ENDOSCOPE WITH FLEXIBLE LIGHT GUIDE HAVING OFFSET DISTAL END

TECHNICAL FIELD OF THE INVENTION

This invention relates generally to endoscopes, and more particularly to endoscopes useful in connection with placing or confirming placement of endotracheal breathing tubes.

BACKGROUND OF THE INVENTION

Endotracheal intubation is a common medical procedure by which a flexible plastic endotracheal breathing tube is inserted into a patient's trachea for providing oxygen or anesthetic gases to the lungs. Usually, the endotracheal tube is introduced into the patient's trachea after the patient has been sedated or has become unconscious. The endotracheal tube must be inserted past the patient's teeth and tongue and further past the epiglottis and vocal cords into the trachea. When so placed, the endotracheal tube is disposed in a curved configuration that may have a relatively small radius of curvature on the order of about two inches.

Initial placement of the endotracheal breathing tube is often performed under emergency conditions. Therefore, it is desirable to inspect, and if necessary change, a patient's endotracheal tube soon after the patient arrives at the emergency room of the hospital. In cases of long-term intubation, the breathing tube also should be inspected at weekly intervals or whenever the patient is moved with a change of personnel responsible for the patient's care. This is to avoid or alleviate harmful reactions from long-term intubation such as granulation tissue reaction, infection, and stenosis of the trachea, larynx or subglottis, and to confirm continued proper placement.

An endoscope can be used by the practitioner to view the patient's tracheal area and more accurately place or assess the placement of the breathing tube. Such a device also can be used by the practitioner to verify proper placement of the breathing tube immediately after intubation or at any time thereafter.

Many types of endoscopes use a light guide having a fiber optic bundle that cooperates with an eyepiece optical assembly to permit viewing within a body cavity. The fiber optic bundle and any associated connectors generally can be referred to as a viewing assembly. The fiber optic bundle can include an image bundle and at least one illumination bundle. The image bundle is a coherent bundle of image-carrying optical fibers. The illumination bundle is a bundle of illumination light-carrying optical fibers.

The image bundle typically cooperates with the eyepiece optics, and the illumination bundle typically cooperates with a light source. The distal ends of the image bundle and the illumination bundle are often co-terminal at the distal end of the light guide. The proximal end of the image bundle may terminate in a connector that cooperates with the eyepiece. The proximal end of the illumination bundle may terminate in a connector that cooperates with the light source. The illumination bundle carries light from a light source to the distal end of the light guide to illuminate the area in front of the endoscope. An image of the illuminated area is then carried back through the light guide to the eyepiece via the image bundle.

Many endoscopes also include a handle that holds the eyepiece and the light guide and associated connectors. Some hand held endoscopes include a power source and a light source associated with the handle. Also, the handle can be configured to connect to the light guide and to the eyepiece to hold the entire system in operable relationship. The eyepiece assembly of an endoscope can be used with the naked eye of the practitioner or, alternatively, can be configured to connect to a camera or an electronic monitor to provide still photographs or video images.

Some intubation endoscopes are provided with a slender, elongate light guide that is plastically and inelastically malleable. In other words, the light guide can be bent or curved from its ordinarily straight configuration and will hold the desired configuration without springing back to the original straight configuration. This can be achieved by encasing the light guide with a thin-walled tube made of steel, aluminum or other plastically and inelastically malleable material. Other malleable, biocompatible metals and materials would also be suitable. The practitioner can pre-shape the light guide to a desired curvature to fit the curvature of the breathing tube and the patient's anatomy. The pre-shaped light guide can be placed within and inserted along with the breathing tube so that the practitioner can view anatomic structures as the tube is inserted into the patient.

In cases where a breathing tube has been placed previously, it is desirable to visually inspect the placement of the breathing tube. When inspecting a previously placed breathing tube, use of an endoscope having a plastically and inelastically malleable light guide has some disadvantages. The light guides of such endoscopes are usually too stiff to easily traverse the bend of the breathing tube while being pushed from the outside. Such bends are often curved to relatively small radii of curvature. An endoscope having an elastically flexible light guide that can bend to relatively small radii without excessive resistance to flexure is more suitable for inspecting previously placed breathing tubes.

As an elastically flexible light guide is inserted into a previously placed breathing tube, the distal end of the light guide can follow the inner wall of the curved breathing tube along the outer radius of the bend. Lateral forces imposed on the distal end of the light guide by the wall of the breathing tube cause the flexible light guide to bend, generally following the curvature of the breathing tube. Consequently, the light guide can traverse the full length of the breathing tube while being pushed from an external location.

If the breathing tube has been in place for some time, inspection with a flexible endoscope can be complicated by mucus and fluids that may have accumulated on the interior surface of the breathing tube. As the endoscope light guide is inserted into the endotracheal breathing tube, the distal objective end of the light guide tends to contact the inner wall of the tube as the light guide passes through the bend in the breathing tube. As a result, mucus and other deposits on the inner wall of the breathing tube may incidentally be scraped from the inner wall of the tube and become accumulated on the distal end of the light guide, obscuring the endoscopic view.

In a flexible light guide undergoing curvature from contact with the inner wall of the breathing tube, the curvature tends to occur somewhat proximally of the distal end, with the most terminal portion of the light guide tending to remain straight. Therefore, the distal end would approach the curved inner wall of the breathing tube at an angle and would tend to dig into the inner wall of the breathing tube, which would aggravate the problem of scraping up mucus or other fluids that could obscure the view. Moreover, the angular approach may cause the distal end to stick to the breathing tube wall rather than slide freely along the tube wall, thereby impeding insertion.