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ORIGINAL ARTICLE

# The axillary access in unilateral thyroid resection

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**Abstract**
*Background and study aims* With this study, we intended to find out if it is possible to avoid the typical scar after thyroid resection by using a 20 mm axillary access and a 3.5 mm incision in the jugulum.
*Materials and methods* We present the results of our proof-of-concept study with 12 patients. For this technique, a modified axilloscope and ultrasonic scissors were used, which permit a total resection of the unilateral thyroid.
*Results* The feasibility of this endoscopic technique was shown by the successful operation of these patients with unilateral pathological findings. Furthermore, we showed that this technique allows to resect tissue up to a whole lobe while at the same time finding and identifying the recurrent laryngeal nerve and subsequently verifying the findings by using the neuro-monitoring system.
*Conclusions* This study shows that endoscopic thyroid surgery approximates the norms of endocrine neck surgery. The presented method is useful in thyroid surgery for patients with single nodules and a small thyroid gland.

**Keywords** Endoscopic surgery · Thyroidectomy · Axillary access · Endoscopic thyroid resection · Neuro-monitoring system

## Introduction

Endoscopic thyroid resections should meet the standards of minimally invasive surgery. Consequently, a minimally invasive resection of the thyroid gland should not be a compromise: it should be as safe as open surgery and the thyroid gland must be extracted without enlarging the incision. Besides, it should meet cosmetic demands, which means that it should be carried out without leaving a prominent scar in the front neck region. We present the results of our proof-of-concept study with 12 patients.

In the course of this study we wanted to find out if a resection of the thyroid using a 20 mm axillary access and a 3.5 mm incision in the jugulum is possible, thus avoiding the abovementioned scar. The technique was successfully applied in thyroid operations of corpses and living pigs before. At present, our results show that this technique is likely to become an alternative to open thyroid surgery in well-selected patients.

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## Materials and methods

Patients included in this proof-of-concept study had to meet requirements: scintiscan and ultrasound examination showed only one individual node in the thyroid gland. The volume of the thyroid gland had to be less than 30 ml.

Only patients with a unilateral node of not more than 2×2×4 cm were included. Endocrinologically inactive nodes were histologically examined after puncture. Only patients with no evidence of malignancy were included. None of the included patients took thyreostatic medicaments or suffered from hyperthyrosis. The T3 and T4 were within the reference values.

A 20 mm incision in the anterior axillary line provides access for the ipsilateral resection. The modified axilloscope with a 12° optic (Wolf Endoskopie, Knittlingen, Germany) is subsequently introduced (Fig. 1). This instrument, consisting of two telescoped tubes, is pushed

**Fig. 1** The modified axilloscope for endoscopic thyroid resections

hypodermically into the jugulum under visual control so that unnecessary injuries are avoided. When the jugulum is reached, the inner tube with its transparent top is removed so that the ultrasonic scissors (5 mm Ultracision Ethicon Endosurgery©) can be introduced for preparation. The space for preparation is created by inflating $CO_2$ gas at 6 mm pressure. Next, a 3.5 mm incision is made to permit the introduction of a trocar. After localizing the sternocleidomastoid muscle, we start to prepare towards the thyroid along the side of the muscle. The ipsilateral strap muscles are divided lengthwise between the omohyoid and sternohyoid muscles. After the identification of the ipsilateral thyroid, we hold and lift it carefully with a forceps. In each patient the ipsilateral recurrent laryngeal nerve is dissected first and visually identified. The Medtronic© neuro-monitoring system (Jacksonville, USA) permits to prove the recurrent laryngeal nerve. When the nerve was identified, we start to dissect the thyroid using ultrasonic scissors. The resected tissue is extracted via the 20 mm tube. A redon drain without suction was inserted via the axillary incision and remained for 24 h (Figs. 2 and 3).

Sufficient informed consent and agreement in accordance with the Helsinki declaration were obtained from the

**Fig. 2** The axilloscope on the patient's left side

**Fig. 3** The hypodermic approach from the axilla to the jugulum

patients. All patients were informed about open and endoscopic surgeries such as conversion to open surgery and complications, the amount of tissue we intended to resect and were told what consequences they might have to expect after post-operative histological examination. They were free to choose between being operated in the conventional open way and in the here described endoscopic technique. The ethics committee of the LAEK Hessen (No. 32005) approved the endoscopic procedure.

## Results

We have operated on 12 patients (11 female, 1 male) according to the above described technique, using a left side access with 8 patients and a right side access with 4 patients. The patients were between 34 and 64 years old (average 42.8 years) (Table 1).

Of these 12 patients, 6 had antero-lateral isthmus nodes removed, so that it was very difficult to reach the nerve with the inflexible and straight probe of the neuro-monitoring system. However, in two cases, we performed a hemithyroidectomy using the neuro-monitoring system to prove the identification of the recurrent laryngeal nerve. In one case, two nodes in the lower pole were resected by an enlarged resection of the lower pole with the neuro-monitoring system being used for proving the visually identified recurrent laryngeal nerve. In the other three operations, we made a sub-total resection including the isthmus. In one of these cases, the neuro-monitoring system was successfully used; in the other cases, we were certain to have identified the recurrent laryngeal nerve visually. Because of the necessity of an additional incision for the exact positioning of the neuro-monitoring probe, we decided against using the system. The average operation time was 120.5 min (88 to 151 min).

The average weight of the resected tissue was 19.6 g. In all cases, it was possible to extract the thyroid tissue via the

**Table 1** Data on operation type, blood loss, weight, operation time and identification of the recurrent laryngeal nerve in 12 patients

| | Number of patients | Blood loss till 24 h after beginning the procedure (ml) | Average weight of resected tissue (g) | Average operation time (min) | Successful identification of the recurrent laryngeal nerve (in %) with the neuro-monitoring system | Successful visual endoscopic identification of the ipsilateral recurrent laryngeal nerve (in %) |
|---|---|---|---|---|---|---|
| Hemithyroidectomy | 2 | 18 (15, 21) | 26 | 148 (141–151) | 100 | 100 |
| Unilateral subtotal resection | 3 | 20 (7, 11, 42) | 23 | 130 (114–142) | 33 | 100 |
| Unilateral enlarged lower pole resection | 1 | 12 | 24 | 142 | 100 | 100 |
| Isolated resection of isthmus nodes | 6 | 12 (3–22) | 15 | 103 (88–111) | 0 | 100 |

20 mm tube without its touching other tissue and without enlarging the incision. No complications whatsoever—bleeding, infection—were observed with any of these 12 patients and none had persisting subcutaneous emphysema.

The patients stayed in the hospital for an average of 3.4 days (3–6 days). Our subjective impression is that patients suffer less from perioperative pain than after open surgery. Ultrasonic controls after the operation (days 2, 7, 14 and 30) and a histological examination of the resected tissue showed the correct resection of the pathological tissue in each case. The function of the recurrent laryngeal nerves in all 12 patients was shown by post-operative laryngoscopy.

The scintiscan of the patients 8 weeks after surgery and the follow up examination with ultrasound examination 6 months after surgery proved the complete resection of the nodes and regular results (Fig. 4).

At that time the patients' cosmetic results were very good: the small incision scar in the front neck region had disappeared, there was no other scar here and the axillary scar was small and hidden in the armpit (Fig. 5).

## Discussion

Cosmetic aspects have become increasingly important in thyroid surgery. On these grounds it makes sense, and is important, to develop endoscopic or minimally invasive techniques of operating on the thyroid and parathyroid gland because scars are particularly prominent in the front neck region. Young women in particular consider such scars as disturbing or even disfiguring, even when they are quite small and unobtrusive [1–3].

In 2002, Miccoli described a video-assisted resection of the thyroid gland (MIVAT) for which an incision of only 2 cm in the anterior was necessary [4].

However, the era of endoscopic endocrine neck surgery begun with the first description of a parathyroidectomy using $CO_2$ inflation [5] in 1996. Less than 2 years later, Yeung [6] reported on endoscopic thyroid resections. Since then, quite a number of similar reports were published with all of them describing an access aloof from the anterior neck region. Such accesses are the lateral neck [7], chest [8, 9], axillary [9–11] or a combined bilateral breast–axillary [12, 13] access. It is the aim of such procedures to achieve an optimal cosmetic result while keeping the access trauma acceptable [14, 15].

The use of the term "minimally invasive" in the context of axillary or breast access was criticised. A long access cannot be called minimally invasive, even if the cosmetic result is good. It is therefore important to apply significant pre-conditions and standards of open endocrine surgery to endoscopic techniques to avoid a compromise that favours cosmetic aspects at the expense of the patient's security and the quality of the result [16]. This is particularly valid concerning the extent to which one resects thyroid tissue. The resection of an isolated node is contrary to the demands of endocrine surgery, but more easily realized with endoscopic techniques than a complete resection. It follows that the measure of resection must be the same in endoscopic or minimally invasive endocrine surgery as in conventional operation techniques [17], which was not the case in our study because in our opinion the pre-operative

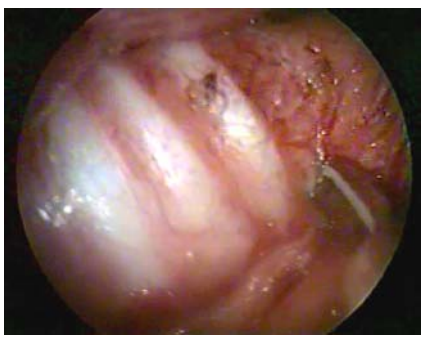

**Fig. 4** The trachea and the recurrent laryngeal nerve after hemithyroidectomy

**Fig. 5** Cosmetic result 20 days after hemithyroidectomy

examinations and the benefits that were to be expected justified a deviation from these standards. We explained to our patients that we had carefully considered the ensuing risks before the operation. All patients demanded the endoscopic procedure nevertheless.

Another important point is the safety of the recurrent laryngeal nerve.

The majority of the authors who report on endoscopic thyroidectomy call for an intra-operative identification of this nerve. The neuro-monitoring system is seen as quite helpful if such an identification proves to be difficult and thus more and more often asked for. This is another aspect, which has not yet been given due consideration in endocrine endoscopic surgery. The instrument we developed for this technique and the operation technique itself make it easy to find and identify the recurrent laryngeal nerve: the surgeon here profits from the benefits of endoscopic surgery. Consequently, we believe that using the neuro-monitoring system for verifying the findings might be less necessary and seems acceptable to us to do without it if the nerve has already been clearly identified and is very difficult to reach with the inflexible and straight probe of the neuro-monitoring system.

All in all, we believe that the following requirements were met in our study: The access trauma was as small as possible and did not significantly exceed the access of open video-assisted surgery. The access itself was close enough to the thyroid gland to deserve the term minimally invasive and not just endoscopic [18]. The result of the operation was optimal and would not have been any better had we opted for open surgery: if the scars in the front neck region disappear, this should not entail larger scars in other places that are bigger than those caused by open surgery [8]. It was possible to resect the specimen of the thyroid tissue in all—e.g. in the case of follicular neoplasias in particular it is vital to safeguard the complete integrity of the resected tissue so that it may be classified correctly. The extraction of the resected thyroid tissue via the modified axilloscope was comfortable and is one of the great advantages of the described procedure because the resected thyroid tissue does not have any contact with other tissue in the access channel.

Our experience shows that by using the above described procedure the hypodermic access to the jugulum under visual control does not cause any problems. A complicated step of the procedure is the correct access through the strap muscles because there are no landmarks to facilitate orientation. Due to this lack of anatomical landmarks, this is probably the most difficult part of the procedure. It is much easier to find your way using your index finger, which, however, is only possible in slender patients. When operating on patients with broad shoulders, a compromise needs to be found. This could be to choose a more medial access, which enables the surgeon to use his index to safeguard a correct preparation, but has, considering cosmetic aspects, less acceptable results. However, such patients with digital support for orientation were not included in the presented study.

Once the thyroid was detected, it is as simple to identify the important structures as in open surgery. For lifting up the muscles in front of the thyroid gland, we used a suture that is inserted through the skin. Identifying the recurrent laryngeal nerve is easier than in open surgery because the pictures transmitted by the camera are enlarged.

The preparation with the ultrasonic scissors permits resection without any bleeding. All vessels can be cut without clipping. A problem might be the temperatures the ultrasonic scissors produces when cutting. One of the animals operated on in this technique before this study had an invisible tracheal lesion that we noticed due to hypodermic emphysema that persisted after we had removed the tracheal tube. Possibly, 15% of all patients may be operated in such an endoscopic technique in the future [6]. With getting more experience in this technique, the operation time could be reduced in the future. The realistic aim should be an endoscopic standard procedure as a hemithyroidectomy.

## Conclusion

To sum up, we can say that this procedure is appropriate for the resection of unilateral nodes of the thyroid gland. Our study shows that endoscopic thyroid surgery can approximate the norms of endocrine neck surgery. The presented technique may become standard in thyroid surgery for patients with single nodules and a small thyroid gland.

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