

# EYE CARE AFTER ACOUSTIC NEUROMA SURGERY

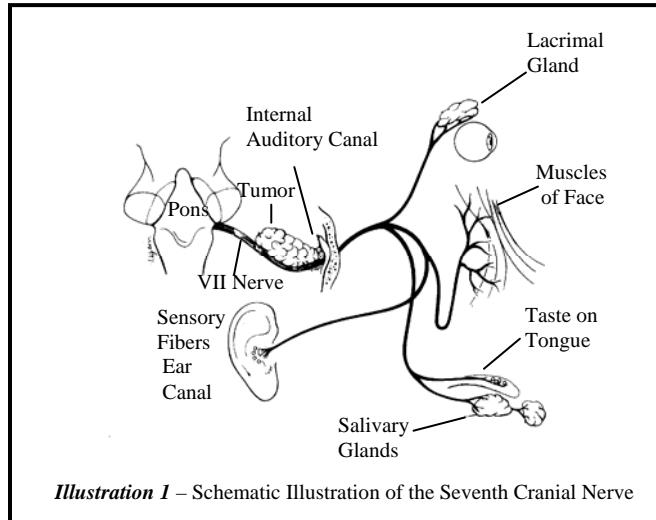
## INTRODUCTION

Some patients who have an acoustic neuroma removed have eye problems after surgery. Proper eye care after hospital discharge is vitally important for those whose 5th, 6th, or 7th cranial nerves have been affected. With appropriate care, however, eye problems can usually be managed successfully, allowing the patient to return to his or her normal lifestyle.

It's important to note that the patient is often responsible for proper care of the eye, or needs to be aware of eye problems which require medical attention. This booklet is intended to help the patient and his or her family understand the many factors which lead to eye problems, in the hope that by so doing those problems will be prevented or minimized.

## REASONS FOR EYE PROBLEMS AFTER ACOUSTIC NEUROMA SURGERY

The nerves that leave the brain are numbered from 1 to 12, starting at the front of the brain. An acoustic tumor arises from the 8th cranial nerve (also called the acoustic nerve since it goes to the ear). Nerves number 5, 6, 7 and 8 all exit the brain in close proximity, and, therefore, any combination of these nerves may be compromised by the tumor. The 5th, 6th and 7th nerves are all concerned with functions necessary to the eye.



### A. SEVENTH NERVE FUNCTION

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 close to the facial nerve.

## **B. FIFTH AND SIXTH NERVE FUNCTION**

Acoustic tumors involve the 5th and 6th nerves less commonly than the 7th nerve. The 5th nerve supplies sensation to the face and to the cornea (the clear front surface of the eye), and also promotes maintenance of tissue integrity and healing ability. The 6th nerve controls the eye muscle that moves the eye on that side laterally (outward).

## **COMMON OCULAR SYMPTOMS AND THEIR CAUSES**

### **A. SEVENTH NERVE INVOLVEMENT**

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

#### **1. Symptoms Related to Dryness and Their Causes**

##### **a. Dryness, irritation and/or a mucoid discharge**

The eye can feel scratchy, burn, 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.

##### **b. Ocular redness and/or sensitivity to light**

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

##### **c. Intermittent or constant blurring of vision**

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

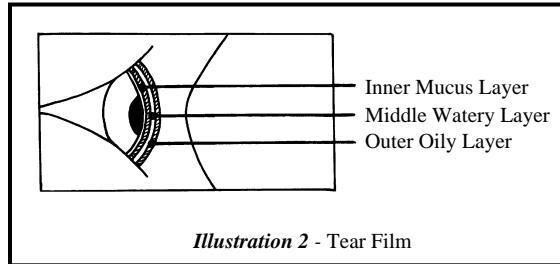
#### **2. Why the Symptoms Related to Dryness Occur**

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.

##### **a. Inadequate tear production**

This is usually caused by a deficiency in the water layer of the natural tear film produced 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 conjunctiva, a membrane that covers the white of the eye and lines the eyelids, and by lid glands) persist, often leaving the eye with a mucoid discharge. Since tears have antibacterial properties, a dry eye is also at increased risk of infection.



**b. 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.

**c. 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). A poorly positioned lower lid also fails to protect adequately 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.

**d. 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.

**e. 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).

### **3. Symptoms Related to Wetness and Their Causes**

#### **a. Symptoms**

##### **1. Early excessive tearing**

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.

##### **2. Late excessive tearing**

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

#### **b. Why the symptoms of early excessive tearing occur**

##### **1. 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.

##### **2. Failure of lacrimal drainage**

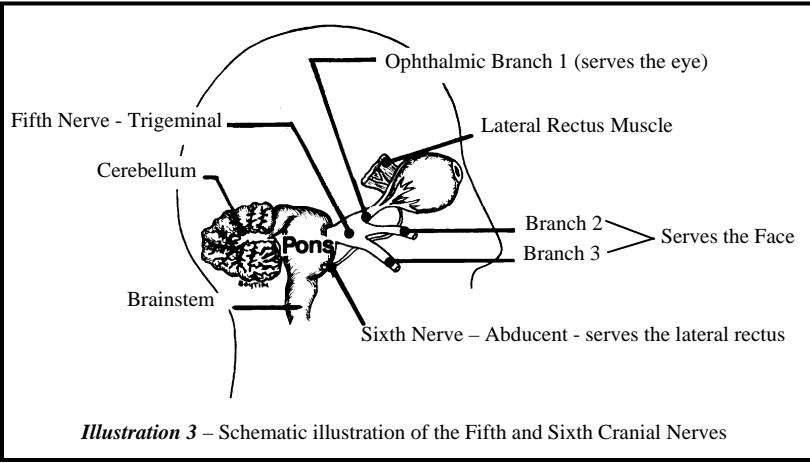
Excess tearing may also result from the inability of the eyelids to properly drain the tears. Tears do not just drain into the outflow channels (which are located at the lid margins, near the inner corners of the eyelids). Rather, they are pumped through the drainage ducts by the muscular contraction 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.

#### **c. Why the symptoms of late excessive tearing occur**

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.

## **B. FIFTH NERVE INVOLVEMENT**

Some patients with acoustic tumors have a decrease or total loss of corneal sensation due to 5th nerve involvement.



## 1. Symptoms

### a. Loss of reflex blinking and tearing

The patient does not feel when an irritant touches the cornea, and the eye does not attempt to blink or tear in response to the irritant.

### b. Loss of pain as a warning sign

The patient with a numb cornea will not feel pain when the eye is injured and must look for other signs (i.e., redness or blurring of vision) that the eye is at risk.

### c. Ocular redness

A cornea which lacks 5th nerve supply may break down spontaneously, causing the eye to become inflamed.

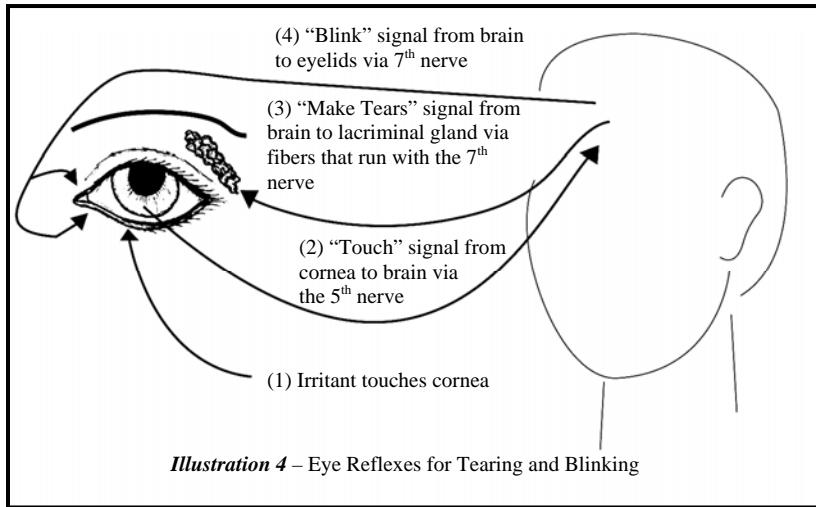
## 2. Why the Symptoms Occur

### a. Loss of corneal sensation

Blinking is a reflex. Suppose an irritant, such as a foreign body, touches the cornea. A “touch” signal is sent from the cornea to the brain, resulting in the brain returning a signal to the eyelid to blink. The signal from the cornea to the brain is sent via the 5th nerve, and the return signal is sent via the 7th nerve. The brain also sends a signal via the fibers that run along with the 7th nerve to the tear gland, telling the gland to produce extra tears to wash out the irritant. An acoustic neuroma patient, therefore, may have deficits which interfere with both aspects of this reflex.

### b. Loss of trophic (nourishment) function

The 5th nerve has a role (referred to as its trophic function) in maintaining tissue integrity. The exact mechanism by which this occurs is poorly understood. It is very likely that the 5th nerve produces or transmits some chemical substance which is involved in the healing process. Not only do corneas without 5th nerve supplies break down easily, they also heal poorly. One can thus readily understand why a patient with combined 5th and 7th nerve deficits must take special precautions to avoid ocular problems.



### C. SIXTH NERVE INVOLVEMENT

The 6th nerve controls the eye muscle that moves the eye on that side laterally (outward). Some acoustic neuroma patients have double vision (diplopia) immediately after surgery because the 6th (abducent) nerve involvement with the tumor limits the normal lateral movements of the eye on the involved side. This problem usually resolves quickly, but improvement occasionally may be delayed. Rarely, the deficit persists for more than a year and requires eye muscle surgery.

### EYE CARE

#### A. NON SURGICAL CARE – PATIENT CONTROLLED

##### 1. 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 simulate more closely the normal tear film. The wetting agent functions in a manner similar to the mucinous inner tear layer—it helps bond the artificial tear to the cornea. Carboxymethylcellulose (found in numerous Refresh™ preparations and others listed in the table at the end of the booklet) is used to bond the drop to the cornea via ionic bonding. Systane Ultra™ attempts to coat the cornea with a newly formed Guar-HP and borate viscoelastic gel. Refresh Optive Advanced™ uses carbomer copolymer A and an oxychloro complex to achieve the same effect.

Some newer eye drops attempt to replace the function of the oily layer. Soothe XP™ attempts to replace the oily layer of tears using light mineral oil. Systane Balance™ also augments the lipid layer by utilizing a high concentration of propylene glycol in its solution. Both may be used alone, or placed in the eye after a conventional tear drop, to limit the evaporation of that drop by providing an oily barrier, as in normal tears. Refresh Dry Eye Sensitive Therapy™ also attempts to restore the oily layer of the tears by combining an oily component, castor oil. It thus attempts to replace all three layers in a single preparation.

Eye drops also contain a variety of preservatives, some or all of which may be allergenic or irritating. Benzalkonium chloride appears to be the most irritating, and has been replaced by other preservatives in many preparations. Patients who experience irritation from a particular eye drop may be comfortable with a drop prepared with a different preservative, or which is free of preservatives. Preservative-free drops are packaged in droperettes rather than bottles, since they need to be used the same day the container is opened. Without a preservative, they cannot be stored without risk of contamination. Unless a patient is sensitive to preservatives, or has to use a drop more than four times a day, using a drop with a preservative, packaged in a bottle, is generally more convenient and less expensive.

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. Viscous drops and oily drops may also coat bandage contact lenses and cause even more blur in the presence of a bandage lens. The patient and the ophthalmologist must, then, work out a regimen of drops which will be best suited to the needs of that particular patient. A chart of common brand eye drops is found at the end of this booklet.

In very severe cases of dryness, it is possible to use eye drops made from the serum of the patient's own blood. Natural human tears contain many growth factors, antibodies, etc., which are also present in serum, so using serum eye drops may provide these substances to help heal the corneal surface. The major disadvantage of serum treatment is the requirement to draw blood and prepare the blood as serum for use as substitute tears. The active components of serum are stable for up to six months; therefore, blood draw and serum preparation are required two to three times a year. Your ophthalmologist may be able to locate a blood bank or compounding pharmacy in your area which will assist in preparing substitute tears from your own blood.

## **2. Eye gels and ointments**

There are three preparations available which are thicker than eye drops but not as thick as conventional ointments. These are GenTeal Gel<sup>TM</sup>, Systane Gel<sup>TM</sup> and Tears Again Night & Day Gel<sup>TM</sup>. These may be suitable for situations where more protection is needed than can be provided by a drop, but where an ointment, with its attendant blurring, is not required. Since they differ chemically, one may work better than another in a given patient.

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

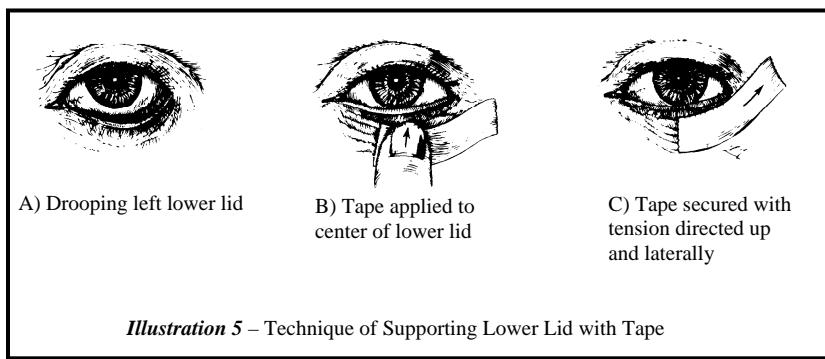
### **3. Slow release ophthalmic inserts (Lacrisert™)**

These inserts are little pellets which are tucked under the lower 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.

### **4. 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 a numb 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.

### **5. Protective devices**

Protective glasses such as wrap around sun glasses or goggles (such as the motorcycle glasses made by Harley-Davidson which have a foam rubber seal around

the lenses) 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. Bubbles may cause a problem with chronic use because of skin irritation.

#### **6. 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, also helps prevent irritation.

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).

#### **7. 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, i.e., 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.

#### **8. Increasing blinking**

The important windshield 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, i.e., at the end of every page while reading. Think blink!

#### **9. 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.

## **B. NON SURGICAL EYE CARE – PHYSICIAN AIDED**

### **1. Bandage contact lenses**

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, artificial tears must be used with the lenses to prevent the lenses from becoming dry. If the lens itself becomes dry, it will become hard and brittle and come out of the eye.

Since long-wear (continuous use) disposable lenses have become available, they have generally been preferable to non-disposable lenses for bandage lens use. The disposable long-wear lenses are thinner than the disposable lenses intended specifically for daily wear. Although that makes them somewhat more difficult to handle, the increased comfort with the thinner lenses makes the trade-off worthwhile, even if the thin lens is to be used as a daily wear lens, rather than the continuous use for which it was originally designed.

One of the newest types of lens is the silicone hydrogel lens. Although it is a thicker lens, it has the advantage of much higher oxygen transmission than conventional lenses, and therefore can be left in the eye for 30 days without replacement. The only two silicone hydrogel lenses approved for extended 30 day wear by the FDA are Purevision™ and Air Optix Night and Day™. Being able to leave a lens in for several days can be a real advantage for those patients who find it difficult to place contacts in their eyes. Another development has been the availability of high water content contact lenses. In selected cases these lenses may be more comfortable than conventional lenses.

Patients with lax lids, decreased closure and blinking secondary to facial paralysis are more likely to lose contact lenses than patients with normally innervated lids. However, the relatively low cost of disposable lenses (about \$5 per lens) prevents economics from becoming a significant issue with regard to their use as bandage lenses, even with the probability that some lenses will be lost.

If a continuous wear bandage lens is used in an eye with poor lid closure, a thick lubricating drop such as Celluvisc™ or Liquigel™ should be instilled at bedtime and the eye should be taped shut. This will prevent the lens from drying out during the night.

If bandage lenses cannot be made to work well because there is very poor lid closure or significant lower lid droop, these conditions may first be corrected surgically before fitting the bandage contact lens.

### **2. Scleral lenses**

Still another development has been the availability of new scleral lenses. The scleral lenses are rigid gas permeable lenses that are modified to have a large diameter and steeper profile compared to regular gas permeable lenses. The scleral lenses completely vault over the cornea to provide moisture and protection for the entire cornea while providing comfort comparable to soft contact lenses. Because the space between the sclera lens and the cornea is filled with saline, the cornea stays

moist. The selection of the best lens in a given situation must be worked out by the patient and his or her ophthalmologist.

### **3. Temporary lid closure**

It is sometimes necessary to close the eye temporarily 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.

## **C. SURGICAL TECHNIQUES TO IMPROVE LID POSITION**

### **1. 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 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.

### **2. Tissue grafts and stents**

A piece of connective tissue (fascia lata) can be threaded into the lower lid and anchored at each corner, to support a severely sagging lid. The fascia may be sterilized donor tissue, or may be taken from the patient's own thigh. Sometimes a tendon taken from the arm (palmaris longus tendon) is utilized in a similar manner.

In the past, tissue taken from the outer ear (ear cartilage) or mouth (hard palate) have been placed as a stent to support a sagging lower lid. More recently, artificial materials such as Medpore<sup>TM</sup> is used, obviating the need to perform surgery at another site to obtain stent material, and providing more uniform stent material.

### **3. Cheek suspension**

Cheek tissue may be pulled up and secured to the lower aspect of the orbit. This helps to push up the lower lid and reduce the drag on the lower lid from the paralyzed lower face. A new bioabsorbable implant, the Endotine Ribbon<sup>TM</sup>, can be used for this purpose.

### **4. Combined procedures**

A combination of the various procedures described above may be used to achieve the desired results.

### **5. 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.

## 6. 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, usually is disfiguring, and may lead to abnormal lash growth in the area where the lids are sewn together. Whenever possible, it is preferable to use other surgical techniques to protect the eye.

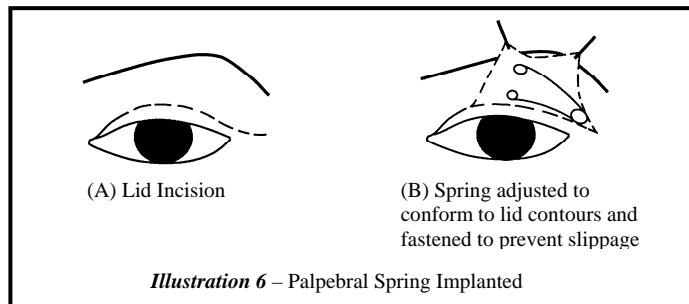
## D. SURGICAL TECHNIQUES TO ANIMATE THE UPPER EYELID

All of the prosthetic devices described below 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.

### 1. Palpebral spring

In this procedure, a wire spring is implanted in the upper lid. The force of the spring is directed to oppose the opening muscle of the eyelid. When the opening muscle relaxes, i.e., 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. New non-ferrous alloys are currently used for making the spring. These alloys are not affected by MRI magnets and do not prevent subsequent MRI studies of the brain.

To further improve blink speed and to make the eyes appear more equal, the opening muscle of the eyelid (levator muscle) is tightened at the same time the spring is implanted. The combined procedure (called "enhanced palpebral spring implantation") provides excellent closure of the eyelid, regardless if the patient is upright or lying down. It is the procedure of choice to achieve excellent closure of the upper lid.

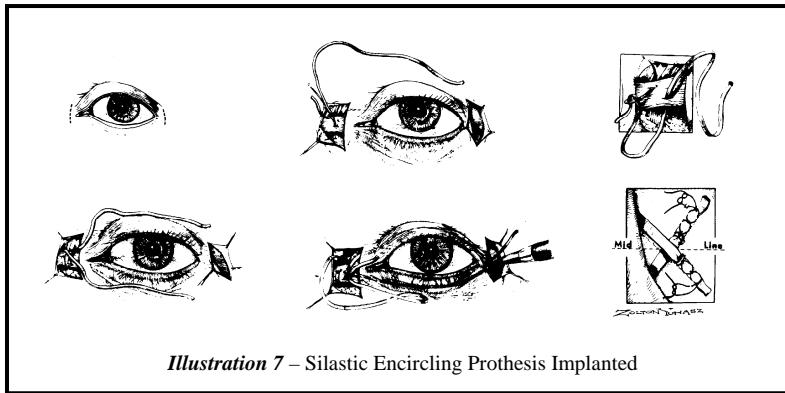


Unlike other devices, the spring may be adjusted without removing it. In patients who get some function back, but not enough to allow for removal of the spring, the spring tension can be adjusted as an office procedure. Alternatively, the balance of forces in the lid can be adjusted by further tightening the opening muscle (levator) of the eyelid. The enhanced palpebral spring procedure is often combined with procedures to improve lower lid position, to correct upper lid entropion and to elevate the brow.

## 2. Silastic elastic prosthesis (Arion Cerclage)

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.



## 3. 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. In many mild cases in which gold weights are considered, bandage lenses may be an equally effective alternative and should be evaluated before deciding on gold weight implantation.

## E. 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 removing excess 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.

Procedures are also available to elevate the brow without creating an incision above the brow or in the mid-forehead. The brow may also be elevated endoscopically. In that procedure, the brow is freed from its attachments, starting just above the hairline, and secured in an elevated position. Alternatively, the brow can be elevated through a hidden incision made in the eyelid fold. Working through that incision requires a biodegradable device called the Endotone TransBleph Implant that can be

anchored to the bone above the brow and used to fixate the brow tissue in an elevated position.

Regardless of which approach is used, it is critical that the effects of brow elevation on lid closure be considered. In the presence of weak lid closure, elevating the brow may cause the eye to close even more poorly. In such cases, brow elevation should not be performed unless a procedure to insure lid closure is also performed, i.e., enhanced palpebral spring implantation.

#### **F. 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, or can be closed by placing permanent plugs either in the puncta or in the canaliculi which lead to the tear sac.

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. The punctal plugs are most useful in patients with partial facial paralysis, or where adequate facial nerve function has returned to restore the lacrimal pump, but where tear production is still deficient.

#### **NEW DEVELOPMENTS**

Innovations in surgical techniques have become available for various facial nerve paralysis problems: the use of the enhanced palpebral spring to restore lid closure and blinking, the use of Medpore<sup>TM</sup> to support the lower lid, Endotene Ribbon<sup>TM</sup> to elevate the cheek and the TransBleph<sup>TM</sup> device to elevate the brow. Improved bandage contact lenses, scleral lenses and new and improved eye drops, also have been of great help.

#### **CONCLUSION**

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. Evaluation of these changes by an eye specialist (ophthalmologist) is necessary before any medication or other treatment is begun.

Most eye problems following acoustic neuroma surgery can be successfully managed with modern techniques. No longer is it usually necessary for patients to have their eyes sewn shut or to fill their eyes with so much ointment that their vision is constantly blurred. For more information, contact your ophthalmologist.

## **ARTIFICIAL TEAR PREPARATIONS, EYE GELS AND EYE OINTMENTS**

Trade Names	Ingredients
<b>Artificial Tears</b>	
<b>Long acting, high viscosity</b>	
Bion Tears	Duosorb polymeric system*
Clear Eyes Tears Liquid Gel	Carboxymethylcellulose Sodium 1.0%, glycerin 0.25%
Celluvisc	Carboxymethylcellulose 1%*
Murocel	Methylcellulose 1%
Refresh Liquigel	Carboxymethylcellulose 1% (blended from a 0.35% high-viscosity and a 0.65% medium viscosity carboxymethylcellulose and is much less viscous than Celluvisc)
Visculose 1%	Methylcellulose 1%
<b>Long acting, medium viscosity</b>	
Adsorbotear	Hydroxyethylcellulose, povidone 1.67 % with water soluble polymers
Advanced Eye Relief	Glycerin 1%
Blink Gel Tears	Polyethylene glycol 400 0.25%
Clear Eyes Tears**	Dextran 70 0.1%, Hypromellose 0.3%*
Computer Eye Drops	Glycerin 1%
Optive	Carboxymethylcellulose 0.5%, glycerin 0.9%
Optive Advanced	Carboxymethylcellulose 0.5%, glycerin 1.0% Polysorbate 80 0.5%
Refresh Dry Eye Therapy Sensitive	Glycerin 1%, polysorbate 80 1%*
Refresh Plus	Carboxymethylcellulose 0.5%*
Refresh Tears	Carboxymethylcellulose 0.5%
Systane	Polyethylene glycol 400 0.4%, propylene glycol 0.3%*
Systane Ultra	Polyethylene glycol 400 0.4%, propylene glycol 0.3% in HP-Guar-borate delivery system*
Systane Balance	Propylene glycol 0.6%
Visine Tears	Glycerin 0.2%, Hypromellose 0.2%, Polyethylene glycol 400 1%
Visine Pure Tears	Glycerin 0.2%, Hypromellose 0.2%, Polyethylene glycol 400 1%*
<b>Medium duration, medium viscosity</b>	
Blink Tears	Polyethylene glycol 400 0.1%
GenTeal	Hydroxypropyl methylcellulose 0.3%, boric acid*
GenTeal Mild	Hydroxypropyl methylcellulose 0.2%, boric acid
IsoptoTears	Hydroxypropyl methylcellulose 0.5%

Lacril	Hydroxypropyl methylcellulose 0.5%, gelatin A 0.01%
Liquifim Forte	Polyvinyl alcohol 3%
Lubrifair Solution	Hydroxypropyl methylcellulose, Dextran 70
Lyteers	Cellulose derivative
Moisture Drops	Hydroxypropyl methylcellulose 0.5%, Dextran 30
Ocucoat	Hydroxypropyl methylcellulose 0.8%, Dextran 70
Ocucoat PF	Hydroxypropyl methylcellulose 0.8%, Dextran 70*
Refresh Dry Eye	
Therapy Sensitive	Castor oil, polysorbate-80, Carbomer 1342 & Glycerin
Soothe	Glycerin 0.6%, Propylene Glycol 0.6%*
Soothe XP	Light Mineral Oil 1.0%, Mineral Oil 4.5%
Tearisol	Hydroxypropyl methylcellulose 0.5%, boric acid
Tears Again	Lecithin, ethanol 1%, vitamins A and E, phenoxyethanol 0.5%
Tears Naturale II	Hydroxypropyl methylcellulose 0.3% in water soluble polymeric system
Tears Naturale Forte	Hydroxypropyl methylcellulose 0.3% in water soluble polymeric system, 0.1% Dextran 70, 0.2% glycerin
Tears Naturale Free	Hydroxypropyl methylcellulose 0.3% in water soluble polymeric system*
Visculose 0.5%	Methylcellulose 0.5%

#### **Short duration, low viscosity**

AKWA Tears Solution	Polyvinyl alcohol 1.4%
Hypotears	Polyvinyl alcohol 1% in Lipiden polymer
Hypotears PF	Polyvinyl alcohol 1% in Lipiden polymer*
Liquifilm	Polyvinyl alcohol 1.4%
Methulose	Methylcellulose 0.25%
Murine Tears	Polyvinyl alcohol 0.5%, providone 0.6%
OcuTears	Polyvinyl alcohol
Tears Again	Polyvinyl alcohol 1.4%
Tearfair Solution	Polyvinyl alcohol
Tears Plus	Polyvinyl alcohol 1.4%, povidone 0.6%
Theratears	Sodium carboxymethylcellulose 0.25%, buffers*
Viva	Polysorbate 80 1%*

#### **Ocular Gels**

GenTeal Gel	Hydroxypropyl Methylcellulose 0.3%, Carbopol 980
Systane Gel	Polyethylene glycol 400 0.4%, propylene glycol 0.3%
Tears Again Night & Day Gel	1.5 % Carboxy Methylcellulose

### **Ocular Ointments**

AKWA Tears Ointment	White petroleum, mineral oil*
Duolube	White petroleum, mineral oil*
Duratears Naturale	White petroleum, anhydrous liquid lanolin*
Hypotears Ointment	White petroleum, light mineral oil*
Laci-lube NP	White petroleum, mineral oil*
Lubrifair	White petroleum, mineral oil, liquid lanolin
Ocu-Lube	White petroleum
Petrolatum	White petroleum
Refresh Lacri-Lube	White petroleum, mineral oil
Refresh P.M.	White petroleum 57.3%, mineral oil 42.5%*
Soothe Ointment	Mineral Oil 20%, White Petrolatum 80%
Systane Eye Ointment	White petrolatum 94%, Mineral oil 3%
Tearfair	White petroleum, mineral oil, lanolin derivatives
Tears Naturale PM Ointment	White petroleum 56.8%, mineral oil 42.5%*

### **Slow release Lubricants (Inserts)**

Lacrisert	Hydroxypropyl cellulose
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**Note: Asterisk (\*) indicates available as preservative free preparation**

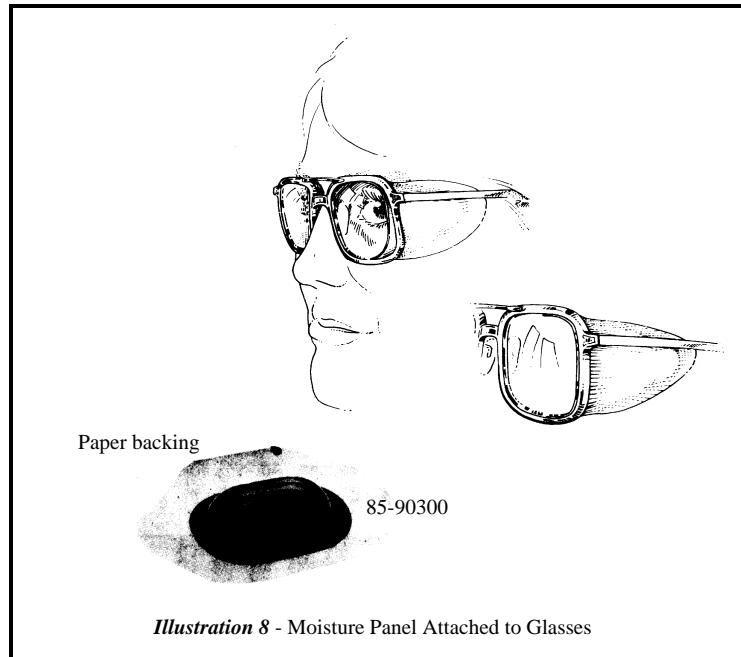
**Note: Two asterisks (\*\*) indicates that only Clear Eyes Tears is suitable as other Clear Eyes products contain anti-redness agents, which make drying worse.**

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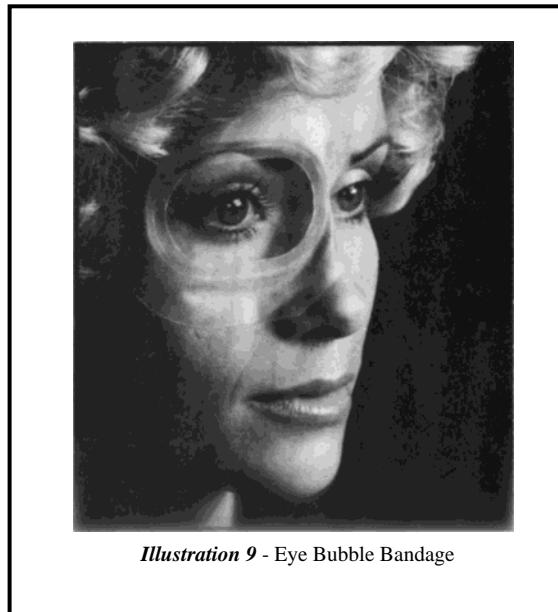
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### **Illustration Credits**

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**Illustration 8** - Moisture Panel Attached to Glasses



**Illustration 9** - Eye Bubble Bandage

## **WHAT IS THE ACOUSTIC NEUROMA ASSOCIATION (ANA)?**

Acoustic Neuroma Association was founded in Carlisle, Pennsylvania, in 1981 by a recovered patient, Virginia Fickel Ehr. She found no patient information or patient support available when she had surgery for the removal of an acoustic neuroma in 1977. She resolved that future acoustic neuroma patients should have easy-to-read medical material about their condition, and support and comfort from each other. With the help of her physician, she contacted eight other patients and formed the organization.

The association is incorporated and is a 501(c)(3) non-profit organization. The patient-focused, member organization now serves close to 5,000 members, is governed by an all-patient Board of Directors and is operated by a small staff in metropolitan Atlanta, GA.

ANA membership benefits include receipt of a quarterly newsletter, patient information booklets, access to a network of local support groups, access to a list of acoustic neuroma patients willing to talk about their experience throughout the country, our website Member Section and an invitation to a biennial symposium on acoustic neuroma. Our exclusive website Member Section includes published medical journal articles on acoustic neuroma and all of our patient information booklets and newsletters and many symposium presentations. ANA also maintains an interactive website at [www.ANAUSA.org](http://www.ANAUSA.org) with an ANA Discussion Forum.

ANA is patient-founded, patient-focused and patient-funded. ANA recommends treatment from a medical team with substantial acoustic neuroma experience. Although the association cannot recommend specific doctors, medical centers or medical procedures, guidelines for selecting a qualified medical professional can be found at the ANA website, [www.ANAUSA.org](http://www.ANAUSA.org). Now available on our website is a listing of medical resources. The physicians and organizations listed have self-reported data to meet criteria established by ANA for having substantial experience in treating acoustic neuromas. The listings should NOT in any way be construed as an endorsement or recommendation by ANA. It is every individual's responsibility to verify the qualifications, education and experience of any healthcare professional.

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