ENT Department I.P.Pavlov Medical University

CONTRIBUTION TO MODERN ENDOSCOPICAL AND LASER TECHNOLOGIES IN OTORHINOLARYNGOLOGY

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Протокол № 4 от 15.11.11

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CHAPTER 1.
ENT Department of Saint Petersburg I. P. Pavlov State Medical University. 110th ANNIVERSARY

S.A. Karpischenko

Professor and Chairman ENT Department I.P. Pavlov Medical University

In 2010 our Department celebrated 110 th anniversary of its foundation. According to the historical scale 110 years is not a long period of time, but as for ENT specialty it is almost the whole life.

The main concept of this short article is to emphasize the most important points of the history of ENT Department of I.P.Pavlov State Medical University.

With deepest gratitude to my teachers and Professors who left as a legacy the description of the previous chronicle of our Clinic I have based this article upon their data.

First of all it should be noted that the history of our Department starts from the first years of existence of the University itself. That is why the consideration of the events cannot be described without taking into the account the development story of I.P.Pavlov Medical University.

Now the age of the University is 113 years old. However that is only the educational age. Medical history of the place where our University is situated goes back to the dates of Saint Petersburg foundation. After the year of 1703 Peter the Great ordered to create "a chemist's garden" on the coasts of Bolshaya Nevka and Korpi rivers. The title of Korpi river means in Finnish "deuce-firwood". Now it calls "Karpovka" river (border between the territory of I.P.Pavlov Medical University and Saint Petersburg Botanical gardens). Area which lies opposite to "chemist's garden" Peter the Great presented to Commandant of Saint Petersburg R.V.Bruce. After his death the estate was passed to the Head of the Russian Synod — **Archbishop Theophanes Prokopovich** who built a church and an asylum for poor, needy, handicapped and ill people.

Arch. Theophanes Prokopovich

Archbishop Theophanes Prokopivich died in 1735 and his charity becomes Hospital for poor people for male and female patients with capacity of 250 beds. New founded Hospital was named as "Peter and Paul Hospital".

Many years later "Women's Medical Institute" was opened on its base.

Ladies were not admitted to be educated at the medical faculties of the University. There was no any Medical University in the world for Ladies education especially for training ladies as the physicians.

V.K.von Anrep

After numerous unsuccessful attempts to train gentlemen and ladies together at the medical faculties, in January 1895 the Ministry of People's Education worked out the Regulation on Women's Medical Institute which was approved by His Majesty Tsar Nikolai the Second in June 1895. This event was a real break-through that changed the basis of civil community structure and enable ladies to have equal rights and possibilities which was involved not only in Russia.

At the same time **Vassily Konstantinovoch von Anrep** a prominent pharmacologist was appointed as a Director of the Institute.

The ceremonious opening of the Women's Medical Institute took place in September 14, 1897. V.K.Anrep was a world-wide famous scientist, who worked out the basic experimental and clinical researches in the field of local anesthesia. He also published his results in ENT in the main scientific journals of Europe and North America. These papers became classic and essential ones.

The figures of the year of the foundation of our University are one of the most significant points of its Emblem. The motto written beyond the date "Medicina ARS Nobilissia" means that "Medicine is the main art". Hygienc's head which is in the center of the Emblem near the Asclepius staff on the left and Prometheous torn on the right symbolize medical educational and scientific traditions in all activities. СПбГМУ is the abbreviation of Saint Petersburg I.P.Pavlov State Medical University. Laurel wreath below is the traditional Antique symbol of glory.

Prof. V.K. Anrep was a Director of Women's Medical Institute only during 2 years. But the main mission of his directorship was successfully realized. Institute was founded.

It became possible due to his personal excellence and his high-ranking social and official position. He was a noble man, famous scientist and politician.

B.V. Verkhovsky on his graduation from Military Academy

Only 3 years passed after the ceremonious opening of the Institute when Professor **Boris Vladimirovich Verhovsky** was invited to be a founder and a Chairman the ENT Department. B.V. Verhovsky was born in Moscow in 1863, in the family of the railway engineer. On leaving a Gymnasium he entered physical and mathematical faculty of Saint Petersburg University. 3 years later he was transferred to study at the first course of the Medico Military Academy. He was awarded a grant by Professor Bush when he was a student of the last course. On graduating from the Medico Military Academy B.V.Verhovsky entered the therapeutic Clinic of Professor Sergyei Petrovich Botkin for postgraduate education. He started to learn the pathology of ear, nose, throat and larynx under the supervision of Professors A.F.Proussak, D.I.Koshlakov and N.P.Simanovsky. During 2 years since 1894 B.V.Verhovsky was educated in leading Clinics of Europe such as Killian's in Frieburg, Betzold's in Munich, Troutman's in Berlin, etc. Later in 1900 he became a founder and a first Chairman of ENT Department of Women's Medical Institute.

First years of existence of the Clinic were not easy. Wards for 24 patients, operating room as well as examination and dressing rooms were opened in typhus barrack. There were no special rooms for scientific research, education and for outpatient practice. Nevertheless, personal activities of Professor Verhovsky and his staff made it possible to develop effectively ENT Department those days and in the future. Prof. Verhovsky had the huge organizing

A.F.Proussak

D.I.Koshlakov

N.P.Simanovsky

abilities which were noticed by his colleagues from Women's Medical Institute and as a result he was elected as a Director of the Institute.

Rector B.V.Verkhovsky

The period of directorship of Prof. B. V. Verhovsky coincided with a difficult period of history such as the First World War, Revolution and Civil War. The main task was to eliminate the deficit of medical specialists in the acting army. Many female students took the field as volunteers, medical assistants and nurses. During the directorship of Prof. B.V.Verhovksy the Institute lost its status of a solely women's one. But it was absolutely necessary for Institute survival during the first years of young Soviet system. All the actions related to the saving of the Institute belonged to Prof. B.V.Verhovsky himself.

In 2000, the year of 100th anniversary of ENT Department the monument to Prof. B.V.Verhovsky was ceremoniously opened at the entrance of our Clinic.

Leonid Efimovich Komendantov became the second Chairman of ENT Department of First Leningrad Medical Institute as it was named that time. L.E.Komendantov was born on 8th of February, 1883 in Central Russia on the banks of Volga River in teacher's family. In 1900 he entered the Military Medical Academy and in 1907 graduated from it with honour. For many years he worked as Associated Professor in Clinic of Professor M.K.Tsitovich in Saratov. Prof. M.K.Tsitovich before his leadership in ENT Department in Saratov Institute worked as Associated Professor in the Clinic headed by Prof. N.P.Simanovsky. So, it proves that Professors B.V.Verhovsky, L.E.Komendantov as well as their follower Prof. W.F.Undrits were the pupils of the main Russian ENT cradle — Otorhinolaryngological Department of Medico Military Academy which was founded by Prof. N.P.Simanovsky.

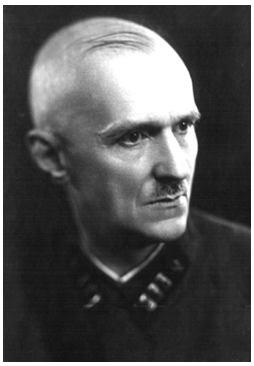
L.E. Komendantov

During 10 years of the leadership of Prof. L.E.Komendantov in ENT Clinic of First Leningrad Medical Institute from 1930 year up to 1939 there was received a lot of new space situated on 3 flours of the building. Number of beds reached up to 60. New op-

erating room, dressing room, three laboratories, X-ray room and photo laboratory were opened in Clinic.

Wilhelm Fomich Undrits was born in 8th of September, 1891in teacher's family in Germany. His family spoke German, all his school education was in German. Russian was his second language. He also studied English from his childhood. This point of his biography was important and significant for his future incorporation into international ENT Society. After graduating from Medico Military Academy and 4 years practice as a military surgeon on the battle fields of World War I, Wilhelm Fomich Undrits made an excellent carrier having gone upstairs from a resident to Professor in Clinic of Professor V.I.Voiachek.

In 1940 he became a Chairman of ENT Department of First Leningrad Medical Institute. Unfortunately the Second World War destroyed all dreams about the development of ENT specialty. During first years of his directorship Wilhelm Fomich applied all his activities for survival of the Clinic and its staff. The experience of military surgeon received in the fights in Russian army was very helpful to him. And as a medical officer Wilhelm Fomich became the Main Otorhinolaryngologist of Leningrad front. In comparison with the year before the Second World War type of ENT pathology seriously changed. "Epidemic" of military trauma started. Well-educated in military medicine Wilhelm Fomich successfully organized effective treatment of patients not only in his Clinic. With the beginning of Blockade a huge number of hypotrophic and dystrophic patients became patients of the Clinic. The situation with food supply of Leningrad was terrible and of course the adequate nutrition of patients was difficult. Wilhelm Fomich and his colleagues also suffered from starvation as all the citizens, nevertheless they did everything they could to save the patients. When Blockade and War finished Professor W.F.Undrits thoroughly analyzed his clinical observations and unique experience which was carefully collected by him as a real scientist during these difficult years.



W.F. Undrits

Prof. W.F.Undrits was an excellent, unforgettable surgeon, brilliant scientist who created his personal school of otorhinolaryngology. In spite of the time of Iron Curtain and Cold War Wilhelm Fomich was one of the small numbers of Soviet medical specialists who were admitted to present their achievements to International ENT Society at European and World Congresses. W.F.Undrits died in 1963.

At present days every medical student in Russia knows "Undrits directoscope" — a special tool for hypopharyngo- and laryngoscopy as well as otoscopical symptom of cholesteatoma — "Undrits symptom"

D.A.Pigulevsky

Afterwards since 1963 until 1974 the head of our Department became the follower of Prof. W.F.Undrits Professor **Dmitry Alexandrovich Pigulevsky**. He was born in 1899 in Belorussia in the city of Minsk, in bishop's family. In 1926 after graduating from Leningrad Medical Institute Dmitri Alexandrovich started his ENT practice in different Leningrad and its suburban hospitals. He began his carrier in our Department as an assistant-professor in 1942. Scientific interests of D.A.Pigulevsky were initiated in many points by his teacher Prof. W.F.Undrits under the influence of military period of the specialty. So, the subject of his scientific research was "Importance of sympathic nervous system in patients with laryngeal trauma". After 1945 in collaboration with Prof. W.F.Undrits he summarized the experience of ENT Clinics of Leningrad front during the Second World War. The obtained results were presented as the monographs "Traumas and gunshot Injuries" and "Atlas of gunshot injures of ENT Organs".

Marius Stefanovich Plouzhnikov was a pupil of Prof. W.F.Undrits.

Professor Marius Plouzhnikov was born in Saint Petersburg in the family of Doctors.

M.S.Plouzhnikov

Graduated from I.P.Pavlov Medical University in Saint Petersburg in 1962 and since that time he served medicine and patients during all his life. He was Professor and Chief of ENT Department of I.P. Pavlov Medical University for 32 years. In 2008 he was elected Doctor Honoris Causa of the University for his enormous contribution for education of medical students, postgraduates, as well as for development of otorhinolaryngology and medicine at all.

He was the Actual Member of Russian Academy of Natural Sciences, of Laser's Academy, of Medico-Technical Academy. He was the Honoured Member of Polish Academy of Science and

Corresponding Member of Deutsche Gesellschaft für Hals-Nasen-Ohren-Heilkunde, Kopf- und Hals-Chirurgie. Also he was elected Honoured Member of Belgian ENT Society. He was Chairman of ENT Scientific Society of USSR.

Since 1991 up to 2008 year he was the President of International Academy of Otorhinolaryngology-Head and Neck Surgery.

He was a talented teacher. More than 100 pupils worked all over the world. He was Chief for 60 doctors who made their PhD dissertations under his supervision, he was the author of 450 scientific papers and 11 books written for doctors and medical students.

Prof. Plouzhnikov founded his own school in specialty. He worked out many special problems in medicine, new types of surgery. He was the pioneer of application of contact laser surgery, laser interstitial thermotherapy (LITT) in otorhinolaryngology. He was an excellent surgeon. He allotted much time to theoretical problems in medicine. He worked out the "auron" theory of hearing. He studied the influence of laser beam upon the processes in different tissues of human being.

He was Chief Editor of "Folia Otorhinolaryngologiae et Pathologiae Respiratotriae" for 13 years.

He was the founder of the International Conferences for Young Otorhinolaryngologists. He organized these Conferences for youngsters 24 times.

He was a talented writer. He published 3 books of stories in Russian and English Languages. He wrote very nice poems in English and Russian. He knew the literature, art, history perfectly. He was a brilliant speaker with good sense of humour.

Due to his perfect English he was a "bridge", which connected Western and Eastern specialists.

And finally I would like to write some words about the modern history of ENT Department of I.P.Pavlov Medical University. Nowadays all the colleagues of our Department united by clinical, educational and scientific traditions are making a huge job. All these traditions are carefully preserved and supported. As to our opinion there are no insignificant points in our beloved otorhinolaryngology. We are all the pupils and the followers of Professor Marius Plouzhnikov. Less than one year ago we performed the memorial plaque opening ceremony dedicated to the memory of Professor Marius Plouzhnikov. A lot of his friends and colleagues came to this ceremony to say good words about our teacher, to remember him and to support us. Scientific and educational conference was held on the next day after the memorial meeting.

CHAPTER 2.
ADDITIONAL FIBROLARYNGOSCOPICAL TESTS. CLINICAL SIGNIFICANCE

O.E. Vereschagina

Fibrolaringoscopy is one of the most informative endoscopical methods in practice. Transnasal fibrolaryngoscopy gives pharyngeal and laryngeal endoscopical picture in detail and under physiological conditions in the process of breathing and phonation. The procedure is available in practically all the patients. All the parts of the larynx, which are often not seen during indirect laryngoscopy, can be observed.

Advantages of fibrolaryngoscopy: it can be used in most clinical cases, active mobility of vocal folds can be assessed, examination of the larynx in physiological position is possible, the patient is in contact with the doctor during the examination.

However, like any other research method it has disadvantages and limitations: low resolution of the picture, which makes difficulties for differentiation of microscopical pathology, difficult visual examination of valleculae, Morganii spaces and recessus piriformis, difficult examination of cricoarytenoid joints passive mobility, narrowing of breathing pathways by endoscope in patients with stenosis, the endoscopical picture is not static in comparison with rigid endoscopy, manipulations possibility is limited.

At the ENT clinic of Saint Petersburg I.P. Pavlov State Medical University the fibrolaryngoscopy has been performed for many years and certain experience has been accumulated. Between 2004 and 2008 — 375 patients with different pathology of the larynx underwent fibrolaryngoscopy. Besides routine examination in the process of phonation or forced respiration for better view of some anatomical areas of the larynx and laryngopharynx, we use a number of additional tests:

– test with palpation in projection of valleculae;
– Valsalva test;
– measurement of anterior commissure angle;
– measurement of vocal fold length;
– test with press on eye-balls;
– test with palpation of hyoid bone;
– test on exclude glottal insufficiency;
– videofibrolaryngoscopy with measurement of glottal space;
– analysis of slow reproduction of video record;

– videofibrolaryngoscopy with the voice computer analysis.

These last three tests have been performed for many years and the results have been discussed. Several reports on the topic have been made.

Let me introduce some more fibrolaryngoscopy tests.

– Tongue and lingual tonsils hypertrophy is the main cause of low visibility of valleculae. In such cases we use external neck palpation in the projection of valleculae.

– Valsalva test during fibrolaryngoscopy examination is helpful for better vision of Morganii spaces.

– Measurement of anterior comissure angle is an opportune criterion of treatment effectiveness in patients with unilateral vocal fold paresis.

– Another test is measurement of vocal fold length in cases of anterior comissure webbing before and after surgical treatment.

– The test with pressing on eye-balls is useful to reduce spasm component in differential diagnostics between paresis and laryngeal spasm.

– The test with palpation and active moving of the hyoid bone permits to identify its projection endoscopicaly.

– To exclude glottal insufficiency we ask the patient to stop breathing, as if you dived.

We present some details and results of fibrolaryngoscopical tests. Since 2006 our department has examined 81 patients with normal vocal folds mobility, 32 males and 49 females. During still-frame reproduction of the video record the measurement of anterior commissure angle is conducted with help of a protractor. This part of our research was performed for improvement of the method and for further employment in various cases. The results were from 65 to 80 degrees among males and from 50 and 60 degrees in females (*tabl. 2.1*).

Table 2.1

Index of the anterior commissure angle. Patients with normal indices

Patients	Number	Min Index, (degree)	Max Index, (degree)	Middle Index, (degree)
Male	32	65	80	70
Female	49	50	60	50

Later this method was applied for estimation of the effectiveness of treatment in patients with unilateral vocal fold paresis, the fold being in medial position in 9 patients, among them were 3 males and 6 females. The results

of angle measurement during unilateral vocal fold palsy were from 35 to 40 degrees among males and from 25 to 30 degrees among females (tabl. 2.2).

Table 2.2

Index of the anterior commissure angle.
Patients with unilateral paresis of larynx on medial position of vocal fold

Patients	Number	Min Index, (degree)	Max Index, (degree)	Middle Index, (degree)
Male	3	35	40	35
Female	6	25	30	30

As an example let us to demonstrate the next clinical case. Fibrolaryngoscopy of the patient with right vocal fold paresis in medial position. Anterior commissure angle changed from 25 degrees before to 55 degrees after therapy. So, positive dynamics of rehabilitation of abductive function showed effectiveness of our treatment (*Fig. 2.1, 2.2*).

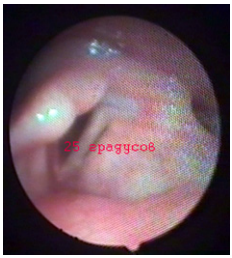


Fig. 2.1. Measurement of the anterior commissure angle before treatment

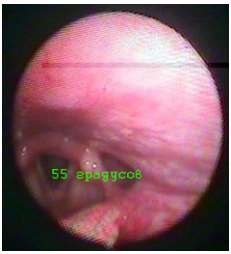


Fig. 2.2. Measurement of the anterior commissure angle after treatment

The next case shows external neck palpation on the level of cricoarytenoid joints, which is a helpful method of differentiation of neurological and inflammatory arytenoid fixation. We can see passive mobility during palpation.

Dislocation by external pushing of the epiglottis backwards from the base of the tongue in patients with low visibility of valleculae, allows to see this space better. During palpation in the area of the right recessus piriformis local malignant infiltration was verified.

And the last clinical case shows Morganii space visual examination during Valsalva test. Intralaryngeal pressure sharply rises, which allows to assess open Morganii spaces which are normally locked. This is a case of la-

ryngeal hematoma, localized on right vestibular fold and the test shows that Morganii space is intact (*Fig. 2.3, 2.4*).

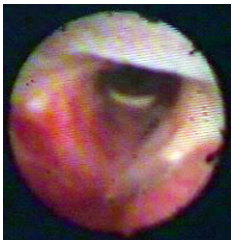


Fig. 2.3. Fibrolaryngoscopical picture

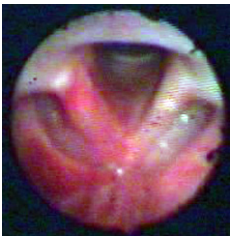


Fig. 2.4. Valsalva test

The experience of our Department shows that:

– additional tests and methods extend diagnostic possibilities of fibrolaryngoscopy;

– fibrolaryngoscopy is a method of choice to examining the patients with suspected laryngeal and laryngopharyngeal pathology;

– additional tests can be used in every-day practice and do not require special training of a doctor.

Endoscopic Examination of Tracheotomised patients

Fibrolaryngoscopy is one of the main modern endoscopical methods in laryngologists practice. Fibrolaryngoscopical examination is helpful for better visualization of specific pathological changes in the airpassages, for prognosis and follow-up management strategy in the cannula-carriers.

The aim of our study: to analyze diagnostic possibilities of laryngoscopy and to describe indications for different diagnostic methods during endoscopy of tracheostomised patients.

Advantages of fibrolaryngoscopy in cannula-carries: visualization of trachea space, identification of tracheal rings differentiations, mucosa membrane condition in trachea, carina and bronchus, position of tracheostomy cannula distal end. In case of correct tracheostomy tube position its inner space continues in the same line with tracheal space. Tracheostomy cannula is unique possibility of retrograde examination of larynx from below. To perform this procedure laryngologist covering distal part of fiberscope change to up to the larynx. In case of long term tracheostomy fibroendoscopic examination of tracheostoma canal without cannula usually have no hazards of spontaneous canal space closure. Subglottal space and lower surface of vocal cords can be visualized. Transcannulare fibrolaryngoscopy is obligatory

method for patients with tracheostoma at first days. First days after operation active phlegm and crust formation can lead to breathing disturbance and asphyxia because of cannula obturation. In this case fibrolaryngoscopy is effective not only for diagnostics, but also for treatment. Fibrotracheoscopy must be performed in all cases of regular and intraoperative cannula insertion. For example, during lower tracheotomy distal part of the tube may be in right primary bronchus and its branching may imitate bifurcation of trachea.

715 patients aged from 19 to 73 were examined with fibrolaryngoscopy at the ENT clinic of Saint Petersburg I.P. Pavlov State Medical University during last 5 years. 210 patients were the cannula-carries. All these patients underwent fibrotracheoscopy. In these group endoscopic findings were as follows: stenosis and paresis of larynx, cicatricial and granulation stenosis of larynx and trachea, papillomatosis of upper airways, malignant laryngeal tumors.

133 patients with granulations of tracheal anterior wall of were examined by fibrotracheoscopy. Among them, in 73 patients incorrect cannula position was found. 11 patients after frequent and rough cannula and trachea sanation by suction tube had erosion of tracheal mucosa membrane with bleeding from tracheostomy canal. In the early postoperative period right bronchi cannula was found in 9 patients. In 4 patients correction of tracheal tube position was performed intraoperatively with visual control of distal part. Only in 40 patients correct position of cannula was found. Our experience shows the importance of cannula-carriers fibroendoscopical examination as a part of panendoscopy.

The experience of our department enables to come to the following conclusions: additional tests and methods are extending diagnostic possibilities of fibroscopy; retrograde laryngeal examination by flexible endoscope is informative, non-traumatic diagnostic manipulation; transcannula fibroscopy is an important method of examination at the end of tracheostomy; control examination during cannula sanation helps to do full delicate suction of trachea; detail endoscopical control is an important diagnostic part before decanulation planning.

CHAPTER 3.
CONTACT LASER PHONOSURGERY

Professor S.A. Karpischenko

Term "phonosurgery" was proposed by Hans Von Leden in 1950. And first it was a group of different types of surgical interventions in patients with unilateral vocal fold paralysis for correction of glottal insufficiency. Later benign lesions of vocal folds become the target of phonosurgical procedure.

Distant mode of laser application is the most popular technique in modern laryngological practice. In our Clinic contact mode of laser application becomes the routine method in different types of laryngeal pathology. The idea of such method of application belongs to Professor Plouzhnikov.

Approach which will be presented here is routine in our Clinic already during 10 years.

In most cases we perform the surgical interventions under the conditions of direct laryngoscopy with general anesthesia with high frequency jet ventilation via tracheopuncture.

Technique of a puncture and a catheterization of trachea. We use Seldinger technique of catheterization. This preoperative procedure is better to perform under local anesthesia because this method gives a possibility to start a relaxation and general anesthesia without apnea. Also due to this fact tracheopuncture can be used as an adequate and a helpful method not only in laser phonosurgery but in general anesthesiological practice.

At first we make a local infiltration of the soft tissues in the point a choice of which depends upon the type of pathology. In cases of vocal fold lesions conicopuncture is preferable. When a pathological process is spreading into a subvocal space — tracheopuncture increases a risk of a catheter damage by laser beam.

During thin needle puncture a surgeon or an anesthesiologist can check a position of trachea and inject local anesthetic into air-space before a catheterization. The second step is a thick needle puncture which presents a tunnel for an elastic guide. Seldinger technique is well wide-known and we use it similar with venous catheterization by intravenous catheter of 1,4cm diameter. Such diameter is adequate to normal high frequency ventilation during phonosurgical procedure. At every stage of catheterization aspiration control must be realized. Bubbles inside the syringe and easier aspiration of the air are an adequate criteria of correct needle or catheter position. After a proce-

dure completes catheter should be connected with a respiratory apparatus and an anesthesiologist starts with relaxation.

Passive expiration noise is helpful to control a depth of anesthesia and for direct laryngoscope performance.

There is no official statistics of benign vocal fold lesions in Russian Federation and as far as I know in other countries also. We can know only statistics inside of laryngeal pathology due to the experience of laryngological Clinics. Four hundred four patients were operated in our Clinic during last 5 years. This table shows ratio of different vocal fold lesions in results of our Clinic. Lesions were presented by:

- polyps — 42,07%;
- papillomas — 16,33%;
- Reinke edema — 7,92%;
- granulomas — 5,44%;
- cysts — 15,84%;
- varix — 1,98%;
- nodules — 2,97%;
- leukoplakia — 8,41%.

For pre and post-operative examination of our phonosurgical patients we use routinely several methods.

– indirect laryngoscopy;

– fibrolaryngoscopy;

– videofibrolaryngoscopy with different modifications and functional tests (for example: measurement of rimma glottidis);

– the voice computer analisis

– and in cases of stenosis suspicion — spirometry (Oscar Kleinsasser classifies **polyps** in 3 types: Edematous, Fibrous, Angiomatous);

– Edematous, 42 patients underwent laser removal in our Clinic;

– 30 patients with fibrous polyps,

– with angiomatous — 98.

And totally one hundred seventy patients with polyps were operated

Direct microlaryngoscopical view shows typical left vocal fold (*Fig. 3.1*).

Angiomatous polyp in anterior third. Polyp must be removed by laser without submicosal tissues damaging and without vocal muscle damaging (*Fig. 3.2*). This principle is the main for absolute voice rehabilitation in post-operative period.

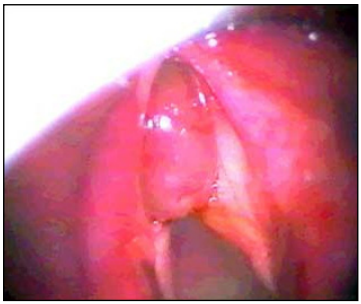


Fig. 3.1. Angiomatous polyp in anterior third

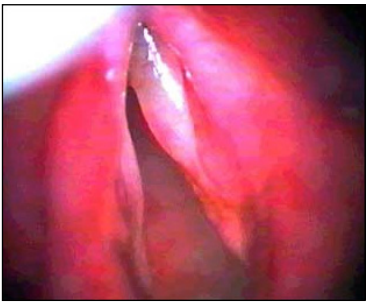


Fig. 3.2. Direct microlaryngoscopical view after removal

Reinke edema is a very frequent form of chronic laryngitis, known as "polypoid chorditis" and "Reinke laryngitis" and other.

Endoscopically Reinke edema looks similar with edematous polyp. Usually Reinke edema localizes bilaterally but fold can be observed on one vocal.

Main etiological fact is increasing of subglottal pressure in patients with chronic coughing and smokers.

Due to disturbance of elasticity of vocal fold mucous membrane gelatinous substance accumulates in Reinke space (between mucous membrane and vocal muscle) (*Fig. 3.3*).

Yonekava describes three stages of Reinke edema.

In I stage Reinke edema can be successfully treated without surgery with conservative therapy and phonosurgery.

II stage only surgery can be effective.

In III stage the respiratory dysfunction becomes the main syndrome. Hyperplastic changes of mucous membrane are often observed.

In our practice we use 2 main types of surgical technique: suction for II stage and removing excess of mucosa for III stage.

Number of operated patients you can see in *table*.

One-stage surgical procedure	
Micro-suction	4
Micro-suction and removing excess of mucosa	8
Removing excess of mucosa	12
Two-stage surgical procedure	
Removing excess of mucosa	8
Total	32

First cut before suction we perform by contact laser without bleeding, then remove glue (*Fig. 3.4*). Hyperplastic mucosa also can be successfully removed by laser.

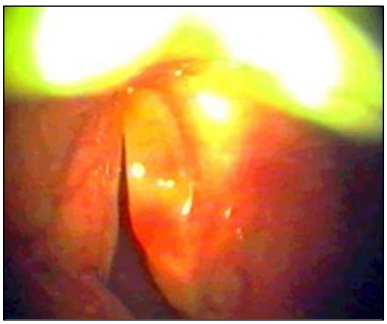


Fig. 3.3. Reinke edema

Fig. 3.4. Direct microlaryngoscopical view after removal

To prevent scarification of rimma glottidis in patients with laryngeal **papillomatosis** we apply Laser Interstitial Thermo Therapy (LITT) technique. During experimental researches we traced morphologically that basal membrane of mucosa was not altered (*Fig. 3.5, 3.6*).

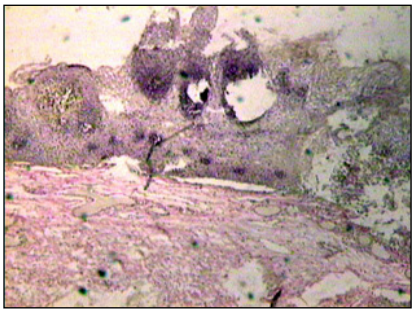


Fig. 3.5. Papilloma after LITT

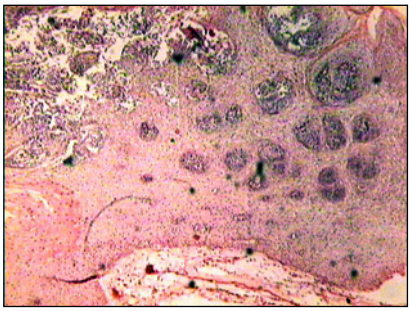


Fig. 3.6. Basal membrane of mucosa was not altered

Advantages of LITT:

- the integrity of basal membrane is preserved, hence, providing no scarring;
- the surgery is bloodless and induces no postop inflammation;
- the technique provides radicality as well as large scale of intervention.

Visually milky white color of the papilloma indicated the final stage of LITT. Laser energy even spreads inside the medium. Not only solitary papillomas (*Fig. 3.7*) but massive papillomatosis of the anterior comissure can be successfully treated (*Fig. 3.8*).

Sometimes LITT may be used with indirect and fibrolaryngoscopy.

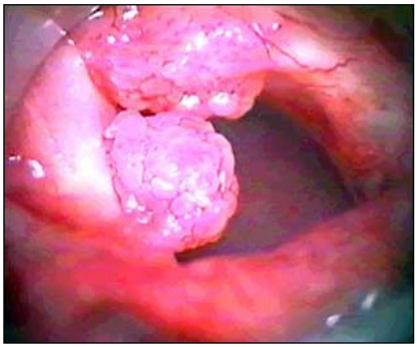


Fig. 3.7. Laryngeal papillomas

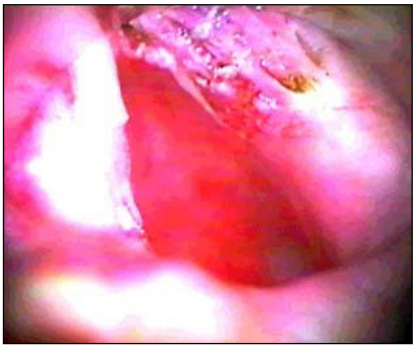


Fig. 3.8. Direct microlaryngoscopical view after LITT removal

Etiology of **granulomas** depends upon direct and indirect trauma of vocal process by surgery, intubation or by contralateral arithenoid cartilage in patients with reflux syndrome and hypermobility of the larynx.

Fig. 3.9 presents contact reflux-associated left vocal process granuloma. Surgical treatment (*Fig. 3.10*) of such type of granulomas should be performed only in cases of six month ineffective conservative antureflux therapy. Therapy of pharyngeo-larygeal reflux must be applied also after surgery, to prevent relapse.

Fig. 3.9. Contact reflux-associated left vocal process granuloma

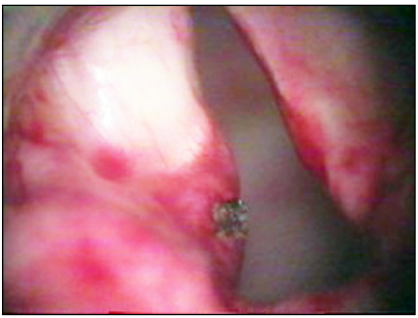


Fig. 3.10. Direct microlaryngoscopical view after contact laser removal

Varicosity or varix presenting by vascular malformation of vocal folds mucous membrane. Usually it can be observed in female patients with voice abuse. *Fig. 3.11* presenting varicous changes in female patient-professional singer. Surgical laser is really unique instrument for adequate and delicate removal of pathologically vascular lesions.

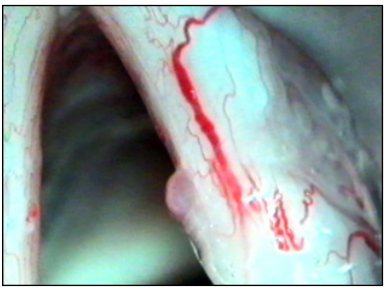


Fig. 3.11. Varicous vocal fold changes in female patient

Fig. 3.12. Direct microlaryngoscopical view after contact laser removal

Totally here are two main types of laryngeal **cysts**. Fluid containing cysts are met much more often than laryngocells. In both cases contact laser technique is helpful and effective. Retention vocal fold cysts (*Fig. 3.13*) can be removed in the same way as a polyp (*Fig. 3.14*).

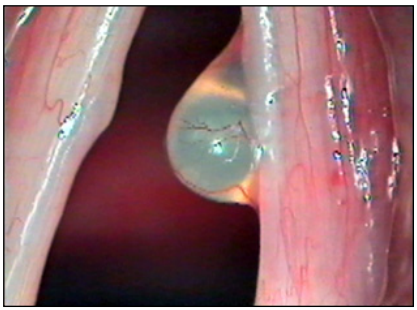


Fig. 3.13. Retention vocal fold cyst

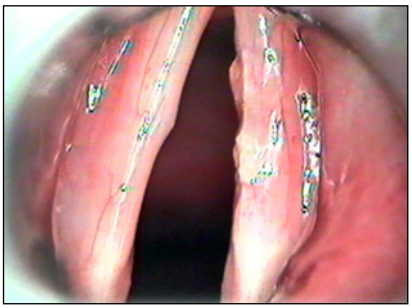


Fig. 3.14. Direct microlaryngoscopical view after contact laser removal

Of course, **leukoplakia** is not really benign lesion, because it is impossible to differentiate malignant and non malignant leukoplakia. Also the prevalence is not a criteria of malignant leukoplakia. But distinguishing features of vocal folds anatomy and mucous membrane mobility give a possibility to identify invasive malignant leukoplakia, when phonosurgery intervention is

impossible. In all other cases preserving of full voice function can be achieved.

Fig. 3.15. Left vocal fold leukoplakia

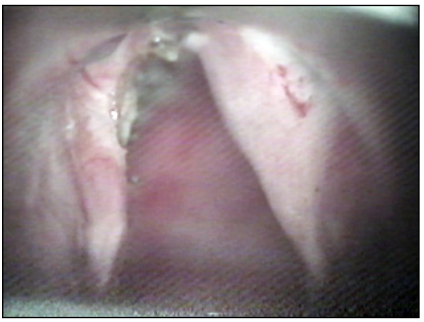


Fig. 3.16. Direct microlaryngoscopical view after contact laser removal

For improvement of visual assessment of leukoplakia prevalence we use additional to direct laryngoscopy optic endoscopy (*Fig. 3.17*) of subglottal space of trachea and anterior commissure. Anterior comissure is the most inaccessible area of the larynx during direct laryngoscopy. Laryngologists can change view only by microscope magnification and laryngoscope position. With using of rigid endoscope in the same case in the same position of direct laryngoscope, pathology can be observed much more clear and closer (*Fig. 3.18*). Morgani spaces, subglotal space, trachea and position of ventilation catheter can be estimated.

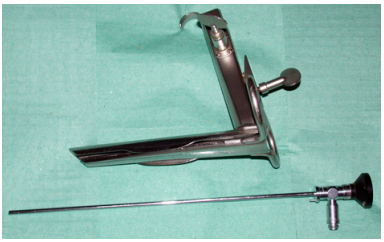


Fig. 3.17. Direct laryngoscope and optic endoscope

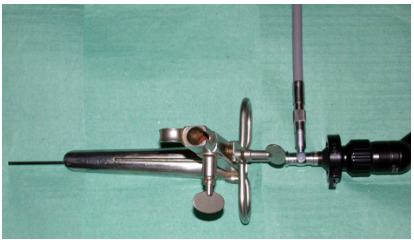


Fig. 3.18. Pathology can be observed much more clear and closer

Last benign lesion of this presentation is **singers nodules**. *Fig. 3.19* shows fibrolaryngoscopical view of professional Mariinskii Theatre singer. Type of voice is tenor. Fibrolaryngoscopy gives typical for chronic laryngitis view. Because of inadequate conservative therapy, direct laryngoscopy was

indicated. Hyperkeratotic masses occupies anterior part of both vocal folds (*Fig. 3.20*). After keratosis removal stone like nodule was detected in classic localization (*Fig. 21*). Nodule was removed (*Fig. 3.22*). And in short period patient had started with his usual vocal practice.

Fig. 3.19. Fibrolaryngoscopy gives typical for chronic laryngitis view

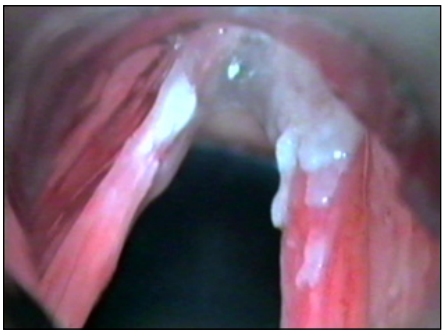


Fig. 3.20. Hyperkeratotic masses occupies anterior part of both vocal folds

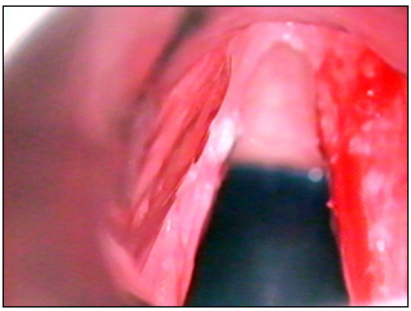


Fig. 3.21. After keratosis removal stone like nodule was detected in classic localization

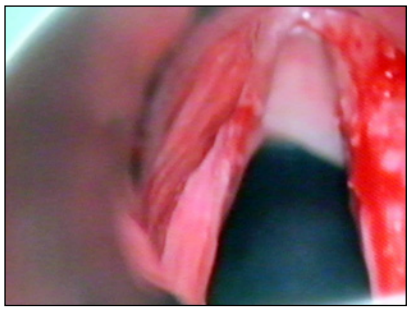


Fig. 22. Nodule was removed

Spectrogramm is the main quantitative method of voice function. It can not be used for diagnostic of pathology but only for results assessing. Different voice programming can be used with large number of numeral criteria.

In our Clinic we use “praat program” which was created by Dutch computer and acoustic specialist — Paal Borsma (*Fig. 3.23*).

And for example let me present you voice spectrogramms of the patient with laryngeal polyp before and after contact laser phonosurgical removal.

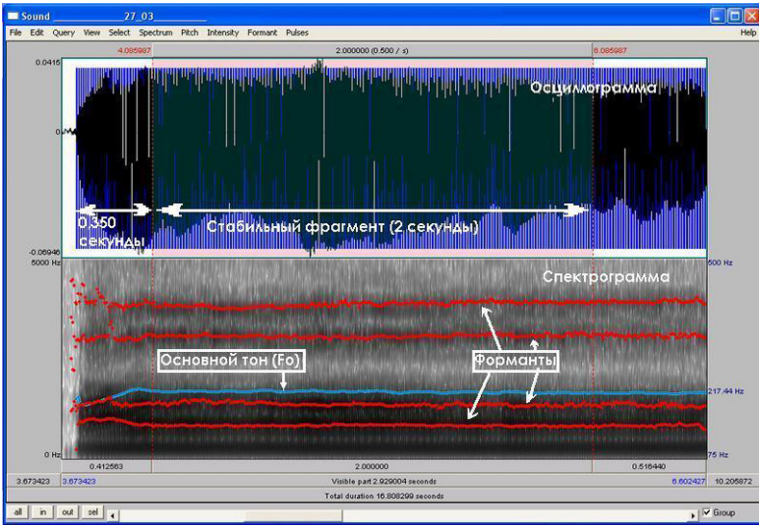


Fig. 3.23. "Praat" was created by Dutch computer and acoustic specialist Paal Borsma

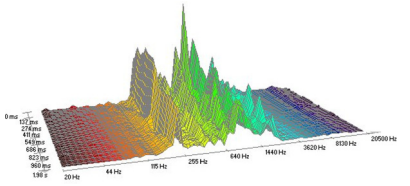


Fig. 3.24. Spectrogram of the patient with laryngeal polyp

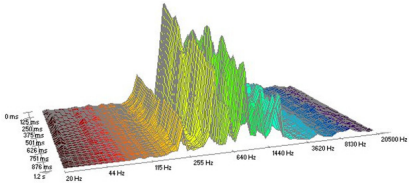


Fig. 25. Spectrogram after contact laser phonosurgical removal

CHAPTER 4.
LASER SURGERY OF PARALYTIC LARYNGEAL STENOSIS

Prof. S. A. Karpischenko

ENT Department of I.P.Pavlov Medical University has a good experience in laser endoscopic laryngeal surgery including the field of stenosis. Our conventional approach in such cases is a partial chordarytenoidectomy carried out by surgical laser in contact mode. We operated non-tracheotomized patients under high-frequency ventilation via tracheopuncture. Some years ago such procedure became a routine in our Clinic.

Passive expiration noise is helpful to control a depth of anesthesia and for direct laryngoscopy performance.

In tracheotomized patients we also prefer to apply high high-frequency ventilation via a small space tracheal canula. This method of ventilation gives two air streams, one going to tracheobroncheal tree and additional one which goes retrograde to upper respiratory tract removing smoke produced by laser coagulation from the operative field. So, using of an aspirator inside the larynx is not necessary.

We control the position of ventilation catheter by endoscope (*Fig. 4.1*). Endoscopic examination is important for every concrete clinical situation and also for analysis of probable complications and difficulties of tracheopuncture and high-frequency catheter. Most common complication of tracheopuncture is a trauma of posterior tracheal wall (*Fig. 4.2*). It means that a

Fig. 4.1. Ventilation catheter is inside the tracheal lumen

Fig. 4.2. Tip of the catheter is close to tracheal mucous membrane

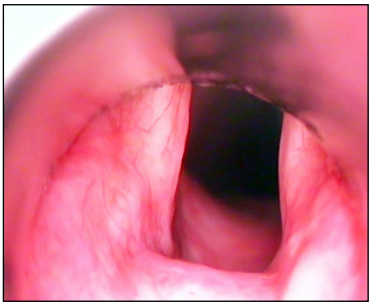


Fig. 4.3. Preoperative direct laryngoscopical view

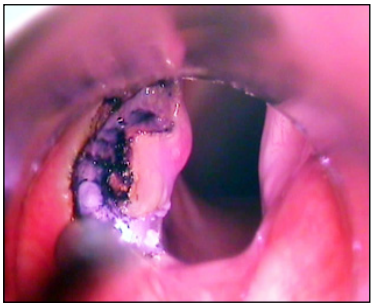


Fig. 4.4. First laser incision shows the contour of resection

procedure should be performed by well-experienced laryngologist or anesthesiologist. An important advantage of our ventilation method in patients with paralytic laryngeal stenosis is a possibility of making a procedure without neck extension. Most of these patients have the serious scarring changes of neck anterior surface after oncological surgical interventions and radiotherapy. So, classic intubation in these patients can be complicated. Chordarytenoidectomy itself also may be realized without maximal extension and anterior comissure visualization. Partial resection of vocal process and posterior third of vocal fold needs only "posterior" direct laryngoscopy (*Fig. 4.3*).

After a beginning of ventilation in stenotic patients intrabroncheal air pressure control becomes one of the most important position. Modern high-frequency equipment has a feedback of intratracheal and intrabroncheal pressure control. In case of its inadequate increase ventilation stops automatically.

If passive crycoaryteroid joint movement persists after direct laryngoscopy performance was made glottal blocking will be unusual. During a preoperative fiberlaryngoscopy we make a definite decision about the side to be operated. Usually it is a left side.

When we removed vocal fold soft tissues laterally about 10 years ago we did it as wide as possible. But the results of the analysis showed that breathing function after the economic resection is the same. Moreover, economic resection gives no bleeding during the operation and less postoperative inflammation. Last position is a very important for non-tracheotomized patients. We use a semiconductor laser system as a surgical instrument. First laser cut shows the contour of a resection (*Fig. 4.4*). Then we follow this contour level by level until the complete resection is fulfilled (*Fig. 4.5*). Laser fiber tip action should be slow and in this case it produces better coagulation.

Average time of operation in such a technique is about 5–15 minutes (*Fig. 4.6*).

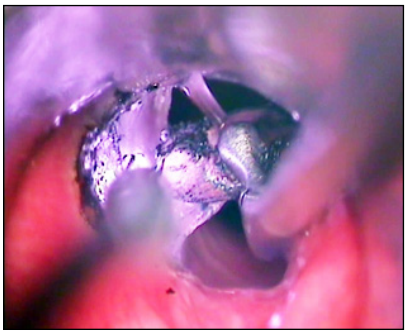


Fig. 4.5. Resection stage (level by level)

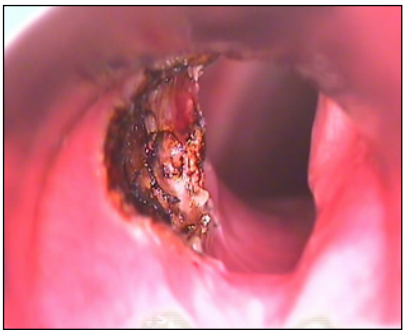


Fig. 4.6. Resection is completed. Final stage of operation

In postoperative period patient feels a significant increase of breathing function. On 3–5th days some changes to the worse can be observed because of the inflammation. Only one patient was tracheotomized because of inflammation in postoperative period but it was about 10 years ago in a case of "wide" chordarytenoidectomy. One month after surgery a glottic shape changes due to scarification of operated area and anterior becomes wider because of abduction of anterior third of resected fold (*Fig. 4.7*). Breathing function becomes better than that in the earlier postoperative period (*Fig. 4.8*). Insufficient abduction can be observed when scarification includes contra lateral cricoaritenoid joint. This complication can be avoided by performance of correct resection without crossing of posterior comissure midline. In case of such a complication endoscopical revision of the larynx is indicated (*Fig. 4.9, 4.10*).

Fig. 4.7. One month after surgery. Scar in resected area abducts anterior part of vocal fold

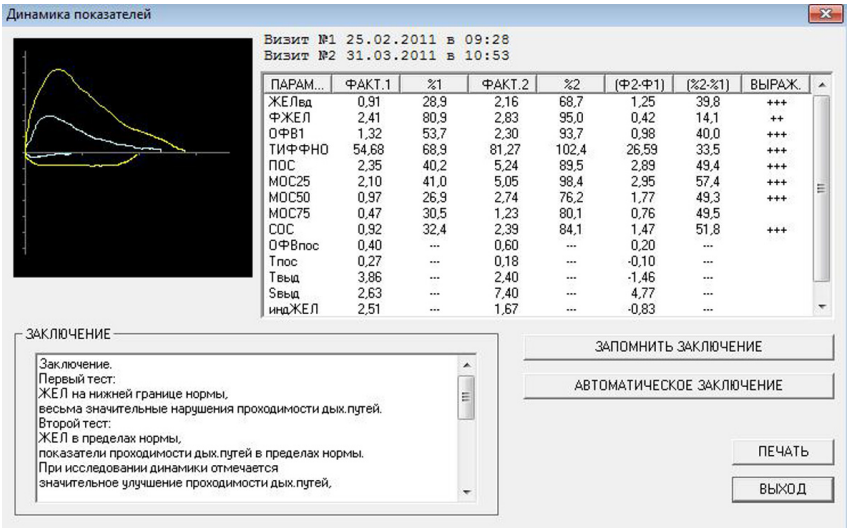


Fig. 4.8. Computer respiratory function assessment shows the absence of stenotic symptoms postoperatively

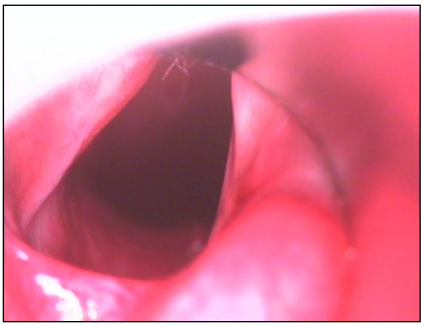


Fig. 4.9. Scar "bridge" is in posterior comissure

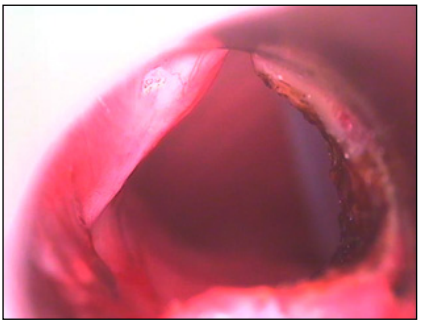


Fig. 4.10. Laser cut made through scar "bridge" is not in a contact with right side of resection. Final stage of operation

Number of patients	**106 (100%)**
female	104 (98,1%)
male	2 (1,9%)
Number of tracheotomised patients	**43 (40,5%)**

Number of operations	**117 (100%)**
left side chordaritenoidectomy	81 (69,2%)
right side chordaritenoidectomy	36 (30,8%)

During last 10 years 106 patients with paralytic laryngeal stenosis underwent surgery. Among them were 104 (98,1%) female and 2 (1,9%) male patients. 43 (40,5%) of them were trachetomized previously. Total number of operations was 117. Left side chordaritenoidectomy was performed in 81 (69,2%) cases. The main cause of paralytic laryngeal stenosis (75,4%) was thyroid gland surgical interventions. In 11 cases second contralateral intervention was performed because of insufficient functional result. In all these cases of paralytic laryngeal stenosis posteriour comissure scar bridge was found. For objective results assessment we use an external respiration examination. Also measurement of anterior comissure angle can be applied for results assessment.

CHAPTER 5.
LASER SURGERY IN THE MANAGEMENT OF LARYNGEAL STENOSIS

Professor M.A. Ryabova

Laryngeal stenosis is hard to solve clinical problem which is in the spotlight for a century. Before "laser time" endoscopic approach to the larynx was not practically realistic, therefore, only "open" surgery was in use to get rid of tracheostomas. The use of endoscopic and laser techniques in the management of chronic laryngeal stenosis marked a new stage in the topical surgery. Though different types of lasers have been proposed for that purpose, the problem of laryngeal restenosis, the preservation of phonatory and dividing functions of the organ have not been satisfactorily solved.

The ENT Clinic of the Saint Petersburg Medical University has been resorting since 1986 to special endoscopic microsurgical interventions by means of semi-conductor laser, using the contact mode of application under general anaesthesia with high-frequency lung ventilation via tracheopuncture [Plouzhnikov M.S., 1986, 2000]

Professor M.S.Plouzhnikov proved at experiment and clinically that the contact method has some biological properties: limited damage beyond the contact area, no edema, fast healing, no or slight cicatrication, no bleeding and, consequently, "dry" operating field [Plouzhnikov M.S., 1999]. Besides, the contact technique is very handy to be used in anatomical zones difficult for surgical access, in particular, anterior comissure of the larynx, subglottic area. Fiberoptic with laser beam is placed into a miniature tube which serves at the same time as a probe which can be applied to pull the structures apart wherever necessary. The distal end of the manipulator containing fiberoptic can be bent to a certain degree. This circumstances are very important in endolaryngeal stenosis surgery.

The method of general anaesthesia with high-frequency lung ventilation via tracheopuncture is convenient for laser laryngeal stenoses surgery as it provides free operation field, with the air flow exhaled from the larynx drawing out from the operation field the smoke formed in laser carbonization. Moreover, it creates a beautiful visualization of the larynx during surgery by constant drainage of the plumes out of the operating field. Absence of the catheter in the operation field gives the necessary freedom for surgical maneuvers and excludes entirely the emergencies of accidental ignition of the catheter by high-energy laser. When pathologies localized on the vocal cords

or in the vestibule conicopuncture was made whereas tracheopuncture was more suitable when subglottis was involved [М.С.Плужников, 1986].

Our department has experience in treating chronic laryngeal stenoses with laser technique for about 20 years [Плужников М.С., 2004]. 133 patients with different kinds of laryngeal stenoses were operated in our clinic during the last 5 years, 52 of them were constant cannula-bearers (*table*).

The reason of chronic laryngeal stenosis	Number			
	constant cannula-bearer	men	women	patients
Cicatrical laryngeal stenosis	26	14	22	36 (27,0%)
Paralytic laryngeal stenosis	15	23	30	53 (39,8%)
Benings	4	26	9	35 (26,3%)
Granulomas	1	–	2	2 (1,5%)
Scleroma	3	–	3	3 (2,3%)
Laryngeal air cysts	3	2	2	4 (3.1%)
Total	52	65	68	133 (100%)

36 patients with cicatrical laryngeal stenosis, including 26 constant cannula-bearers, were treated in our clinic by means of contact laser surgery. Iatrogenic reasons of stenoses were in the majority of cases.

Restricted laryngeal scarring stenosis (thin intercordial membranes, webs, synechia, etc.) were successfully managed by means of laser application. Congenital and acquired laryngeal membranes could be effectively removed endoscopically only if their thickness was not more than 2–3 mm and the membranes were of limited expanse. We don`t use the bougienage of the larynx in the postop period. It is very important to use antibiotics parenteral and topically in all cases, antireflux therapy if it is necessary (*Fig. 5.1–5.4*)

It is enough to produce laser dissection of the posterior glottic scars in the cases with good function of cricoarytenoid joints. If there is immobility of the joints the risk of restenosis is very high and after the incision of the scar we produce unilateral chordarytenoidotomy. Such tactics gives good functional results, the risk of restenosis is minimal (*Fig. 5.7–5.9*).

Circular cicatricial stenosis, particularly longer than a centimeter, may be removed in one procedure by means of laser. However, due to the danger of restenosing it is necessary to employ stents in the postoperative period prior to complete reepithelization of the laser wound. We use the silicon *T*-tube stents. Immediately after laser recanalisation of the laryngeal lumen by the

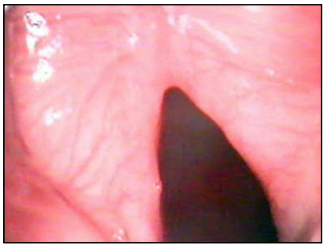


Fig. 5.1. The view of the patient S. (25 years old) larynx with web before surgery

Fig. 5.2. The view of the patient S. (25 years old) larynx with web during the laser surgery

Fig. 5.3. The fiberoptic picture of the same patient in 5 years after laser surgery. She has good voice and breathing

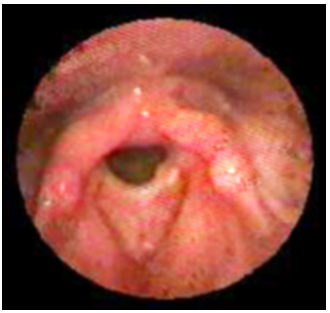


Fig. 5.4. The fiberoptic picture of the patient T. 32 years old with laryngeal web

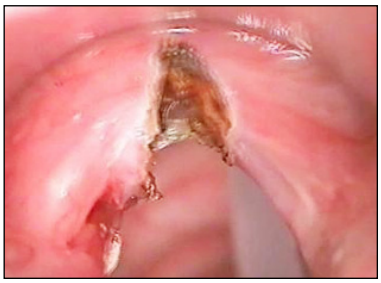


Fig. 5.5. The view of the patient T. (32 years old) larynx with web during the laser surgery

Fig. 5.6. The fiberoptic picture of the same patient in 3 months after laser surgery. She has good voice and breathing

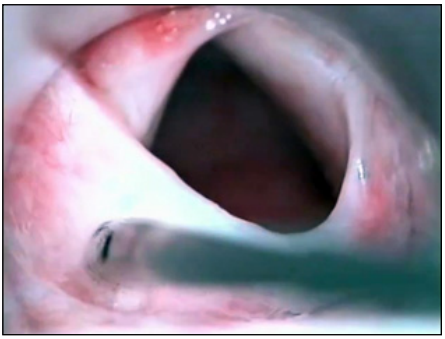


Fig. 5.7. The direct laryngoscopy of the patient T. 54 years old with the posterior glottic scars after prolonged intubation before laser surgery

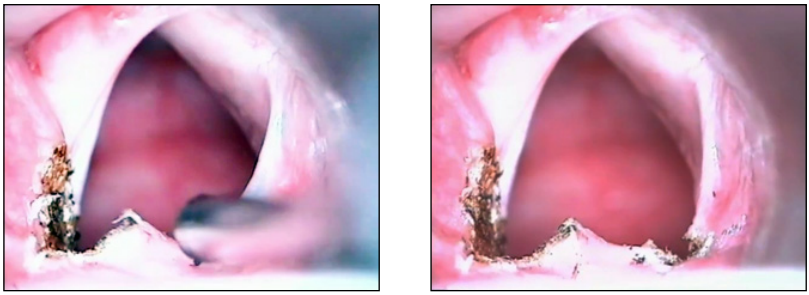


Fig. 5.8–9. The stages of laser dissection of laryngeal scars. The same patient

direct laryngoscopy we place the *T*-tube stent endoscopically. It is important to keep the stent for 6 months. Antiphlogistic therapy should be repeated during this period several times. In six months the stent should be removed, but the patient must stay at hospital, because the risk of restenosis is still high. Under the fibroscopical control the observation of the laryngeal lumen must be performed daily to reveal the tendency towards the restenosis. 50% of the patients need the repeated laryngeal stenting for six months. Respiration via the natural route was restored or improved considerably in 16 patients with subglottic stenoses. (*Fig. 5.10–5.12*)

53 patients with paralytic laryngeal stenosis, including 15 constant cannula-bearers were operated, the Ossoff laser chordarytenoidotomy technique being used [Ossoff R.H., 1983, 1984, 1990]. In most cases unilateral resection of arytenoid with its vocal process was sufficient. In 6 women, because of the little larynx size, however, a repeated operation on the contralateral

side of the larynx was required to obtain a satisfactory respiratory function (*Fig. 5.13*).

Fig. 5.10. The total obliteration of subglottis after prolonged intubation

Fig. 5.11 Laser recanalisation was performed

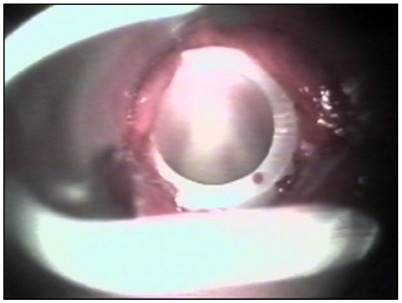


Fig. 5.12 Stent was placed for 6 months

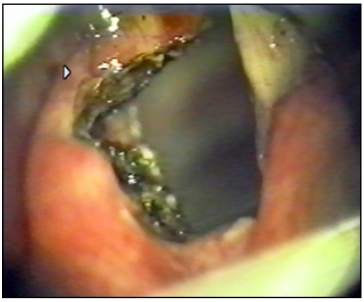


Fig. 5.13. The direct laryngoscopy of the patient H. 64 years old with the paralytic laryngeal stenosis immediately after laser chordarytenoidotomy

35 patients with benign lesions, causing dispnea were treated with laser surgery. Large benign lesions in larynx are often ballot, so the high-frequency lung ventilation via tracheopuncture is convenient for this kind of surgery, because during exhalation the mass moves and there is no risk of increasing gas pressure in the lungs.

Obstructive laryngeal papillomatosis was in the majority of benign cases. It is notorious for its frequent papillomata recurrences in spite if any modern antivirus treatments. The only way, therefore, to preserve patency of the respiratory airway remains, therefore, surgery. Recently habitual approach to use forceps in direct laryngoscopy would inevitably cause postop endolaryn-

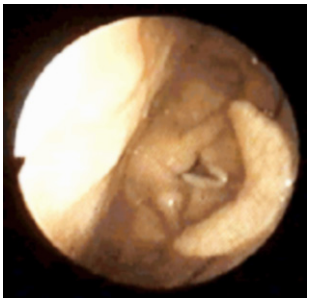


Fig. 5.14. The fiberoptic picture of the same patient in 5 years after chordarytenoidotomy

geal cicatrication. In some cases laryngeal scarring grows into the major problem in the clinical history of a patient suffering a lot to become a constant cannula-bearer. Another problem of papilloma surgery is a high disposition of papillomata towards bleeding. Even gentle touching of the papillomata masses with forceps causes immediate hemorrhagic reaction. Laser surgery of the laryngeal papillomatosis, on the contrary, is absolutely bloodless technique, sparing and precision. (*Fig. 5.15–5.17*). If papillomas are in the anterior commissure we use the LITT method of their destruction to prevent scarring [Plouzhnikov M., 1999].

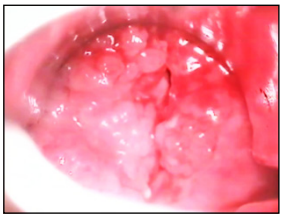


Fig. 5.15. The direct laryngoscopy of the patient B. 24 years old with obstructive laryngeal papillomatosis

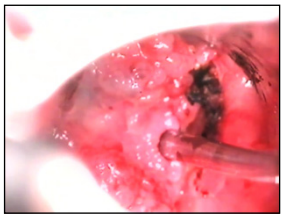


Fig. 5.16. The laser surgery of the same patient

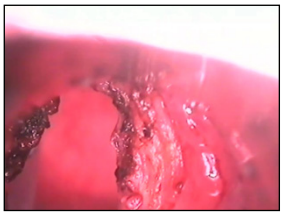


Fig. 5.17. The direct laryngoscopy immediately after laser surgery

We use semiconductor laser endoscopically in contact mode to resect laryngeal air cysts. We produce trachestomy before removing air cysts to prevent recurrence of the cysts post-op because of cough. We keep tracheostomy for about a week, and remove it after wound healing (*Fig. 5.18–19*).

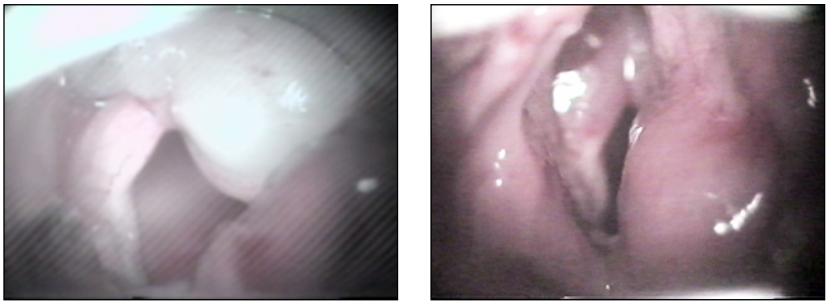


Fig. 5.18–19. The direct laryngoscopy of the patient G. 74 years old with laryngeal air cyst before and after laser cyst removing

Patient with laryngeal scleroma 30 mm subglottal extension was treated using laser technique. We used LITT to avoid large wound surface to prevent restenosing. (Fig. 5.20–21)

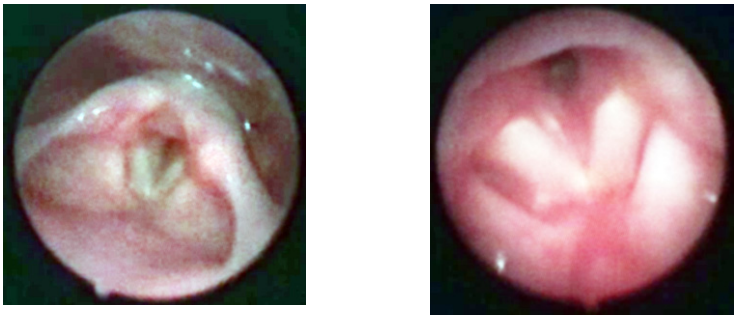


Fig. 5.20–21. The fiberoptic image of the patient M. 35 years old with laryngeal scleroma before and 2 months after laser surgery

It is very important to use proper conservative therapy before and after surgery: antibiotics, steroids in inhalation and in some cases – intravenously, antireflux therapy. We believe that only careful antiinflammative therapy gives the guaranty of good functional results in endoscopic laser surgery of laryngeal stenoses.

The use of laser in the contact mode for endolaryngeal microsurgery enables to perform bloodless operation and therefore with greater precision in areas hard of access. Minimal reactive events within the post-op wound make it possible to apply surgery without preliminary tracheostomy in the majority of cases.

CHAPTER 6.
PHOTODYNAMIC THERAPY IN ENT

M.J.Ulupov

Photodynamic therapy is a contemporary treatment method in oncology, which is based on irradiation of tumor cells containing photosensitizing agent with light of appropriate wavelength. Interaction of light and photosensitizer molecule in presence of molecular oxygen results in photochemical reactions with production of highly active singlet oxygen and free radicals, which directly or indirectly damage tumor cells. During interstitial PDT the light source is placed inside the irradiated tissues, which allows treatment of bigger or deeply located tumors than distant irradiation does. Nowadays, laser is the most widely used light source for PDT.

There is one variant of interstitial PDT, when laser irradiation is performed using bare optical fiber. P.J. Lou et al. treated 45 patients with recurrent head and neck cancer using this technique. A bare optical fiber was introduced into the tumor through the lumen of an injection needle under CT control. Big tumors were irradiated from several injection points. Foscan was used as photosensitizing agent. Irradiation parameters were as follows: output power — 100 mW, exposure — 200 seconds and total energy — 20 J.

Russian second generation chlorine-based photosensitizers such as Radochlorin, Fotoditazin, Fotolon need 200–300 J/cm^2 to develop antitumor effect. Obviously, the irradiation time should be increased up to fifteen times to perform interstitial PDT with bare fiber using these photosensitizers. The time of iPDT session can be further increased if irradiation from several injection points is needed. The irradiation power should not exceed 100–200 mW if a bare fiber is used, otherwise tissue or blood carbonization at the tip of the fiber is very likely to occur. Black carbonized clot decreases tissue transparency to red light and thus makes interstitial PDT less efficient. In such case the irradiation should be interrupted and the clot mechanically removed, which also prolongs the procedure.

Interstitial laser irradiation with cylindrical diffuser tip is the second known variant of iPDT. The diffuser is about 1–2 mm in diameter and up to 3 cm long. As the light is emitted along the whole diffuser tip length, thermal impact on exposed tissues is lower than with bare fiber. This allows using output power from 200 to 500 mW without any risk of tissue carbonization. Moghissi et al. treated 3 patients with incurable lung cancer using this variant of interstitial PDT. However, there are certain shortcomings of this irradia-

tion technique: the tip is disposable and rather expensive, and its diameter of 1–2 mm does not allow to use standard injection needle as a guide.

To solve the above mentioned problems we use the following method of interstitial laser irradiation. One or more transparent catheters for intravenous injections are introduced into the tumor percutaniously under ultrasound control. About 1 ml of saline solution is injected into the catheter after the needle is removed from it. This is to prevent contact of the fiber tip with blood. After that the optical fiber is placed inside the catheter so that its tip does not stick out from the catheter end. Absence of direct contact between the fiber and the tumor tissue decreases thermal effect of irradiation allowing higher output power to be used. Experiments which were carried out at our otorhinolaryngological department have shown that this method of interstitial laser irradiation allows increase of the output power up to 600 mW without any risk of carbonization. Another advantage is that the fiber can be freely moved inside the catheter lumen during irradiation, so the tumor can be irradiated in sequential manner from deep to superficial layers along the whole catheter length.

This method of iPDT was used in clinical practice. A 70-year old patient with recurrent cancer after laryngectomy and radiotherapy was admitted to the ENT department of Pavlov State Medical University in 2007. The tumor was located above the tracheostome firmly adhering to the skin and underlying tissues. Ultrasound scanning showed that dimensions of the tumor were 30 to 40 mm. No signs of major vessels involvement were observed. Taking into account that the patient denied surgery and chemotherapy, he was suggested to undergo an interstitial photodynamic therapy of the recurrent carcinoma. As the tumor was rather large preference was given to interstitial variant of PDT.

Photosensitizer Radachlorine was introduced intravenously in the dose of 1 mg per kg 1 hour prior to irradiation. Three plastic catheters were put into the tumor percutaniously at the equal distance from each other under ultrasound control. A beam splitting device was connected to a light source, therefore the light was delivered to three fibers simultaneously. The power at the end of each fiber was 400 mW. Irradiation was performed at 3 consecutive positions of the fiber inside the catheter (from deep to superficial layers of the tumor). So the total number of irradiation points was 9. An exposure of 500 seconds and a light dose of 200 J at each irradiation point were used. Moderate edema and hyperaemia of the soft tissues were observed by the end of the procedure. These signs disappeared completely 5 days later.

1 day after the procedure the patient experienced mild pain in the irradiation area. Body temperature was normal. Ultrasound scanning showed pro-

nounced heterogeneity of the tumor structure, which was the sonographic sign of necrotic changes. 3 months later the tumor size was the same. Thus the antitumoral effect of interstitial PDT in presented case was stopping of the tumor growth. Before the PDT progressive tumor growth was observed.

Conclusions

1. The introduced variant of interstitial PDT is simple, convenient, inexpensive and can be used for palliative treatment of head and neck carcinoma.
2. Further clinical studies are needed to evaluate efficiency and safety of this variant of iPDT.

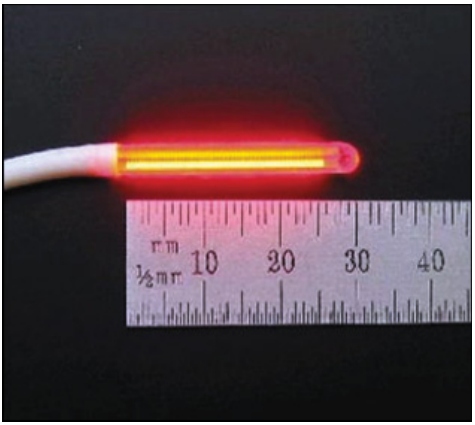


Fig. 6.1. Interstitial laser irradiation using cylindrical diffuser tip

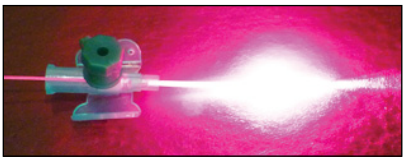


Fig. 6.2. Interstitial laser irradiation using bare fiber and catheter

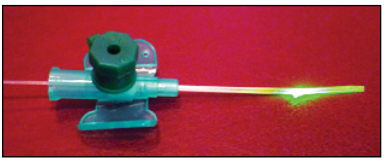


Fig. 6.3.The fiber (400 µm) can be freely moved inside the catheter (18 g in diameter)

CHAPTER 7.
LASER INTERSTITIAL THERMOTHERAPY IN NASAL AND NASOPHARYNGEAL PAPILLOMATOSIS TREATMENT

S.A. Karpischenko

Professor and Chairman ENT Department I.P. Pavlov Medical University

Massive papillomatosis growth in nasopharygeal and nasal cavities is a rare clinical situation in patients with recurrent respiratory papillomatosis.

One of the possible causes of this unusual localization is a iatrogenenic implantation of the nasopharyngeal intubation in patients with laryngeal papillomatosis.

ENT Department of I.P. Pavlov Medical University has an experience of several observations. Removal of massive papilloma of this localization usually is complicated by severe bleeding. This bleeding makes sometimes impossible to finish the surgical procedure or to fulfill it adequately because of visual control absence.

In such cases we use laser interstitial thermotherapy technique (LITT). This method is widely used in general oncology. In ENT practice this method of tissue destruction was used in our Clinic at first in patients with nasal polips, later in laryngeal papillomatosis. Method of LITT shows a high-level effectiveness in cases of treatment of nasal and nasopharyngeal huge papillomatosis. This procedure is a bloodless and an ablasic one and causes less postop inflammation. It gives a high level of visual control in all stages of surgical removal and postoperative treatment. The concept of laser interstitial thermotherapy consists of protein denaturation in the target area due to the heat in the range of 56–70 ˚C. The technique is based on contact mode of laser action. Not only denaturation, but apoptosis is also the intimate mechanism of cell degradation.

Experiments were made in the cattle liver ex vivo. White of the egg was also used as an experimental homogeneous material to demonstrate even spreading of the laser energy inside the medium. Nasal polyps served as well as a model for a clinical trial.

It was highly important to trace morphologically if the basal membrane damaged or not in the process of LITT performance. Therefore, papillomas frequently observed on the edge of veli palatini were excised at LAUP with

the underling tissue for thorough investigation of all the tissue layers. It was finally found that at 1,5–2,0 W output the basal membrane is entirely preserved as well as the underlying tissue layers. Basal membrane vascularisation was not altered. The papilloma bulk was irreversibly degraded. The experimental results obtained were successfully utilized at laryngeal papillomas destruction. The LITT technique was applied in cases of disseminated pathological process and in the area of the anterior laryngeal comissure. Visually milky white color of the papillomas indicated the final stage of LITT.

The technique advantages:

• the integrity of basal membrane is preserved, hence, providing no scarring;

• the surgery is bloodless and induces no inflammation in postop period;

• the technique provides radicalism as well as a large scale in intervention.

Y.S. Fu et al. (1992) performed the virological researches in 9 patients with nasal papillomas. In 9 patients 6/11 viruses types were founded. No one case of 16 and 18 virus types were detected.

The same results were published by P. Ward and P. Mounts (1989). No difference between viruses of nasal and laryngeal papilloma was found.

Colquhoun-Flannery W. et al (1995) supposed as a main cause of papilloma nasal cavity implantation in patients with laryngeal papillomatosis and different manipulations in upper respiratory tract first of all with the cold instruments. The authors recommend using of a surgical laser for laryngeal papilloma removal. But nevertheless nasopharyngeal intubation increases a risk of papillomas dissemination. R.L. Welsh and J.L. Gluckman (1984) consider as a cause of papillomas implantation in nasal cavity different medical manipulations such as bronchoscopy, intubation, tracheostomy and so on. As an example the authors describe a case of middle ear papillomas appearance after simultaneous removal of nasopharyngeal tumor and a paracentesis.

Small size papillomas can persist in nasal cavity asymptomatically for a long time and can be found accidently. Epistaxis is a rare symptom. Nasal breathing disorders can arise only in extended tumors.

We would like to present a next clinical case as an example of successful LITT treatment of extensive papilloma tumor of nasal and nasopharyngeal cavities.

Male patient of 23 years old with complaints of nasal breathing absence, rhinolalia and headache was consulted in the ENT Department of I.P. Pavlov Medical University.

Patient suffered from recurrent laryngeal papillomatosis from early childhood. He underwent the surgical treatment under general anesthesia with nasotracheal intubation for many times in different ENT pediatric clinics.

10 years ago papillomas growth was found. In our opinion papillomas were iantrogenicaly implanted by nasotracheal tube during extubation which was performed after a cold instrument removal was fulfilled. Laryngeal papillomatosis recidivation was not observed during last 6 years.

4 years ago the patient underwent a cold instrument removal of papillomas and septoplasty under general anesthesia not in our clinic. During intervention severe bleeding started that's why posterior nasal packing was performed at the end of the surgery. In postoperative period the nasal breathing was blocked in a few months. Four years after the patient was firstly examined in our clinic. That moment papillomas were observed on soft palate, anterior and posterior pharyngeal pillars. Laryngoscopy: no papillomas were found, web of anterior comissure was without stenotic symptoms. Nasal endoscopy: papillomas mass totally blocks posterior part of right hole of nasal cavity; nasopharynx is full of tumor masses. Bleeding starts from papillomas after light contact. CT scans shows no bone structures destruction (*Fig. 7.1*). As to surgical treatment the first decision was to make shaver removal under general anesthesia and soft palate retraction (*Fig. 7.2, 7.3*). But unfortunately a surgical procedure was stopped because of severe bleeding and impossibility of adequate visual control. Secondly, an application of LITT under local anesthesia and endoscopic control was a successful attempt (*Fig. 7.4, 7.5*). The procedure was realized in 3 stages during one week. On the first day the anterior part of the tumor was destructed with an application of LITT technique. On the second day a demarcation line between destructed and viable tumor becomes well-observed (*Fig. 7.6, 7.7*). Milky white destructed tumor was easily removed by suction tube without any bleeding (*Fig. 7.8*). Then second LITT procedure was performed. Finally good clinical result was achieved; nasal and nasopharyngeal spaces became free, nasal breathing became adequate (*Fig. 7.9*).

The interest of described case is that a successful result in treatment of huge pappiloma tumor of nasal and nasopharygeal cavities was achieved without evident vascularization and without bleeding. The postoperative period can be compared with that of one day surgery procedure.

Conclusions:

• LITT shows a high level efficiency in treatment of expanded nasal cavity benign tumors.

• Low level of inflammation in early postop period gives a possibility for an adequate endoscopic observation and local management

• LITT procedure is bloodless, so a nasal tamponade is not necessary. It leads to the better tolerance of the treatment by patients.

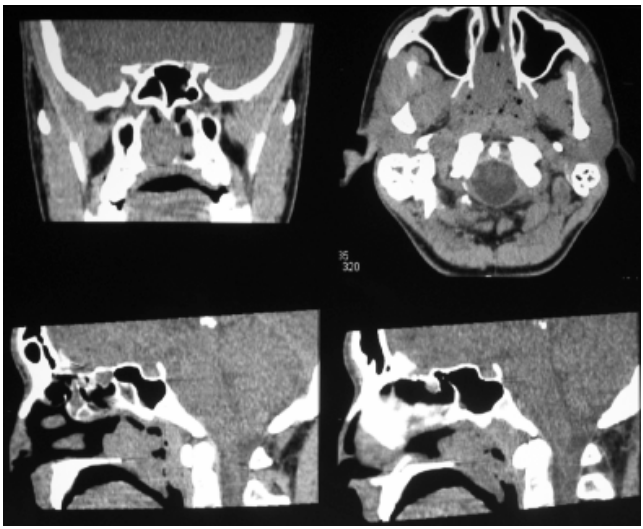


Fig. 7.1. Patient Ch. computed tomography scans. Tumor occupies posterior part of nasal cavity and nasopharyngeal space, spreading to soft palate back surface

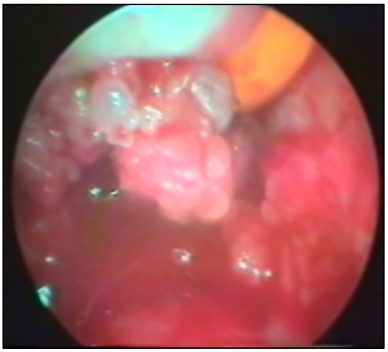


Fig. 7.2. Posterior nasal endoscopy with soft palate retraction, shows block of nasopharyngeal space by haemorrhagic papillomas

Fig. 7.3. View of nasopharynx after first stage of surgical treatment. Nasopharyngeal space is free. Papilloma mass within right half of nasal cavity

Fig. 7.4. Rigid nasal endoscopy.
Papillloma mass in posterior third of nasal cavity

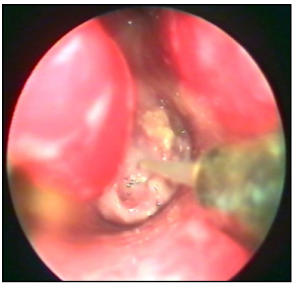


Fig. 7.5. First stage of LITT

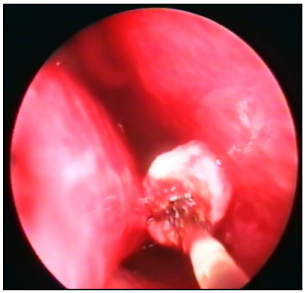


Fig. 7.6. Some papillomas can be removed burned on the tip of laser fiber

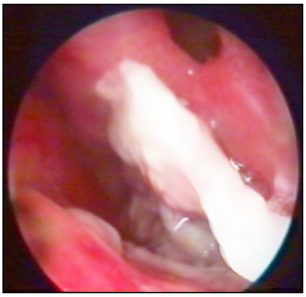


Fig. 7.7. Endoscopic view on the second day after LITT.
Demarcation line is well observed. Destructed tumor looks milky white, can be removed easily without bleeding

Fig. 7.8. Part of removed tumor specimen after LITT

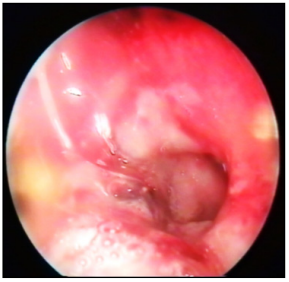


Fig. 7.9. At the end of the procedure nasal and nasopharyngeal spaces are free, nasal breathing is adequate

CHAPTER 8.
NASAL POLYPOSIS: LITT

S.A. Karpischenko, M.A. Ryabova, M.A. Shavgulidze

When heated to over 56 °C the proteins denaturate, this process is leading to a complete or partial loss of their natural properties, including biological activity. Further heating gives rise to coagulation, i.e. formation of large aggregations of protein particles (curdling) and then, at temperatures above 100 °C, carbonization (charring) takes place. That is the sequence of physicochemical alterations in proteins on exposure to a continuously rising temperature.

Denaturation of Proteins, coagulation and carbonization are destructive phenomena which can be achieved for clinical purposes through the agency of various physical factors. In the past decade, however, preference has been given to the laser beam and there are sufficient reasons to do so. Laser radiation possesses a number of physical properties which permit precise actions upon tissue within the parameters specified by the operator. High-energy laser radiation at different wavelengths has found extensive application in surgery for evaporation, coagulation and, primarily, for cutting tissues Intermittent (pulsating) beaming has proved a convenient means for biological welding, concrement fragmentation, etc.

For all practical purposes, depending on the manner of transmitting energy to the object, lasers are divided by convention into two groups: distant or contact application.

Owing to characteristic feature of inducing a minimum reaction in the target-surrounding tissues, carbon dioxide laser holds in "open" surgery a leading position among "distant" quantum generators.

However, radiation at a carbon dioxide wavelength is not transmitted via fiber glass. For this reason gaining acceptance in Endosurgery were lasers with wavelengths of near infrared band, the beam travelling through quarts glass without appreciable heat losses.

Biological effects of "fiber" lasers associated with the development of deep necrosis and ulcers, as well as long-lasting adhesion, frequently with cicatrization, appeared to be less beneficial than the dosed spatially confined action on tissues of the CO_2-laser.

The problem was resolved when it was demonstrated experimentally and afterwards clinically, that "contact" laser impact induces in tissues effects comparable to those resulting from irradiation with high-energy carbon

dioxide laser. It was on the basis of the contact methods that the LITT technique was initiated, that of minimum invasive interstitial laser thermotherapy or, to be more precise, thermo-destruction.

Ideally, with the application of the LITT technique the specified amount of pathological tissue should be exposed to irreversible degradation, i.e. protein denaturation or coagulation. Theoretically, that is possible only by condition that the tissue is heated within 60–100 °C throughout its entire mass. Hence it appears that the amount of the tissue undergoing destruction will depend on the temperature drop, a gradient decreasing uniformly from the epicenter of the heat-up towards the periphery, provided the optic properties of the tissue are uniform throughout it. This proposition assumes the existence of a homogenous tissue with uniform properties of transmitting and absorbing luminous energy. In the meantime, the temperatures at the epicenter should not exceed the critical values at which carbonization may get under way and inevitably impede the transmission of light from the center to the periphery. Moreover, to achieve maximum destruction, the luminous energy, and consequently the temperature factor, should expand uniformly in all directions (if no special restrictions prevail). For that purpose special diffusers at the fiber butt are employed.

However, considerable practical difficulties are encountered in achieving the general conditions outlined above. Firstly, represented in pathological formations are, as a rule, dissimilar structures with distinct optic properties. Secondly, their volume may often exceed the extent of destruction attainable with presently available means.

Indeed, LITT may prove to be an alternative to conventional surgery, particularly in cases of neoplasm anatomically difficult for access or those where operative access is fraught with traumatism, such as brain tumors. In this connection, an intensive search has been under way aimed at improving the LITT technique.

Dr. R. Chapman, one of the pioneers in developing the method and the first to accumulate extensive experience in interstitial thermal destruction of uterine fibromyomas, has achieved convincing results in this field. According to Dr. R. Chapman the neoplasms degraded completely and were replaced with fine muscular tissue without cicatrization, thus making possible normal delivery by patients of childbearing age.

In the event of large fibromas, simultaneously 8 to 12 fibres would be laparoscopically introduced into the tumor. Positive results were achieved in employing special stereometry of (the arrangement of) coagulation centers in neoplasms without superposition of coagulation foci. It was carried out in such a way as to prevent interruption of normal circulation in tissues free

from exposure to elevated temperatures. To the best of our knowledge, the first similar experience in otorhinolaryngology, as reported by Feigh et al at the International Symposium on Metastatic Cancer (Carcinoma) of the Neck in Kiel (Germany) in 1998, was concerned with laser thermo-destruction of tumor of the base of the skull and the parapharyngeal space.

The aim of the present study was to explore the possibility of applying LITT in cases of nasal Polyposis, a condition, requiring no commentary in professional intercourse.

Nevertheless, certain specific points responsible for undertaking that work are probably worth mentioning.

Firstly, it was anticipated that the LITT would permit avoiding even a little hemorrhage and therefore the tamponade with all of its negative features.

Secondly, the technique could be tested out in somatically complex cases, including those of concomitant cardiovascular insufficiency of various etiologies, where conventional surgery so often is inappropriate.

Thirdly, it was intended to take advantage of the method in cases of Polyposis whenever it was technically difficult to operate or else surgery was fraught with the risk of complications. That is to say in the event of Polyposis in combination with a deviation of the nasal septum and turbinated bone progeny, numerous preceding interventions, small polyps in the region of the nasal cavity fornix, etc.

Fourthly, owing to the relatively homogeneous structure of polyps and their accessibility (visual control and high incidence) they could be used as a model in the work on the LITT as a method.

Prior to the clinical stage, experiments were carried out using special pastes (phantoms) devised by Prof. A.I. Nevorotin. The pastes consisted of four ingredients: human hemoglobin, glycerin as cryoprotector, chicken egg white and a stabilizing component (additive). Traced on such phantoms were the geometric parameters of "laser" coagulates as a function of the output power and the exposure to the effect of the laser beam and for the specific type of the diffusing fiber optic tool.

Afterwards such experiments were carried out in vitro on polyps under histological control.

Serving as the radiation source was the TH-102 and Nd:YAG-laser, with a wavelength of 1.064 HM

The laser beam was aligned into a quarts fiber, 400 MK in diameter, protected with a polyethylene sheath. The tool used was a hollow thin cylinder 1 mm diameter: the fiber placed inside was secured with a clamp which also served as a hand holder. The outward-protruding part of the fiber (about 1 cm long) was freed from the protective polyethylene sheath and

used as the working tip sunk into the tissue to be destroyed. It was accordingly found that by means of end face radiation, with no diffuser, it was possible to obtain ellipsoid coagulates at an output power of 14–16 W and exposure of up to 1 min with no distinct carbonization zone at the site of the fiber tip-tissue contact.

Operative procedure. Application anesthesia with 10% lidocaine solution proved to be adequate in every case. LITT was employed with the patient in the sitting position as while traditional anterior rhinoscopy. The optimal situation was one when the fiber tip could be inserted into the polyp pedicle or the adjacent necked part of the polyp. In such cases a single exposure could be sufficient. Whenever for anatomical reasons (stenosed nasal cavity) the operative field was not adequately observable, the surgeon had to resort to several exposures, trying to draw the whole of the visible part of the polyp into the zones being coagulated. Fairly indicative from the viewpoint of visual control over the appearance of the coagulate, it was change in colour of the polyp tissue, which in the course of thermo-destruction was turning milky white. After the operation no attempts were ever made to remove at once the coagulated parts of the polyp mechanically, with loops or nasal forceps. As a rule, 3 or 4 days after the intervention the polyps were spontaneously expelled by nose-blowing. At times repeated LITT operations had to be performed either when new polyps were "shed" from the ethmoidal labyrinth in the postoperative period or when it was not feasible to expose all the polyps in the nasal cavity to the LITT procedure in one operation due to the large scale of the process. In the latter case spontaneous expulsion of coagulated polyps by nose-blowing was difficult to attain and they were removed with nasal forceps prior to repeated surgery. The 3–4 day period for cleansing the nasal cavity of coagulated polypous tissue is empiric and purely conventional. Oftentimes the expulsion of polyps may occur earlier and not only due to tissue necrosis (protein coagulation and denaturation zones experiencing both the direct effect of the temperature factor and the profound disruption of the microcirculation bed and, consequently, of tissue alimentation with ensuing tissue dystrophy and cell death) but also owing to the individual reaction to the intervention on the part of the patients. LITT is a "one-day" type of surgery, and many patients at home, eager to precipitate the events, tried to expel the polyps by forceful nose-blowing. In some individual cases their attempts were successful. However even among patients with blood coagulation pathology (Werlhof's disease, hemophilia, etc.) there were no cases of nasal bleeding under such circumstances.

Altogether we have operated on 368 patients (213 men and 155 women) ranging in age from 17 to 84 years.

Clinically, the situations were similar in that all other surgical techniques involved various difficulties, including the refusal of patients to undergo such surgical treatment as they had had in the past. The postoperative follow-up periods being one-year long at most and the number of observations quite limited, we would be hardly justified now in discussing the clinical efficiency of LITT in cases of nasal Polyposis relative to other methods. At the same time the possibility must not be ruled out of changes in the local immunoreactivity resulting from postoperative absorption of protein substances in the exposed zones. There is no doubt, however, that LITT is easily tolerated by patients and from the surgical point of view in a number of cases it offers decisive advantages over the methods of conventional management.

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