

OPTIMALISATION OF ENDOLARYNGEAL THREAD GUIDE INSTRUMENT (ETGI)  
FOR VARIOUS ANATOMICAL CIRCUMSTANCES – AND APPLICATION ITS  
RESULTS IN THE INFANT AIRWAYS

Ph.D. Thesis

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## 1. INTRODUCTION

Bilateral vocal cord immobility (BVCI) is a term used to describe vocal cords that are restricted secondary to neuropathy, muscular disorders, or mechanical fixation (MF). The moderate to severe dyspnea generally requires surgical intervention. Their solution is considered to be one of the most difficult fields in laryngology. In the past decades several open and endoscopic surgical techniques were introduced for the treatment. It is a 'hot topic', according to the PubMed database 1975 publications have been listed under only the label, the "bilateral vocal cord/fold paralysis" until now.

Our work group has been working on the treatment of upper airway stenosis for more than 20 years. We published various surgical solutions for stenosis of different etiology: uni- and bilateral vocal cord paralysis and mechanical cricoarytenoid joint's fixation causing posterior glottis stenosis. The 'key factor' of our surgical concept is a glottis enlarging technique, the endoscopic arytenoid abduction lateropexy (EAAL). The mobile or mobilized arytenoid cartilage is tilted and fixed into its physiologically most abducted position, which cause large 'glottis opening', vocal cord lateralization. In vocal cord paralysis the procedure produce immediately wide airway, in case of glottic stenosis the bilateral temporary lateralization prevents restenosis.

In previous cadaver studies EAAL was compared to other popular glottis enlarging techniques. It proved its efficacy: provided the largest glottic space, the postoperative glottis configuration was beneficial to preserve the patients' voice quality. In the past years more than 400 patients were treated successfully with EAAL, our clinical results were accepted for publication in prestigious journals as well. We introduced a complex clinical results' evaluation panel for these surgeries (spirometry, phoniatric tests, Quality of Life Questionnaire).

However, to perform a perfect arytenoid abduction the ideal lateralization suture position is necessary. Nevertheless, in vivo the correct creation of this fixating loop location is practically impossible by existing needle carrier devices or through externally inserted needles. Therefore, a new endoscopic thread guide instrument (ETGI) was designed. The configuration of male, female and pediatric larynges is so different, that no single device is suitable for all. Modern, high resolution imaging techniques (MRI and CT) provide really

good opportunity for measuring the most important parameters of laryngeal configuration in living subjects relatively easily. These images could help to optimize ETGI device with different size and shape for males, females and also for young children, because the difficulties arisen from the wide variety of laryngeal configurations require different endolaryngeal part of the device. These parts are commutable, this study makes possible to design different sizes of blades and stems which is overlap these laryngeal individualities.

### **1.1.ENDOSCOPIC ARYTENOID ABDUCTION LATEROPEXY (EAAL)**

Endoscopically inserted suture which directly lateralizes the arytenoid cartilage to the normal physiological abducted position may provide long-term dependable results.

In our earlier cadaver studies, performed on one hundred fresh cadaver larynges, we proved that EAAL provided the most beneficial glottis configuration compared to other suture lateralizing techniques. In vivo larger glottic gap, and larger posterior commissure angle might lead to better breathing; smaller anterior commissure angle and tensed vocal cords might preserve better the patients' voice. Nevertheless, in vivo the correct creation of this more posterior fixating loop location is practically impossible through an externally inserted needle or by the original *Lichtenberger's* device because the thyroid cartilage is more dense in that area. For this reason a new thread guide instrument is purposely designed for safe, accurate, and fast suture loop creation for the endoscopic arytenoid abduction lateropexy (EAAL). The efficacy of this device, the postoperative clinical results mainly depends on the maneuverability in the larynx and the ideal suture position for tilting the arytenoid joint into abducted position. The anatomy of male, female and children larynx is so different that no single instrument would suit for them. The laryngeal size, shape, thickness and density of cartilages differ very much.

Analysis of the high resolution cervical CT scans provides good possibility for non-invasive measurement of the laryngeal structures. Based on this study different size blades for male's, female's and children's larynx were designed.

The principle of the endolaryngeal thread guide instrument (ETGI) is the utilization of a built-in, movable curved blade with a hole at its tip allowing a suture thread to be guided in and out between the exterior surface of the neck and the internal laryngeal cavity. The stem of

the instrument is a rigid steel pipe, curved at its distal, blade-holding end, created to fit into midsized, closed laryngoscopes. The second component is a rod, largely cased within the steel pipe stem. At the uncased proximal end of the rod is a freely rotating finger clip. At the distal end of the rod is the curved blade, appropriately designed to fit the curvature of its stem casing. The connection between the blade and the rod is fixed but flexible, ensuring forceful blade movement on exit and re-entry of the curved stem end. The pull and push of the finger clip (with the thumb) causes the in-and-out blade movement from the stem end. At rest, the blade is inside the curved stem end. The third component of the instrument is the ergonomic handle, which also serves as a shaft to hold the instrument in a straight position. The steel stem of the instrument is fixed to the handle with a clamping screw after turning it to the desired direction. The structural rigidity of the ETGI ensures easy penetration through the thyroid cartilage. The device has the approval of the Hungarian Health Care Institute.

Disinfection of the mucosa the ETGI is led through the laryngoscope to the glottic level. The mobile (or mobilized) arytenoid cartilage is tilted backward and upward with the end of the instrument. The built-in, curved blade is then pushed through under the vocal process out to the surface of the neck. A non-absorbable suture thread (Prolene 1.0; *Ethicon*, Somerville, NJ) is laced through the hole at the tip of the blade by an assistant surgeon. The doubled-over thread is pulled back with the blade, into the laryngeal cavity

After a repeated tilting of the arytenoid cartilage, the blade is pushed out with the thread above the vocal process to the outer surface of the neck. The assistant surgeon then cuts the double folded thread to remove it from the blade tip. The blade is then pulled back into the laryngeal cavity, and the ETGI can be removed.

A small skin incision (approximately 5 mm) is then created to withdraw the ends of the thread by a Jansen hook to the surface of the sternohyoid muscle. The corresponding ends are knotted above it. This simple procedure enables the endoscopic creation of two fixating loops in one step at suitable laryngeal locations, providing maximal physiological abduction of the arytenoid cartilage within 5 minutes.

## **1.2. A NEW SOLUTION FOR NEONATAL BILATERAL VOCAL CORD PARALYSIS -ENDOSCOPIC ARYTENOID ABDUCTION LATEROPEXY**

In early childhood the possible treatment options for BVCP are much more limited compared to the ones in adulthood. Tracheostomy is the conventional treatment strategy with its well-known challenging care problems, as well as psychological and physical side effects . The small anatomical structures, surgery associated post-operative edema and the relatively long and difficult surgical procedures practically exclude the application of both external approaches and endoscopic resection glottis enlarging procedures. We performed successfully EAAL with the help of pediatric ETGI.

## **2. AIMS OF THE THESIS**

Endolaryngeal Thread Guide Instrument (ETGI) has some standard size parts suitable for all larynges (handle, rod, clamping screw and finger clip). However, only stem pipe with the blade has to be introduced into the larynx. Therefore, intralaryngeal parts, shape and length should be appropriate for allowing precise maneuvers in the larynx, in order to make ideal lateralization suture position over the arytenoid body. Since we did not found detailed size measurements in the literature, development of ETGI, morphometric study of larynx and neck configuration was performed. The aim of our study was to determinate human endolaryngeal distances and neck configuration in order to develop intraluminal part of ETGI. We also applied our new instrument in infants with bilateral vocal cord paralysis. Quality of Life Test (QLT) also applied to verify postoperative results.

## **3. MATERIALS AND METHODS**

### **3.1. MORPHOMETRIC ANALYSIS OF HUMAN LARYNGES - RADIO-ANATOMICAL MEASUREMENTS.**

To evaluate human glottis and neck configuration, CT scan of adult and children group were analyzed. All of the CT scans had been reported to have normal radiological findings.

In our retrospective study cervical CT scans of caucasian patients who presented for other head and neck complaints to our institute were analyzed. Male and female candidates were randomly selected. Two groups were created based on the age of the candidates adults and children

Bone and soft tissue filter settings were used to calculate the measurements. The glottic opening was measured using the measuring tool provided on the (Picture Archiving and Communication System -PACS). To evaluate the configuration of the larynx, glottis space and surrounding anatomical structures and layers (i.e. neck configuration), the following parameters were determined and calculated symmetrically, in both side: **VP-TC** - The distance from the mucosa of the vocal process to internal lamina of thyroid cartilage (mm). **TC** - Thickness of thyroid cartilage is the distance between external and internal lamina of thyroid cartilage (mm). **TC-S** – The distance from external lamina of thyroid cartilage to the surface of skin (mm). **VP-S** – Summation of the distance of the vocal process to the skin.

Parameters, determinates glottis space **AP**- The anterior to posterior length in the midline (mm). **TM** - Transverse length at the mid-point of the AP length (mm). **TP** - transverse length at the level of the vocal process of the arytenoid cartilage (mm).

To supplement our data, degree of compressibility of the soft tissues of the neck- i.e. tissue layer above thyroid cartilage was also measured on adults. A group of patient, underwent neck surgery was selected based on criteria of CT measurements (n=20, 52±17 year). Soft tissue thickness was measured first without compression, with calibrated needle in three different point at the level of vocal folds, both side of the neck. Compression was carried out evenly on the side of the neck and the measurement was repeated. Average compressibility- i.e. difference between thicknesses in mm, before and after compression- was calculated.

To evaluate characteristic of the tissue, density of the thyroid cartilage was measured at three points: anterior midline- i.e. central, anterior one-third i.e. anterior and posteriorly at the level of vocal process i.e. posterior in Hounsfield units.

Based on morphometric analysis, inralaryngeal parts of ETGI i.e. stem pipe and blade were designed.



### **3.2. NEW SOLUTION FOR NEONATAL BILATERAL VOCAL CORD PARALYSIS**

In the second part of the study, we wanted to prove the advantages of the ETGI, designed for newborns based on previously detailed morphometric CT measurements. Four newborns with congenital bilateral vocal cord paralysis (BVCP) were chosen as patients.

## **4. RESULTS**

### **4.1. MORPHOMETRIC ANALYSIS OF HUMAN LARYNGES - RADIO-ANATOMICAL MEASUREMENTS**

A total of 107 CT examination, 97 adult and 10 young children were perform. No significant difference can be proved in the values between left and right side within the male and female group. Comparing the same sides and distances in the two genders, the variables do show significant difference. The VP-TC distance in the male group is significantly longer in both sides than the female group ( $p=0.001$ ) The TC-skin parameter showed the largest difference between the genders, females have significantly thicker soft tissue component as compared to the male group. ( $p=0.001$ ). To determinate blade trajectory, summation of three above parameters were calculated:  $(VP-TC)+TC+(TC-skin)=VP-skin$ . There is no significant difference between male and female group in VP-skin values. Distribution was normal, with a level of significance  $p>0.200$ .

Compression basically shortens TC-skin distance, therefore VP-skin distance also getting smaller.

Statistically significant differences were found in the three measured glottis length between male and female group. Based on our data, female have significant smaller glottic space compare to male.

In the male group, the density was the highest in the midline and decreased posteriorly. The density pattern was different in the female group, central area density was significantly lower compare to male group, and the density of posterior lamina was equivocal. There was no intergroup significant difference between left and right side within the groups.

Since there is no expected difference in sex specific body and organ size in children, especially in infants, male and female candidates created one group. Thickness of anatomical

layers was calculated similar way as in adult group. VP-skin thickness showed normal distribution in the group ( $p>0.20$ ).

#### **4.2. DESIGN OF THE INTRALARYNGEAL UNITS OF ENDOLARYNGEAL THREAD GUIDE INSTRUMENT**

To determine necessary length of the ETGI blades, neck configuration should be considered. In adult group, based on VP-skin distance i.e. thickness which should be penetrated, we applied a 41 mm blade. This length calculated to long enough in more than 50% of the cases. A bigger, 55 mm blade also prepared which is capable for lateralization procedure more than 90% of the cases. Longer blade size was not necessary, since soft tissue compression can reduce blade trajectory. Re-calculate VP-skin distance with soft tissue compression, 90% of the cases can be solved with 41 and 99% with 55 mm blade.

Based on CT measurements, the TM length is the critical value of the atraumatic introduction of the device; therefore the bisector length (i.e. the width of the territory occupied by the blade in the glottis area) should not exceed the TM. Bisector length of 55mm blade ( $b_1=13\text{mm}$ ) and 41 mm blade ( $b_2=7\text{mm}$ ) are suitable in all of the cases.

Density of thyroid cartilage determinates the strength of the blade. Therefore massive, bigger blade is necessary for male patients, since cartilage density was significantly higher those group. However, sharp edged blade is better for penetration, but the risk of possible tissue and vessel trauma is higher. Therefore we applied blade with blunt edge.

In children, small glottic size and the thin soft tissue layer over the larynx requires a shorter and less curved endolaryngeal portion of the stem-pipe as opposed to the curve of the adult sized device. Especially in newborn, small glottic area significantly reduces possible size and shape of the blade. We applied a 21mm curvature length bade, suitable in 100% of the cases. Bisector length of 21mm blade, created for children is  $b_4=2.1\text{ mm}$ .

#### **4.3. NEW SOLUTION FOR NEONATAL BILATERAL VOCAL CORD PARALYSIS- ENDOSCOPIC ARYTENOID ABDUCTION LATEROPEXY**

Compared to the preoperative values, the QOL scores improved significantly in all cases. Based on the parent's observations, the voice of the patients was normal in 3 cases and

slightly impaired in 1 case. In the first three patients, the crying sounds were powerful. Gurgling and cooing were similar to their siblings, according to the parents. Speech development was appropriate in the fourth case, which was the only case followed long enough (55 months) to be able to evaluate it adequately. Partial regeneration of the vocal cord movements was observed in 2 of the 4 cases: bilateral in infant #2 and unilateral in #3, at 6 and 3 weeks of age respectively. Lateralization sutures were not removed in any of the cases.

## **5. DISCUSSION**

Endoscopic arytenoid abduction lateropexy (EAAL) has already been shown to be safe and effective for the treatment of vocal cord immobility of various etiologies. To create an instrument, capable to perform the intervention in minimal invasive way, neck and laryngeal conformation should be studied first. We wanted to design intralaryngeal units of ETGI-prepared for manipulation in glottis space and penetration of the tissue layers- suitable for different glottic size and neck configuration. Resistance of the most compact layer i.e. density of the thyroid cartilage have also been taken into consideration. In the first part of the thesis, a retrospective morphometric study of the human larynx was detailed. Based on these findings, design of intralaryngeal ETGI units was demonstrated. Considering the conformation differences between genders, adults and infants; three different blades have been created.

Minimal invasive treatment of BVCP is an important question especially in childhood. EAAL is a good solution even in infants to avoid tracheotomy and consequent, long term structural and functional damage of the larynx. In the second part of the thesis, we demonstrated the advantages of our minimal invasive method with ETGI, designed for children.

### **5.1. Morphometric analysis of human laryngeal images for optimization of suture lateralization instruments**

We analyzed a large series of cervical CT scans of 56 males and 41 females and 10 children (total of 107) which examined the anatomy of the larynx. We found a gender difference between the layers of the neck: VP-TC distance, which represents the mucosa and vocal fold thickness was significantly bigger in male. While neck soft tissue thickness i.e.

distance between thyroid cartilage and the surface (TC-skin) was bigger in females. This difference might be due to the fact that male larynx is in a more anterior position generally compared to the female larynx position or fat distribution is different in the neck according to gender.

No gender difference was presented in average cross section of neck soft tissues (VP-skin), moreover, it showed normal distribution. Based on VP-skin distance, which is identical with blade trajectory, two different adult ETGI blade lengths have been designed. With the 41 mm curvature length blade, 50%; with the 55 mm curvature length, 90% of the cases could have been solved. We have also proved that application of longer blades is not necessary; with soft tissue compression of the neck, cross-section can be reduced adequately, and even with the 41 mm blade 90% of the cases could be treated. Moreover, limited space in the level of the vocal cord also requires shorter blade length.

Endolaryngeal space measurements showed, that female glottis is significantly smaller in sagittal as well as in transversal diameter than male ones. To avoid spatial incompatibility, blades were designed to have a round caliber. Moreover, round shape also provide ideal penetration angle for soft tissue and cartilage, and gives enough rigidity to resist bending. To determine the curvature, middle and posterior transverse diameters i.e. TM and TP were calculated. Since the instrument and also the tip of the blade meets the surface of the mucosa with  $45^\circ$ , we designed bisector length (proportional with the width occupied by the blade in the glottis area) shorter, then transverse glottis length.

Determination of cartilage density was also necessary to create ETGI blades resistant enough. Moreover, density distribution also influences the site of blade penetration. We found a gender difference between thyroid cartilage densities at all measured level. However, the cartilage thickness increases posteriorly; density measurement showed that the posterior third is less compact. This might be due to the structure of the cartilage; there is a compact surface lamina, conjugating in the middle and anterior third (identical with the sample site of anterior density measurement), while posteriorly a spongy intermediate substance can be found (posterior sample site). However, cartilage is thinner anteriorly, our density measurements have confirmed, that posterior part of the cartilage is more sufficient for penetration. Moreover, calcification usually affects the anterior part of the lamina, therefore here density, and consequent resistance increases with time. At the beginning, lateralization of vocal cord

was performed anteriorly, since intralaryngeal units of previous instruments were not capable to penetrate the thick posterior part of the cartilage. We recommend blade penetration at the posterior part of the lamina based on the density measurements; moreover, this position secures the maximal abduction of the vocal cord. Since the density of cartilage is higher in males, we also recommend the application of 55 mm blade in these cases, to utilize higher instrument resistance provided by the size of the blade.

The small glottic area of newborns made the use of the original endolaryngeal thread guide instrument (ETGI) difficult, so it had to be modified. First step was the miniaturization of the instrument to make it easier to maneuver in the neonatal glottis. The small glottis size and the thin soft tissue layer over the larynx requires a shorter and less curved endolaryngeal portion of the pipe-stem as opposed to the curve of the adult sized device. For children, a 21mm curvature length blade has been designed, capable to perform EAAL in 100% of the cases. Since superficial soft tissue (i.e. tissue above thyroid cartilage) in children, especially in infants is thin, soft tissue compression is not optimal to reduce cross-section. Therefore, application of a 21 mm blade was necessary. Second step has been the conversion to the neonatal *Miller* laryngoscope (size 0; *Welch Allyn* Inc., NY, USA) which provides a good view for the lateralization of the left arytenoid cartilage (in three cases). In the last patient, a *Macintosh* Baby Laryngoscope (*Welch Allyn* Inc., NY, USA) has been used to expose the larynx.

However, sharp edged blade is better for penetration, but the risk of possible tissue and vessel trauma is higher. Therefore we applied a blade with blunt edge. In order not to weaken the tip of the blade the eyelet was placed proximal to the tip.

Since there are a number of factors, which have to be taken into consideration when performing the EAAL procedure, a cervical neck CT is a helpful investigation in the pre-planning stage. Since imaging is usually performed in order to find the cause of vocal cord immobility, patients do not receive any extra radiation.

The results of the scan will help to clarify the degree of ossification of the TC at the vocal process level, the distance of the blade trajectory and the thickness of the neck.

## **5.2. New Solution for Neonatal Bilateral Vocal Cord Paralysis - Endoscopic Arytenoid Abduction Lateropexy**

Due to the many etiologies of bilateral vocal cord palsy (BVCP), the potential comorbidities, the related anatomical abnormalities, and the complex requirements of the treatment, many authors recommend a “watch and wait policy” in neonates. However, the associated airway limitations significantly limit the normal physical activity and development of the child, even in milder cases. In cases of severe dyspnea, tracheotomy is still the most frequently performed surgical intervention despite its many well-known risks, including severe complications such as airway stenosis and accidental decannulation which can be life threatening. The need to minimize surgery in the neonate and the many risks of neonatal anesthesia (small reserve capacity, high oxygen requirements, risk of hypothermia and hyperthermia, undiagnosed heart problems, limited cardiac output, etc.) make surgical options even more limited in this age group. The optimal surgical intervention would be both quick and reversible as well as provide an immediate adequate airway, acceptable voice quality, and good swallowing function. A simple suture lateralization technique of the vocal cord from an external approach was introduced by *Zawadzka-Głós* in children aged 1 year and older, but this technique did not become popular. *Triglia et al.* applied the arytenoid lateropexy from an external approach on 15 children between 1 month and 9 years with more encouraging results; however, the undertaking of this relatively complex and long-lasting intervention is significant in neonates. Because of the extensive, surgical dissection of the arytenoid region and the resulting scar formation, this procedure is considered to be irreversible even on adults.

Our preliminary results show that the endoscopic arytenoid abduction lateropexy (EAAL) can be relatively easily and quickly performed with low surgical stress even in the first days of life. Moreover, it provides a stable, long-lasting, and wide airway that is potentially reversible because the endoscopically inserted lateralization sutures do not significantly disturb the anatomical structures. This has been proven in several adult cases in which definite re-innervation occurred

The supraglottic jet ventilation and the novel use of pediatric laryngoscopes ensure excellent visualization of the glottis with access unencumbered by an endotracheal tube. If jet ventilation is not available, however, this fast procedure can be performed under spontaneous

ventilation with intermittent intubation. Based on our experience, the new, modified endoscopic thread guide instrument (ETGI) is suitable for fast and safe maneuvering in the narrow laryngeal space of the newborns.

The blade is connected with the stem-pipe. Continuously, thus the device can be removed promptly in case of the need for intubation. Visual control during the technique is paramount. Moreover, the positioning of the lateralization suture can be made more precisely with endoscopic guidance. With these associated technologies and instrumentation, the procedure can be performed quickly and safely.

This intrinsically reduces the potential complications from anesthesia and jet ventilation. In adult patients, no postoperative intubation, temporary tracheostomy, or intensive care are required after EAAL. Due to the limited anatomical space, the increased vulnerability, and swelling of the soft tissue of the neonates, a short-term postoperative intubation is always prudent along with parenteral steroid therapy. Temporary intubation may also help by the maintaining of the lateralized position of the arytenoid cartilage though our report did not compare this to any cases that were immediately extubated. Perioperative empiric intravenous antibiotic therapy is also indicated.

The presented lateralization technique does not impair laryngeal sensation, which is essential for protective laryngeal reflexes. This is consistent with our experience in adult patients who have not had significant aspiration after arytenoid cartilage lateralization. After the removal of the nasogastric feeding tube, the newborns in this series could be easily fed and be nurtured. This is supported by parental reports and by the registered weight gain and length growth. Despite the comorbidities and the long hospitalizations, the weight-for-age and length-for-age percentiles show normalization after the initial growth delay. The objective measurements of voice quality are very limited at this age, but the results of the voice analysis are consistent with the QOL questionnaire's results. The postoperative glottic configuration of a small angle in the anterior commissure and the straight and tensed vocal cords allows acceptable phonation closure in case of contralateral vocal cord recovery. This allows not only a voice improvement after spontaneous re-innervation, as was seen in the second and third case, but it helps to maintain the airway patency. This procedure is reversible in adults, and therefore likely reversible in children. However, we did not undertake any reversal on the infants during this study period. Reversal needs to be carefully considered because re-

innervation of the two vocal cords does not necessarily occur simultaneously. We have observed in adults that when reversal is undertaken because the contralateral vocal cord's movement has recovered, the released (but potentially still paralyzed) vocal cord can re-medialize after the suture removal.. While that is acceptable in an adult, in the young and very small larynx this medialisation might cause a significant increase in airway resistance. As the unilateral lateralization suture does not cause any swallowing or phonation impairment, it was not removed after partial functional recovery. This was in accord with the parent's decision. The suture removal can be considered in the future if the endoscopic and/or LEMG examinations confirm the re-innervations or when the larynx has grown larger.

Endoscopic examinations proved the stable position of the lateralization sutures and the abducted arytenoid cartilage after 4 years in the one patient that we followed for that long. This surgical intervention might be a long-term solution, even in fast-growing laryngeal structures

## **6. CONCLUSIONS AND NEW RESULTS**

This study showed that the glottis configuration is significantly different between the two genders. The density at the post lamina of the thyroid at the level of the vocal process of the arytenoid is not significantly different in the two genders. The soft tissue compressibility allowed the shorter blade to be used in the majority of cases giving greater flexibility. However considering the size of larynx, maneuverability of instrument and density of thyroid cartilage the larger blade was advised to be used for greater success. CT evaluation of cervical neck and the above measurements described will provide the preoperative planning for choosing the required type of blade to be used.

EAAL as a primary treatment might serve as a minimally invasive, effective, dynamic solution for most cases of BVCI. ETGI is specifically designed for this method; therefore it can facilitate this procedure. With blades and stem pipes of different shapes and sizes the operation can be carried out in the case of almost every laryngeal configuration.

According to our preliminary results, the minimally invasive, quick, reversible endoscopic arytenoid abduction lateropexy (EAAL) might be a more favorable solution for neonatal bilateral vocal cord paralysis (BVCP) than earlier treatment strategies. In one step, the airway can be maintained without the risk of any permanent damage to voice production. Good



swallowing function is also preserved. The specially modified endolaryngeal thread guide instrument (ETGI) gives a fast and effective option to create the lateralized arytenoid position even in this technically challenging surgical field of a neonate larynx.

According to our preliminary results, the minimally invasive and quick endoscopic arytenoid abduction lateropexy (EAAL) might be a more favorable solution for neonatal bilateral vocal cord paralysis (BVCP) than earlier treatment strategies. In one step, the airway can be maintained without the risk of any permanent damage to voice production. Good swallowing function is also preserved. In addition to these benefits, it should be easily reversible. The specially modified endolaryngeal thread guide instrument (ETGI) gives a fast and effective option to create the lateralized arytenoid position even in the technically challenging surgical field of a neonatal larynx. Follow up long-term outcomes and additional patients need to be studied to further validate this procedure.