

Eyelid Reanimation for the Treatment of Paralytic Lagophthalmos: Historical Perspectives and Current Applications of the Gold Weight Implant

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Summary: Gold weight implants have been used for over 30 years in the setting of eyelid rehabilitation following facial nerve paralysis; however, there has been a renewed interest by ophthalmologists in this reanimation technique in recent years. This article reviews the history of gold weight eyelid implantation and presents the results of gold weight eyelid implantation over a 15-month period in 23 patients. A 92% success rate was obtained (average follow-up, 12 months). Surgical technique and indications are discussed along with postoperative complications. **Key Words:** Gold weights—Facial nerve paralysis—Eyelid reanimation—Lid-loading—Paralytic ectropion.

Exposure keratitis and lagophthalmos are common ocular sequelae of facial nerve paralysis. Ultimately, inadequate ocular surface protection can lead to corneal ulceration and even ocular perforation. Initial treatment options include lubrication of the eye with topical drops and ointments, eyelid patching and taping, and such sophisticated techniques as moisture chambers and special ocular devices to increase the humidity of the ambient environment.

Surgical therapies have traditionally involved medial and lateral tarsorrhaphy, lower lid ectropion repair, temporalis muscle transfer procedures to the eyelids, and other types of canthoplasty. Unfortunately, many of these techniques have unwanted cosmetic drawbacks. They may produce unsightly local facial scars and obstruct peripheral vision and may not provide adequate corneal protection.

A second category of surgical techniques includes eyelid reanimation with prosthetic devices. These prosthetics are applied to help relieve exposure keratitis and lagophthalmos by improving the ability of the eyelid to close completely. One of the first prosthetic devices was the Arion prosthesis, a

silicone band placed in the subcutaneous tissue of both the upper and lower lids to help facilitate lid function (1). Through elastic recoil, the silicone bands allowed eyelid closure (and levator function) to be maintained. Unfortunately, this technique has fallen into disfavor because it is difficult to assess the balance between the elastic recoil of the silicone rubber and the elevating force of the levator muscle (2). In some cases, subsequent erosion of the element through the skin has been documented.

Morel-Fatio and Lalande first described the use of implanted palpebral wire springs in 1964 (2). However, reoperations were required on 23 of 67 patients because of the unsatisfactory fixation of the lower arc of the spring. Modifications by Levine (3) and others (4,5) have significantly improved the functional and cosmetic results of this procedure, especially when a Dacron shield is placed over the lower subcutaneous wire, but adjustments of the orthodontic wire are often necessary postoperatively. In addition, significant rates of infection, extrusion, and local granuloma formation have been reported (5,6).

Recently, Oh and McNeill described another modification of the palpebral wire spring—directly wiring the spring to drilled holes in the bony lateral

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TABLE 1. Etiology of facial nerve paralysis

Cause	No. of patients (n=23)
Trauma	1
Tumor	
Benign	
Acoustic neuroma	11
Facial nerve neuroma	1
Malignant	
Squamous cell	1
Parotid	2
Inflammatory/infectious	
H. zoster oticus	1
Bell's palsy	4
Congenital/infantile	2

orbital rim (6). They reported an improved success rate of 83% in restoring and maintaining eyelid function in 24 patients. They also have been able to make spring adjustments without further skin incisions (6).

Loading the upper eyelid to provide gravity-assisted closure in cases of facial paralysis was initially described by Illig in 1958 (7). He stated that "the principal is the replacement of the lost tonus of the orbicularis oculi muscle by a small gold weight, which, covered by a nonirritating material, is implanted into the upper lid." This procedure is based on the fact that the upper lid provides significantly more of the actual closure in coverage of the cornea than the lower lid, which has only approximately 1 mm of extrusion on the normal blink reflex (8). In 1966, Smellie reported the use of a lead-based lid load to replace the orbicularis function (9). He thought that a number of metals, in-



FIG. 1. Extruding gold weight implant.

cluding gold, lead, tantalum, and platinum, would be satisfactory for the implants because of their high density, availability, and malleability. Additionally, he recommended that the weight conform to the corneal surface and all its curvatures, incorporating an 8-mm radius (10). According to Smellie, gold is the most cosmetically acceptable metal for the thin eyelid skin, because of its color.

Smellie summarized his report by saying that the "lid loading operation has the merit of simplicity and probably a unique advantage in that the surgeon is able to assess the result before the operation is performed merely by attaching the weight to the skin of the upper eyelid" (9). He thought that this procedure had an important advantage over the temporalis muscle transplant, a procedure popular at that time—lid loading did not interfere with the normal blinking reflex.

In 1969, Barclay and Roberts reported the use of gold weight implants for gravity-assisted closure of the eyelids in a total of six patients (8). They agreed with Smellie that the simplicity of the procedure was its chief advantage. In addition, they described a technique for the wax casting of the gold weights in their report.

A few modifications were described by Jobe in 1974 (11) after he had been using the gold weights for 4 years. The gold weight in use today is chiefly the result of his efforts. The modifications included improvements to the weight's contour and the addition of holes for tarsal fixation and fibrous ingrowth, thus obviating the need for a covering made of nonirritating material. In addition, May has also reported on a total of 94 patients, with a 2-year follow-up (5). The success rate was 91%; the 9% failure rate was related to residual lagophthalmos or unacceptable ptosis.

An extensive evaluation of the gold weight implant was provided by Kartush and Linstrom (12) in 1990. Like May, they had a success rate of 91% in their 38 patients. Both May and Kartush have published reports in otolaryngology journals, but very little information about the gold weight implants has appeared in the ophthalmic literature over the past decade.

PATIENTS AND METHODS

The study involved a total of 23 patients, 13 female and 10 male, with an age range of 26 to 77. They were referred for evaluation of facial paralysis to the Facial Nerve Center at the Massachusetts Eye



FIG. 2. Standard gold weight implant.

& Ear Infirmary. Average age was 53 years. Approximately half of the patients had acoustic neuromas and suffered either preoperative or intraoperative loss of facial nerve function related to their acoustic neuroma (see Table 1). Other categories of facial paralysis etiology included noniatrogenic trauma, malignant tumors, inflammatory/infectious etiology, and congenital/infantile. Of the two patients with congenital and infantile etiologies, one case may have been iatrogenic. That patient had undergone early mastoid surgery years ago, and the surgical intervention itself may have caused the facial nerve paralysis. An average follow-up of 12 months was obtained on the patients after eyelid reanimation surgery was performed.

Indications for surgical intervention included ocular findings of significant lagophthalmos with exposure keratopathy present, despite standard medical therapy. Patients were apprised of the relative likelihood of the return of the facial nerve function and were also given the option of continuing with either straight medical therapy or pursuing surgery as well.

Complete ocular, neurologic, and otolaryngologic evaluations were obtained on each patient. The average time between onset of facial paralysis and eyelid reanimation surgery was 2.5 months. However, a majority of patients had surgery before 1 month had



FIG. 3. Left facial paralysis. Primary gaze.



FIG. 4. Left facial paralysis. Attempted lid closure with lagophthalmos.

elapsed. Visual acuity, degree of exposure keratitis, lagophthalmos, fifth and seventh nerve function, presence of Bell's phenomenon, eyelid palpebral fissure distances, and levator function were also tested. In addition to videographic and photographic documentation of lid function, the work-up also included auditory evoked responses, electroneurography where appropriate, MRI (with gadolinium), and CT scans.

RESULTS

Of the 23 patients who underwent eyelid reanimation using the gold weights, a total of 21 patients (92%) still have the gold weight implants in place. Follow-up after the initial placement of the gold weights ranged from 8 to 21 months (average, 12 months). In three cases, the gold weights were re-



FIG. 5. Placement of properly sized gold weight to eliminate lagophthalmos.

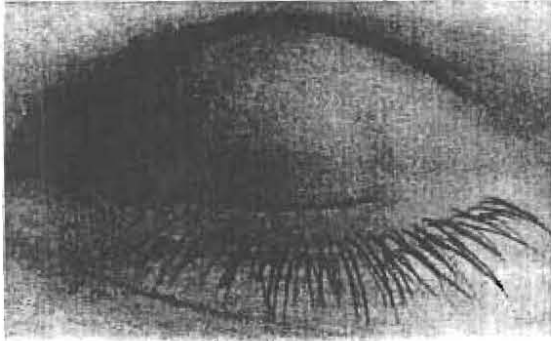


FIG. 6. Inclusion required for placement of gold weight implant.

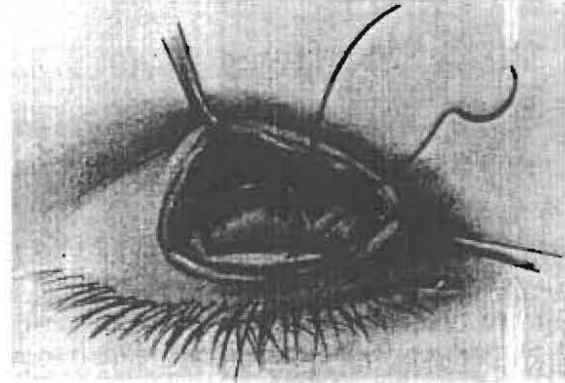


FIG. 8. Implant sutured onto tarsal plate.

moved. In one case, removal was necessitated by frank extrusion of the gold weight (Fig. 1). Two other patients developed increased and variable astigmatic refractive error related to the gravitational effect of the gold weight upon the corneal surface curvature. In one of those two patients, the gold weight (1.4 g) was replaced with a lighter implant (0.8 g); this patient experienced no further problems with variable astigmatism.

Gold weights weighing 0.8–1.6 g were used (average weight, 1.1 g). There have been no cases of migration or infection caused by the gold weight. The average improvement in terms of visual acuity has been three to four lines of vision from the preoperative findings; on the average, the patient improved from the 20/80 level to the 20/30 level. The patients also experienced significant improvement in the degree of exposure keratopathy; average preoperative findings were 2–3+ keratopathy (scale, 0–4), while postoperative findings were down to 0–1+ keratopathy. In addition, the amount of relative lagophthalmos improved postoperatively from an average of 4 mm to 0.5 mm.

SURGICAL TECHNIQUE

The patients are tested preoperatively by taping the gold weight implants to the affected upper eyelids to determine how much weight is necessary to provide adequate closure of the eyelid and eliminate lagophthalmos without causing excessive ptosis. This procedure is done in the office with a set of gold implants weighing 0.6 to 1.6 g (Fig. 2) that are manufactured of 99.9% pure 24 K gold. The gold weight is centered on the upper eyelid and taped in place (Figs. 3–5).

Surgery is performed under local anesthesia using 2% Xylocaine with epinephrine. With a protective corneal contact lens in place, an incision is made along the superior eyelid crease of the affected eyelid. Dissection is carried out through the anterior lamellar layers to reach the tarsal plate (Fig. 6). The tarsus is freed up from the overlying orbicularis muscle, and dissection is carried out to within 1–2 mm of the eyelash roots. The gold weight implant, which has preformed holes, is placed onto the anterior tarsal plate (Figs. 7–9) and sutured into place with a total of three 6-0 nylon sutures partial thick-

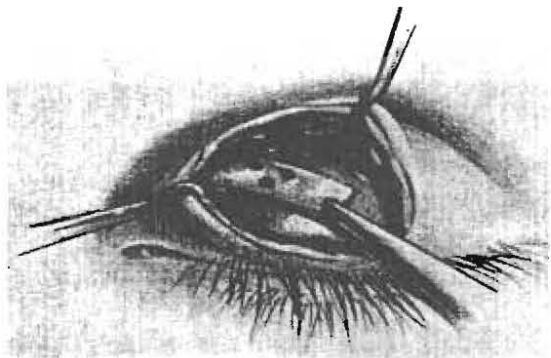


FIG. 7. Implant positioned over tarsal plate.

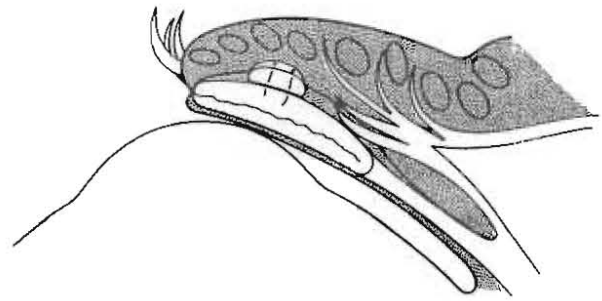


FIG. 9. Correct position of implant on tarsus (cross-sectional view).

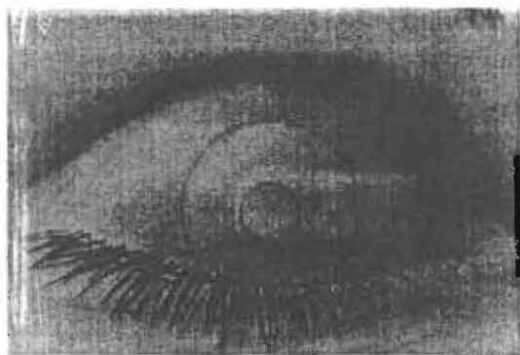


FIG. 10. Implant centered between medial and middle thirds of eyelid.

ness through tarsal plate. The implant is centered between the medial and central thirds of the eyelid (Fig. 10).

The gold weight implant is checked for appropriate eyelid contour and position. If necessary, a small amount of pretarsal orbicularis muscle can be removed to improve the position of the implant. A slight degree (~1 mm) of ptosis may be present at this time, but this condition will resolve in the first 1-2 months postoperatively as the levator function returns.

The overlying orbicularis muscle is sutured together using 6-0 absorbable sutures. The skin is then closed with interrupted 7-0 absorbable sutures. The eye is treated with a lubricating ointment for the next 1-2 weeks, and sutures are removed 1 week postoperatively. Visual acuities, degree of exposure keratopathy, lagophthalmos, lid function, and relative presence of ptosis are also checked postoperatively (Figs. 11-14).

DISCUSSION

Facial nerve paresis with secondary paralytic lagophthalmos has potentially devastating sequelae, including corneal drying, ulceration, and ocular perforation.



FIG. 11. Right facial paralysis. Primary gaze.



FIG. 12. Right facial paralysis with secondary paralytic lagophthalmos.

Lack of orbicularis function, secondary to loss of seventh nerve innervation, prevents eyelid closure; it also causes poor tear film movement and increased tear evaporation. Progressive degrees of exposure keratitis may then occur. In addition, other coexisting problems—such as fifth nerve paresis, decreased lacrimation, and poor Bell's phenomenon (upward movement of the eye with forced eyelid closure)—contribute to the serious nature of this disorder.

This study has shown that satisfactory results can be obtained with the use of gold weight implants early in the postinjury course in patients with facial nerve paralysis. A success rate of $\geq 90\%$ has been achieved. Temporary surgical treatment, especially for the lower lid, including lateral tarsorrhaphy and lower eyelid paralytic ectropion repair (usually through a horizontal eyelid shortening or lateral tarsal tongue procedure), can provide initial relief of ocular symptoms. This lower lid surgical treatment, in combination with medical therapy, will help stabilize the patient until the exact level of potential facial nerve recovery and prognosis can be determined.

At ~4-8 weeks after the initial paralysis, the gold weight implant procedure can be performed. Follow-up is then provided every 3-4 months thereafter. Rehabilitation of the lower face can be obtained later; this may include such techniques as temporalis



FIG. 13. Status post gold weight implant on right upper eyelid 1 week postoperatively.



FIG. 14. Status post gold weight implant on right upper eyelid with elimination of lagophthalmos 1 week postoperatively.

muscle reanimation flaps to the lower face, nerve grafts—especially between hypoglossal and facial nerves, eyebrow lifts, even the use of botulinum toxin injections to provide dynamic facial symmetry (G. Borodic, personal communication, Mass. Eye & Ear Human Studies Protocol Approval).

The advantages of the gold weight implants are several: they are well tolerated; they are relatively inert biologically; and they do not cause problems with other radiologic imaging studies, including MRI scans. Extrusion and migration do not appear to be significant. In the two patients who did have the gold weight implants removed, nonepithelialized "pseudocapsules" of fibrous connective tissue with a chronic lymphocytic infiltrate had developed around the gold, perhaps preventing implant movement as well (F. Jakobiec, personal communication, Mass. Eye & Ear Ophthalmology Pathology Department).

In addition, the surgical technique is a relatively straightforward one that is familiar to any oculo-plastic surgeon. Readjustments of the prosthesis usually are not necessary once the weight is in place. The gold weight implant provides reasonably good cosmesis and is a good color match for eyelid skin. Furthermore, it is essentially maintenance free. Finally, removal of the implant is simple if orbicularis function does return.

Potential disadvantages include the possibility of infection and extrusion; however, this has represented a potential rather than a real problem with both this study and other studies to date. There is also some concern about cosmetic appearance; if it is placed too superficially, the gold weight implant may resemble a chalazion-like subcutaneous lump in the eyelid. The patient may have an ongoing need for topical lubricant drops or ointments. Mild ptosis may occur as a consequence of efforts to eliminate lagophthalmos completely. Such problems of the lower lid as poor lid tone and ectropion are not addressed by this technique. Finally, the weights are expensive.

SUMMARY

Over 20 years ago, Barclay and Roberts stated that "no satisfactory solution to the problem of eyelid closure has yet emerged" (8). Although that is still true today, the judicious use of gold weight implants for upper eyelid reanimation following facial nerve paralysis is very promising. This study achieved a 92% success rate, and other recent studies have shown comparable results. Early surgical rehabilitation of the eyelids is recommended for patients with a high risk of progressive and chronic exposure keratopathy and lagophthalmos.

In the future, thinner and more pliable gold weight implants may become available. Such weights would improve eyelid contour, extrude less often, and be less noticeable. In addition, a multidisciplinary approach to facial paralysis—i.e., using gold weight implants in combination with other facial plastic surgical techniques to reconstruct the lower face concomitantly, along with botulinum toxin injections for treatment of facial asymmetry—could lead to more effective therapy.

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