

# Office-based CO<sub>2</sub> laser surgery in the larynx utilizing the Lumenis AcuPulse™ DUO CO<sub>2</sub> laser and Lumenis flexible CO<sub>2</sub> fiber

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## Introduction

Since the introduction of distal chip endoscopes with a working channel, many ENT procedures can be performed in the outpatient clinic under topical anesthesia. Advantages of these so-called office-based procedures include decreased diagnostic and therapeutic delay, elimination of general anesthesia, and reduced costs.

The case described in this technical guide is the ablation of a severe dysplastic tumor on the right true vocal cord, under local anesthesia, using the Multi-use CO<sub>2</sub> fiber with AcuPulse DUO CO<sub>2</sub> laser.

## Preoperative

### Medical history & current complaint

- › 88 year old male.
- › April 2011: previous transoral laser microsurgery under general anesthesia for cT1N0M0 squamous cell carcinoma on the right true vocal cord.
- › High risk of undergoing general anesthesia due to cardiac and pulmonary morbidity.

### Current physical examination & diagnostics

- › Worsening of the voice and small tumor seen on the right true vocal cord. The tumor appears to be superficial and extends from the anterior commissure until halfway up the right true vocal cord, as seen on the images below.
- › One month prior to the office-based laser surgery procedure, a flexible endoscopic biopsy was performed under topical anesthesia. The topical anesthesia method used was equal to the office-based laser surgery method, described below. A flexible distal chip endoscope with working channel was introduced and directed just above the vocal cords. A flexible biopsy forceps (Single Use Radial Jaw™ 4, Boston Scientific, Costa Rica) was passed through the working channel of the endoscope. Three biopsy specimens were obtained from the right true vocal cord, each from the first half of the right true vocal cord. Two specimens were 1 mm and one specimen was 3 mm wide in diameter. Histological assessment showed severe dysplasia.

### Diagnosis

- › Severe dysplasia of right true vocal cord.

## Operative

### Surgical procedure

- › Transnasal flexible laryngoscopy with CO<sub>2</sub> laser surgery under topical anesthesia for removal of severe dysplastic tumor on the anterior first half of the right true vocal fold.
- › Office-based CO<sub>2</sub> laser surgery was performed by passing the laser fiber with endoscope protective sheath (EPS) through the working channel of the flexible laryngoscope.

### Characteristics which made this patient ideal for office-based laser surgery

- › Sufficient nasal passage.
- › Ability to tolerate topical anesthesia without difficulty.
- › Ability to follow verbal instructions.
- › Inability to undergo general anesthesia.

### Anesthesia

- › Local anesthesia.
  - › Nasal cavity: two cotton pledgets soaked with 10% lidocaine and 0.1% xylometazoline in each nasal cavity for a minimum of 10 minutes.
  - › Oropharynx: 10% lidocaine, 8-14 sprays.
  - › Larynx: 10% lidocaine, 1.0-1.5 ml injection through the cricothyroid membrane.

### Room setup

- › This procedure was conducted in the outpatient clinic operating room.
- › The room was laser safe, containing laser safety warning sign, windows that can be shut, door that can be closed and no reflecting material in the room.

## Operative Con.

- › List of available equipment and medication:
  - › Four cotton pledgets.
  - › 10% lidocaine spray.
  - › 0.1% xylometazoline solution.
  - › 2 ml syringe with 23 gauge needle.
  - › Paper instrument tray.
  - › Tongue depressor.
  - › Nasal speculum.
  - › Blake ear forceps.
  - › 10x10 gauze pads.
  - › Flexible biopsy forceps (Single –Use Radial Jaw™ 4, Boston Scientific, Costa Rica).
  - › Suction regulator, canister, tubing setup.
  - › Pentax VNL-1570STK flexible nasolaryngoscope with 2.0 mm working channel (PENTAX Nederland B.V., Dodewaard, the Netherlands).
  - › Pentax EPK-i5000-HD-videoprocessor (PENTAX Nederland B.V., Dodewaard, The Netherlands).
  - › Moveable cart with videoprocessor, computer and monitor to record procedures.
  - › Lumenis AcuPulse DUO CO<sub>2</sub> laser.
  - › Lumenis CO<sub>2</sub> fiber.
  - › Lumenis Endoscope Protection Sheath (EPS).
  - › CO<sub>2</sub> laser safety glasses for patient and all personnel in room.
  - › CO<sub>2</sub> laser safety masks (3M™) for all personnel in the room
- › Emergency equipment
  - › Corticosteroids nebulized and intravenous.
  - › Adrenaline nebulized.
  - › Xylometazoline nebulized.
  - › Tracheotomy quick set.

## Operative Con.

- › Patient in a seated ‘sniffing’ position with laser protection glasses on.
- › The first surgeon guides the laryngoscope and controls the laser footswitch and is positioned in front and on the left side of the patient. Wears protection glasses and surgical mask.
- › The second surgeon guides the laser fiber through the working channel and is positioned in front and on the right side of the patient. Wears protection glasses and surgical mask.
- › The video processor cart is located on the right side behind the patient.
- › The laser is positioned behind both surgeons with the fiber port pointing toward the laryngoscope and patient. The laser is controlled by a trained nurse who wears protection glasses and a surgical mask. The nurse always performs laser check and documents on checklist of laser safety prior to treatment.
- › A second nurse manages the video recording and provides assistance, when needed. Wears protection glasses and surgical mask. The nurse also confirms the laser safety check list prior to start of treatment.

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## Laser system and accessories

- › Laser system: Lumenis AcuPulse™ DUO CO<sub>2</sub> laser.
- › Lumenis Multi-use CO<sub>2</sub> laser fiber (reusable, up to 5 procedures per fiber).
- › Lumenis Endoscope Protection Sheath (EPS, single-use)
  - › This is used to protect the flexible endoscope when the fiber is passed through the working channel of the endoscope. The outer diameter is 1.7 mm.

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## Smoke evacuation

- › Generated smoke is evacuated by a suction tube, which is connected to the suction port on the laryngoscope. The smoke evacuation is constant, so the surgeon has both hands free to operate the laryngoscope.

## Operative Con.

### Laser settings

- › Laser settings:
  - › Power mode: Continuous Wave (CW), 4-8 Watts
  - › Exposure mode: Continuous (laser energy emits as long as footswitch is depressed)
- › Distance from fiber tip to tissue: depends on the ability of the patient to control the larynx. When a patient is able to keep the true vocal cords relatively still during surgery, the ideal distance is between 5 and 10 mm. When a patients' larynx reacts to introduction of the laser fiber near the true vocal cords, the ideal distance is above the false vocal cords, which is approximately 15 to 20 mm away.
- › Office-based laser surgery is a dynamic process, meaning that the exact distance from laser fiber tip to the designated lesion is variable. The above mentioned distances are recommended, but one will notice that during surgery distance from laser fiber tip to the lesion varies, mainly because of laryngeal movement.
- › Air flow: air is supplied by an internal pump integrated in the AcuPulse DUO system. air is set to automatic while using the laser.

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### Laser technique

- › Endoscope Protection Sheath (EPS) is placed over the laser fiber, with the laser fiber not protruding from the distal end of the EPS.
- › The EPS is inserted into the working channel of the endoscope, not protruding from the distal end. Then, the flexible endoscope with the EPS and laser fiber are passed through the nasal cavity and positioned above the designated lesion.
- › The EPS is further pushed approximately 1 cm out of the working channel of the endoscope.
- › The fiber is passed approximately 1 cm out of the EPS and positioned close to the lesion.

## Laser technique

- › To ablate, the tip of the fiber is held as perpendicular as possible and approximately 5 to 10 mm from the tissue surface. For ablation, the laser is fired in continuous exposure mode ablating the affected tissue, until desired effect is observed. Ideally, the laser fiber is used for a maximum of 3 seconds and then paused. The fiber should be moved across a small segment of the vocal cord each session, in a constant manual 'scanning' method, therefore minimizing deep thermal damage to the vocal cords. By using the continuous mode in short laser sessions, the procedure is rapidly performed, thus more comfortable for the patient.
- › When treatment is completed, the fiber is pulled into the EPS and the EPS is pulled into the working channel of the endoscope. Then, the flexible endoscope is removed from the patient.

## Hemostasis

- › Minimal bleeding occurred thus hemostasis with the laser was not necessary.

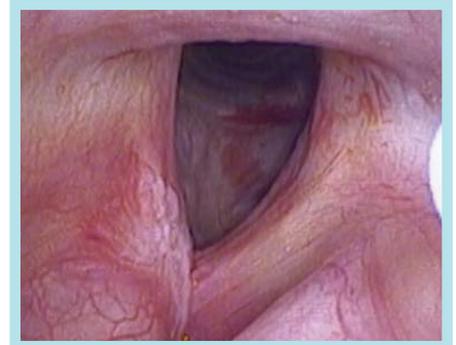
## Operative Photos



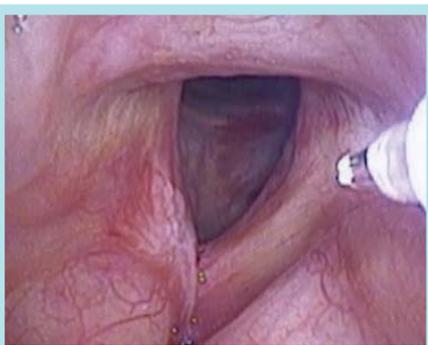
**Fig. 1** Laryngeal overview



**Fig. 2** Lesion right true vocal cord



**Fig. 3** Endoscope Protection Sheath seen protruding from endoscope working channel



**Fig. 4** Laser fiber pushed out of the Endoscope Protection Sheath



**Fig. 5** CO<sub>2</sub> laser application to the designated lesion



**Fig. 6** Post procedural image

## Technique Tips

### Local anesthesia

- › Adequate topical anesthesia is the key to a successful procedure
- › Laryngeal anesthesia can also be applied through the working channel of the endoscope. It is recommended to use lidocaine with a lower percentage, such as 4%. 10% lidocaine is a viscous solution, which can blurry the view of the endoscope when applied through the working channel.

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### Endoscope

- › The use of an EPS to cover the laser fiber protects the working channel of the endoscope from scratches.
- › If possible, the endoscope should be passed through the nasal cavity that is contralateral to the designated vocal cord lesion. Therefore, when approaching the vocal cord with the endoscope, there is a more clear access to perform laser surgery. When the ipsilateral nasal cavity is used, the false vocal cord tends to block part of the surgical field for the true vocal cord.

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### Patient management

- › Provide clear instructions to the patient:
  - › Try to breathe through the nose to provide better passage of the endoscope through the nasal cavity.
  - › A seated 'sniffing' position provides better access to the larynx.
  - › During laser surgery, the patient should breathe through the mouth.
  - › Vocal cord movement can be minimized by relaxed normal breathing. A patient should not take deep breathes or hold the breath. Therefore, patients with chronic obstructive pulmonary disease are not suitable candidates for office-based laser surgery.
- › Adequate topical anesthesia to the vocal cords is essential to prevent excessive laryngeal movement. Administer local anesthesia through a cricothyroid membrane injection or through the working channel of the endoscope. If excessive laryngeal movement occurs, repeat administration of anesthesia prior to laser surgery, to prevent sensitization of the larynx.

## Technique Tips

- › In case of laryngeal movement, stop the laser, pull the laser fiber into the EPS, pull the EPS into the working channel, and direct the endoscope above the epiglottis. Resume the procedure, once laryngeal movement has passed.

## Selection of laser parameters

- › **Laser power mode:** the AcuPulse DUO has three power modes that can be selected according to the desired degree of precision or hemostasis. CW laser energy flows at a constant level for the highest degree of hemostasis. Pulsed SuperPulse energy is useful for excision, particularly for fibrous tissue. Pulser provides a blend of precision and hemostasis, with highest precision at lower power levels (10 watts or less).
- › **Laser power:** laser energy penetrates tissue until all of the energy is extinguished, due to absorption by the intracellular water in the tissue. High laser power can penetrate deep into tissue, unless the beam is moved quickly across the tissue surface. Therefore, the power level mostly impacts the rate of tissue removal by the laser.
- › **Exposure modes:** when thermal spread is a concern and/or greater control of the laser beam is desired, single or repeat exposure modes enable the beam to be moved more slowly.
- › **Working distance:** spot size is regulated by the distance of the laser fiber tip from the tissue surface. For incision, the tip is usually held very close to the tissue, and the distance is increased to make a larger spot size for coagulation and ablation – the power adjusted accordingly.

## Treating near the anterior commissure

- › The anterior commissure is difficult to accurately treat with office-based laser surgery, because a full view is often difficult to obtain. Laser surgery in general anesthesia is more suitable, because one can stretch the vocal cords to provide a clear view of the anterior commissure.

## Patient selection tips for office-based laryngeal surgery

### Patient and Pathology Characteristics Suitable for Office Procedures

- › Ability to sit still.
- › Sufficient nasal passage.
- › Undergoing topical anesthesia without difficulty.
- › Being able to follow instructions, such as certain head movements to require better access to the designated lesion or controlling of the breathing pattern to keep the larynx still.
- › Benign or small (pre-) malignant tumors of the larynx.

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### Patient and Pathology Characteristics Not Suitable for Office Procedures

- › Excessive gag reflex
- › Inability to sit still and follow instructions.
- › Inability to undergo flexible laryngoscopy.
- › Patients with pulmonary disease can be harder to treat.
- › Large lesions.

## Postoperative

### Postoperative Instructions and Follow-up

- › Direct discharge.
- › No eating or drinking for 1 hour after topical anesthesia administration.
- › Voice rest for three days.
- › Follow-up is done according to our department protocol, and depends on histology of the lesion.
  - › **Benign lesions**
    - › Patients are seen for one year
    - › Laryngoscopy in the outpatient clinic at 2, 6 and 12 months
    - › Voice quality reporting using the Voice Handicap Index (VHI) at 2 and 6 months, which is compared to the VHI prior to surgery.
  - › **Pre-malignant lesions**
    - › Patient are seen for three years
    - › Voice quality reporting using the Voice Handicap Index (VHI) at 2 and 6 months, which is compared to the VHI prior to surgery.

## Discussion

Due to his cardiac and pulmonary morbidity, this patient could not undergo general anesthesia, making him an ideal candidate for office-based laser surgery. Furthermore, this was a small recurrent tumor with limited extension into the true vocal cord.

Office-based laser surgery has the advantage of decreasing therapeutic delay, thus being able to rapidly schedule surgery when a recurrent tumor is suspected. Furthermore, because the procedure is performed under local anesthesia, surgery can be more easily performed in several steps, particularly when there is anterior commissure involvement. Also, the lack of general anesthesia provides health benefits and reduces costs of surgery.

Procedure success depends on adequate topical anesthesia technique and patient selection. Office-based laser surgery is a suitable treatment method for small laryngopharyngeal lesions. This treatment method is relatively new and thus, future studies need to be performed to investigate the most suitable treatment indications.

Unlike the office-based endoscopic practice, which utilizes the ablative technique, in the operating room the surgeon has the opportunity to cut and to excise the lesion more carefully. Therefore, treating malignant tumors in the operating room under general anesthesia is still the first choice for treatment.

The AcuPulse DUO CO<sub>2</sub> laser and ENDURE laser fiber can be used to treat benign lesions and small (pre-) malignant tumors of the larynx under topical anesthesia. To achieve the most effective treatment for this patient, the laser energy was between 4 and 8 Watts and was delivered in short continuous exposure bursts (3 seconds). By using an Endoscope Protection Sheath over the laser fiber, the endoscope is protected as the fiber is introduced and withdrawn from the working channel.

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### Risk Information

CO<sub>2</sub> lasers (10.6 μm wavelength) are intended solely for use by trained physicians. Incorrect treatment settings or misuse of the technology can present risk of serious injury to patient and operating personnel.

The use of Lumenis CO<sub>2</sub> laser is contraindicated where a clinical procedure is limited by anesthesia requirements, site access, or other general operative considerations. Risks may include excessive thermal injury and infection. Read and understand the CO<sub>2</sub> systems and accessories operator manuals for a complete list of intended use, contraindications and risks.



AcuPulse DUO CO<sub>2</sub> laser



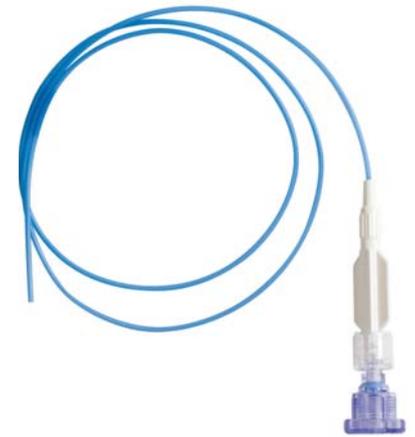
VNL-1570STK naso pharyngo-laryngo-videoscope (PENTAX Nederland B.V., Dodewaard, The Netherlands)



FiberLase ENDURE™ CO<sub>2</sub> laser fiber



EPK-i5000-HD-videoprocessor (PENTAX Nederland B.V., Dodewaard, The Netherlands)



Endoscope Protection Sheath



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