

Reanimation of the Paretic Eyelid Using Gold Weight Implantation

A New Approach and Prospective Evaluation

Steven M. Gilbard, M.D., and C. Phillip Daspit, M.D.

Sixty-one lid-loading procedures, performed by the author, were evaluated prospectively. Simple, gold weight implantation, combined with lower lid retractor recession, placement of fascia lata, and lateral tarsal strip tightening is effective for promoting voluntary closure and correction of lower lid paralytic ectropion. Placement of a heavier gold weight, in combination with mullerectomy, is a reliable new approach for mimicking involuntary blink without ptosis.

Key Words: Gold weight implantation-Paralytic lagophthalmos-Reanimation-Lid-loading-Paralytic ectropion.

Eyelid paralysis creates functional deficits, which may lead to blindness. Thus, management of paralysis following facial nerve injury due to Bell's palsy, suppuration, trauma, tumor invasion, or resection of tumors involving the facial nerve is extremely important. Ultimate goals of reanimation procedures of the eye are to restore function, provide needed corneal protection, and establish an acceptable aesthetic appearance. Ideally, this would involve promotion of both voluntary and involuntary blink and maintenance of the ideal lower eyelid position, with the lower lid at the limbus.

Although tarsorrhaphy has been the classic method of providing corneal coverage, this procedure has many limitations: patients abhor the aesthetic result, there is limitation of peripheral vision, and the cornea can break down and scar, despite tarsorrhaphy, causing permanent visual loss. In the

From the Departments of Ophthalmology (S.M.G.), St. Joseph's Hospital and Maricopa Medical Center, Phoenix, Arizona, and Desert Samaritan Hospital, Mesa, Arizona; and the Section of Neurology (C.P.D.), Barrow Neurological Institute, St. Joseph's Hospital, Phoenix, Arizona, U.S.A.

Address correspondence and reprint requests to Steven M. Gilbard, M.D., 222 West Thomas Road, Suite 410, Phoenix, Arizona 85013, U.S.A.

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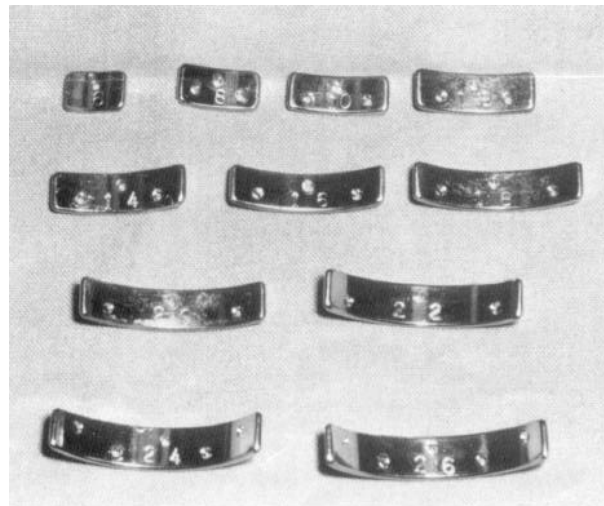


FIG. 1. Gold weights vary in mass and are available in 0.6-2.6 g.

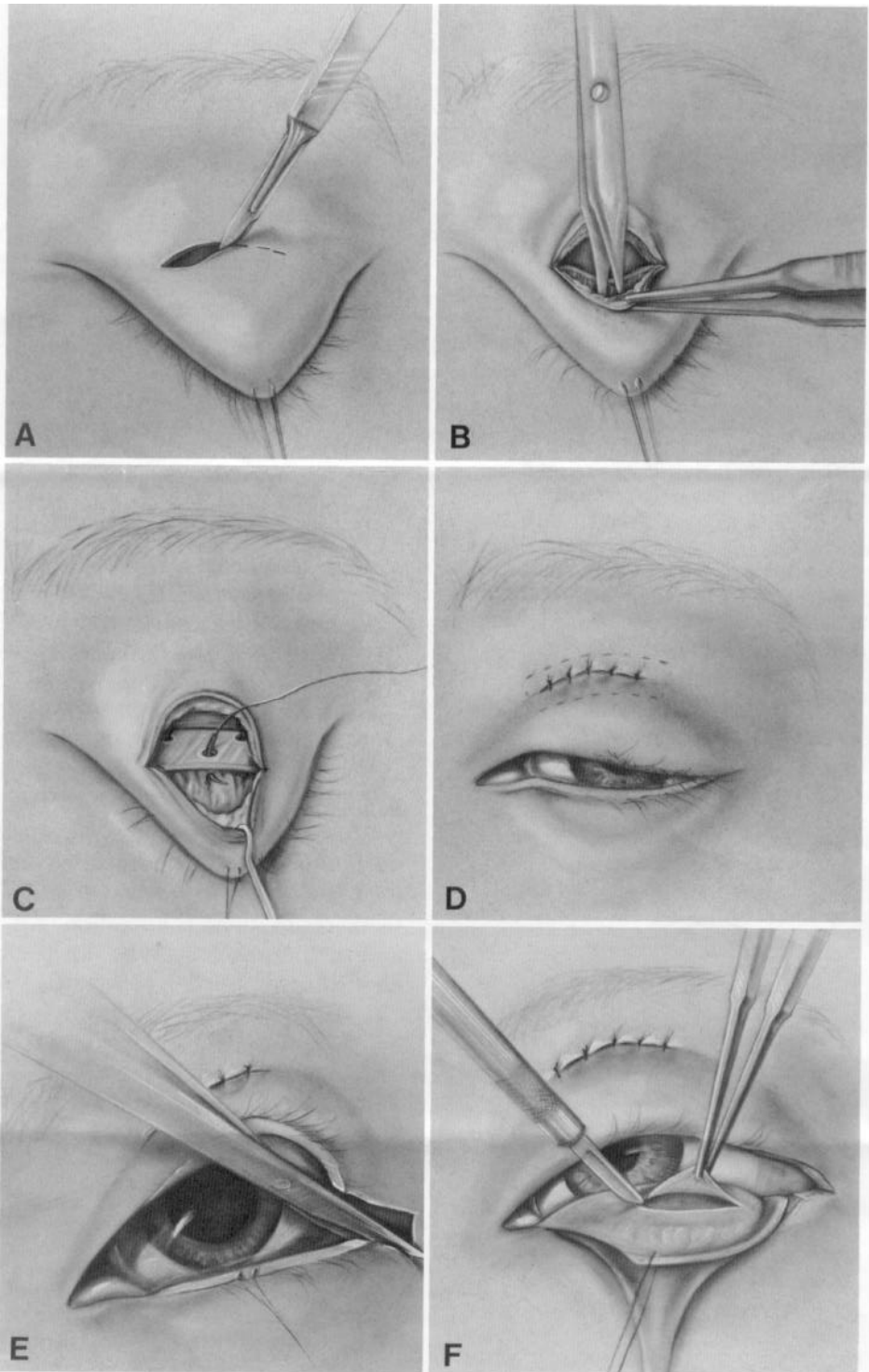


FIG. 2. Gold weight implantation, combined with recession of lower lid retractors and lateral tarsal strip. A: Incision in upper eyelid through the lid crease. B: Orbicularis muscle elevated from tarsal plate and orbital septum. C: Gold weight sutured to superior tarsal border and orbital septum with 6-0 silk suture. D: Closure with 6-0 nylon suture. E: Lateral canthotomy and inferior cantholysis. F: 64 Beaver Blade incises conjunctiva at the level of inferior tarsal border.

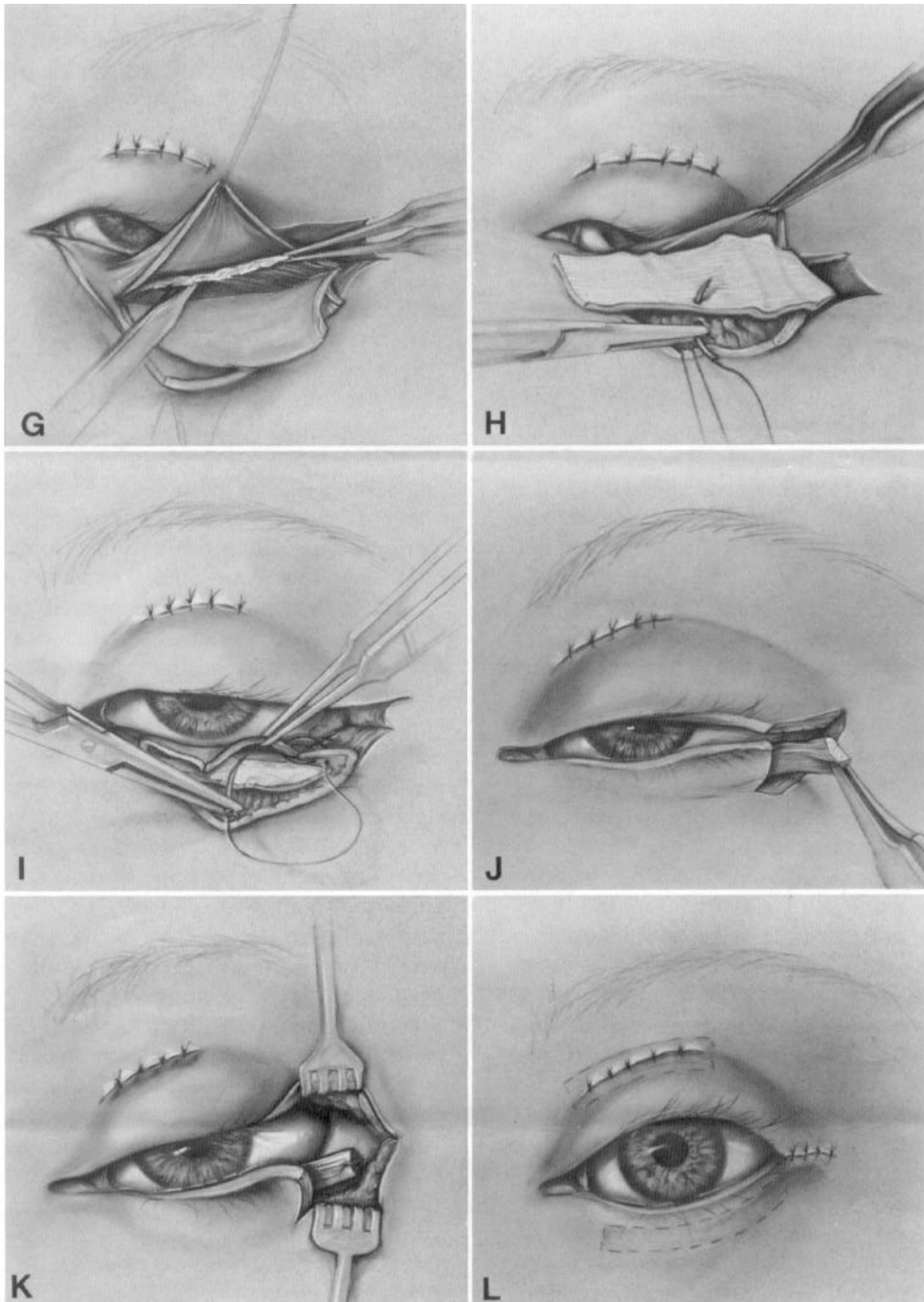


FIG. 2. G: Muller's muscle and capsulopalpebral fascia are dissected off overlying attachments to orbicularis muscle and orbital septum, and underlying attachments to conjunctiva. H: Bovine fascia lata is sutured to inferior tarsal border and retractors with 5-0 vicryl suture. I: Conjunctiva, closed with running 5-0 plain suture. J: Lateral tarsal strip, fashioned. K: Lateral tarsal strip, sutured to lateral orbital rim with 4-0 prolene suture. L: Closure with 6-0 nylon suture.

event that facial function recovers enough to permit lysis of the tarsorrhaphy, notching of the eyelid margin may occur, as may entropion, with irritation of the globe by the lashes, and formation of epithelial cysts. Dynamic prosthetic implants such as silastic encircling bands, have been advocated (1), but these lack longevity of correction, as the prosthesis stretches. Palpebral springs may, frequently, require adjustment or replacement (2,3). Temporalis muscle transfer lacks the problems of prosthetic implants, but has the disadvantage of changing the lid aperture from an oval to a slit configuration (4); also, it does not allow for spontaneous blink.

Reanimation of paralyzed eyelids, with a gold weight, has been suggested as a means of overcoming some of the above limitations. The technique of lid-loading was first conceived by Sheehan (5) and described, in 1958, by Illig (6) (in the German literature). More recently, the technique was popularized by Smellie (7), Jobe (8), and May (3). Despite these reports, the technique has not been well-accepted in the ophthalmic literature (9,4). In a 1978 survey of 50 members of the American Society of Ophthalmic Plastic Surgery, regarding techniques of repair in orbicularis palsy, gold weight implantation was being performed in less than 1 percent of cases (10).

The lid-loading method attempts to overcome action of the levator muscle of the upper eyelid, by loading the lid with a gold weight. With relaxation of the levator muscle, lid closure is initiated. Concerns of color match, specific gravity, relative non-reactivity, and ease of reversibility have centered around use of a highly pure (99.99%) gold prosthesis. This report details our surgical procedure for reanimation and paralytic ectropion repair, and provides results from our three-year, prospective study to evaluate effectiveness of treatment.

SURGICAL PROCEDURE

Proper informed consent is obtained prior to all procedures. The 99.99% gold bars measure 1 x 4.5 mm. Lengths used vary with weight required. Gold bars are available from Meddev Corporation, Los Altos, CA, U.S.A. in sizes of 0.6 to 2.6 g at 0.2 g intervals (Fig. 1).

Weight of the prosthesis to be implanted is determined before the operation by testing the lid with different weights. A small amount of benzoin is applied to the concave side of a 1.6 gm prosthesis. With the patient sitting upright, the weight is affixed to the upper lid just above the lashes and centered at the junction of the medial and central thirds of the

lid, the point at which levator function is maximal. The effect is noted, as the patient opens and closes. The appropriate weight (that which allows closure of the eyelid, with ptosis of not more than 2 mm) is selected. If closure is still inadequate, plans are made for a combined mullerectomy and gold weight insertion. In these patients, one drop of 10% neosynephrine is placed into the superior cul-de-sac to mimic lid level following mullerectomy. Gold weights are then reapplied to the lid margin surface, until adequate closure has been achieved with ptosis of not more than 2 mm.

The patient's lower lid is examined and the extent of lower lid ectropion determined. Presence of medial canthal laxity is determined.

At the start of the surgical procedure, 1% lidocaine with epinephrine is infiltrated into the upper eyelid along the lid crease and at the lid margin edge. While the surgeon scrubs, the anesthetic is allowed to diffuse into the tissues. The patient is then prepped and draped and methylene blue ink is used to mark the lid crease incision at a level corresponding to the normal side. A 4-0 black silk suture is then placed through the lid margin and upper eyelid, placed on stretch. A 15 Bard-Parker blade is used to incise the skin. Westcott scissors are used to enter the orbicularis plane, which is elevated from underlying orbital septal plane and tarsal plate. The gold weight is inserted into the pocket between orbicularis muscle and orbital septum-tarsal plate and sutured to the superior tarsal border and orbital septum, using a 6-0 silk suture, passed through pre-drilled holes in the weight (Figs. 2A-D). Pre-drilled holes are placed 2 mm from the edge of the gold weight, which is 5 mm wide and varies in length according to size. The weight is set over the medial two-thirds of the superior tarsal border. The weight is oriented with a single hole overlying the superior tarsal border and two holes overlying the orbital septum; this prevents rotation of weight once sutured. In heavier weights, ranging from 2.4 to 2.6 g, there are a total of five pre-drilled holes. These weights are oriented with two holes overlying the superior tarsal border and three overlying the orbital septum.

When mullerectomy is performed, the posterior approach, as originally described by Putterman (11), is performed prior to the placement of the gold weight. In this procedure, the eyelid is everted over a Desmarres retractor, 8 mm are measured from the superior tarsal border up into the superior cul-de-sac, and this distance marked with a 6-0 black silk suture. A toothed forceps is used to grasp conjunctiva and underlying tightly adherent Muller's mus-

cle, which is easily separated, since it is loosely attached to the levator aponeurosis. A specially-designed clamp is applied to conjunctiva and Muller's muscle, with one edge of the clamp at the superior tarsal border and the other at the marker suture. A 5-0 double-armed, plain catgut suture is passed, in a serpiginous fashion, 1.5 mm below the clamp. Clamp contents are excised with a 15 Bard-Parker blade and the conjunctiva closed with the opposite arm of the 5-0 plain suture.

The mullerectomy procedure is easily combined with gold weight insertion, since it leaves behind an intact, orbital septal plane.

Repair of ectropion is accomplished with a lateral tarsal strip and recession of lower lid retractors (Fig. 2E-L). Here again, 1% lidocaine with epinephrine can be used for anesthesia. A straight hemostat is placed across the lateral canthal angle and blunt tip tenotomy scissors are used to ligate the lateral canthal tendon. The scissors are then slid along the lateral orbital rim and an inferior cantholysis performed. A 4-0 black silk traction suture is placed through the lower lid, and the lid is everted over a Desmarres retractor. One percent lidocaine with epinephrine is infiltrated subconjunctively. A 64 Beaver blade is used to incise conjunctiva at the level of the inferior tarsal border. Conjunctiva is elevated off underlying Muller's muscle plane, using a 64 Beaver blade and Wescott scissors. Muller's muscle and capsulopalpebral fascia are located and marked with a 4-0 black silk suture. Both muscles are dissected off overlying attachments to the orbicularis muscle and orbital septum, and from underlying attachments to conjunctiva. A Bovine fascia lata spacer (Ethicon, Inc.), measuring 5 mm in width, is used, which is sutured to the inferior tarsal border and to the recessed lower lid retractors. The fascia is then tucked behind the orbicularis plane, and the conjunctiva is closed with a running 5-0 plain suture. A lateral tarsal strip procedure is then performed, as described previously in the literature (12-15). The lower eyelid is not placed on stretch.

Patients undergo lid-loading, mullerectomy, and fascia lata-retractor recession surgery depending on clinical findings. Since these surgeries are in different tissue planes, they may all be performed simultaneously, if necessary (Fig. 3). In cases of medial canthal laxity the canthal tendon is plicated.

PATIENTS AND METHODS

A total of 55 patients, undergoing reanimation surgery for eyelid paralysis between March, 1987 and January, 1990, were studied prospectively. Indications for surgical intervention were as follows:

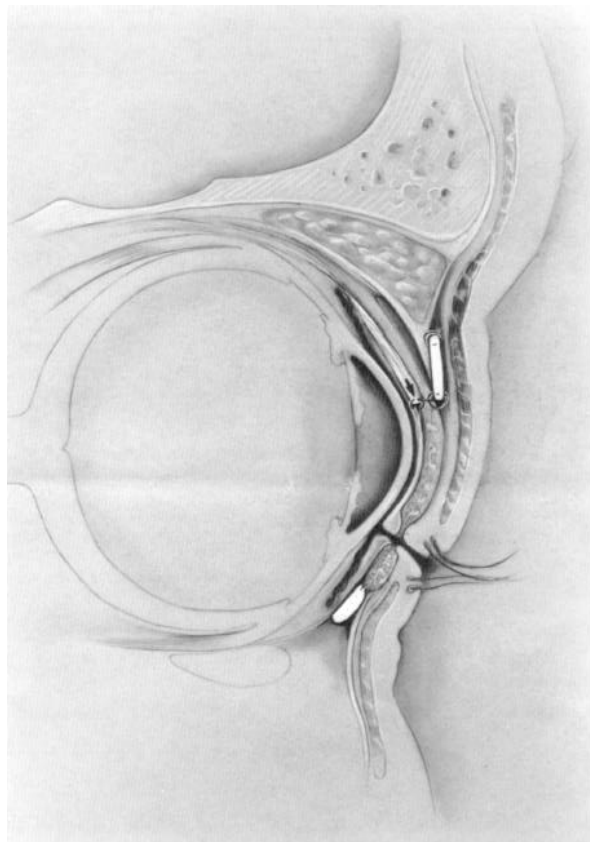


FIG. 3. Cross-section of gold weight implantation, mullerectomy, and fascia lata-retractor recession surgery.

corneal deterioration, noncompliant patient, medically infirm patient, marked progressive lagophthalmos, monocular vision on paralytic side, no return of facial function expected, lack of Bell's phenomenon, anesthetic eye, and dry eye. Patients were evaluated for facial nerve function, according to a universal standard (Table 1), as described by House (16). All patients were measured with a Hertel exophthalmometer and tested for corneal sensitivity and Schirmer wetting. Careful history was obtained regarding etiology and topical ocular medications. Palpebral fissure width, inferior scleral show, voluntary and involuntary blink, and visual acuity were measured prior to surgery and postoperatively, at one month intervals. Voluntary blink measurements were made using a millimeter ruler. Involuntary blink measurements were made at the slit-lamp.

RESULTS

A total of 55 patients were evaluated in this study, with 27 right and 28 left eyes represented. Of

TABLE 1. Facial nerve grading system

| Grade | Description | Characteristics |
|-------|-------------------------------|--|
| I | Normal | Normal facial function |
| II | Mild Dysfunction | Gross: Slight weakness noticeable; slight synkinesis At rest: normal symmetry Motion: Forehead: moderate to good function Eye: complete closure with minimum effort Mouth: slight asymmetry |
| III | Moderate dysfunction | Gross: obvious but not disfiguring difference between two sides; noticeable but not severe synkinesis, contracture, and/or hemifacial spasm At rest: normal symmetry Motion: Forehead: slight to moderate movement Eye: complete closure with effort Mouth: slightly weak with maximum effort |
| IV | Moderately severe dysfunction | Gross: obvious weakness and/or disfiguring asymmetry At rest: normal symmetry Motion: Forehead: none Eye: incomplete closure Mouth: asymmetric with maximum effort |
| V | Severe dysfunction | Gross: barely perceptible At rest: asymmetry Motion: Forehead: none Eye: incomplete closure Mouth: slight movement |
| VI | Total paralysis | No movement |

the 55 patients, there were nine with moderate dysfunction (Grade III), five with moderately severe dysfunction (Grade IV), 11 with severe dysfunction (Grade V), and 30 with total paralysis (Grade VI). Maximum follow-up time was 33 months, while the shortest follow-up time was 6 months; mean follow-up time was 12.8 months. Etiologies for the 55 patients varied and included 33 with acoustic neuromas, 8 following stroke, 2 with squamous cell carcinoma, 2 following parotidectomy, 2 with cholesteatoma, 2 with glomus jugulari tumor, 2 with congenital paralysis, 1 with meningioma, 1 following trauma and 1 following decompression of the VII nerve.

Initial surgery varied depending on the degree of paralysis. None of the nine patients with moderate dysfunction (Grade III) had lower lid ectropion but, instead, had limitation in both voluntary and involuntary blink. These patients underwent upper eyelid-loading only. Forty-three patients, with moderately severe function to total paralysis (Grades IV to VI), demonstrated, on initial examination, limitation of both voluntary and involuntary blink, as well as ectropion. These patients underwent lid-loading, combined with lateral tarsal strip, recession of lower eyelid retractor, and placement of fascia lata (Figs. 4A-D).

Beginning in June, 1989, combined mullerectomy

and gold weight insertion was initiated (Figs. 5A-D). This surgical procedure was used on a total of nine patients—three as primary procedures, in combination with lateral tarsal strips, retractor recession, and placement of fascial lata (in cases of total paralysis) and six as secondary procedures, to achieve better closure or eliminate ptosis. Four patients were noted to have incomplete closure and so underwent placement of a heavier gold weight, in combination with mullerectomy. One patient underwent mullerectomy alone, following previous lid-loading for ptosis. Another patient underwent mullerectomy, with insertion of a lighter weight for the same reason. Thus, with 55 study patients, there were 61 surgical procedures performed and evaluated.

In these 61 surgical procedures there were four extrusions; two after one month, one each after 3 and 4 months respectively. In all cases, these extrusions occurred in very elderly patients, who had thin, atrophic tissues. None were associated with mullerectomy and occurred with a variety of weights (1.4, 1.6, 1.8, and 2.0 g). In 36 patients, the gold weight remained in place. In eight patients, the gold weight was electively removed after return of function; two after 18 months, two after 12 months, and one each after 10, 8, 6, and 4 months. One patient underwent placement of a heavier weight for continued incomplete closure. Six patients under-



FIG. 4. Pre- and postoperative appearances (6 mo) of patient with total facial paralysis, undergoing gold weight implantation (1.6 g), fascia lata-retractor recession surgery, and lateral tarsal strip. A: Preoperative appearance, eyes open. B: Preoperative appearance, voluntary closure. C: Postoperative appearance, eyes open. D: Postoperative appearance, voluntary closure.

went two surgical procedures; initial gold weight placement and, later, secondary mullerectomy with or -without reinsertion of a gold weight. In follow-up, all secondary mullerectomy patients continued to have the gold weight in place.

Gold weights for the 61 surgical procedures are summarized in Table 2. In standard lid-loading, without mullerectomy, weights ranged from 1.2 to 2.2 g. In gold weight insertion combined with mullerectomy, the range was 1.2 to 2.6 g. The only 1.2 g weight used was in the patient who, because of ptosis, required placement of a lighter gold weight and mullerectomy.

Upper eyelid position following gold weight insertion, and gold weight insertion combined with mullerectomy, are summarized in Table 3. Standard insertion, to allow for proper closure, typically resulted in 1-2 mm of ptosis. Ptosis was rarely a problem in gold weight insertion combined with mullerectomy.

Lower eyelid position was successfully maintained in all but three cases, where ectropion developed at 2 months, 4 months, and 1 year, in elderly patients with total paralysis of the orbicularis muscle. Medial canthal laxity was noted in these cases, requiring a secondary plication.

When pre- and postoperative visual acuity was compared graphically (Fig. 6), significant visual improvement was noted in most patients. However, vision remained unchanged in cases of good preoperative visual acuity, as would be expected. In five patients, where vision was initially poor and did not improve, three patients had absent corneal sensation and no tear production, one had amblyopia, and one had retinitis pigmentosa.

Amounts of ocular lubrication used decreased in all patients except for two with absent corneal sensation and no tear production. Patients' needs varied widely, depending on other factors, including Bell's phenomenon, Schirmer testing, and sleeping position.

In the 61 surgeries, only 12 patients failed to achieve complete voluntary closure. Seven of these had only trace lagophthalmos (1 mm). The five cases of clinically significant lagophthalmos (2-3 mm) were in patients with severe dysfunction or total paralysis, and with Hertels greater than 17 mm. Three of these five patients underwent mullerectomy, with insertion of a heavier weight, with achievement of voluntary closure.

While voluntary blink was almost universally achieved with gold weight insertion, and lower eyelid

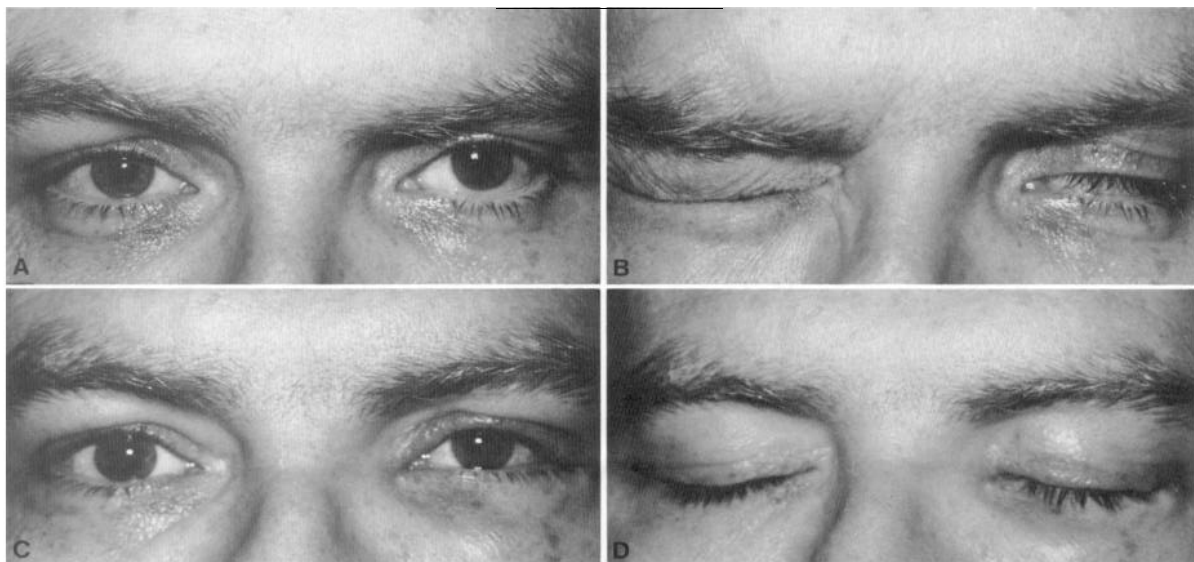


FIG. 5. Pre- and postoperative (6 mo) appearances of patient with total facial paralysis, undergoing gold weight implantation (2.6 g), Mullerectomy, fascia lata retractor recession surgery, and lateral tarsal strip. **A:** Preoperative appearance, eyes open. **B:** Preoperative appearance, voluntary closure. **C:** Postoperative appearance, eyes open. **D:** Postoperative appearance, voluntary closure.

position was maintained with lower lid retractor recession and lateral tarsal strip tightening, involuntary blink (in most patients) was rarely achieved with simple, gold weight insertion. Involuntary blink was the best in Grade III patients (1-3 mm of lagophthalmos) but improvement in blink was not significantly different from that of other groups, where simple gold weight insertion was performed. Involuntary blink improvement averaged 3.2, 3.8, 3.5, and 3.2 mm in patients with facial function Grades III, IV, V, and VI respectively (Fig. 7). Patients undergoing gold weight insertion, in combination with mullerectomy, achieved superior involuntary closure without ptosis. Involuntary blink improvement averaged 7.4 mm. When involuntary blink improvement was compared

graphically to Hertel measurements, there was a nonlinear inverse relationship (Fig. 8) for all paralysis groups and for patients undergoing simple gold weight insertion and combined mullerectomy-gold weight insertion.

DISCUSSION

Smellie (7) described the technique of upper lid weight insertion in 1966. He found that 0.75-1.0 g were necessary for most effective lid closure (7). Jobe (8) found that variation in weight and thickness of eyelid tissues, as well as strength of levator muscle, caused considerable variation in amount of gold necessary to achieve a satisfactory result. He

TABLE 2. Gold weights utilized in 61 surgical procedures

| Grade of facial paralysis | Mass of gold weights (g) | | | | | | | |
|---------------------------|--------------------------|-----|-----|-----|-----|-----|-----|-----|
| | 1.2 | 1.4 | 1.6 | 1.8 | 2.0 | 2.2 | 2.4 | 2.6 |
| III | | 5 | 4 | | | | | |
| IV | 1 | 1 | 3 | | | | | |
| V | 2 | 1 | 8 | | | | | |
| VI | 1 | 7 | 13 | 3 | 2 | 1 | | |
| gold weight+ mullerectomy | | | 1 | | 1 | 4 | | 2 |
| Total patients (No.) | 5 | 14 | 29 | 3 | 3 | 5 | 2 | |

TABLE 3. Depression of upper eyelid position after implantation of gold weights

| A. Gold weight implantation | | | | |
|-----------------------------|-----------------------------|----|----|---|
| Mass of weight (g) | Ptosis of upper eyelid (nm) | | | |
| | 0 | 1 | 2 | 3 |
| 1.2 | 1 | 3 | | |
| 1.4 | 2 | 8 | 4 | |
| 1.6 | 7 | 13 | 8 | |
| 1.8 | | 2 | | 1 |
| 2.0 | | | 2 | |
| 2.2 | | 1 | | |
| 2.4 | | | | |
| 2.6 | | | | |
| Total patients (No.) | 10 | 27 | 14 | 1 |

| B. Gold weight implantation and mullerectomy | | | | |
|--|-----------------------------|---|---|---|
| Mass of weight (g) | Ptosis of upper eyelid (nm) | | | |
| | 0 | 1 | 2 | 3 |
| 1.2 | 1 | | | |
| 1.4 | | | | |
| 1.6 | 1 | | | |
| 1.8 | | | | |
| 2.0 | 1 | | | |
| 2.2 | 3 | 1 | | |
| 2.4 | | | | |
| 2.6 | 2 | | | |
| Total patients (No.) | 8 | 1 | | |

recommended insertion of from 0.6 to 1.6 gm, depending on clinical response (8). May (3), in 1987, reported on 94 gold implantations ranging from 0.6 g to 1.2 g; 9% were unsuccessful, due to lack of closure or ptosis. There were no extrusions. He

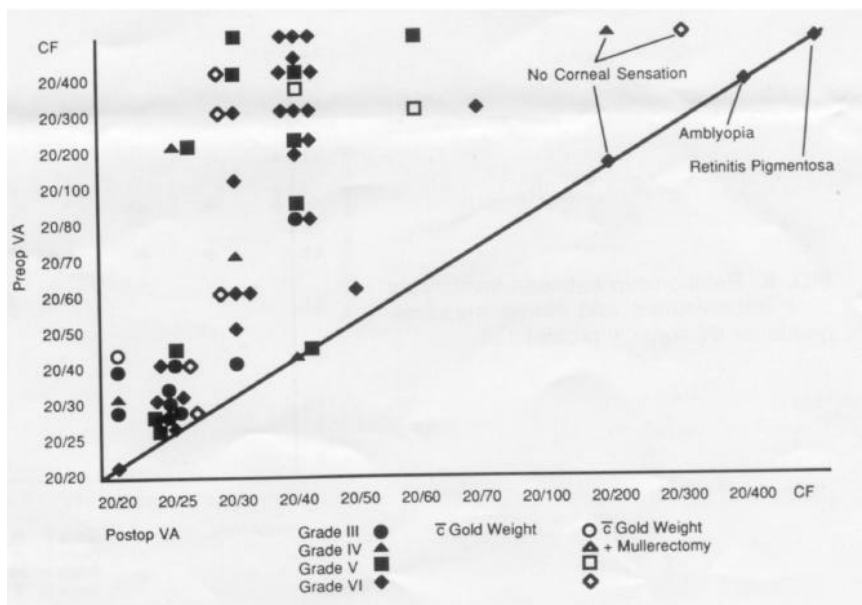
noted a slow voluntary blink for all patients and recommended lower eyelid tightening, in combination with gold weight insertion, to correct the lower eyelid problem (3). Lisman et al. (9) reviewed over 200 cases of paralytic ectropion, noting that 93% of gold weight insertions required reoperation or failed to work 3 years postoperatively.

To my knowledge, this is the first prospective study to evaluate effectiveness of gold weight implantation. From the data, a number of important conclusions have been suggested. Gold weight insertion is reliable and effective for promoting voluntary closure in most patients. Previously, May (3) recommended use of 0.6-1.2 g to achieve voluntary closure. Our findings indicate the need for a much heavier weight (1.2-2.6 g) to achieve closure.

Hertel measurements appear to be important prognosticators of effectiveness of improvement following gold weight placement. In the more exophthalmic patient, the eyelid would need to roll over the globe as opposed to falling in a more vertical direction. Thus, in the former case, gravitational effect of the weight would be less effective. It is also possible that, in more exophthalmic patients, a greater force is required for lid closure. Doane (17) reported a measurable retraction (1.0-1.6 mm), or a pushing inward of the globe, during descent of the upper eyelid. No doubt, however, there are other factors that play a role in this, including weight of eyelid tissues and, possibly, elasticity of the levator muscle.

Simple gold weight insertion is ineffective in promoting involuntary blink, in cases of moderately severe to total paralysis (Grades IV-VI). A weight,

FIG. 6. Pre- and postoperative (2 mo) visual acuity, compared in 61 surgical procedures.



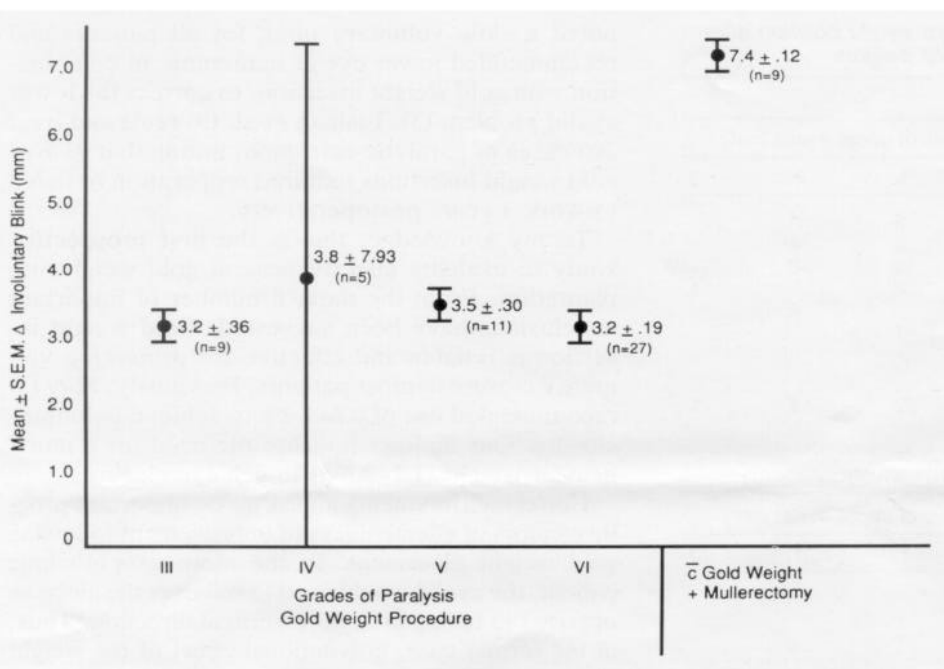


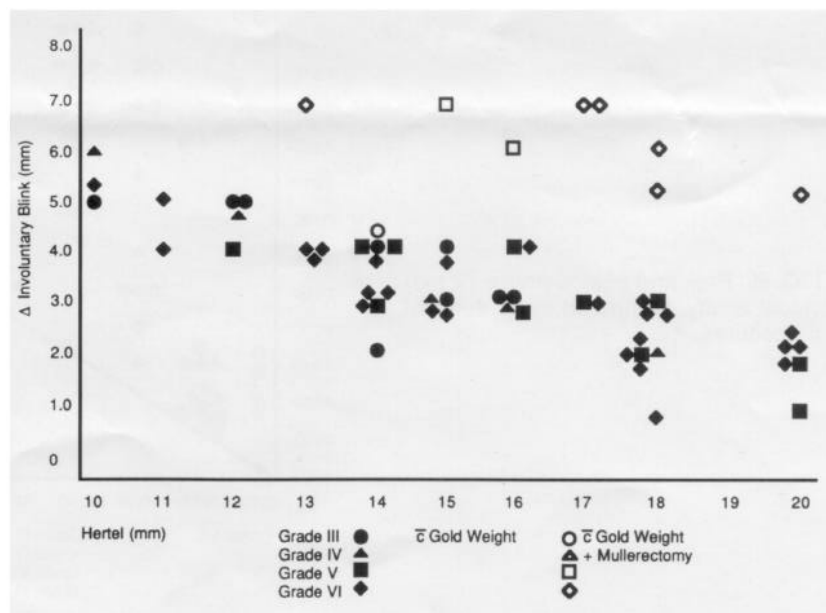
FIG. 7. Mean involuntary blink improvement in facial paralysis, Groups III, IV, V, and VI (standard gold weight implantation), and in patients with gold weight implantation plus mullerectomy.

heavy enough to achieve rapid closure during the 80 msec of involuntary blink (17), will result in unacceptable ptosis. In cases where involuntary blink is absent and significant improvement is desired, mullerectomy surgery, combined with insertion of a much heavier gold weight, is a reliable, new surgical approach. It most closely mimics involuntary closure, but does not stretch as do other prosthetic implants. The heavier weight (1.6-2.6 g) is easily

tolerated by the patient and, since the weight is hidden in the lid fold, is cosmetically desirable.

Further, since upper lid-loading does not treat lower lid ectropion, it must be combined with a lower lid procedure. D. Sol1 (unpublished observations) has successfully been using cartilage in lower eyelid for support in paralytic ectropion. Fascia lata, as a spacer, in paralytic ectropion is a new approach. In the context of paralysis of orbicularis muscle, reces-

FIG. 8. Relationship between involuntary blink improvement and Hertel measurements for 61 surgical procedures.



sion of retractor may serve to weaken the antagonist of the paretic orbicularis and prevent a progressive downward movement of the eyelid. Because of the flexibility of fascia, it is unlikely that it functions as support for the ectropic eyelid. In this series, only patients with Grades IV-VI paralysis required lower lid, ectropion surgery. Patients with moderate dysfunction (Grade III) did not present with ectropion nor did they develop it later. Only three patients required reoperation following lower lid retractor recession and lateral tarsal strip tightening, and these reoperations may have been prevented by initial medial canthal plication.

In summary, gold weight insertion, combined with lateral tarsal strip fixation and recession of lower lid retractors, is a reliable method for correcting paralytic, voluntary lagophthalmos and ectropion. With addition of mullerectomy and a heavier gold weight, involuntary closure can be mimicked without ptosis.



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