Within the past three years, the average duration of the surgery was 90 min. The subcutaneous emphysema that was initially observed (CO_2 insufflation pressure of 10 mm Hg) in the neck and face area disappeared after 24 hours at most. Reducing the insufflation pressure to 6 mm Hg from the tenth patient onwards, combined with a shorter operating time, made it possible to avoid emphysema in most cases.

8. Indications

Indications
Unilateral pathology, scintigraphically and sonographically inconspicuous contralateral thyroid lobe
Nodule size < 3 cm (Exception: cysts)

Contraindications
Verified malignancy
Thyroiditis
Relapse



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8. Indications

In order to achieve the best possible results, careful patient selection plays a central role in endoscopic surgery (table). The most important factors are the nature and size of the pathology, which is preoperatively diagnosed using scintigraphy, sonography and fine needle puncture.

1. Unilateral indication: If bilateral resection is necessary, the conventional Kocher approach is sensible, since it is impossible to foresee preoperatively whether the operation can be completed endoscopically. A bilateral endoscopic operation would however relativize the cosmetic effect.

2. Nodules up to 3 cm: A solitary nodule, cold or autonomous, up to 3 cm in size is currently the best indication for this technique. Larger nodule formations make endoscopic dissection difficult because of the minimal dissection space and the reduced overview that has to be expected. In any case, a more extensive incision would be indicated in order to recover bulkier dissected tissue.

3. Relapsing cysts with a larger diameter are also suitable, since the size of the nodule can be reduced by intraoperative puncture.

4. Findings that point towards difficult dissection and inadequate layers represent a contraindication. These include relapse operations and thyroiditis. One should also refrain from performing this surgery on verified malignancies for the time being.

Aesculap® Instrumentation for Endoscopic Thyroid Surgery

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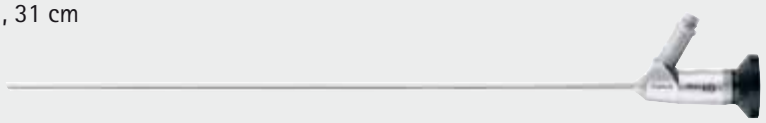
Art. No.	Pieces	Description
1. Endoscopes		
PE610A	1	5 mm Endoscope, 30°, 31 cm  or alternatively
PE505A	1	4 mm Endoscope, 30°, 18 cm 
2. Trocars		
1 x 3,5 mm trocar with suture fixation		
EK311R	1	Trocar sleeve smooth, without stopcock diam. 3.5/60 mm
EK380P	1	Sealing unit for trocars diam. 3.5 mm (20 pieces)
EK345R	1	Trocar pin, conical sharp, diam. 3.5/60 mm
EK397R	1	Suture fixation for trocars diam. 3.5 mm 
2 x 5 mm trocar with suture fixation		
EK010R	2	Trocar sleeve smooth, with stopcock diam. 5/60 mm
EK080P	1	Sealing unit for trocars diam. 5 mm (20 pieces)
EK045R	1	Trocar pin, conical sharp, diam. 5/60 mm
EK097R	2	Suture fixation for trocars diam. 5 mm 

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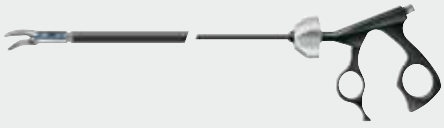
Art. No.	Pieces	Description	
3. Instruments			
PO320R	1	METZENBAUM scissors, tips curved to the left diam. 3.5/200 mm	
PO322R	1	MARYLAND, fixation and dissecting forceps, curved diam. 3.5/200 mm	
PO323R	1	Atraumatic fixation and dissecting forceps, straight diam. 3.5/200 mm	
PM410R	1	MARYLAND Fixation Forceps – bipolar, diam. 5/220 mm	
PL603R	1	Challenger Ti-P, SM clip applicator, diam. 5/205 mm	
PL574T	1	Challenger Ti-P, SM clip cartridge, 12 small-medium titanium clips per cartridge and CO_2-cylinder, last clip colour-coded (12 cartridges and CO_2-cylinders, per pack)	

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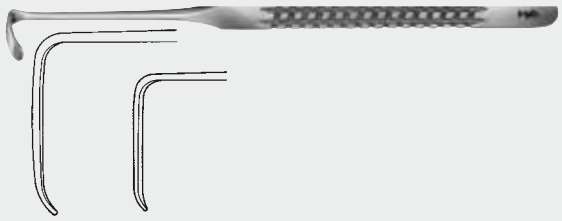
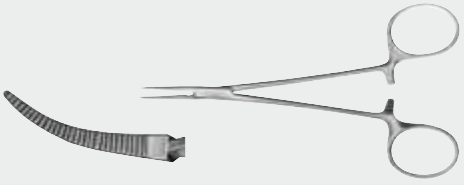
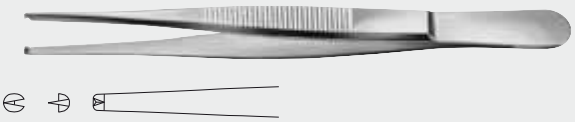
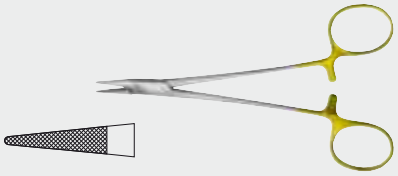
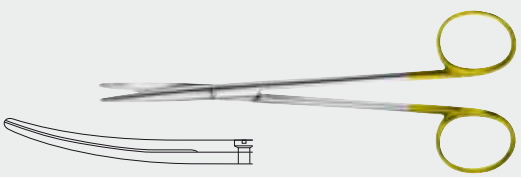
Art. No.	Pieces	Description	
3. Instruments			
BT177R	2	LANGENBECK-GREEN retractor 16 x 6 mm, 160 mm instrument length	
BT178R	2	LANGENBECK-GREEN retractor 24 x 6 mm, 160 mm instrument length	
BH111R	4	HALSTED-MOSQUITO forceps, 125 mm instrument length	
BD557R	1	Tissue forceps, 1 x 2 teeth, 145 mm instrument length	
BM013R	1	BABY CRILE-WOOD durogrip needleholder, 150 mm instrument length	
BC259W	1	METZENBAUM Durotip dissecting scissors, serrated, 145 mm instrument length	

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