SURGICAL TECHNIQUE
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Laser surgery differs from conventional surgery in a number of ways, as follows:

**Lack of feedback**

Surgery is undertaken with a free beam, or with the beam being transmitted via a fibre which is held in the near-contact position. Thus, unlike conventional scalpel or scissor procedures, there is no feedback to the surgeon's hand. Therefore, it is necessary to assess the surgical progress by direct palpation or by palpation with instruments.

**Localization of the target**

When using a microscope, it is sometimes easier to move the patient's head in order to bring the target tissue into view.

**Third-hand technique**

If the target tissue is at the edge of the laryngoscope, gentle pressure on the laryngeal framework from outside brings the tissue into view within the laryngoscope. During prolonged surgical procedures, the correct position of the larynx can be maintained by strapping sticking plaster to the neck, or by the assistant maintaining gentle pressure if the procedure is short.

**Non-target strikes**

The face is covered with wet Gamgee in order to protect it and other flammable material. Wet swabs are used to cover the areas in the Theatre protocol and surgical technique immediate vicinity or, where possible, deep in the tissue. These swabs tend to dry out and may cause a fire, so they should be periodically moistened or removed and replaced. Any metal instrument such as the suction cannula or forceps can also be used as a beam-stopper, thus protecting the non-target areas. However, sustained laser
strikes on metallic beam stoppers should be avoided since the metal can get hot and will cause burns to non-target tissue in the vicinity.

*Evacuation of smoke*

Smoke and vapor impair the surgical progress. They are also a health hazard, for both the patient and the theatre personnel. They must be evacuated in the vicinity of the operative field.

*Depth of destruction*

Vaporization results in the immediate loss of tissue. However, there is also a delayed loss due to the irreversible thermal damage, which is dependent on a number of factors.

*Carbonization*

Charring results from inefficient vaporization. Charred tissue absorbs the energy and heats up to high levels of temperature. The thermal energy causes flares, and it is also conducted deep into the tissue, thus resulting in much deeper thermal damage. Therefore, it is necessary to remove any charred tissue frequently with a wet swab or suction.

* Stretching the tissue *

As with conventional surgery, the effects of the laser are maximized when the tissues are stretched prior to vaporization.
**Vaporization or Excision?**

**Vaporization**

Lasers can be used to ablate a given tissue by vaporizing it, layer by layer. Thus, vaporization is the prime and most important effect in the clinical application of lasers. During the first exposure, as the temperature rises to 100°C, a layer of tissue vaporizes. Continuing exposure will produce similar effect in the next layer of tissue. Thus, the layer of vaporization is an ever-advancing layer, so long as the beam continues to strike the tissue. Therefore, increasing the power setting cannot result in a deeper cut. It will only result in an increase in the *rate* of vaporization of the layers of tissue. If the speed of vaporization is very high, due to high-energy settings, the beam will reach the underlying non-target tissue very quickly and it may be damaged inadvertently before the exposure is stopped. The analogy can be given of a car being driven at high speed in a dead-end street. By the time the breaks are applied as it is approaching the end, it may be too late. It is important to note that the subsequent layer of tissue following initial vaporization is not of the same virginity with regard to its water content. This layer would contain tissue that has already suffered thermal damage. Therefore, having lower water content, it will be less efficiently 'ablated'. Increasing the energy beyond the vaporization level will not increase the efficiency of vaporization, but will merely result in the excess energy being conducted away, resulting in greater thermal damage to the tissues beyond the visible vaporization.

**Excision**

Lasers can also be used to 'excise' a tissue, by vaporizing a narrow band of tissue in the line of the incision, in order to develop a flap, deep enough to hold with a micro-forceps, and retracting it medially. This method allows dissection of the nodule from the normal underlying tissue and provides material for histological confirmation.
**Intra-operative bleeding**

Oozing should be controlled with wet swabs or swabs impregnated with a decongestant. Diathermy is necessary for large bleeders.

**Wound toilet**

At the end of the procedure, the wound should be wiped clean with a wet swab. Any debris and charring will thus be removed. If fresh bleeding starts, it should be controlled with decongestant swabs held briefly in position. Diathermy or further laser strikes may be necessary, but should be avoided to limit any delayed thermal damage. If a laser beam is used, it should be defocused so that the tissues are coagulated around the bleeding area.

**Team work**

In an operating theatre, the weakest link for a mishap to occur is untrained staff. However, when the procedure is undertaken by a trained team, the mishap will be due to complacency, pressure on the surgical time, tiredness, and so on. Accidents pertaining to laser usage are usually serious and extra care is necessary. Close liaison of the laser and effective surgery for the patient and will protect the staff from accidental injury. In cases of a mishap, the ultimate responsibility lies with the senior health care staff and the management.
THE LASER SURGEON

Prior to commencing surgery, the surgeon inspects the laser equipment. In the specific case of the CO₂ laser, the aiming beam (HeNe) and the treatment beam (CO₂) must be co-axial. The surgeon tests the laser's impact on a wooden tongue depressor placed on a wet towel. If the two beams are not precisely aligned, the operation must be rescheduled or conventional instruments used. An electrical mono- or bipolar scalpel should also be at hand. In order to avoid any fire hazard, flammable liquids (ethyl chloride, acetone, alcohol) must be removed during lasing. Whenever possible, paper drapes should be avoided. Soaked cotton pledgets should be available for protecting non-target tissue. During lasing, the use of pure oxygen must be avoided when flammable material is present within the airway.

Important points of CO₂ laser in ENT.

Out of several laser types existing, the CO₂ laser is considered the “workhorse” of laser surgery due to its unique capabilities in doing precise, haemostatic incisions, excisions and ablations of tissue.

The CO₂ laser emits continuous or pulsed infrared radiation which is well absorbed in water. Since any soft tissue is made mainly of water, tissue at the focal point of the laser beam is immediately vaporized, leaving behind a thin necrotic layer of tissue which measures homeostasis.

On humans, CO₂ laser surgery is implemented in the freehand mode, in microsurgery and in rigid endoscopy, enabling surgical precision to a fraction of a millimeter.

CO₂ lasers produce light with a wavelength of 10.6 nm in the infrared range of the electromagnetic spectrum. A second, built-in, co-axial helium-neon laser is necessary as its red light indicated the spot.
where the invisible CO$_2$ laser beam will impact the target tissue. So, this laser acts as an aiming beam for the invisible CO$_2$ laser beam.

The radiant energy created by the CO$_2$ laser is strongly absorbed by pure, homogeneous water and by all biologic tissue rich in water content. The extinction length of this wavelength is about 0.03mm in water and in soft tissue. Reflection and scattering are insignificant. Because absorption of the radiant energy produced by the CO$_2$ laser is independent of tissue color and because the thermal effects produced by this wavelength on nearby non target tissues are minimal, the CO$_2$ laser has become extremely versatile in otolaryngology.

Until lately, light from the CO$_2$ laser could not be transmitted through flexible endoscopes and was restricted to transmission from the optical resonating chamber to the target tissue via a series of mirrors through an articulating arm to the target tissue. In this manner, the CO$_2$ laser can be used free hand for macroscopic surgery, attached to the operating microscope for microscopic surgery, and adapted to an endoscopic coupler for bronchoscopic surgery. Pattern generators fixed with a micromanipulator on the operating microscope too help with surgical exactness of the CO$_2$ laser in laryngology.

Nowadays, with the emphasis on in office procedure, the CO$_2$ laser has been coupled with a new flexible waveguide to allow passage through the working channel of a transnasal endoscope.