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Phonosurgical voice rehabilitation in patients with primary larynx cancer after laser cordectomy CO_2

Fonochirurgiczna rehabilitacja głosu u pacjentów z wczesnym rakiem krtani po chordektomii laserowej CO_2

Authors' Contribution:
A – Study Design
B – Data Collection
C – Statistical Analysis
D – Manuscript Preparation
E – Literature Search
F – Funds Collection

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ABSTRACT:

The aim of the treatment of early laryngeal cancer is complete oncological cure and simultaneously voice and swallowing preservation. According to European Laryngological Society (ELS) classification of CO2 laser cordectomy, full voice recovery is seen in subepithelial cordectomy (ELS Type I) and near complete in subligamental cordectomy (ELS type II). Voice deterioration is usually seen after more extensive levels of cordectomy (ELS types III–V). Voice quality after laser microsurgical laser cordectomy depends on the presence or absence of synechiae in the anterior commissure and on the quantity of the removed thyro-arytenoid muscle. More extensive reduction of the vocal muscle quantity causes more intensive glottic incompetence. Contralateral healthy vocal fold, rudimentary, cicatrixial previously operated vocal fold and false ventricular folds may take part in postoperative supraglottic voice compensation. All patients should undergo speech and voice therapy after terminating of the scaring process on the operated vocal fold. Patients routinely undergo a minimum of 6 months voice rehabilitation which allows speech therapy to yield the best possible voice. Phonosurgical techniques i.e. medialization thyroplasty, augmentation techniques, Zeitels's laryngoplasty or Lichtenberger's technique in treatment of synechia in the anterior commissure are successfully performed to restore the vocal competence. Voice preservation after treatment of early laryngeal cancer of the vocal fold improves life quality of the patient.

KEYWORDS: medialization thyroplasty, larynx cancer, cordectomy, vocal folds, Lichtenberger technique

STRESZCZENIE:

Celem leczenia wczesnego raka krtani o lokalizacji w obrębie głośni jest uzyskanie pełnego wyleczenia onkologicznego z jednoczesnym zachowaniem głosu, fizjologicznego toru oddychania oraz sprawnego mechanizmu połykania. Według Europejskiego Towarzystwa Laryngologicznego (European Laryngological Society), klasyfikacja chordektomii przy użyciu lasera dwutlenkowęglowego (CO2) uwzględnia pełne odzyskanie głosu w przypadku przeprowadzenia chordektomii podnabłonkowej (subepithelial cordectomy – ELS typ I) oraz prawie całkowity powrót czynności głosowej w przypadku chordektomii podwięzadłowej (subligamental cordectomy – ELS typ II). Pogorszenie jakości głosu obserwuje się zwykle w bardziej rozszerzonych zabiegach chordektomii (transmuscular, total, extended cordectomy – ELS typy III–V). Jakość głosu po mikrochirurgicznej laserowej chordektomii zależy od obecności zrostów w spoidle przednim oraz od ilości usuniętego mięśnia głosowego. Bardziej radykalna redukcja masy mięśniowej powoduje większą niedomykalność fonacyjną fałdów głosowych, co spowodowane jest powstaniem szczeliny niedomykalności w obrębie głośni. Pooperacyjna nadgłośniowa kompensacja może przybierać formy: udziału zdrowego fałdu głosowego po stronie przeciwnej, kompensacji z udziałem blizny wcześniej operowanego fałdu lub kompensacji fałdów przedsionkowych krtani (głos przedsionkowy prawdziwy). Wszyscy pacjenci – po zakończeniu procesu tworzenia blizny i wygojeniu operowanego fałdu głosowego – powinni zostać poddani terapii foniatryczno-logopedycznej głosu i mowy. Pacjenci rutynowo poddawani są 6-miesięcznej rehabilitacji głosu i mowy, co pozwala na uzyskanie możliwie najlepszej fonacji. Z udziałem tzw. „neocord" – czyli fałdu głosowego pokrytego włóknistą, bliznowatą powierzchnią – uzyskuje się optymalne warunki procesu kompensacyjnej fonacji. Techniki leczenia fonochirurgicznego, np. medializacyjna tyreoplas-

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tyka, techniki augmentacyjne, laryngoplastyka wg Zeitelsa czy technika Lichtenbergera w leczeniu zrostów w okolicy spoidła przedniego, są z sukcesem wykonywane jako zabiegi przywracające wydolność głosową. Zachowanie dobrej jakości głosu po leczeniu onkologicznym wczesnego raka fałdów głosowych stwarza szansę szybszego powrotu do aktywności społecznej i zawodowej pacjenta.

SŁOWA KLUCZOWE: medializacja tyroplastyczna, rak krtani, cordectomia, fałdki wokalne, technika Lichtenbergera

INTRODUCTION

Larynx is an organ with a variety of functions, complex anatomy and physiology. Due to its functional and structural complexity, the diagnostic approach has to be interdisciplinary, i.e. histopathologic, phoniatric and larygological. Thurnher et al. [25] emphasize the role of histologic, patomorphologic and anatomical considerations in clinical management of different conditions. Laryngeal mucosa is covered with ciliated, columnar epithelium, except for free marginal ridges of the aryepiglottic folds and epiglottis which are covered with stratified squamous epithelium. The junction between two epithelial types localized on the vocal folds is a histological characteristic denotes histologically the lower border of the glottic area located from 5 to 10 mm below the vocal folds. Squamous cell carcinoma is the most common epithelial neoplasm concerning head and neck region, with the main predisposing factors being smoking and excessive alcohol consumption. Other predisposing factors to SCC are Human Papilloma (HPV) and Ebstein Baar Virus (EBV) infections. The histological characteristics of the neoplasm are differentiation of the epithelium with various grades of keratinization, nuclear pleomorphisms and many cell divisions depending on the stage of the neoplasm. Carcinoma usually develops directly on the vocal folds (75%), in 20% of cases the process starts above the vocal folds, in the supraglottic area, or in 5% of cases - below the vocal folds in the hypoglottic area.[8] The neoplasms located in the area of the glottis have very scarce lymphatic vessels which contributes to very low rates of metastases in local lymph nodes. It increases the prognosis if the neoplasm is diagnosed at an early stage.

The European Laryngological Society (ELS) resolved in 2000 that there is no uniform method useful in assessing both the function and the quality of voice. The functional voice assessment should be conducted multidiciplinary. According to ELS, it is necessary to assess 3 aspects of voice: the quality, the function and the efficiency.[4] The quality of voice can be evaluated with the perceptual GRBAS scale (Grade, Roughness, Breadiness, Astenia, Strain) and with acoustic analysis: (jitter, shimmer, basal frequency (F0) and intensity (dB). Vocal fold mobility can be examined by stroboscopic laryngeal evaluation (phonatory contraction of the glottis, regularity, symmetry and synchronization of vibration, mucosal wave). Another method involves using aerodynamic instruments to measure and evaluate the phonation quotient (PQ). Subjective voice evaluation can by carried out by a patient with Voice Handicap Index (VHI).

ELS developed a chordectomy classification, which divides foldectomy procedures into 5 types, depending on the grade of radicality of the procedure. Type I (subepithelial) - Fig. 2A; type II (subligamental foldectomy) – Fig. 2B; type III (transmuscular) – Fig. 2C; type IV (total foldectomy) – Fig. 2D; type V (extended foldectomy) – Fig. 2E. Laser foldectomy type I and II is a conservative procedure which preserves the elasticity and shape of the vocal fold, even if the resection ranges from the vocal process to the anterior commissure in the vertical dimension. Other types of foldectiomies which usually involve more extended resection of tissues were classified as type III, IV and V by ELS.[16]

Type I (subepithelial foldectomy) is a resection of the vocal fold epithelium passing through the superficial layer of lamina propria. Type II (subligamental foldectomy) is a resection of the epithelium, Reinke's space and vocal ligament. Type III (transmuscular foldectomy) is a resection proceeding through vocalis muscle, with or without partial vestibular fold resection. This type of partial vestibular fold resection has been proposed by Swarc and Kashima.[24] Type IV (total foldectomy) extends from vocal process to the anterior commissure. The resection may encompass the perichondral tissue covering the interior of the thyroid cartilage. Type Va – Fig. 2E1 is an extended foldectomy procedure with resection of the affected vocal fold and the anterior commissure and partially the contralateral vocal fold. Type Vb – Fig. 2E2 of extended foldectomy requires performing the resection of the anterior segment of the arytenoid cartilage and the affected vocal fold. Type Vc – Fig. 2E3 is a resection of both ventricular and the affected vocal fold. Type Vd – Fig. 2E4 is on the other hand a resection of the affected vocal fold encompassing the subglottis with resection margin of 1 cm. Remacle et al. [19] suggested in 2007 to introduce changes in the classification system developed by ELS. They added a new type to the previous classification which they called type VI foldectomy. The main indication to perform type VI foldectomy is neoplasm deriving from the anterior commisure affecting one or both vocal folds without

infiltration of the thyroid cartilage. The full name of the procedure is anterior commisurectomy with bilateral anterior foldectomy. This procedure has been classified as extended foldectomy type Va so far. Moreover, according to Zeitels, [29] it is necessary to perform a thorough exposition and exploration of the epiglottic area and petiolus epiglottis (constriction of the lower part of the epiglottic cartilage, which is ligated with connective tissue to the thyroic cartilage) with microlarygoscopy because of the possibility that the neoplasm infiltrates the region of the anterior commissure. The petiolus of the epiglottis makes proper visulalisation of the anterior part of the anterior commissure very difficult.

LASER FOLDECTOMY AND RESECTION MARGINS

Histological evaluation of resection margins is depends on the power of carbon dioxide laser used, as it determines the possibility of thermal damage to surrounding tissues. Folz et al. [33] found a positive correlation between the power of carbon dioxide laser used in the resection procedure and the extent of thermally-induced tissue damage during surgery. Histopathological evaluation of resection margins has been made significantly more difficult when the procedure was performed using a laser with a relatively high power (10-20 W, focal diameter 0.64 mm). Conducting surgery with a lower power laser (1-3 W, focal diameter 0.25 mm) resulted in less uncertainty in histopathological assessment. High power laser caused charring and necrosis zones that were twice more extensive than those caused by low-power laser. When the super plus mode is applied, the thermal damage can be reduced to minimum, but it does not facilitate histopathological evaluation of margins either, mainly due to tissue fissures and tearing. High-power carbon dioxide lasers with high energy doses have been shown to cause thermal tissue damage and because of that their use should be avoided as it prevents conducting reliable histological evaluation of the tissue samples. Contemporary high-precision laser micromanipulators focus a laser beam of low diameter and thus contribute to increased precision and minimize potential damage to the tissues. Precise assessment of tissue specimen including the incision line can be made only if thermal artifacts are absent. Moreover, low-power carbon dioxide laser surgery reduces the range of necrosis zone surrounding the incision line, with no detectable p53 protein. The presence of protein P53 is a sensitive marker indicating the presence of neoplastic cells at the incision line. The P53 protein is an indicator of neoplastic transformation process.[33] Looser and Shah [30] in 1978 defined that resection margins where p53 protein was present are a site of invasive neoplasm location, i.e. 1) at the incision line, 2) 0.5 cm from the incision line, 3)

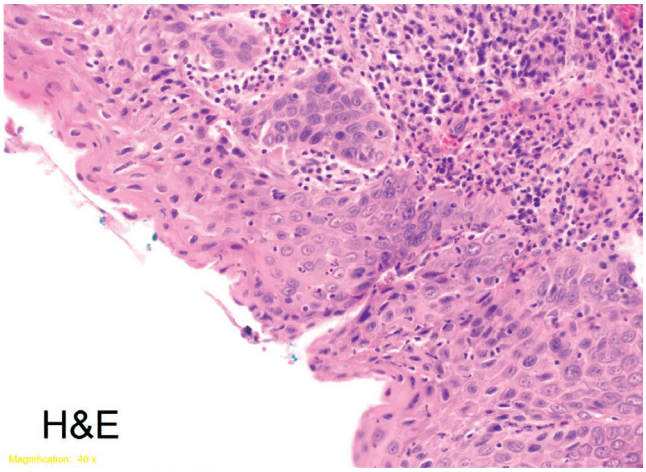

Fig. 1. a) Squamous Cell Carcinoma in situ, right vocal fold, H&E.

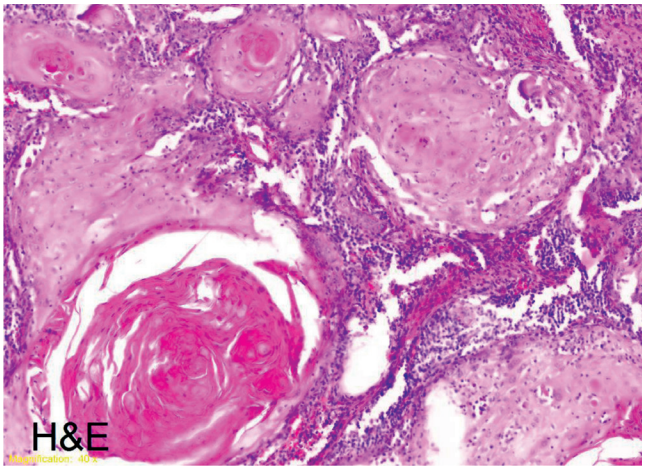

Fig. 1. b) Well Differentiated Squamous Cell Carcinoma, right vocal fold G1.

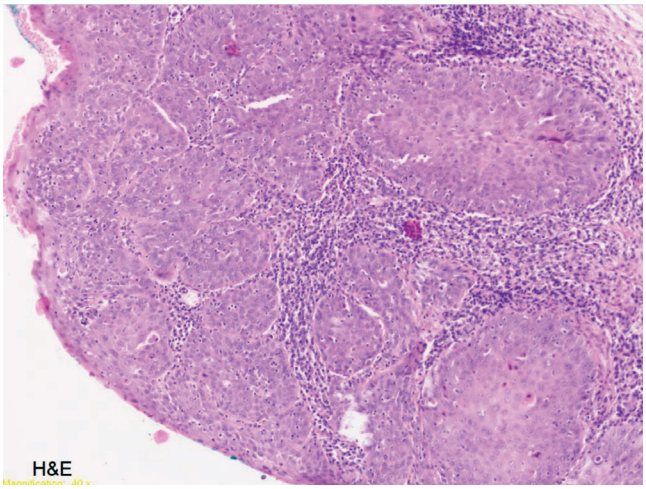

Fig. 1. c) Low Differentiated Squamous Cell Carcinoma G2, right vocal fold.

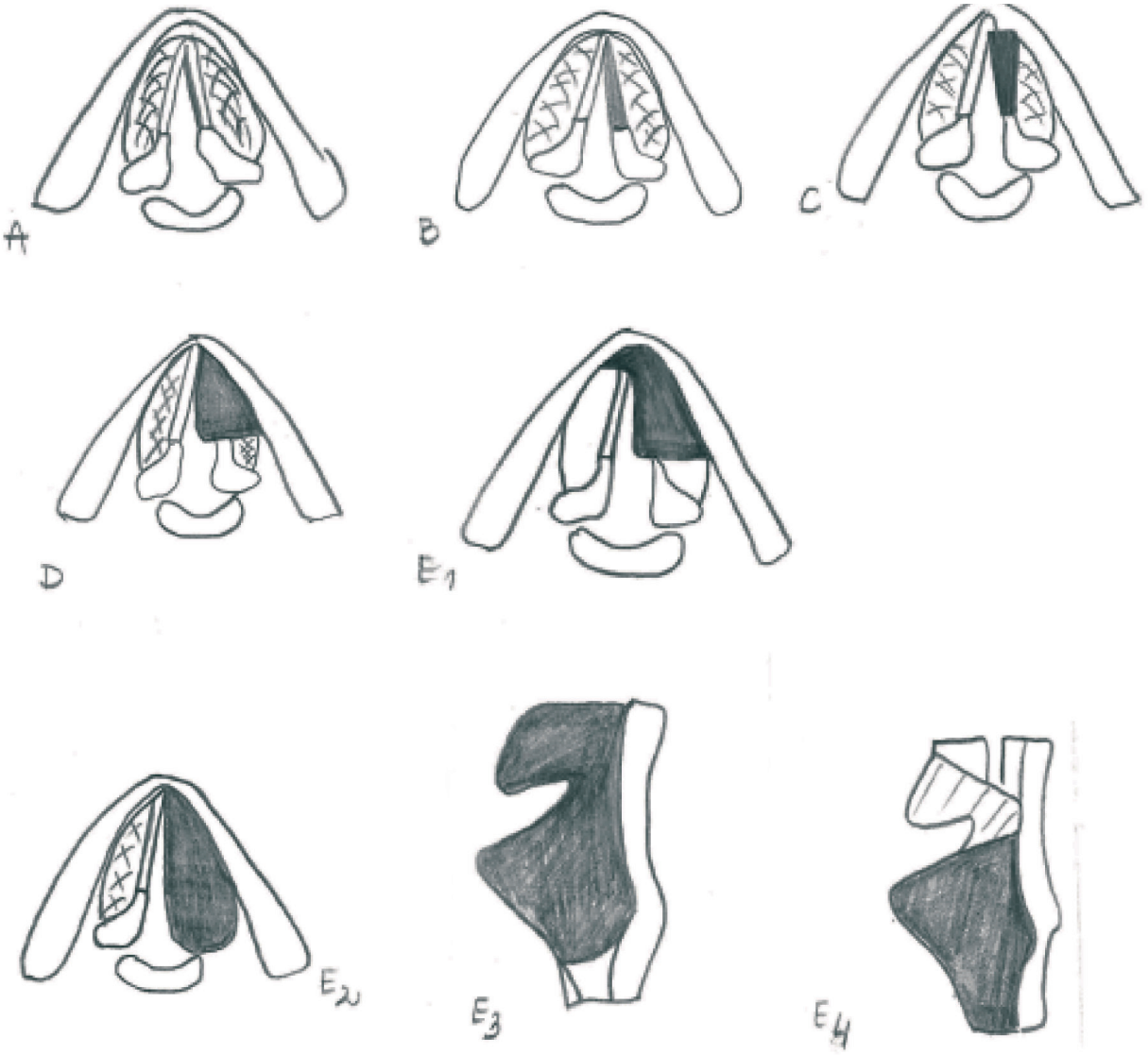

Fig. 2. Ryc. 2A. Chordektomia podnabłonkowa typ I (subepithelial cordectomy). Ryc. 2B. chordektomia podwiezadłowa typ II (subligamental cordectomy). Ryc. 2C. Chordetomia Przezmięsniowa typ III (transmuscular cordectomy). Ryc. 2D. Chordektomia całkowita typ IV (total cordectomy). Ryc. 2E1. Chordektomia rozszerzona typ Va obejmująca przeciwległy fałd głosowy (extended cordectomy encompassing contralateral vocal fold). Ryc. 2E2. Chordektomia rozszerzona typ Vb obejmująca część przednia chrząstki nalewkowatej (extended cordectomy encompassing arythenoid). Ryc. 2E3. Chordektomia rozszerzona obejmujaca fałd przedsionkowy typ Vc (extended cordectomy encompassing ventricular fold). Ryc. 2E4. Chordektomia rozszerzona obejmująca okolicę podgłośni do 1 cm typ Vd (extended cordectomy encompassing subglottis to a distance of 1 cm).

preneoplastic lesion at the margin and 4) carcinoma in situ at the margin. There are different definitions of resection margins in laser microsurgery of laryngeal cancer among authors, ranging from 0.5 mm to 2 mm.[5,32] Moreover, charred margins, thermally damaged tissues, constricted tissue specimen, spatial orientation of the specimen in a narrow triangular space of the glottis are additional factors that may increase the difficulty in proper histopathologic evaluation of the specimen, especially if the specimen is not properly marked. It is believed that the resection margins for the vocal folds can be limited to

Fig. 3. anterior bilateral cordectomy and commisurectomy proposed by European Laryngological Society

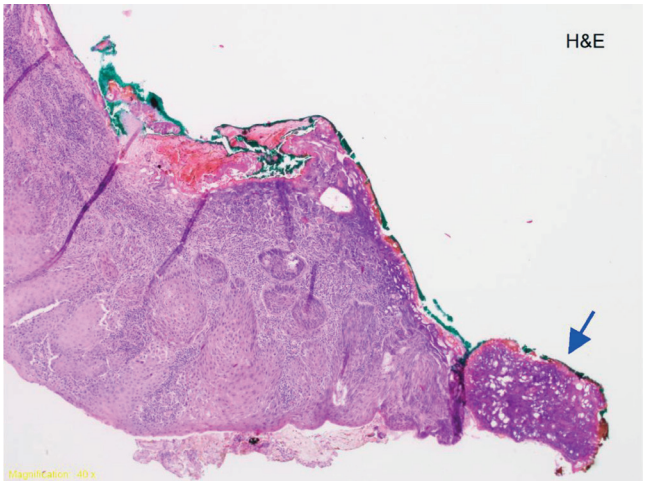

Fig. 4. a) Oncologicalmargin impossible to estimate due to thermic alteriations in the tissue (arrow).

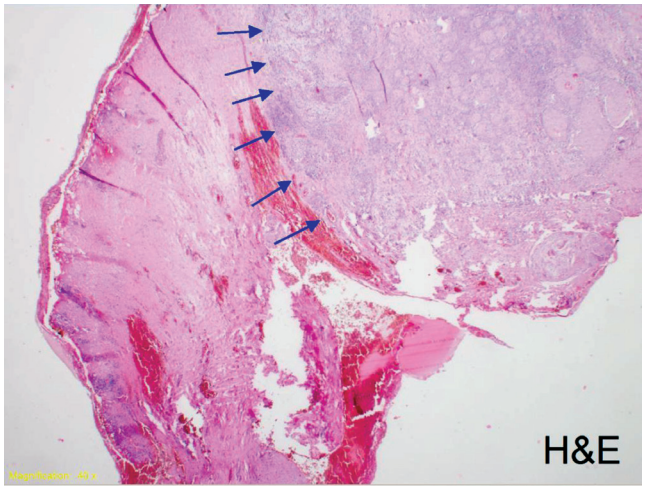

Fig. 4. b)Right vocal fold with a tumor, Squamous Cell Carcinoma (SCC) G1. Arrows indicate margin between tumor and tissue without tumor infiltration.(arrow).

1-2 mm.[32] Peretti et al. [31] investigated this problem in 600 patients with glottic neoplasms, stage Tis – T3, and found that the recurrence of the illness occurred more often when deep margins were assessed as positive. The greatest challenge in glottis surgery in comparison to superficial lesions is the area of the anterior commissure. Deep margins in the anterior commissure need to be in direct contact with the thyroid cartilage.

Glottis carcinoma staged T1a can be treated with laser type II foldectomy if the diameter of the lesion does not exceed 1 cm. T1a vocal fold carcinoma may require a total foldectomy type IV procedure if the neoplasm infiltrates the larynx in the antero-posterior dimension. Depending on the direction of infiltration, for example in medio-lateral direction, a tumor staged T1a not limiting the mobility of the vocal fold, may require extended foldectomy type V. Laryngeal tumor staged according to TMN classification as vocal fold tumor may require an extended surgical procedure, which may end in deterioration of the voice quality. A consequence of laser microsurgery of the vocal folds, depending on the range of the procedure, is the formation of adhesions in the anterior commissure and fissures in the glottis during phonation. This is caused by a necessity to maintain oncological margins during resection. Piazza et al. [15] assessed the degree of glottic insufficiency during phonation in patients after laser foldectomy videostroboscopically. According to a scale described by Chhetrii et al., [31], grade I was glottic closure not complete, grade II – closure of less than one-third of the glottis, grade III – closure between one-third to two-thirds of the glottis, grade IV – closure of more than two-thirds of the glottis, but still incomplete, grade V – complete glottic closure. Piazza et al. [15] confirmed the need for phonosurgical correction of the fissure in the glottis in order to achieve full closure in 47% of patients. The grade of closure in other patients was satisfactory and did not require correction (grade IV). The results confirm the need of phonosurgical treatment in patients after laser surgery. Because of extensive tissue resection a common occurrence after surgery is vocal fold paresis during phonation, which causes vocal fatigue and dysphonia reported in patients who underwent surgery. Directly after surgery the voice is weak, puffing; the maximal phonation time (MPT), which is a parameter of laryngeal aerodynamic function, is shortened. MPT (normally 20-25 sec), an aerodynamic parameter, has been used since 1960 in the assessment of airflow through the glottis and is considered as a reliable and useful parameter in phonetic function evaluation until now. The evaluation of voice quality is best performed with a phonation quotient (150-250 ml/sec) - which is a quotient of vital capacity and maximal phonation time - and subglottical pressure (6.1-8 hPa).

The basal frequency (F0) changes depending on the range of foldectomy. Bertino et al. [2] concluded that mean basal frequency measured in patients after type I and II foldectomy was 156 Hz and was lower than the frequency of 183 Hz in patients who underwent type III-V procedure. Higher values in patients after foldectomy III-V are caused by a decrease in the vocalis muscle mass. Moreover, type I and II foldectomies are associated with elastic cicatrix, which does not reduce the mobility of the vocal fold. Patients after type III-V foldectomies developed a way to compensate for the damage by vestibular folds or arytenoid hyperadduction causing aperiodic vibrations with higher basal frequency (F0). Among other commonly used tools to assess voice quality, Voice Handicap Index (VHI) is worth mentioning. VHI assists in the evaluation of physical, functional and emotional conse-

quences of voice impairment. Voice quality can be evaluated by perceptual scale GRBAS by Hirano (G-Grade, R-Roughness, B-Breathiness, A-Astenia, S-Strain). The increase in voice roughness according to the GRBAS scale is often diagnosed in patients who underwent extended foldectomies and in whom adhesions in the anterior commissure developed. According to Lee et al. [9] the post-operative voice quality depends on the range of resection. Patients who underwent extended foldectomies (type III, IV, V) achieved worse results in acoustic voice parameters: Jitter, Shimmer, Noise to Harmonic Ratio (NHR), VHI scale and all parameters assessed in GRBAS scale. Moreover, resection of the commissure or the upper one-third of both vocal folds resulted in impairment of voice quality. Rucci et al. [21] investigated histologically tissue specimens from the commissure in adults, newborns, and fetal tissues. Broyle's ligament located under the mucosa, in the infrapetiolar region is a weak point in the laryngeal structure, being a gateway for the neoplasm to infiltrate the thyroid tissue through many dehiscences in the perichondrium. Involvement of the anterior commissure in early glottis carcinoma is considered a risk factor of recurrence of the lesion after laser foldectomy or radiotherapy. Rucci et al. [20] introduced a classification of neoplasms affecting the anterior commissure (Anterior Commisure Involvement – ACI). AC0 stands for lack of anterior commissure involvement, AC1 – infiltration of neoplasm at one side, laterally to the midline, AC2 – involvement of anterior commissure, passing the midline; AC3 – involvement of anterior commissure, on both sides. Hoffman et al. [5] implies that laser foldectomy may be a good treatment alternative, even if the infiltration of the anterior commissure makes the prognosis and treatment outcomes negative. Remacle [18] emphasizes that resecting a tumor in the anterior commissure is a one-stage surgery. Multistage surgery should be performed in benign lesions only, like Reinke's oedema or when resecting papillomas located in the upper one-third of the vocal folds – in order to prevent cicatrix formation and development of adhesions in the anterior commissure region.

VOCAL THERAPY:

Vocal therapy has minimal effect on increasing voice quality and efficiency. It has no significant effect on voice fatigue due to glottis insufficiency and rigid cicatrix in the operated vocal fold. Sittel [23] suggests that there is no evidence that vocal therapy may bring any benefits after foldectomy. He proposes empirical use of phoniatric therapy in order to prevent the development of supraglottic hyperfunctional dysphonia. Voice therapy post partial laryngectomy aims to increase phonation seal of the glottis, voice strength and breathing effectiveness, and to make speech more understandable. Little or no effect of the previously mentioned methods is an indication for phonosurgical treatment. Phonosurgical techniques allow to significantly decrease vocal insufficiency, particularly after total and extended foldectomies, and thus the rima in the anterior part of the glottis, the so called key hole, can be closed.

PHONOSURGICAL TECHNIQUES

Laryngoplasty of the anterior region of the glottis according to Zeitels [29]

The aim of this procedure is to reduce the rima glottis in the anterior region, a so called key hole to achieve full glottis seal. The procedure is conducted under general anaesthesia and its essence is paramedian incision on the contralateral side of the previously operated vocal fold lesion. Cutting through cartilage in the horizontal plane can be done using an oscillating cutter in order to expose the anterior commissure. Infracture and subluxation of one part of the thyroid cartilage contralaterally to the lesion is followed by implantation of a rigid titanium microplate. The plate allows the vocal fold to be shortened and thus the rima in the region of the anterior commissure can be filled.[15] This technique according to Zeitels can be implemented with other medialization techniques, which enable alteration of the glottis anatomy. Piazza et al. [15] performed medialization thyreoplasty (using Gore-Tex implant) in conjunction with anterior commissure laryngoplasty according to Zeitels in three among nineteen patients. The postoperative outcomes were satisfactory. The voice quality was improved according to the GRBAS scale. Acoustic analysis revealed a decrease in the basal frequency (F0). This finding is correlated with a reduction in hiperfunctional supraglottic compensation. Many acoustic parameters, like jitter, shimmer, NHR and MPT were improved in all patients who underwent phonosurgical treatment. Piazza et al. [15] suggested that the minimal time after laser foldectomy should be up to 12 months before implementing phonosurgery, in order to avoid neoplasm recurrence. Medialisation thyreoplasty though is a technique whose stages do not conceal the signs of recurrence in the vocal fold. This is the implant that causes medial movement of the fold with the cicatrix in the direction of the rima glottis, making clinical evaluation even easier.

MEDIALIZATION THYREOPLASTY

Medialization thyreoplasty is a popular procedure with many indications, including treatment of unilateral paralysis of the

vocal fold, vocal fold atrophy or a cicatrix after oncological treatment causing fold deformation. [13] The procedure is performed according to the thyreoplasty type I technique by Isshika and is called medialization thyreoplasty nowadays. A window in the thyroid cartilage is created and cut subperichondrally, depending on the implant type. Implants used may include: Montogomery implant, GORE-TEX implant, calcium hydroxyapatite or titanium Friedrich implant. Another possibility is using a specimen of thyroid cartilage as an implant. Titanium Friedrich implant seems to be too rigid in order to be implemented, especially if the fibrous tissue is prone to tearing damage, as a result of previous laser surgery treatment. Calcium hydroxyapatite implants can be used in a particular situation, namely if a Montgomery implant cannot be placed. This situation occurs when subperichondral preparation cannot be performed to a sufficient extent along the vocal folds. The Gore-Tex implant is very useful in medialization thyreoplasty, is easy to place and has acceptable biocompatibility. An advantage of the Montgomery implant is its elasticity and round edges which do not traumatize the fibrous surface of the vocal fold. Parts of the thyroid cartilage are not easy to use as they require to be placed in a vertical position, perpendicular to the vocal folds, and they may be resorbed after placement.[13] There is always a certain risk of tearing the fibrous tissue of the vocal fold in the process of subperichondral preparation. The preparation between the inner surface of the thyroid cartilage and the fibrous tissue surrounding the window requires patience. It is a long-lasting and labor-intensive procedure in comparison to treating unilateral vocal fold paralysis using the same surgical technique. It is necessary to assure that medialization has the closest possible range in the direction to the midline. According to Remacle et al. [18] it is not possible to achieve such medialization of the fibrous vocal fold as in the treatment of unilateral vocal fold paralysis.

LICHTENBERG'S TECHNIQUE

Laser cutting of an adhesion in the anterior commissure and placement of a laryngeal keel between the commissure and the thyroid cartilage can be done using direct laryngoscopy according to Kleinsasser and requires general anaesthesia with JET ventilation. Cicatrix incision with separation of its edges is performed along the midline to the anterior angle of the thyroid cartilage. The next step is local application of Mitomycin C, 2 mg/ml in 2 minutes' time. The laryngeal keel, 0.2 mm thick, is fabricated from a biocompatible material (silastic) and its shape is adjusted to the shape and length of the cut adhesion in the anterior commissure. After that, the cut is closed with non-absorbable suture and Lichtenber's tool to guide the

Fig. 5. (The implant e.g Gore-Tex is placed through the window in the thyroid cartilage and medializes the postcordectomy, cicatricial, fibrous „neocord").

needle (Wolf, Knittlingen, Germany). The direction of suturing is always the same – from inside to the outside. One end of the suture is guided under the anterior commissure through the cricothyroid ligament. The other end of the suture passes above the anterior commissure through the petiolus of the epiglottis and thyroid cartilage. Under videolaryngoscopy, the keel is placed between the vocal folds at the level of the anterior commissure. The keel has to remain in close contract to the thyroid cartilage in order to avoid development of adhesions in the anterior commissure region. The suture under required strain is led outside and ends on the surface of the neck. After 4 weeks the keel is removed under general anaesthesia. Remacla and Lawson [18] recommend local injection of Mitomycin C 2 mg/mL, after laser cutting the adhesion in the anterior commissure. In order to avoid cicatrix formation in the anterior commissure, some authors suggest topical application of Mitomycin C. This drug can influence wound healing through suppression of fibroblasts, but at lower concentrations – around 0.4 mg/mL, with application time of 5 minutes.[18] A seldom complication may be dyspnea. Dyspnea, lasting for a few hours after the procedure, may occur after laryngeal keel has been placed. Antitussives and local anaesthetics, like lidocaine, may be used to prevent it. Postoperative recommendations include antibiotherapy, nebulized steroid therapy for 5 days, proton pump inhibitors and antitussives. The laryngeal keel position should be monitored weekly with videolaryngoscopy. Physical and vocal activities should be avoided.

AUGMENTATION LIPOINJECTION

Augmentation lipoinjection has been described by Zeitels et al.[29]. This surgical technique aims to correct the fis-

sure that is present in the glottis after endoscopic tumor resection. Bolzoni Villaret et al. [1] used this method in their endoscopic treatment. They called it: Primary Intracordal Autologous Injection (PIAFI). One-stage treatment with laser foldectomy type III and PIAFI technique was implemented as additional treatment, to enhance the effects of phoniatric voice rehabilitation after surgical and oncological treatment. This procedure may be used only as an adjunct to surgical treatment, i.e. type III foldectomy, under two conditions: there is sufficient volume of the cricothyroid muscle present and it if possible to identify the implantation site (horizontally, deep to the level of the vocal process). Remacle et al. [13] emphasize, that medialization techniques have better performance than augmentation procedures. Clinical experience in augmentation described above has not shown any significant results. Augmentation after foldectomy may be difficult, because the implantation site is partially damaged and the material cannot be applied to the Reinke's space. Augmentation lipoinjection or application of collagen as augmentation material is not recommended after total or extended foldectomy. According to Bolzoni Villaret [1], in cases when the cricothyroid musce has been removed other medialization techniques should be implemented, and the time between oncological and phonosurgical treatment should be adjusted properly to minimize the risk of recurrence.

VOICE QUALITY AFTER RADIOTHERAPY:

Radiotherapy is an alternative method of treatment to laser endoscopic surgery in early laryngeal carcinoma. Long-term voice preservation is comparable after treating patients with both methods, with slight advantage of laser surgery (90.1% radiotherapy and 97.4% laser surgery) [18]. Function and voice efficiency after oncological treatment are a very important issue. Phonosurgical methods seem to be significant in this matter, as oncological radicality is granted by radiotherapy and surgical treatment. Phonosurgical techniques allow to preserve voice function without any negative influence on survival rates. Moreover, they help to reduce the cost of prolonged hospitalization associated with radiotherapy. Hocevar – Boltezar et al. [6] reported occurrence of dysphonia in patients with early laryngeal carcinoma treated with radiotherapy. As much as 92% of their patients showed decreased vibration of the vocal folds and decrease in mucosal wave (MV) in stroboscopic examination. Acoustic tests revealed increase in jitter, shimmer, f0, as well as lowered MPT in this group of patients. Verdonck-de Leeuw et al. [26] confirm these observations. Peeters et al. [11] reported that patients with laryngeal carcinoma stage T1a who were treated with radiotherapy were more dysphonic than those treated with laser foldectomy. It is important to note the depth of tumor infiltration and range of resection, though. In a study by Peeters [11] only superficial neoplasms were treated with type I and II laser foldectomies, while deeper-located lesions, which infiltrated the structure of the vocal fold, received only radiotherapy. Wedman et al. [27] reported a perfect outcome of oncological treatment with good voice quality preservation, comparable or even better than in patients treated with radiotherapy.

Peretti et al. [14] suggested that type I and II foldectomies can be assessed as functionally proper treatmeent, even for those who use their voice as their profession. Full voice recovery postoperatively is possible. It has to be emphasized clearly though that type I foldectomy is dedicated to treating only lesions such as hyperplasia, dysplasia or in situ carcinoma. Type II foldectomy is a technique indicated in lesion such as leukoplakia with no clinical signs of neoplastic transformation. In stroboscopic examination deeper infiltration or slight change in fold vibration may be noted. Type II foldectomy is proper for treatment of microinvasive carcinoma or in situ carcinoma with microinvasion inclinations [16]. Keilman et al. [7] conducted a retrospective analysis and compared voice quality after endoscopic laser foldectomy and non-endoscopic procedure. They reported better phonation and better spectrographic parameters in patients treated with endoscopic procedures. On the other hand, Antonio and Oscar Schindler [22] compared clinical outcomes of 57 patients diagnosed with T1a laryngeal carcinoma and stated that voice quality was better after non-endoscopic laser surgery, but the difference was not statistically significant.

CONCLUSIONS:

All treatment methods applied in early vocal fold carcinoma allow for cure with preservation of physiologic breathing and swallowing patterns. However, voice quality still remains a problem. When choosing a proper treatment technique, we should always take into account postoperative voice quality. Voice quality changes both after surgical treatment and radiotherapy. Phonosurgical techniques can be a useful adjunct to the therapy, as they allow to enhance the voice quality after laser foldectomy. Recovery of voice quality is beneficial to the patient and his/her social and professional activity. In subjective assessment of patients after phonosurgical treatment, phonation required less effort and voice fatigue was not noted by the patients.

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