THE FACIAL NERVE AND THE EYE

TOC
EYE AND FACE

Information Series

OCULOFACIAL PLASTIC SURGERY

Oculofacial Plastic or Ophthalmic Plastic Surgery is a surgical subspecialty of Ophthalmology that seeks to improve physical appearance and function, or minimize disfigurement resulting from accidents, disease, or birth defects. The word plastic comes from the Greek meaning "molding" or "giving form".

THE FACIAL NERVE AND THE EYE

The facial nerve plays an important role in normal eyelid closure and lubrication of the cornea. Disorders affecting the facial nerve may have important implications in terms of the health of the eye. Drying of the cornea may result not only in significant discomfort, but also in potential infection with scarring which may impair vision permanently.
This brochure is prepared to provide you with information on facial nerve disorders and protection and treatment of eye problems that develop due to facial nerve dysfunction from disease, injury or infection.

ANATOMY AND FUNCTION OF THE FACIAL AND TRIGEMINAL NERVES

The facial nerve (also known as the seventh cranial nerve) originates in the brain stem. The facial nerve is located near other nerves that control sensation in the face region as well as the sense of hearing and balance. The nerve passes in proximity to the inner ear near the brain center for hearing and balance before exiting through an opening in the bone at the base or bottom of the skull behind the ear. The nerve then passes under the earlobe and reaches the face by passing through the parotid gland, the large salivary gland in the cheek. While inside the gland, the facial nerve divides into several branches. Each branch of the facial nerve travels to a different destination, finally reaching the muscles of the face that control facial movement and expression. Thus, each branch of the facial nerve controls a different set of muscles. For instance, one branch controls the forehead and eyebrow muscle

on one side of the face while another branch controls eyelid blinking. Other branches control the muscles that allow smiling, frowning, lip puckering, and cheek movement.

Additional branches of the facial nerve provide the nerve supply to the lacrimal or tear-secreting gland, which produces tears to moisturize the surface of the eye. The facial nerve also supplies the parotid gland and other salivary glands. These glands produce saliva to moisten the inside of the mouth and begin food digestion. A large portion of the facial nerve is responsible for transmitting the sensation of taste. Without the facial nerve, food does not taste right.
Another important nerve is the trigeminal or fifth cranial nerve. This nerve also originates in the brain stem near the origin of the facial nerve, but it takes a different route to the face, exiting through the skull behind and very near the eye. The nerve fibers of the trigeminal nerve provide sensation to the skin of the face and scalp, and to the eye itself. Because the facial and trigeminal nerves are located so close together in the brain stem, certain disorders involving the facial nerve may also affect the trigeminal nerve, so that both muscle function and sensation are affected.

It is important to understand that nerves from the same side of the brain supply each side of the face. Thus, there are two facial nerves, each one responsible for movement of one side of the face. Likewise, there are two trigeminal nerves, one for right and left sides of the face.

ANATOMY AND FUNCTION OF THE EYELIDS

The eyelids represent anatomically and functionally complex structures, which serve to protect the underlying eye. The front surface of the eyelid is composed of a thin layer of skin, and beneath that is a layer of muscle known as the orbicularis muscle. This muscle functions in blinking and voluntary

eyelid closure. The normal blink in humans occurs on an automatic or involuntary basis 12 to 20 times each minute. Normal eyelid closure when blinking allows for the gentle replacement of the thin, but important tear film layer on the surface of the eye. This surface, termed the cornea, is the window to the inner structures of the eye and is vitally important for vision. The eyelids must spread the tears to maintain clear vision, comfort, and health of the cornea.

The orbicularis muscle is also responsible for voluntary eyelid closure as occurs when squeezing the eyelids closed. Terminal branches of the facial nerve control orbicularis muscle function. Thus if the nerve is not functioning, the orbicularis muscle will not work and problems develop.

Beneath the orbicularis muscle is another muscle, the levator muscle. This is the muscle that opens the eye by elevating the upper eyelid. The levator muscle originates behind the eye and travels forward over the top of the eye where it is attached to a firm fibrous plate of the eyelid known as the tarsus. The tarsus is the structural backbone of the eyelid. The conjunctiva, a smooth, wet, thin membrane that moves rapidly over the cornea during blinking, lines the back surface of the tarsus.

In addition to blinking of the eyelids, the orbicularis muscle also serves to support the lower eyelid. Orbicularis muscle weakness in the setting of facial nerve paralysis may result in drooping and outward turning of the lower eyelid. This condition is termed ectropion. Ectropion causes drying of the cornea and compounds the problems of incomplete blinking that results from paralysis or weakness of the facial nerve. Together, incomplete blinking and ectropion result in ocular irritation, and may lead to poor vision, infection, scarring of the cornea and even loss of the eye.

PROTECTIVE REFLEXES

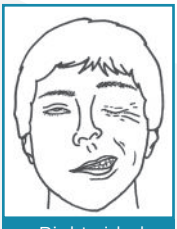
The eye is protected by a number of important eye protective reflex mechanisms. Eye irritation (occurring, for example, when a dust particle strikes the surface of the cornea) results in reflex tearing due to stimulation of sensory fibers of the fifth cranial nerve. Signals travel along the nerve to the brain, which it in turn signals the orbicularis muscle to blink by means of nerve impulses transmitted to the muscle through the fibers of the facial nerve. Additional impulses are carried by the facial nerve to the lacrimal or tear-secreting gland, resulting in the formation of additional tears to flush and clean the surface of the eye.

Another important eye protective mechanism is the automatic tendency for the eyeball to roll upward in the eye socket when the eyelids close. The term for this movement is the Bell's phenomenon. Disorders that impede the ability of the eye to move upward as well as disorders affecting the fifth cranial nerve and/or facial nerve function compromise the normal eye protective mechanisms and cause problems that may result in infection, scarring, loss of vision or loss of the eye.

FACIAL NERVE DISORDERS

A variety of disorders may affect the facial nerve.

Bell's palsy is a condition of an unknown cause in which facial nerve weakness or paralysis typically develops on a sudden basis. This condition may be associated with or follow a viral infection. Partial or complete recovery of facial nerve function generally occurs within two to three months following the onset of facial nerve weakness due to Bell's palsy, although residual abnormalities may persist for a longer period of time.



Right sided Bell's palsy

Trauma may affect the facial nerve anywhere from its origin in the brain to the point where the facial nerve fibers innervate the muscles of facial expression.
Vascular disease, including stroke, may cause facial nerve weakness, often in association with weakness or sensory changes involving other parts of the body.
Facial nerve paralysis in infancy may result from lack of normal development of the facial nerve or in the setting of birth injury.
Tumors may compromise facial nerve function. Among these tumors are acoustic neuroma and schwannoma. Both of these may arise in or involve the brain stem or inner ear. They may involve other cranial nerves including the fifth cranial nerve (controlling facial and ocular sensation), the eighth cranial nerve (controlling hearing and balance), and the cranial nerves that move the eye. Symptoms associated with these tumors may be nonspecific or may involve headache, loss of hearing, loss of coordination and balance, double vision, or loss of skin sensation. The symptoms depend on which combination of nerves is involved. Tumors involving the bone at the base of the skull, the parotid gland, and other facial structures may result in facial nerve paralysis as well.

EVALUATION OF FACIAL NERVE WEAKNESS

Evaluation of facial nerve problems usually involves specialists in the following areas: Oculofacial Plastic Surgery (a subspecialty of Ophthalmology), Otolaryngology - Head and Neck Surgery (commonly known as ENT), Neurology, Neurosurgery, Comprehensive Ophthalmology, Internal Medicine, and Radiology. Your personal physician will usually direct the evaluation process.
Diagnostic studies may include CT and MRI scanning, hearing and balance tests, and a visual field examination. Specialized tests of facial nerve function may be obtained in some cases.

NONSURGICAL MANAGEMENT OF FACIAL NERVE PALSY

Medical Treatment

Medical treatment consists of lubricating the eye with drops and ointments. We recommend that artificial tear lubricant eye drops be applied frequently, sometimes hourly. Commonly available over-the-counter artificial tears include Systane® Ultra, Refresh Optive®, Soothe®, TheraTears®, and Blink® Tears. When artificial tear eye drops are recommended more frequently than four times daily, a preservative-free eye drop should be used to minimize eye irritation from allergic conditions, which may result from preservatives contained in many commercially available artificial tear substitutes. Most artificial tear brands are also available as preservative-free. Although preservative-free eye drops are more expensive, and are packaged in a less convenient single-use container than preservative-containing eye drops, the relative lack of irritation associated with the use of preservative-free eye drops justifies the relative cost and inconvenience. Also available over-the-counter are more viscous liquid gel drops that are more longer lasting than regular artificial tears, but can cause temporary blurring of vision. Currently available liquid gel drops include Systane® Gel, GenTeal® Liquid Gel, Refresh Optive® Gel, and TheraTears® Liquid Gel.

Preservative-free lubricating eye ointments such as Refresh P.M. ®, Systane® Nighttime, and Soothe® Night Time are quite effective at providing topical lubrication. In general, ointments blur vision more than eye drops; therefore it is generally preferable to limit ointment to bedtime use. In cases with significant drying daytime application of ointment will be necessary.

All of the aforementioned eye drops and ointments are available over-the-counter. Most health plans do not cover the cost of over-the-counter medications. Occasionally

it may be necessary to ask the pharmacist to order a particular eye drop that has been recommended. Rarely, prescription eye drops and/or ointments which incorporate antibiotic and anti-inflammatory medications may be recommended instead of or in conjunction with topical lubricants.

Eyelid Taping

The eye is particularly vulnerable to drying during sleep due to a complete lack of voluntary closure as well as a decrease in actual tear secretion at night. Taping of the eyelids in a closed position will decrease drying of the surface of the eye at night. When eyelid taping is performed, the upper eyelid should be taped closed directly over the lower eyelid using hypoallergenic 3M™ Transpore™ surgical tape. This tape is available through a pharmacy or medical supply store. We recommend that patches or gauze not be placed under the tape as the paralyzed eyelids may open underneath the patch, allowing the surface of the patch to rub on the cornea. Although certain individuals may stay comfortable with eyelid taping on a long-term basis, most patients with facial nerve weakness find eyelid taping useful only on a temporary basis due to skin irritation by the tape.

SURGICAL MANAGEMENT OF FACIAL NERVE PALSY

A number of surgical options exist to address the problems associated with facial nerve paralysis. The procedure(s) recommended for a given individual will vary depending upon the degree of facial nerve weakness, the status of the eye protective mechanisms, corneal and facial sensation, the degree of corneal inflammation noted on examination, and the anticipated duration of facial nerve paralysis.

In most cases we perform surgery in our on-site ambulatory surgery center, the Center for Aesthetic and Reconstructive Eyelid and Orbital Surgery (CAREOS). This state-of-

the-art, certified outpatient surgical facility was designed for the safety, convenience and comfort of our patients. It is run by our dedicated and professional nursing staff. Board certified anesthesiologists are available for those patients in need of monitoring and intravenous sedation or general anesthesia. These procedures may also be performed during hospitalization before or following other surgical procedures such as excision of tumors near the facial nerve.

A brief summary of specific surgical procedures follows below. It is important to recognize that the details of treatment may vary significantly from these general descriptions depending on your specific situation. These procedures involve the delicate structures of the eyelid, therefore Oculofacial Plastic Surgeons are often asked to provide surgical and medical care for patients with eye problems caused by facial nerve dysfunction.

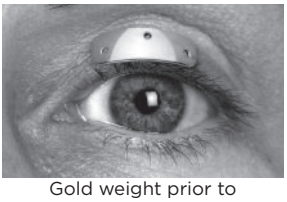
Temporary Suture Tarsorrhaphy
Temporary tarsorrhaphy consists of placement of small sutures passed between the edges of the upper and lower eyelid. When tied, these sutures result in approximation of the eyelids, providing protection of the ocular surface. A temporary tarsorrhaphy suture may be left in place for up to six weeks. Following removal, the eyelids return to their original position. This procedure is used when there is reasonable expectation that the duration of facial nerve weakness will be relatively short and full recovery of facial nerve function over a short period of time is anticipated.

Permanent Tarsorrhaphy
Permanent tarsorrhaphy refers to a procedure in which tissues at the corner of the eye are attached together to partially close the eye. Usually this procedure is performed at the outer corner of the eye, and entails closure of approximately 1/4 inch of the space between the outer

parts of the upper and lower eyelids. A lateral tarsorrhaphy is often combined with a lateral canthoplasty to tighten and elevate the lower eyelid. In some cases, a more extensive lateral tarsorrhaphy and/or medial tarsorrhaphy (closure of the inner corner of the eye) may be performed. Although reversible, this procedure is suitable for longer-term use than is a temporary suture tarsorrhaphy, and is used when facial nerve paralysis is anticipated to be long-standing and/or when the other eye protective mechanisms are compromised. In practice, a permanent tarsorrhaphy and lateral canthoplasty is frequently combined with gold weight implantation in the upper eyelid, as described below.

Gold Eyelid Weight Implantation

Gold weight implantation is currently the most commonly employed procedure for the management of facial nerve paralysis resulting in incomplete eyelid closure. In this procedure, a small, sterilized weight prepared from medical-grade gold alloy is implanted surgically in the central portion of the eyelid just above the tarsus. As noted previously, the lifting of the levator muscle controls the position of the upper eyelid, which opens the eye, and blinking of the eye on contraction of the orbicularis muscle, which closes the eye. Normally, when we open our eyes the levator muscle is activated and the orbicularis muscle relaxes. When we close our eyes as part of the normal blinking mechanism, the levator muscle relaxes and the orbicularis muscle is activated. In the setting of facial nerve paralysis, the orbicularis muscle is weak or non-functional. Following gold weight implantation, the effect of gravity on the gold weight improves eyelid closure when the levator muscle relaxes during the normal closure phase of the blink reflex. When the eyelid opens, the levator muscle is activated



Gold weight prior to implantation inside the eyelid

and lifts the eyelid (and the gold weight) to the open position.

Gold weights are well tolerated by the eyelid tissue and can remain in place for years. Gold weight implantation can be temporary or permanent. When placed on a temporary basis, the gold weight can be removed after return of facial nerve function. If return of facial nerve function is not anticipated, the gold weight can remain in place indefinitely. Gold weights are effective in improving eyelid closure and often reduce the need for lubricating drops and ointments during the day. However, gravity does not have as great of an effect when sleeping in a reclined position. Ointments are usually required at night even when a gold weight has been placed.

The gold weight may be removed if facial nerve function and eyelid closure improves over time. In some cases, exchange of the implanted gold weight for a smaller weight may be recommended if there is a partial but not complete improvement in facial nerve function. Although gold weight implantation is not a perfect substitute for normal orbicularis function, it currently represents the best available method for achieving adequate eyelid closure and ocular surface protection in the setting of facial nerve paralysis.

Ectropion Repair

As noted previously, the orbicularis muscle tends to support the position of the lower eyelid. Facial nerve paralysis may often result in drooping and out-turning of the lower eyelid, a condition called ectropion, which may be associated with tearing, ocular irritation, and ocular surface infection. Ectropion associated with facial nerve paralysis may be repaired via a variety of procedures including tightening of the lower eyelid at the outer corner of the eye combined, in some cases, with a lateral tarsorrhaphy. At other times, muscle transfer

or tightening can be utilized to support the lower eyelid.

Facial Suspension
Face lift surgery with midface suspension utilizing various sling materials can be performed to improve facial symmetry as well as some of the more debilitating effects of facial paralysis such as drooling and biting of the inner gums.

EYE PROBLEMS FOLLOWING RECOVERY

The prognosis for recovery following facial nerve paralysis varies depending on the cause of paralysis as well as poorly understood factors, which are specific to each individual. In general, improvement in facial nerve function may continue for up to one to two years following initial surgery or injury. Even following complete or virtually complete improvement in facial nerve function, a number of residual changes may be evident.

Tearing
Normal orbicularis function is required for the drainage of tears from the surface of the eye. Following recovery of facial nerve function, subtle degrees of orbicularis weakness may result in impairment of tear pumping and abnormal tear drainage even when eyelid closure and facial movement appear satisfactory. In some cases, residual drooping of the lower eyelid may contribute to tearing following recovery from facial nerve paralysis. In these situations, partial improvement may be obtained with lower eyelid tightening via lateral canthoplasty.
A special type of tearing following facial nerve paralysis is so-called “crocodile tears.” This phenomenon relates to increased tear secretion in association with eating or chewing. It is thought to result from regeneration of facial nerve fibers, originally running to the salivary glands, now running to the lacrimal or tear-secreting glands. This abnormal or aberrant pattern of nerve regeneration results in tear secretion at the time that the nerve fibers in the salivary

glands would normally be activated. This condition can sometimes be addressed surgically.

Abnormal Contraction of the Facial Musculature

During the process of nerve regeneration, nerve fibers that originally supply muscles in one portion of the face may regenerate and begin to supply muscles in other areas of the face. Most commonly, this results in a tendency for the eyelid to close involuntarily with movement of the lower face during speech, chewing, or when smiling. In some cases, involuntary eyelid closure may be associated with involuntary contraction of muscles within the lower portion of the face. Other patients notice the sensation of "itchiness" involving the face. This condition is termed aberrant facial nerve regeneration. In some cases, medication, such as Botox® may alleviate abnormal facial muscular contraction following facial nerve paralysis.

CONCLUSION

Although it can take six months or more, most patients with a Bell's facial nerve palsy have almost complete recovery. Other causes of facial nerve palsy may never completely recover. In either case frequent lubrication of the eye with artificial tears and ointments is required to prevent damage to the eye. If there is permanent weakness, or facial nerve function does not return after several months, ocular lubrication may not be enough to maintain the health of the eye. Surgical intervention may be necessary to improve eyelid closure, maintain tone of the eyelids, and to improve visual function.

This brochure is intended as an introduction to facial nerve disorders. It may not cover every aspect of your condition or answer all questions you may have. You should address all your concerns during your appointment. For more information visit our website at www.toceyeandface.com or call to schedule an appointment with one of our TOC surgeons.

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