A Device for Tracheal Tube during CO_2 Laser Irradiation in Laryngomicrosurgery

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We devised that the segment of commercially available defensor II tube coming in contact with the vocal cord was concaved. We used this new tube during CO_2 laser irradiation in laryngomicrosurgery. We comed to the conclusion that it was much more superior to the conventional tube in safety and resistance of the material to CO_2 laser irradiation and in increase of the operation field. (Key words: tracheal tube, laser irradiation, laryngomicrosurgery)

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Since the first clinical case was reported by Strong et al.[1] in 1972, laser surgery of the larynx has been clinically evaluated in many institutes and recently has become one of the important therapeutic procedures.

Nevertheless, CO_2 laser irradiation has been reported to cause several problems[2–6]. Laryngomicrosurgery using CO_2 laser beam posed the following problems.

(1) Laser surgery is frequently carried out under inhalation anesthesia by intubation, involving risks of perforation and ignition of the tracheal tube, heating and burning of anesthetic gas mixture, and producing perforation of tube-wall and rupture of the cuff due to erroneous irradiation.

(2) In patients with involvement of the posterior area of the vocal cord, the tracheal tube reduces the operative field, interfering with the surgical procedure.

Reports suggest the following measures against erroneous irradiation of CO_2 laser: selection of appropriate material for tracheal tube, protection of tubes and cuffs with wet gauze, establishment of conditions for CO_2 laser beam, and the concentration-change of anesthetic gas mixtures[7–10].

To solve some of these problems, we modified the silicone tracheal tube defensor II tube (Fuji Systems Co.). The tube and cuff are made from material composed of mixture of silicone and ceramic powder. This new tube is superior to tracheal tubes made of other materials with respect to the durability against laser beam.

The segment of the tube that comes in contact with the vocal cord is con-

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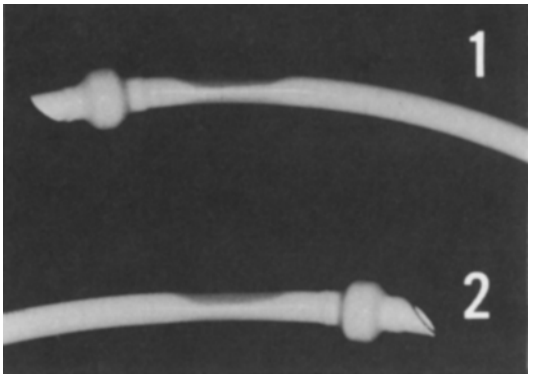

Fig. 1. We made two types of tracheal tubes, one for the right (1) and the other for the left (2).

cave and these are two types of tubes, one for the right (1) and the other for the left (2) (fig. 1).

To evaluate the resistance to laser irradiation of different types of tracheal tubes, tubes and cuffs were irradiated with a CO_2 laser (CO_2 Medilaser Mochida) connected to a surgical microscope (Zeiss Co.). The focal distance was 400 mm, and the output was 20 W in the continuous mode.

Four types of tracheal tubes were tested: Oxford Leyland tube, Portex blue-line tracheal tube. Mallinckrodt reinforced armed spiral tube, and Fuji systems defensor II tube.

These tubes were irradiated at a right angle to their surface, and the time between the start of irraditaion and perforation or ignition was measured using the VTR (Video Tape Recorder) counter.

The test showed that Fuji systems defensor II tube required more than 300 sec until the perforation and ignition, being considerably superior over the other three tubes for the resistance against laser irradiation (table 1).

In surgery, the concave portion of the tube produced a sufficiently laser operative field widely.

The use of a slightly thinner suction tube was needed, but this new tube

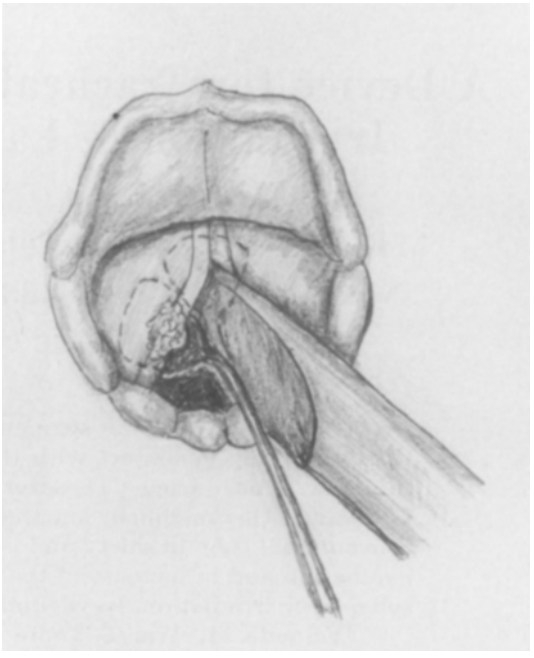

Fig. 2. A illustration of the concaved portion of tracheal tube for the region of left vocal cord and the simultaneously devised protector.

posed few clinical problems in airway resistance.

The simultaneously devised protector for laser surgery could be easily introduced into the posterior surface of the irradiation site, ensuring safer irradiation (fig. 2).

This new tube was superior in suction and airway resistance over previously reported tubes.

We often used this one during laryngomicrosurgery e.g., tumor, papilloma, polyp of laryngopharynx, and vocal cord.

Conclusion: The segment of commercially available defensor II tube coming in contact with the vocal cord was concaved. This new tube was used in laser surgery of the larynx and was found to be much more superior to the conventional tube in safety and easy surgical procedure. The resistance of the material of this tube to laser irradiation and heat was found to be most

Table 1. Durability of materials for tracheal tubes against perforation and ignition due to CO_2 laser irradiation

	Material	The time until the perforation and ignition	
		(tube)	(cuff)
Oxford Leyland tube	natural rubber	0.53 sec	0.03 sec
Portex blue-line tracheal tube	polyvinyl chloride	9.92 sec	0.07 sec
Mallinckrodt reinforced armed spiral tube	polyvinyl chloride	3.56 sec	0.17 sec
Fuji systems defensor II tube	silicone	300 sec over	2.03 sec

⟨irradiated condition⟩ continuous mode output: 20W, focal distance 400 mm

excellent.

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