

Functions of the Seventh Nerve

The 7th nerve, or nerve of facial function, is often closely intertwined with the 8th in the area of acoustic neuroma growth. Thus it often is necessary to manipulate the 7th nerve, or even separate it from the tumor. The tumor may also involve the blood supply to the nerve. Even when the nerve is left intact at surgery, its function may be diminished.

In addition to controlling the muscles used for facial expression and speech, the 7th nerve controls blinking and eyelid closure. The 7th nerve also provides the muscle tone necessary to hold the lower lid in position against the eyeball, and to pump the tears through their outflow system. Consequently, any damage to the 7th nerve will affect these functions. The nerve to the tear gland runs along with the facial nerve.

Seventh Nerve Involvement

The ocular discomfort following acoustic neuroma removal is primarily a result of an impairment of one or more aspects of 7th nerve function.

Symptoms resulting to injury of this nerve can be grouped in two main categories, those resulting from dryness, and those resulting from wetness:

Symptoms

- Dryness, irritation and/or a mucoid discharge
- Ocular redness and/or sensitivity to light
- Intermittent or constant blurring of vision

Dryness, irritation, and/or a mucoid discharge

The eye can feel scratchy, burning, or have the sensation of a foreign body present. It may be particularly sensitive to shampoo, or particles of dust and sand. One might be bothered by air conditioning or other draft conditions, dry air, cold temperatures, or smoke. Symptoms can worsen as the day progresses. These symptoms are due to minimal irregularities on the front surface of the cornea.

Ocular redness and/or sensitivity to light

Generally these are symptoms of corneal irritation or inflammation of moderate or severe degree.

Intermittent or constant blurring of vision

This results from significant roughness of the front surface of the cornea.

Causes of Dryness

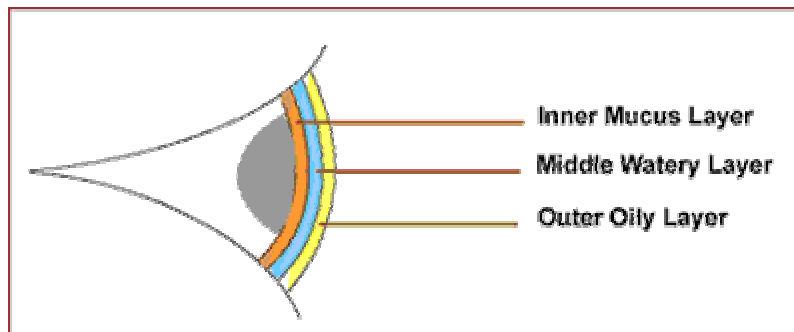
The hydration or "wetness" of the front surface of the eye must be maintained at a certain critical level in order for the cornea to be optically clear and for the eye to feel comfortable. In order for that level to be maintained, the right amount of tears must be produced, the tears must be distributed (by blinking) across the front surface of the eye, and the evaporation of tears must be limited by lid position and closure. Causes include:

- Inadequate tear production
- Reduced blinking and/or incomplete upper lid closure
- Poor lower lid position
- Poor upper lid or brow position
- Increased evaporation of tears

Inadequate tear production

This is usually caused by a deficiency in the water layer of the natural tear film, manufactured by the tear gland. The poor function of the tear gland (which is located under the rim of bone at the upper lateral aspect of the eye) is in turn related to the damage to its nerve supply, which accompanies the 7th nerve.

The tear film consists of three layers: the inner mucinous layer which bonds the tears to the eye, the middle water layer that comes from the tear gland, and the outer oily layer which helps limit evaporation of tears. The middle tear layer (which makes up most of the volume of the tears) is reduced by damage to the nerve fibers to the tear gland. However, the other tear layers (which are produced by glands in the lids and in the conjunctiva, a membrane that covers the white of the eye and lines the eyelids) persist, often leaving the eye with a mucoïd discharge. Since tears have anti-bacterial properties, a dry eye is also at increased risk of infection.



Reduced blinking and/or incomplete upper lid closure

It is the movement of the upper lid that distributes the tears across the front surface of the eye. If the upper lid does not move well or blink well, tears are poorly distributed.

Poor lower lid position

If the upper lid is to function well as a windshield wiper to distribute tears, it must be able to pick up tears from the normal tear reservoir (called the tear lacus). This reservoir consists of a pool of tears which accumulates at the margin of the lower lid, where it contacts the eye. If the reduced muscle tone in the lower lid results in that lid being too low, or turned away from the eyeball (ectropion), the upper lid cannot pick up the tears to distribute (whether those tears are normal tears or artificial tears). Also, a poorly positioned lower lid fails to adequately protect the lower aspect of the cornea.

The inner aspect of the lid is lined with a mucous membrane (conjunctiva) which also becomes reddened, thickened, and irritated if the lid is turned out. Occasionally, the loss of tone in the lower lid causes the lid margin to rotate inward (entropion), which causes the lashes to rub against the eye.

Poor upper lid or brow position

Loss of tone in the upper lid occasionally causes the lid margin to rotate inward, which causes the lashes to rub against the eye. Similarly, loss of tone in the forehead muscles can allow the eyebrows to droop. In some people with deep-set eyes, the hairs of the drooping brow may rub against the eyeball.

Increased evaporation of tears

The more area available for evaporation, the more rapidly the tears will evaporate. A wide open eye will therefore dry out more quickly than one less open. The eye may be excessively open because the lower lid is down and or because the upper lid is up (higher than normal in the open position). Increased evaporation also occurs when the eye is open when it should be closed (for example, during sleep).

Wetness

Symptoms

The eye is excessively wet and tears may drain down the cheek. The symptoms may start immediately after surgery, or within the following few weeks.

Causes

Response to corneal irritation

When the cornea is irritated and the tearing mechanism is intact (i.e., the nerve to the tear gland has not been damaged), extra tear production is a normal protective mechanism which the body utilizes to compensate for the irritation and to attempt to wash out the irritant.

Failure of lacrimal drainage

Excess tearing may also result from the inability of the eyelids to properly drain the tears. Tears do not just drain into the outflow channels (which are located at the lid margins, near the inner corners of the eyelids). Rather, they are pumped through the drainage ducts by the muscular contraction of the lids. This muscular mechanism is called the lacrimal pump. If the lid muscles are not working because of a loss of 7th nerve innervation, failure of the lacrimal pump allows the tears to overflow the lids and run down the cheek.

Wetness- Late Excessive Tearing

Symptoms

This can occur while chewing, usually beginning some months after surgery.

Causes

Aberrant regeneration of nerve fibers

A nerve may be compared to a cable with many wires (fibers) within it. When the nerve is damaged, each of the fibers needs to regrow. Unfortunately, the correct fiber ends do not always connect. If a fiber that is supposed to go to a salivary gland winds up connected to the tear gland, every time the normal reflex mechanism that causes chewing to produce saliva is activated, excess tears result instead of saliva.

Treatments

Although eye problems after acoustic neuroma surgery can be significant, the good news is that prompt and proper attention to a change in eye feeling and function will minimize any harmful effects.

There are several possible methods of treatment:

- [patient controlled non-surgical care](#)
- [physician aided non-surgical care](#)
- [surgical techniques which improve lid position](#)
- [surgical techniques to animate the upper eyelid](#)
- [surgical elevation of the upper brow](#)
- [surgical closure of the tear drainage system](#)

Non-Surgical Care -- Patient Controlled

There are several treatments that a patient can pursue that do not involve a physician's care:

- [Artificial tears](#)
- [Eye ointments](#)
- [Slow release ophthalmic inserts \(Lacriserts\)](#)
- [Taping](#)
- [Protective devices](#)
- [Protecting against ocular irritants](#)
- [Being aware of the humidity](#)
- [Increasing blinking](#)
- [Chewing gum](#)

Artificial tears

The simplest means of protecting the cornea is with the use of eye drops. Some drops consist of methylcellulose, polyvinyl alcohol or a similar agent alone. Others include a wetting agent in order to more closely simulate the normal tear film. The wet-ting agent functions in a manner similar to the mucinous inner tear layer -- it helps bond the artificial tear to the cornea. In some cases, the use of a wetting agent as a separate drop in combination with an artificial tear drop may work better than a preparation containing both ingredients.

Eye drops also contain a variety of preservatives, some or all of which may be allergenic. Patients who experience irritation from a particular eye drop may be comfortable with a similar drop prepared with a different preservative.

The thickness (viscosity) of an eye drop may be increased to prolong its effect. More viscous drops, however, may cause some blurring of vision and tend to crust on the lid. The patient and the ophthalmologist must, then, work out a regimen of drops which will be best suited to the needs to that particular patient.

Eye Ointments

Bland eye ointments consist primarily of sterile petroleum jelly and therefore differ little from each other except that some are free of preservatives and therefore may be less likely to cause an allergic response. Other ointment possibilities include the ointment base which is found in boric acid ointment or in antimicrobials such as Gantrisin or Bacitracin eye ointment.

Because eye ointments cause more blurring of vision than drops, their use is usually limited to bedtime. They offer more protection than drops since ointments stay in the eye

longer. In addition, some patients may benefit from the fact that ointment will help to stick the eyelashes shut at bedtime, thus helping to hold the eye closed.

Patients with low grade lid infections may also benefit from the addition of an antimicrobial (such as Bacitracin or Gantrisin ointment) to their regimen. The normal tear film has an antimicrobial effect. In the presence of tear deficiency, that antimicrobial effect is also lost.

Slow release ophthalmic inserts (Lacriserts)

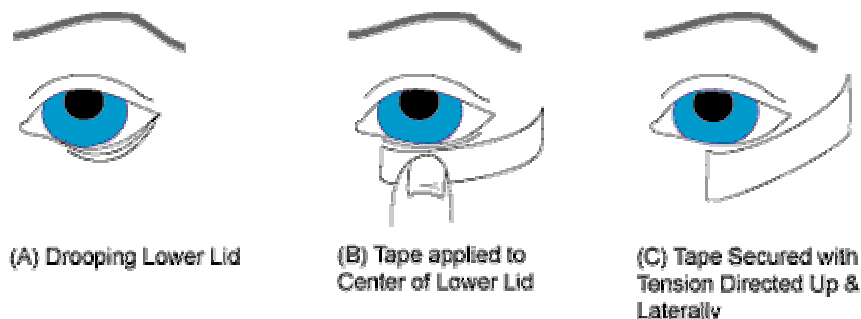
These inserts are little pellets which are tucked under the lid. They melt slowly over a period of hours and lubricate the eye. In general, they cause somewhat more blurring than low viscosity drops, but less than that caused by ointment. They are especially useful in those patients who need to use drops more often than four times a day. In some patients, it may still be necessary to supplement the use of the Lacrisert with drops. In most patients it is helpful to add a drop of artificial tears immediately after placing the Lacrisert in the eye in order to start the melting of the insert.

Although the manufacturer generally recommends that one Lacrisert be used daily, some patients will benefit from the use of more than one per day.

Taping

Tape may be used to keep the eye closed during the night. Especially in the presence of decreased corneal sensation, it is much safer to tape an eye shut than to patch it. An eye with an anesthetic cornea may open under a patch and the patch can abrade the cornea without the patient's knowledge. If the eye is taped, the patient knows when the eye comes open and the stiffness of the tape tends to hold it away from the cornea even when the eye is open.

Tape can also be used to support a drooping lower lid and to limit the opening or to enhance the closure of a paralyzed upper lid. Instruction by the ophthalmologist is required in the proper methods of accomplishing these goals. A clear tape which does not leave an adhesive residue, such as Transpore, seems to work best. Some paper tapes are also useful.



Protective devices

Protective glasses such as wrap-around sun glasses or goggles may be used to decrease evaporation from the eye. Moisture chambers which function as one-sided goggles are available. These can be attached to glasses or held in place by an elastic band. Bubbles which adhere to the skin are also available. These may cause a problem with chronic use because of skin irritation.

Protecting against ocular irritants

Chlorinated pool water, shampoo, dry air currents, dust, and aerosols are potential ocular irritants for a normal eye and can be especially irritating to an eye with decreased tearing and blinking. Common sense precautions to protect against these irritants can prevent major problems. For example, properly fitted swim goggles can offer protection for swimming and even shampooing. Shampooing is also safer if it is done with the head back and the shampoo draining back into a sink (as is the common practice in barber shops and beauty salons) than with the shampoo running down the face into the eye in a shower. The use of a less irritating shampoo, such as baby shampoo, adds an additional safety factor.

The eye can be protected against air conditioning drafts in autos by closing appropriate vents so the draft is not directed toward the eye. In air travel where the vent may not be controllable, (or when sitting under a hair dryer) a moisture chamber can be used to protect the eye. Similarly, a moisture chamber or goggles can be used to protect against dust and common aerosols (such as hair sprays).

Being aware of the humidity

Many patients have less ocular problems when they are in a moist climate than when they are in a dry one, since there is less tear evaporation when the humidity is high. Short of moving to a more humid city, the use of a room humidifier can provide similar benefits. Patients living in areas prone to wide swings in humidity, e.g., due to desert winds, should increase the frequency of their drops whenever such a condition is predicted, rather than wait for the eye to become irritated by the humidity drop.

Increasing blinking

The important wind-shield wiper effect of blinking is often more impaired during involuntary (reflex) blinking than it is during voluntary (forced or conscious) blinking. Better eye lubrication may therefore be achieved by making a conscious effort to close the eye at regular intervals, e.g., at the end of every page while reading. Think blink!

Chewing gum

The patient who has aberrant nerve regeneration and gets a wet eye when he chews may sometimes be able to turn this abnormality into an asset. By chewing gum at those times when the eye is dry, the patient can restore moisture to it. In some patients, spicy gum works best.

Non-Surgical Eye Care -- Physician Aided

Bandage contact lens

A bandage contact lens works like a wet sponge on the front surface of the eye to keep the cornea from drying out. If tearing is deficient, special lubricating drops must be used with the lenses. In some patients, daily wear lenses are adequate. Others require long-wear lenses. It is imperative that such lenses be removed and sterilized at regular intervals, usually every week. If the eye cannot tolerate being without the lens, a back-up lens should be used while the primary lens is being sterilized.

Bandage lenses generally do not work well when there is very poor lid closure or significant lower lid droop. These conditions may first be corrected surgically before fitting the bandage con-tact lens.

Temporary lid closure

It is sometimes necessary to temporarily close the eye to allow it to heal or to protect it. The simplest method is to tape the eye shut. Not all eyes will stay adequately closed with taping, however. In those cases the tape may need to be supplemented with an eye patch or a suture to hold the eye closed. The suture may either pass through both lids, or may pass only through the upper lid and be taped to the cheek.

Surgical Techniques to Improve Lid Position

Canthoplasty

The term "canthus" refers to the corner of the eye, where lid tendons are located. These tendons can be tightened or stitched together at the very corners of the eyelids, thus not limiting vision or causing disfigurement. The surgery can be done on the side near the nose (medial) or the outer side (lateral) and will elevate the lower lid and enhance upper lid closure. In one type of lateral canthoplasty, the lower lid may be tightened by shortening it and reattaching it laterally. Medial and lateral canthoplasty may be used singly, together, or in combination with other procedures to correct ectropion or entropion of the lower lid, or to animate the upper lid.

Upper lid entropion repair

The upper lid skin can be sutured internally to the opening muscle of the eyelid to correct entropion and return the lashes to their normal position.

Tarsorrhaphy

A tarsorrhaphy is a procedure in which the lids are sewn together, either partially or completely. The surgery is often successful in protecting the eye, but creates obstructions to peripheral vision and usually is disfiguring.

Surgical Techniques to Animate the Upper Eyelid

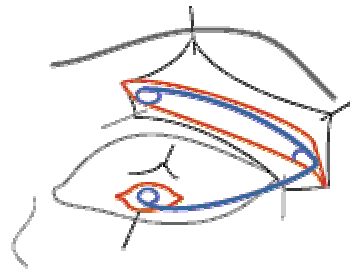
All of the prosthetic devices described are removable. Even though they may be used for long-term problems, they can be removed in those cases where facial nerve function improves to the point that the effect provided by the surgical procedure is no longer required.

Palpebral spring

In this procedure, a stainless steel spring is implanted in the upper lid. The force of the spring is directed to oppose the opening muscle. When the opening muscle relaxes, e.g., when the patient closes the other eye, the spring takes over and closes the affected eye. The affected eye therefore blinks synchronously with the other eye, and closes during sleep. No special conscious effort is needed to open or close the eye. Frequently a medial canthoplasty to improve lower lid position is combined with spring implantation.



(A) Lid Incision



(B) Spring Adjusted to Conform to Lid Contours and Fastened to Prevent Slippage.

Silastic elastic prosthesis (Arion cerlage)

A small (1 mm. diameter) silastic rod is sewn through the tendon at the inner corner of the eye and passed through the upper and lower lids. The arm in the lower lid serves as a hammock to support that lid. The arm in the upper lid functions similarly to the palpebral spring, simulates blinking, and provides closure. It also often is combined with a medial canthoplasty to provide maximum effect.

Unlike the palpebral spring, the silastic prosthesis stretches and loses much of its effect after six months or a year. The palpebral spring is therefore preferred in patients in whom long-term function may be required. Either may be used in short-term situations.

Gold weights

In cases where the closure problem is not too severe and absolutely tight lid closure is not critical, a gold weight placed in the upper lid may enhance lid closure. Since the effect of the gold weight is gravity dependent, it works best when the patient is upright.

Surgical Elevation of the Brow

It is possible to elevate a drooping brow by making an incision over the brow, suspending the brow with sutures to the covering of the bone (periosteum) of the forehead, and excising redundant skin and muscle. The effect is generally cosmetically pleasing, even though the brow still does not move and therefore will not match the other brow in all positions of gaze.

Surgical Closure of the Tear Drainage System

Punctal occlusion (blocking the drainage pathways for tears) is similar to putting a stopper into a sink. Plugging the openings into the tear ducts (the openings are called puncta) preserves the natural (or artificial) tears which are present. The effect of the procedure can be gauged by placing temporary plugs in the puncta. If there appears to be significant benefit, the openings can be surgically closed.

As it turns out, in most patients with severe facial weakness, the tear drainage system is functionally closed even without placing punctal plugs. The reason for this is that the movement of tears through the drainage system is dependent on an active pumping mechanism (called the lacrimal pump). Without proper innervation to the lid muscles, this pump does not work and tears remain in the eye.