

# I. NECK, EARS, MOUTH

# Goiter

Günter H. Willital

## 1. Description of different anatomical variations of the thyroid gland (Fig. 1)



Fig. 1: Survey on the 10 most frequent variations of the thyroid gland.

1) large isthmus; 2) isthmus and middle lobe; 3) agenesis of isthmus; 4) agenesis of isthmus; 5) hypoplasia of right lobe; 6) hypoplasia of left lobe; 7) large middle lobe; 8) double pyramidalis lobe; 9) right pyramidalis lobe; 10) left pyramidalis lobe

## 2. Skin incision

The patient is positioned so that the neck is hyperextended (Fig. 2). The skin is incised parallel to the natural skin folds of the neck, about 2 cms above the manubrium, and extended laterally as shown (Fig. 3).

## 3. Subcutaneous tissue

Incision of the subcutaneous tissue, skin mobilization from the superficial fascia of the neck. Superficial veins are ligated (Fig. 4). In order to isolate these neck veins, the tissue is incised longitudinally along the veins. These structures can easily be identified and then ligated twice, proximally and distally.

Further mobilization of the skin from the subcutaneous tissue and the superficial veins is performed proximal to the skin incision. The tissue is lifted up by 1 or 2 sharp hooks (**Fig. 5**). Further dissection up into the neck is necessary to facilitate the later exposure of the upper poles of the left and right lobes of the thyroid gland. In this case, two LANGENBECK hooks are used in order to retract the tissue (**Fig. 6**).

#### 4. Cutting the infrahyoid muscle layers

A midline incision of the fascia is performed between the infrahyoid muscles and below the hyoid bone. These muscles cover the thyroid gland. The muscle layers are mobilized from the anterior surface of the gland by blunt dissection. Through this maneuver, the gland is exposed and can then be dissected. If necessary, the infrahyoid muscle layers are divided transversely using diathermy and the sternocleidomastoid muscles on either side are retracted using ROUX-hooks (**Fig. 5**).

#### 5. Dissection of the right/left lobe

It is advised to start the operation on the side with the largest swelling. Dissection is commenced at the lower pole by blunt dissection and from there, proceeding to the lateral aspect and then to the upper pole of the gland.

#### 6. Ligation of the upper pole vessels

Two stay sutures are inserted through the tissue of the upper pole. These stay sutures are tied. A LANGENBECK hook is utilised to provide exposure of the upper pole vessels. Demonstration of the vessels is improved by retracting the stay sutures downwards. The vessels are mobilized by blunt forcep dissection. A probe is inserted behind the vessels, which are then ligated proximally and distally (**Fig. 6**). In a similar way, the inferior thyroid artery and vein are identified and ligated, and the recurrent laryngeal nerve protected.

#### 7. Isthmus to the contra-lateral side

In 15% of individuals, anatomical abnormalities of the thyroid gland are present (**Fig. 1**). If there is such a communication between the right and left lobe, blunt dissection is performed to separate the isthmus from the trachea. The isthmus is divided between ligatures.

#### 8. Resection of the goiter

Multiple KOCHER clamps are applied to the vessels which are visible on the lateral aspect of the thyroid capsule (**Fig. 7**). They are applied in a manner which leaves a rim of about 20-30mm of the capsule. Above these clamps, the goiter is resected from above, downwards (**Fig. 8**). In order to avoid damage to the trachea, the surgeon places a finger tip on the lateral side of the trachea behind the goiter. Bleeding vessels are clamped during the resection. After resection, additional tissue or nodes are excised using scissors. At the end, a small tissue rim of about 10-15 mm. is left.

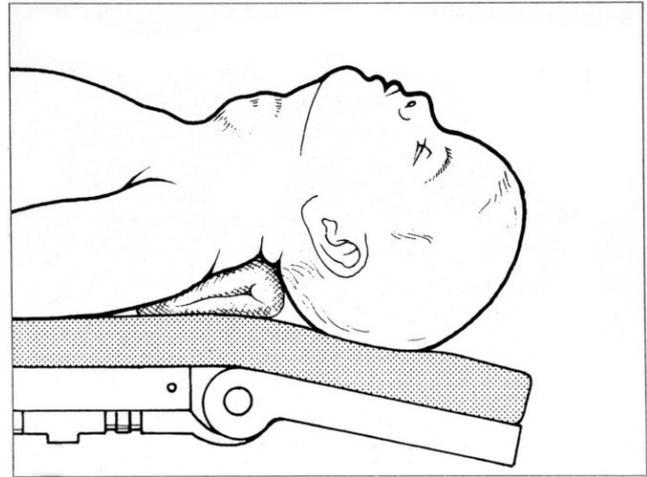


Fig. 2: The patient is positioned so that the neck is hyperextended.



Fig. 3: The skin is incised parallel to the natural skin folds of the neck, about 2 cms above the manubrium.

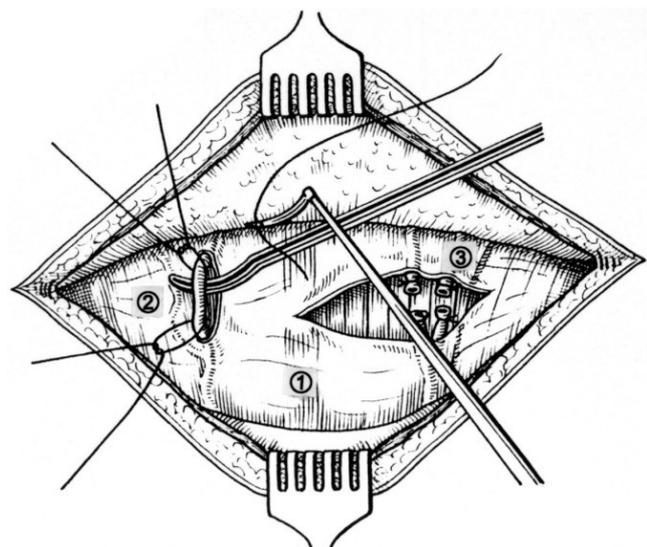


Fig. 4: Superficial veins are ligated. 2) platysma, 1) and 3) deeper veins are ligated and cut on the left side (3).

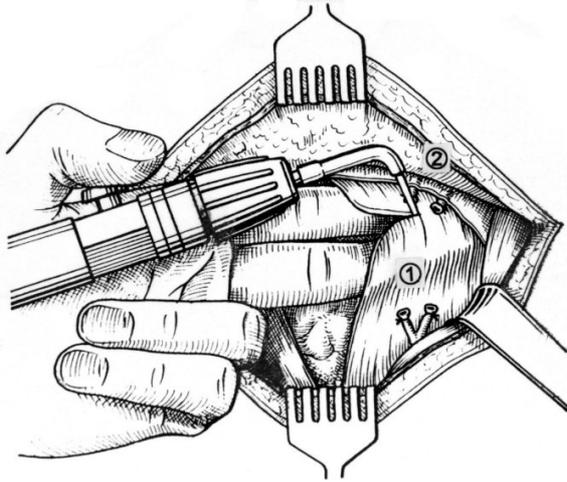


Fig. 5: Cutting the infrahyoid muscle layers.  
1) platysma; 2) ligated and divided superficial veins.

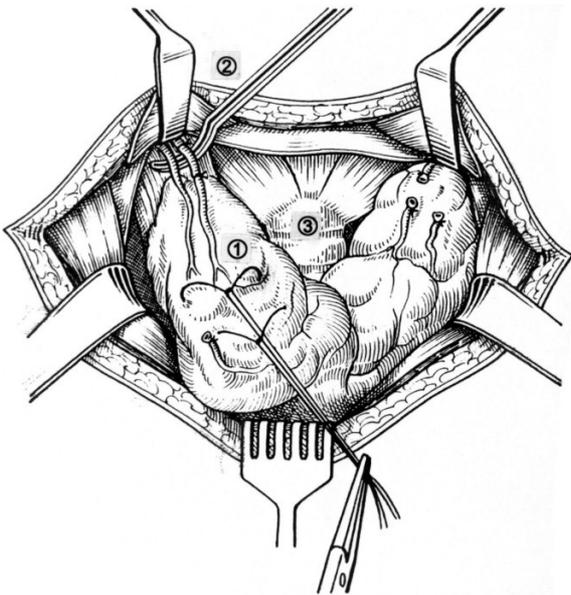


Fig. 6: Ligation of the upper pole vessels.  
1) stay suture right upper lobe; 2) upper pole vessels; 3) trachea;

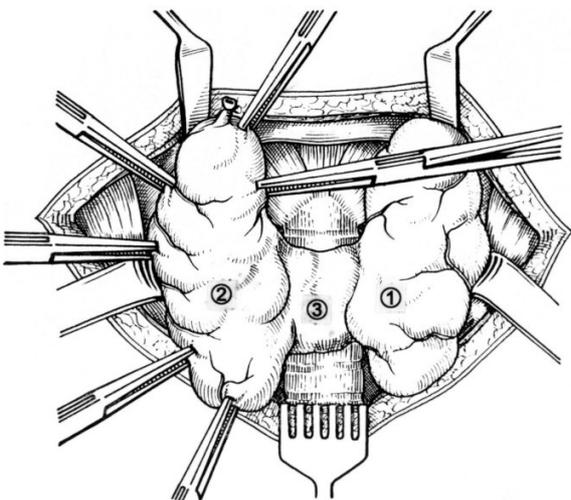


Fig. 7: Multiple KOCHER clamps are applied to the vessels which are visible on the lateral aspect of the thyroid capsule.  
1) left lobe; 2) right lobe; 3) trachea behind isthmus

Following resection of the goiter, the remaining capsule and thyroid is sutured (Vicryl 3/0 or 4/0). Clamped vessels are doubly ligated. Suturing of the rims of the capsule is performed in a sagittal manner. All bleeding vessels are ligated or closed by this procedure (Fig. 9). The same procedure is performed on the other side.

## 9. Wound drainage

In all cases, a wound drain is inserted in front of the resected goiter and behind the sternocleidomastoid muscle, and is brought out at a site remote from the incision.

## 10. Wound closure

The infrahyoid muscles and the platysma are sutured using interrupted sutures. The skin is closed with an intracutaneous suture (Fig. 10).

A child – friendly plaster to cover the wound is recommended (Trusetal Master Aid); this plaster can be removed completely painless for the child.

### Points to be observed – How to avoid complications:

1. Bleeding from upper pole vessels: All vessels, regardless of their origin and course, must be doubly ligated. Vessels at the upper pole must be handled very gently in order to avoid rupture and severe bleeding. The vascular supply of the thyroid gland is demonstrated in Fig. 11.
2. Damage to the recurrent laryngeal nerve: Prior to operations on the thyroid gland, laryngoscopy should be performed in order to ascertain the function of the vocal cords. A description of the anatomical location of the recurrent laryngeal nerve is given in Fig. 12. Temporary disturbance of function of the nerve may be caused by traction, compression during the operation, or by diathermy. Special care must be taken during dissection of the thyroid gland on the lateral and posterior side to avoid injury to the nerve.
3. Iatrogenic resection of the parathyroid glands: Signs of tetany occur within the first 24 hours. Parathyroid function usually recovers within 3-4 months. Permanent tetany signs occur in only 1% (Fig. 13).
4. Genetic hypocalcemia (DI GEORGES sequence) should be excluded in postoperative disorders.
5. In case of a beginning wound dehiscence or scar formation, local application of Contractubex<sup>R</sup> is recommended. In order to achieve a small scar and a cosmetic good result it is advisable to apply Contractubex<sup>R</sup> locally for 3 – 5 min. starting 2 – 3 weeks after surgery over a 3 – 6 months time.

**Key words:** goiter; thyroid gland; recurrent laryngeal nerve; parathyroid glands

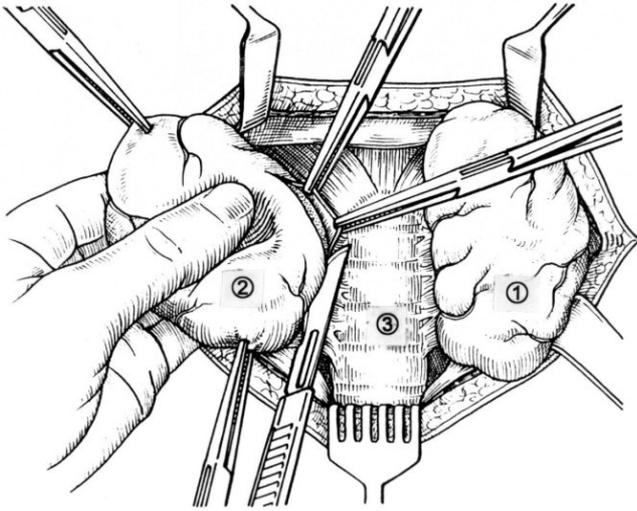


Fig. 8: Resection of the goiter.  
1) left lobe; 2) right lobe; 3) trachea  
In this case no isthmus is present.

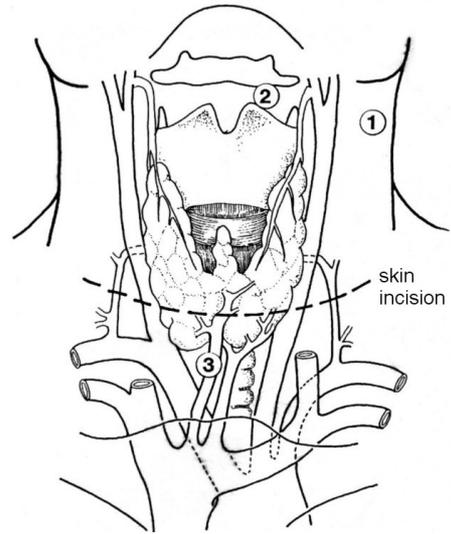


Fig. 11: Surgical anatomy of the vascular supply of the thyroid gland.  
1) common carotid artery; 2) upper thyroid artery; 3) lower thyroid artery

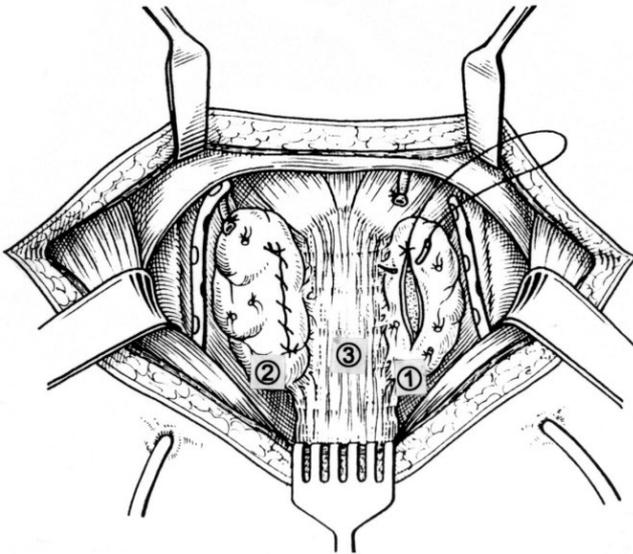


Fig. 9: Remaining capsule is sutured.  
1) rest of left lobe; 2) rest of right lobe; 3) trachea

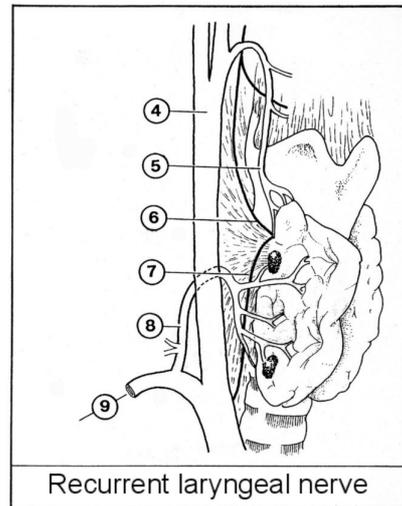


Fig. 12: Surgical anatomy of the recurrent laryngeal nerve.  
4) common carotid artery; 5) upper thyroid artery; 6) upper branch of recurrent laryngeal nerve; 7) recurrent laryngeal nerve; 8) inferior thyroid artery; 9) subclavian artery

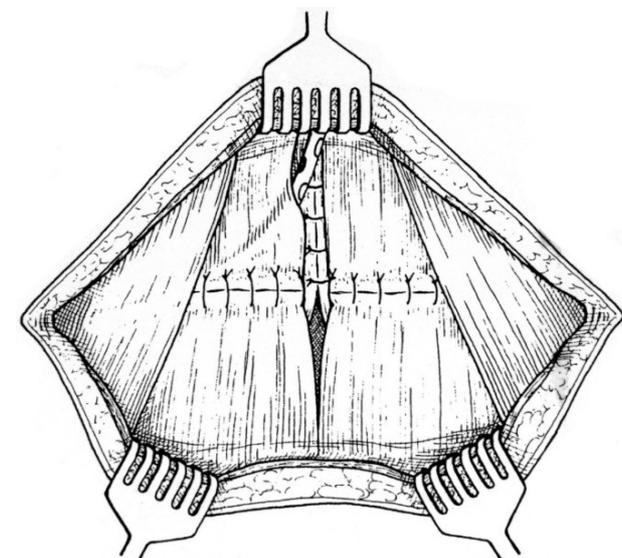


Fig. 10: The infrahyoid muscles and the platysma are sutured.

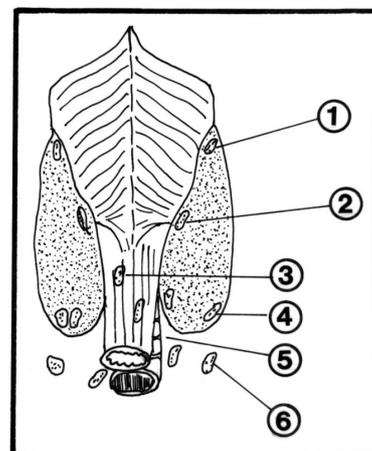


Fig. 13: Localisation of parathyroid glands (posterior aspect).  
1) retrothyroid proximal; 2) retrothyroid middle; 3) retroesophageal; 4) retrothyroid distal; 5) paraesophageal retrotracheal; 6) infrahyoidal

# Torticollis

Marcia A. Cavalaro Pereira da Silva, Günter H. Willital

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## 1. Position of the child

The child is positioned with minimal hyperextension of the neck. The entire operating field is masked using sterile drapes.

## 2. Skin incision

A 2-4cm long horizontal incision is made just above the indurated fibrous muscle (**Fig. 1**).

## 3. Isolation of fibrous muscle

Using two hooked retractors, the skin and the subcutaneous tissue are held apart to allow visualization of the sternocleidomastoid muscle. The sternal (two parts: superficial and deep muscle layers), as well as the clavicular insertions of the sternocleidomastoid muscle are identified (**Fig. 2**). Frequently, the lateral part of the sternocleidomastoid muscle (clavicular segment) is not affected by fibrous contraction. The fibrous segment of the medial part of the muscle (sternal segment) is released on both sides digitally and with a dissector (right angled clamp), until the posterior part of the muscle has been completely mobilized. The common carotid artery and internal jugular vein are located just a few millimeters below the dissection area (**Fig. 2**).

## 4. Where to perform the resection – histological borderline (LEHMANN recommendation to prevent recurrency)

The fibrous part of the muscle is then held upwards using two loops (Mersilene bands), or by a dissector to avoid injury to the underlying structures. The fibrous segment is then resected. Both the superficial, as well as the deep parts of the fibrous muscle (sternal section of muscle) must be divided until normal muscle is encountered, otherwise recurrence may ensue (**Fig. 3**). Histological investigations have shown that there is a transitional zone from fibrous tissue to normal muscle layers (LEHMANN).

Therefore, a margin of 1-2mm of tissue should be resected on each side of the fibrous tissue in order to avoid such a recurrence (LEHMANN). A fine diathermy needle or a laser Nd-YAG (1064 nm), can be used for this resection.

## 5. How to avoid scars of the neck

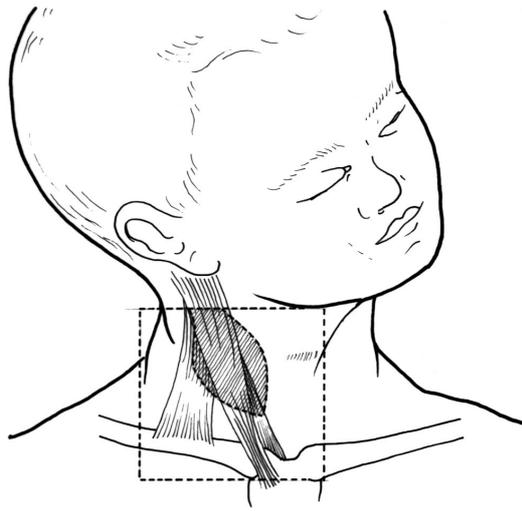
Surgical technique comes first. An additional important point is: in order to achieve cosmetically a nearly invisible scar, postoperative application of Contractubex® (mederma® care) two times a day, starting between 2 to 4 weeks

after wound closure is essential. Local treatment should be continued 4 to 6 months.

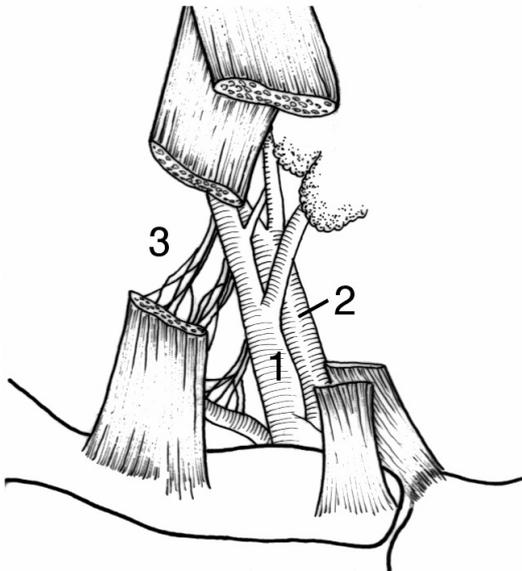
### Points to be observed – How to avoid complications:

1. All bleeding vessels are coagulated using cautery or laser application.
2. Care must again be taken not to injure the internal jugular vein, external jugular vein, the carotid artery, or the fibers of the cervical Plexus (**Fig. 2**).
3. After complete isolation, a 10-25mm thick, fibrous segment of the muscle is resected to avoid fibrous overbridging of the muscle at a later stage.
4. The ends of the sternocleidomastoid muscle are not sutured.
5. Finally, the superficial fascia can be re-sutured using continuous sutures.
6. At the time of surgery, hemostasis is a very important issue. A hematoma can be avoided by using a diathermy dissection. Larger superficial veins may require ligation and division if they cannot be retracted.
7. It is important to dissect the sternocleidomastoid muscle carefully so as to avoid injury of the internal jugular vein and carotid artery, which lie directly posterior to the muscle.
8. Careful inspection and palpation of the neck for residual tightness and bands at the time of surgery should prevent persistent torticollis. Both heads of the sternocleidomastoid muscle, and cervical fascia must be divided, with special attention not to injure the brachial plexus and accessory nerve, which lie posterior to the clavicular branch of the muscle.
9. Recurrent torticollis is rare after surgery, occurring in less than 3% of patients.
10. All bleeding vessels are coagulated using cautery or laser application. After resection of the fibrous segment, the white fascia between the sternocleidomastoid muscle is usually palpable. Care must again be taken not to injure the cervical plexus.
11. The extremely seldom occurring ANGELMAN syndrome should be excluded.

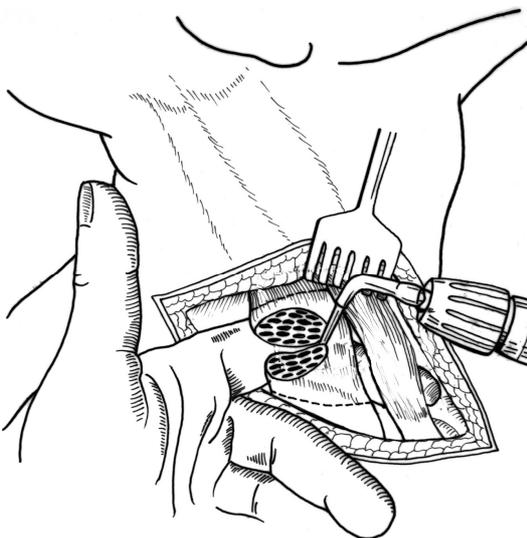
**Key words:** *sternocleidomastoid fibrous tumor; sternocleidomastoid muscle; surgical anatomy of the sternocleidomastoid muscle; torticollis operative technique; torticollis laser cutting technique*



*Fig. 1: Fibrous sternocleidomastoid muscle (dotted area). Resection line 1-2 mm beyond macroscopically normal looking tissue to avoid recurrency (see also under point 3).*



*Fig. 2: Surgical anatomy (right side of the neck) of 3 segments of the sternocleidoid muscle, jugular vein 1); ca-rotid artery 2); cervical plexus 3).*



*Fig. 3: Cutting the sternocleidomastoid muscle with a safety zone following the recommendations of LEHMANN.*

# Lateral Cyst/Fistula of the Neck

Günter H. Willital

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## 1. Position of the head of the child

The head is turned to one side and is in a slightly hyperextended position.

## 2. Surgical anatomy, localization of the cyst/fistula (Fig. 1-2)

The opening of the fistula to the skin is cannulated by a small probe. A mixture containing methylene blue dye and saline, is injected through the probe. The probe is fixed to the skin by a U-suture. Through this procedure, the whole contrast fluid is injected under pressure, filling even small parts of the fistula which provides the surgeon with an ideal orientation during the operation (Fig. 3).

## 3. Treatment of an abscess

In case of an abscess, the primary procedure is a double incision of the skin in order to decompress the abscess. The abscess is cleansed with saline, and a local antibiotic is applied. A complete excision of the fistula is performed 5-7 days after the local infection has disappeared.

In order to avoid an inflammation i.v. administration of antibiotics for example Amoxicillin-ratiopharm<sup>R</sup> is recommended.

## 4. Excision of the fistula/cyst

A small circumcission around the opening of the fistula and around the probe, is made in a horizontal way. Instead of this incision, a longitudinal incision at the anterior side of the sternocleidomastoid muscle is performed in order to identify the fistula more clearly. The direction of the fistula in the subcutaneous tissue is identified through this incision. The fistula either extends proximally by running between the internal and external carotid arteries (Fig. 3), or ends blindly after a few millimeters in the subcutaneous tissue. In this case, the skin and fistula are excised completely and the subcutaneous tissue and the skin are closed.

## 5. Communication of the cyst/fistula

If however, the fistula runs upwards into vascular region (Fig. 3), the probe within the fistula is pulled downwards so that the surrounding tissue comes under tension. The connective tissue is cut with a pair of scissors in order to free the fistula. The wound is opened with blunt and sharp hooks. This can easily be performed because the blue tinged fistula can be identified and followed up very easily.

## 6. Double skin incision

In most cases, the fistula runs at the anterior side of the sternocleidomastoid muscle. If a horizontal skin incision has been performed, another one must be made 3-5 cm parallel and

proximal to the first one. If however, a longitudinal incision has been performed, this additional incision is not necessary (Fig. 4).

## 7. Excision of the fistula and closure

If a double skin incision has been performed, the opening of the fistula with the surrounding skin, is mobilized and pulled out through the upper horizontal skin incision and kept under tension by stay sutures. Further dissections are performed through the second upper incision. The fistula runs between the bifurcation of the carotids and above the hypoglossal nerve (Fig. 5). The blue color of the fistula acts as a guidance. If in this situation the fistula is still under tension from surrounding connective tissue, it can be cut and identified within the deep fascia of the neck. At this stage, an overhold is applied, and the fistula is clamped, ligated, and then cut over the overhold.

It should be kept in mind that besides the mentioned direction of the fistula between the bifurcation of the carotids and above the hypoglossal nerve (83%) there can also be another direction of the fistula behind both carotid arteries and also above the hypoglossal nerve (17%).

## 8. Wound closure

Following this procedure, a wound drainage is applied.

The longitudinal skin incision, along with the double horizontal skin incisions, is closed by subcutaneous inverted single stitches, and an intracutaneous suture, respectively.

### Points to be observed – How to avoid complications:

1. The fistula should be followed up to the internal and external carotid arteries. The fistula should be ligated and cut. Care should be taken not to tear the fistula out of the tissue.
2. A double skin incision gives a better overview of the topographic anatomical location of the fistula.
3. Pressure on the tonsil from inside the mouth with the finger in order to push the fistula forward into the operating field to enable a safer closure of the fistula.
4. Preauricular pits, sinuses or accessory auricles should be excised. Infected lesions may need to be incised before definitive surgery. Preauricular sinuses have in most cases a S-shaped configuration, which is complicated by a higher recurrence rate.
5. In case of a beginning wound dehiscence or scar formation, local application of Contractubex<sup>R</sup> is recommended. In order to achieve a small scar and a cosmetic good result it is advisable to apply Contractubex<sup>R</sup> locally for 3 – 5 min. starting 2 – 3 weeks after surgery over a 3 – 6 months time.

**Key words:** lateral cyst of the neck; fistula of the neck, sinuses of the neck

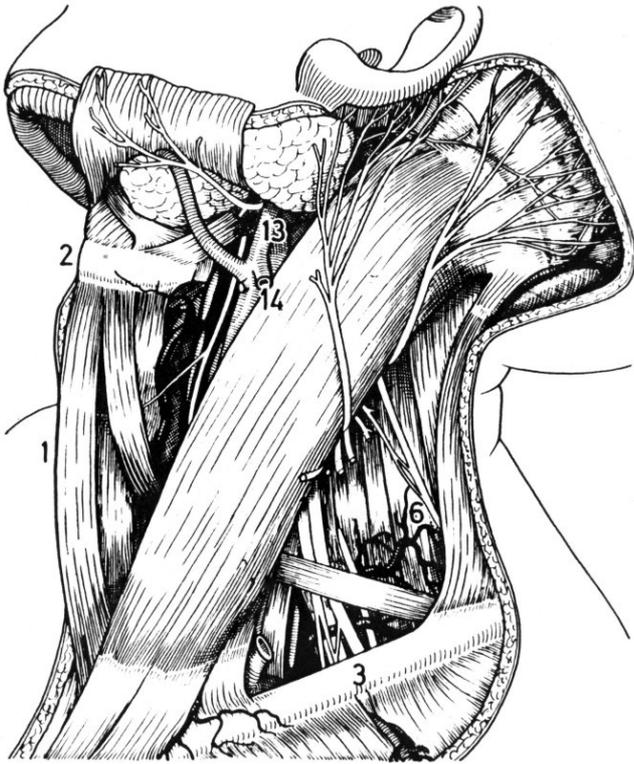


Fig. 1: Surgical anatomy of left side of the neck.  
 1) sterno-hyoid muscle; 2) hyoid bone; 3) clavicle; 6) plexus cervicalis; 13) internal carotid artery; 14) superior thyroid artery

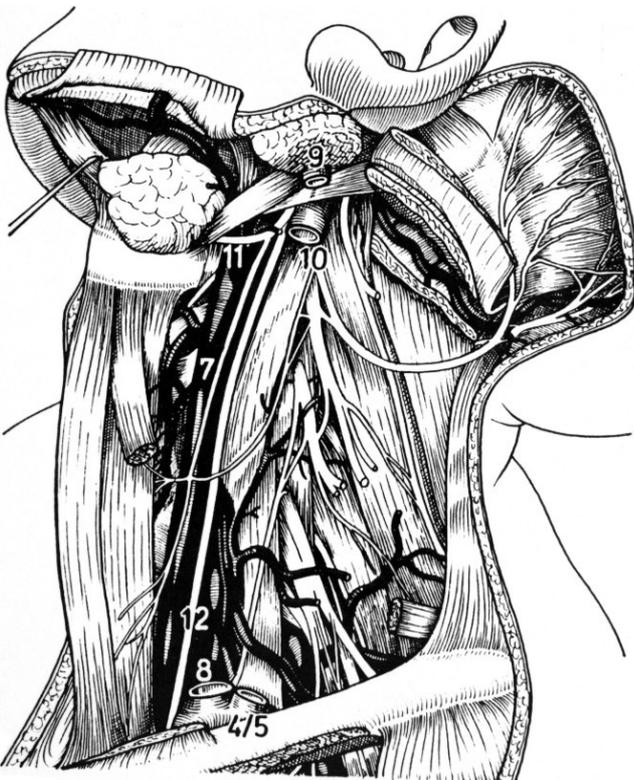


Fig. 2: Surgical anatomy of the left side of the neck after having cut the sternocleidomastoid muscle.  
 4/5) internal/external jugular vein; 7) superior thyroid artery; 8) subclavian artery; 10) internal jugular vein; 11) hypoglossal nerve; 12) vagal nerve

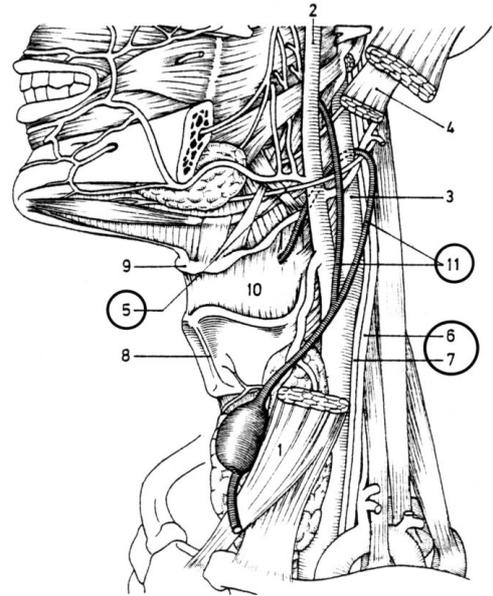


Fig. 3: Surgical anatomy of the two possible locations of the lateral left sided fistulae of the neck.  
 1) sternocleidomastoid muscle; 2) external carotid artery; 3) internal carotid artery; 4) digastric muscle; 5) hypoglossal nerve; 6) vagal nerve; 7) sympathetic trunk; 8) thyroid cartilage; 9) hyoid bone; 10) infrahyoid muscle layers; 11) topographic anatomical locations of lateral fistulae of the neck

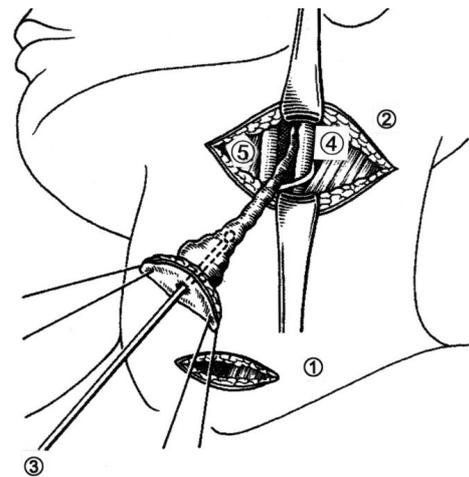


Fig. 4: Double skin incision to identify the course of the fistula of the neck.  
 1) sternocleidomastoid muscle; 2) and 3) probe inside the fistula; 4) hypoglossal nerve; 5) carotid artery

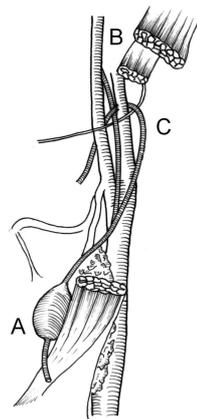


Fig. 5: Lateral fistula (A) of the neck: The fistula (A) runs between the bifurcation of the carotids (B) or above the hypoglossal nerve (C).

# Median Cysts of the Neck

*Jerzy Czernik*

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## 1. Positioning of the child's head

The child is in the supine position. The head is hyperextended (Fig. 1).

## 2. Local aspect

- In the case of a fistula to the skin, a local perforation of the cyst through the skin has occurred.
- If there is an abscess, the cyst has become infected.

## 3. Skin incision

Horizontal skin incision (Fig. 1) around the opening is performed within a distance of 3-4 mm from the opening itself. The skin incision can be extended laterally. If a fistula is present, a probe is placed inside and filled with methylen blue dye for better identification.

In case of a cystic hygroma (see also under point 10 of complications) with extension into the mediastinum a one stage resection through an "inverted hockey stick" incision (GROS-FELD) is the best approach.

## 4. Dissection of the cyst and the fistula

Dissection with an overhold and scissors is performed along the blue tinged tissue surrounding the cyst, without opening the fistula itself. Dissection is performed up to the hyoid bone. The fistula runs either above the hyoid bone, below, or through the hyoid bone itself (Fig. 2).

## 5. A cyst is present, but a fistula can not be found

If there is a cyst without a fistula, a horizontal skin incision is performed, the cyst is grasped, and two stay sutures are applied. These two stay sutures enable the cyst to be lifted up, or pulled in a desired direction, exposing the hyoid bone and a possible connection to a fistula. This is the so called "thyroglossal duct" (Fig. 2).

## 6. Cutting the hyoid bone

After the identification of a fistula travelling to the hyoid bone, right angled forceps are used to dissect along the fistula and around the hyoid bone. The hyoid bone is then cut either by diathermy or with scissors, lateral to the fistula (Fig. 3).

## 7. Closure of the fistula

On the dorsal side of the hyoid bone, the fistula runs to the tongue. Approximately 3-4mm away from the dorsal side of

the hyoid bone, the fistula is grasped by an overhold and cut with a knife, allowing extraction of the entire "skin-fistula-bone segment". The fistula, together with the bone, is excised completely (Fig. 4). The overhold is grasped and pulled slightly forward in order to place a stitch behind it, through the rest of the fistula which has been left in place.

## 8. Closure of the wound

The muscle layers of the omohyoideus are readapted. A drainage can be applied. Closure of the skin is performed with subcutaneously inverted sutures, and an intracutaneous suture of the skin.

A child – friendly plaster to cover the wound is recommended (Trusetal Master Aid): this plaster can be removed completely painless for the child.

## 9. Points that should be observed

Tension on the isolated fistula must be avoided to prevent rupture of the tissues. Recurrences occur if the fistula ruptures and disappears into the soft tissue of the neck.

### Points to be observed – How to avoid complications:

1. A small hyoid bone resection is necessary because in most cases the track of the fistula transverses the hyoid bone.
2. The fistula track behind the hyoid bone should be closed through ligation.
3. In the case of an abscess, one or two incisions should be performed in order to open it up for free drainage. Excision of the fistula is performed as the second step.
4. In the case of infected cysts, based on my experience, I believe it would be much better to commence a conservative treatment of local neck infection first, and subsequently undertake an electively delayed operative management when inflammation has subsided. A surgical procedure of an infected cyst carries a higher risk of recurrence and may be complicated by a poor cosmetic result due to the formation of a hypertrophic scar.
5. The use of methylene blue may be a very helpful step, but one should be very careful with its application. A probe through which the dye is instilled must be perfectly placed within a cyst and well secured to its wall. Inadvertent outflow of a dye into an operative field may spill into all tissues, creating a situation in which a careful and precise dissection is very difficult.
6. I would not recommend applying a stay suture to the cyst itself. Instead, I always try to fix these sutures to the surrounding tissue in order to minimize the risk of cyst rupture while pulling forcefully during preparation.
7. I do not use unipolar diathermy for cutting a hyoid bone. It's use carries a risk of electrical burns of the surrounding tissues when the wound is not wide enough, and one prepares deep into the neck.
8. In regards to "the suprahyoid step" of the operative procedure, it is often extremely difficult to identify a fistulous

tract running to the foramen cecum of the tongue. One should be very careful in blind dissection, high in the neck. The ideal situation of when a probe is introduced into the tract and goes up to the tongue, occurs very seldom.

9. It is a simple truth, that in the case of a median cyst, the first operation should be the last one. A recurrence renders re-operation very difficult with a poorer plan of anatomic dissection.
10. Recommendations for cystic hygroma: most experts recommend early excision to avoid complications such as hemorrhage or growth with infiltration of surrounding tissues. Non surgical techniques in cases of incomplete resection and for recurrent tumors are irradiation, incision, drainage and injection of sclerosing agents (OK 432): anti-neoplastic agents such as bleomycine or cyclophosphamide. For surgical management it is important to have an adequate exposure. Further more it is important to perform a meticulous dissection with a microbipolar technique to protect vascular structures, nerves, the trachea and the esophagus. It is not necessary to completely excise the lesion which is benign. Complications can be: neurological sequelae (HORNER), seroma, infections (usually transient). Fluid refilling cysts are best demonstrated by ultrasonography, CT or MRI.
11. BURKITT tumor should be excluded by histological investigations.
12. In case of a severe infection antibacterial therapy is indicated for example Cefuroxim-ratiopharm®.

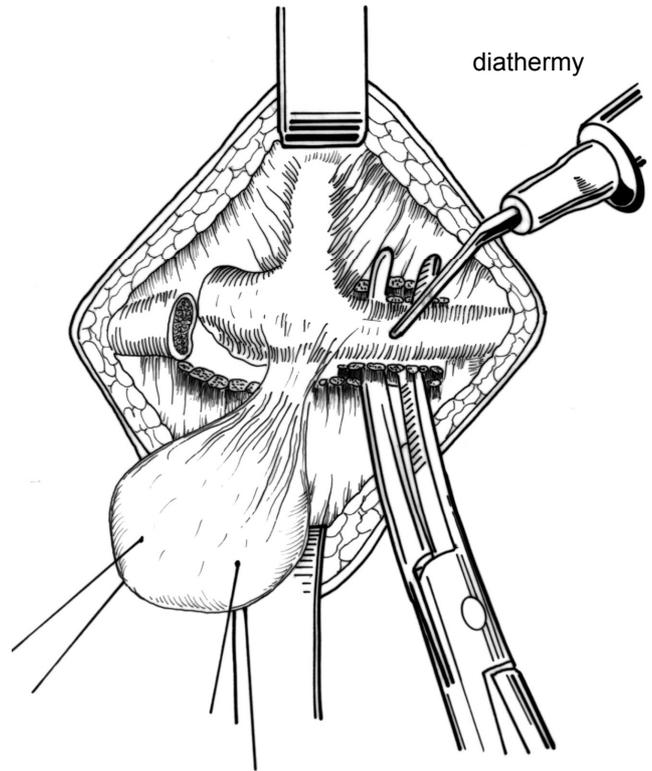


Fig. 3: Dissection of the hyoid bone.

**Key words:** cysts of the neck

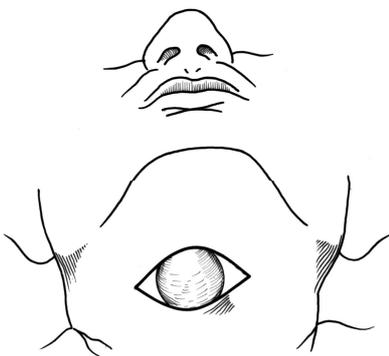


Fig. 1: Skin incision.

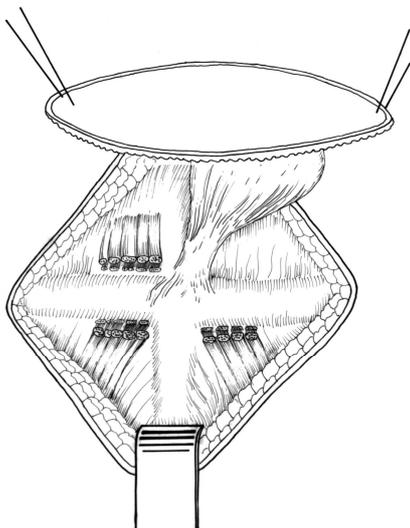


Fig. 2: Skin and cyst lifted up.

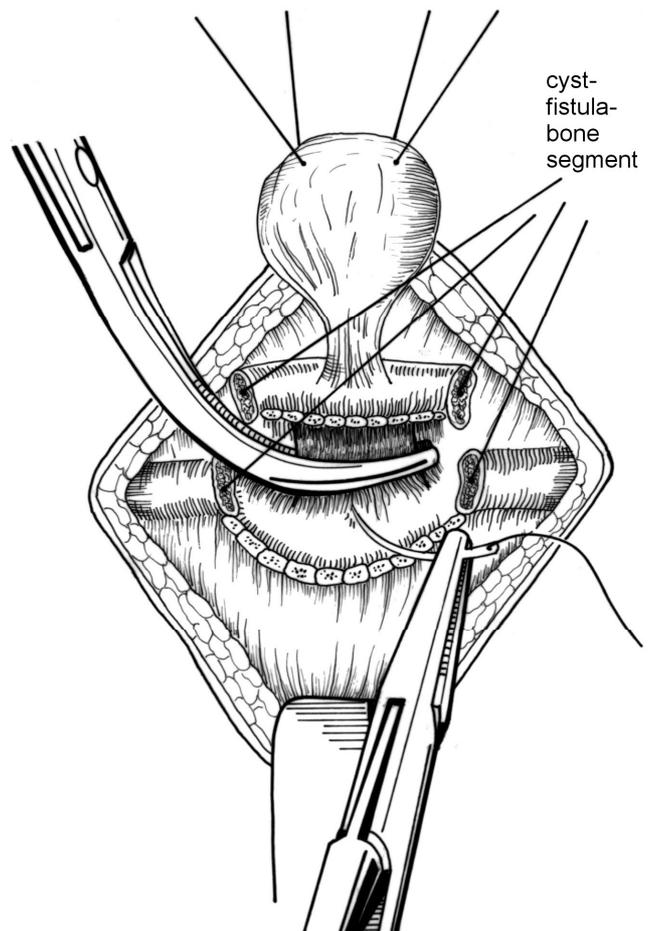


Fig. 4: Closure of the fistula and resection of the entire "skin-fistula-bone segment".

# Macroglossia

Günter H. Willital

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## 1. Classification

Type 1: The tongue is too long and too thick

Type 2: The tongue is too long, but asymmetrically too thick (one side is small, the other side is enormously thick).

Type 3: The tongue is too long, but otherwise of normal thickness.

Type 4: The tongue has macroglossia, but is of normal length

## 2. Aim of therapy

Aim of therapy is to reduce the size of the tongue in regards to the length, and reduce the volume of the tongue to a nearly normal size.

## 3. Mouth-retractor to gain an adequate access to the tongue

The mouth-retractor which is used, is similar in construction to the thoracic retractor, allowing a permanent and adequate access to the tongue.

## 4. Stay sutures at the tip and at the lateral sides of the tongue

Four stay sutures are placed at the tip and lateral sides of the tongue.

## 5. Marking the incision of the tongue

Prior to operation and resection, the incision line on the surface of the tongue should be determined using a special marker (**Fig. 1**). The incision line should be fixed on the tongue, keeping the tongue more or less in place and not under tension by the stay sutures. The tongue is stabilized under light tension by these four stay sutures. The definitive tip of the tongue should be marked in correlation to the front teeth. Another two stay sutures are placed at the lateral rim of the tongue at the marked level of the tip of the tongue. These stay sutures are placed on the lateral sides of the tongue, between the previously placed stay sutures at the lateral points of a V-incision of the tongue.

## 6. Resection technique

Using a laser (Neodym-YAG-Laser 1064 nm) or cautery, the incision (**Fig. 2**) is started at the lateral parts of the tongue where the stay sutures are placed in a 45° angulation to the middle of the tongue, as demonstrated by the incision line

made by the marker. This incision is performed with a laser, at an energy of 35watt and a speed of 1mm/second with a 200µ quartz fiber in the contact technique. Millimeter by millimeter, the tongue is incised and cut at the upper site, corresponding to the incision line in a vertical fashion on the surface of the tongue.

## 7. Identification of nerve fibers

It is important to identify the nerve fibers running inside the tongue with a Faraday probe. Before closing the wound, this identification is necessary in order to “close” the nerve fibers by gluing the neurolem using the Neodym-YAG laser. Histological investigations have demonstrated that the ends of the nerve fiber can be closed completely by readapting the sheath, using the Neodym-YAG laser 30-35 watt and an application time of 2-3 seconds. This is important to avoid future severe and very uncomfortable pain in the tongue if this occlusion of the nerve fibers, in the way described before, is not performed.

## 8. Readapting the tongue flaps

The rims of the tongue are readapted (**Fig. 3**) by inverted, absorbable sutures which are placed at the upper and lower surfaces of the muscle flaps of the tongue. Before readapting the muscle flaps, it is important to have an absolutely dry surface, otherwise hematomas will occur, delayed healing, and sometimes necessitation of re-operation. Using the incision line described before, a nearly normal shape of the tongue can easily be achieved. If this is not the case, reduction of the tongue should be performed by changing the incision line in a way to reduce the size of the tongue.

## 9. Postoperative treatment

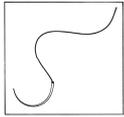
Postoperatively, a local application of anesthesia solution is applied on the upper and lower surface of the tongue 3-4 times a day in order to reduce pain. Using the suture technique mentioned above, there are no knots on the surface of the tongue irritating the patient. The suture lines are cut and the sutures are taken away between the 6<sup>th</sup> and 10<sup>th</sup> postoperative days.

### Points to be observed – How to avoid complications:

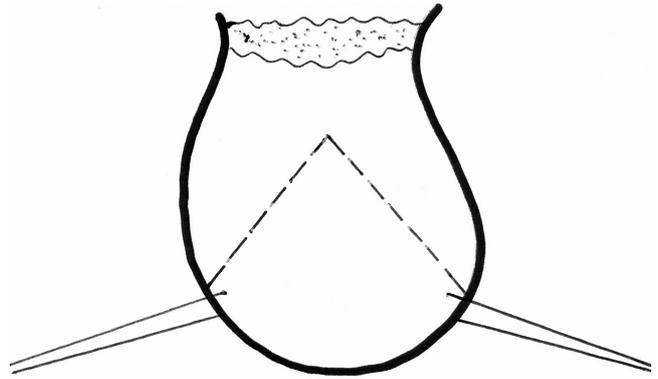
1. A Faraday probe must be used in order to identify nerve fibers inside the tongue which are then closed at the ends using the laser. This induces closure of the sheath, preventing pain at later times.
2. Meticulous care should be taken to occlude all small vessels (venous vessels, arterial vessels, lymph vessels), otherwise massive edema will occur, bleeding could take

place, wound healing is delayed, and sometimes re-operation is necessary.

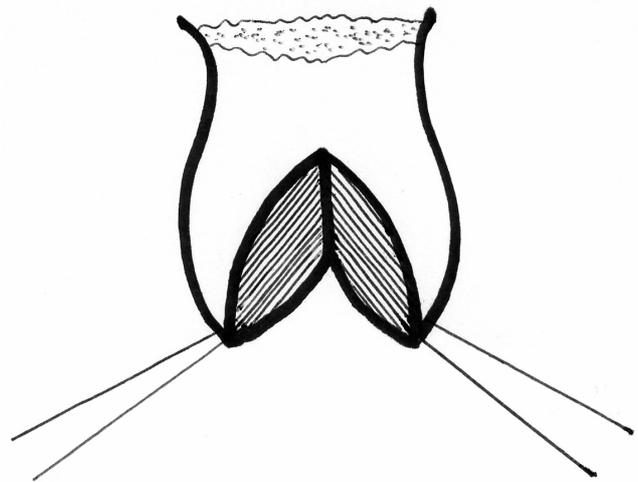
3. If the angle of the V-shaped incision of the tongue is too deep, skin flaps will be very thin, with a bad blood supply, and there will be a danger of tissue necrosis. If the angulation is too big, the necessary reduction in the size of the tongue will not be achieved and re-operation will be necessary. Therefore, an angulation of about 45° is ideal.
4. In a few cases, it is recommended to keep the child intubated in order to avoid rupture of the tongue and respiratory distress syndrome following postoperative swelling of the tongue. In order to avoid this postoperative swelling, it is recommended to use intravenous medication to reduce edema.
5. To avoid bleeding careful hemostasis is necessary using the laser, the harmonic scalpel or a tourniquet effect at the base of the tongue.
6. Nasal intubation secures airway protection.
7. Incision of the tongue is bevelled such that more ventral tissue of the tongue is removed than dorsal tissue. This recreates a natural convexity of the tongue.

	<p><b>Recommended suture materials:</b>  <b>Suture of the tongue</b>  <b>Newborns: Vicryl 4-0, needle type CT-3 plus</b>  <b>Toddlers: Vicryl 3-0, needle type CT-2 plus</b>  <b>Elder children: Vicryl 3-0, needle type CT-2 plus</b></p>
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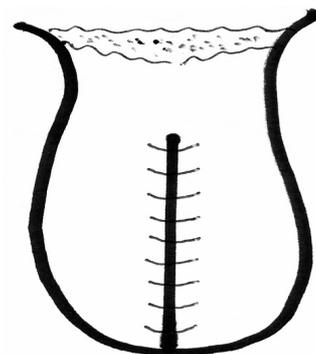
**Key words:** macroglossia; tongue resection



*Fig. 1: Marking the incision of the tongue. Two of the four stay sutures are already applied as described in detail under point five.*



*Fig. 2: Resection technique, using a laser or cautery.*



*Fig. 3: Readapting the tongue flaps. The rims of the tongue are readapted by inverted, absorbable sutures. Sutures are taken away between the 6<sup>th</sup> and 10<sup>th</sup> postoperative day.*