Original Article

Modified silicone sling assisted temporalis muscle transfer in the management of lagophthalmos

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Aim: To evaluate the efficacy of modified temporalis muscle transfer (TMT) by silicone sling for the management of paralytic lagophthalmos. **Settings and Design:** Prospective interventional study. **Materials and Methods**: Ten patients of lagophthalmos due to facial palsy underwent modified TMT using silicone sling. The patients were followed-up for a period of 3 months. Palpebral aperture in primary gaze and during eye closure were assessed both pre- and postoperatively along with problems associated with lagophthalmos like exposure keratopathy and lacrimation. **Statistical Analysis**: Paired *t*-test was applied to measure the statistical outcome. **Results**: Eight patients achieved full correction of lagophthalmos with no lid gap on closing the eye. The mean (standard deviation (SD)) lid gap on eye closure was 7.7 (0.86) mm preoperatively, 0.5 (0.47) mm at 1st postoperative day, and 0.7 (0.75) mm at 3rd month. There was a reduction in mean lid gap on eye closure of 7 mm at 3 months ($P < 0.0001$) which is highly significant. The mean (SD) vertical interpalpebral distance during primary gaze was 12.05 (1.12) mm preoperatively, 10 (0.94) mm at 1st postoperative day, and 10.35 (1.08) mm at 3rd month. There was a reduction in mean vertical inter palpebral distance of 1.7 mm at 3 months ($P = 0.001$) which is significant. Exposure keratitis decreased in five out of six patients at 3 months. **Conclusion**: Modified TMT by silicone sling is a useful procedure with lesser morbidity and good outcomes for the treatment of paralytic lagophthalmos due to long standing facial palsy.

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Patients with facial nerve palsy have a characteristic facial asymmetry and drooping of the angle of mouth. The temporal and zygomatic branches of facial nerve supply the forehead and eyelid muscles. Their involvement in a disease leads to paralysis of orbicularis oculi muscle resulting in lagophthalmos and ectropion. This can lead to dry eye, infection, corneal ulceration, perforation, and even blindness. Preinjury factors that lead to increased risk of complications are the lack of a good Bell's phenomenon, corneal anesthesia, and dry eye.

The facial nerve is susceptible to a variety of injuries and diseases.[1,2] The important causes of facial nerve palsy are congenital, idiophatic like Bell's palsy, infections like leprosy, Ramsay Hunt syndrome, neoplasms, trauma, and other diseases like multiple sclerosis, myasthenia gravis, sarcoidosis, etc.

These ocular complications can be devastating both cosmetically and functionally. The facial nerve once damaged, rarely attains full recovery of function. The ability to restore symmetry and function of eyelids in a patient afflicted with facial nerve palsy is one of the most rewarding skills of a well-trained oculoplastic surgeon.

Various surgical modalities have been developed to treat paralytic lagophthalmos and are classified into static and dynamic procedures. Static procedures include; lateral tarsorrhaphy, lid loading, and palpebral spring; while, dynamic include temporalis muscle transfer (TMT) and free muscle transfer.[3,4] The objective of dynamic procedures is to transfer a functioning motor unit to move the paralyzed eyelids.

The temporalis muscle is used in dynamic procedures as it is spared in a case of facial palsy. TMT was first described by Sir Harold Gillies (1934), who detached the origin of muscle and turned it down across the zygomatic arch.[5] This classic transfer was modified by Anderson who turned down the overlying deep temporal fascia to lengthen the transfer.[6] However, this transfer requires extensive dissection of muscle itself resulting in hollowing of temporal fossa with a bulge in area of zygomatic arch. McLaughlin (1953) mobilized the insertion of the muscle, rather than its origin, by coronoidectomy via an intraoral approach.[7] Breidahl *et al*., (1996) described a technique for the lower half of face in which temporalis was excised just before its insertion into the coronoid, thus avoiding coronoidectomy and lengthened the muscle using fascia lata.[8]

The problem faced with the procedures using fascia lata was attributed to difficulty in its harvesting. In this paper we present our experiences using improved techniques of TMT using silicone sling in place of fascia lata in 10 patients of lagophthalmos due to facial nerve palsy.

Materials and Methods

A prospective interventional study was carried out from June 2011 to December 2012. Ten patients diagnosed as cases of lagophthalmos due to long standing facial palsy on the basis of clinical examination were selected. All patients except those unwilling to undergo trial were included after taking informed consent. The patients underwent modified TMT using silicone sling. All patients were evaluated preoperatively and postoperatively at day 1 and at 3 months under the following headings:

- Lid gap (palpebral aperture) on gentle eye closure
- Vertical interpalpebral distance in primary gaze

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- Associated problems due to lagophthalmos like exposure keratitis.

All the measurements were made using a ruler. The least count taken was 0.5 mm. The reading between two consecutive millimeter marks was recorded as 0.5 mm. Exposure keratitis was assessed by slit lamp examination for the reduction in corneal transparency at the exposed parts of the cornea.

Surgical technique

The procedure was done under local anesthesia. The area of skin incision was shaved prior to the procedure. The part was prepared with betadine. A horizontal skin incision was made in the preauricular region 2 cm in front of the tragus [Fig. 1a], bleeders isolated and tied off and the glistening temporalis fascia exposed from its origin to insertion [Fig. 1b]. Both the superficial and deep temporal fasciae were then incised to expose all the muscle at this level [Fig. 1c]. The temporal muscle strip was disinserted from its origin and the underlying temporal bone [Fig. 1d] and reflected towards the zygoma (lateral wall of the orbit). The muscle was then advanced medially towards the zygomatic arch up to 3 mm from lateral canthal margin and divided into two strips. Two silicone slings were then sutured to the muscle ends in order to suffice the muscle to get attached with medial palpebral ligament or double armed silicone sling was passed through unstriped muscle [Fig. 2a and b]. The sutured temporalis muscle with silicone sling was passed through subcutaneous tunnel by giving incision at 3 mm lateral to the lateral canthus enabling the muscle action to get transferred [Fig. 2c]. Slings were further advanced in both upper and lower lids between the paralyzed orbicularis oculi and the skin. Finally, a sickle-shaped skin incision was given over the medial canthal ligament and the slings were brought out from below the medial palpebral ligament, tied, and secured to ensure proper eye lid closure and avoidance of silicone sling exposure over it [Fig. 2d]. All skin incisions were sutured with 6-0 nylon and pressure dressing applied over the temple. The dressing was opened on the next day. Fig. 3a and b show the pre- and postoperative photograph of a patient of lagophthalmos operated with above procedure.

Our clinical criteria for successful outcome included lid gap <1 mm and improvement in corneal conditions. Paired *t*-test was used to compare pre- and postoperative means of lid gap during eye closure and palpebral aperture.

Ethics

The procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional or regional) and with the Declaration of Helsinki 1975, as revised in 2000.

Results

A total of 10 patients including eight males and two females [Table 1] who had lagophthalmos due to facial nerve palsy were included. The mean age of surgery was 43.9 years [Table 1]. The procedure was highly successful in 80% (eight) patients (lid gap <1 mm) [Table 1]. The mean (SD) preoperative lid gap on eye closure of 7.7 (0.86) mm reduced to 0.5 (0.47) mm at day 1 of surgery and 0.70 (0.75) mm after 3 months of surgery [Fig. 4]. The difference of the mean of lid gap at pre- and postoperative day one was 7.2 mm ($P < 0.0001$). The difference of mean of lid gap at

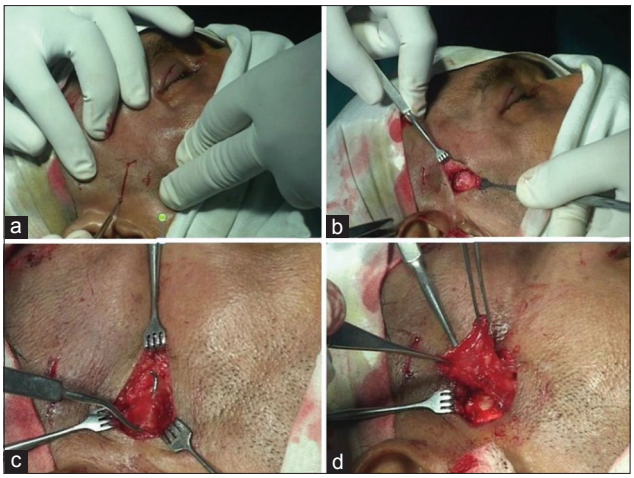

Figure 1: (a) Horizontal skin incision in preauricular region. (b) Glistening temporal fascia exposed. (c) Exposed temporalis muscle. (d) Muscle strip disinserted from its origin

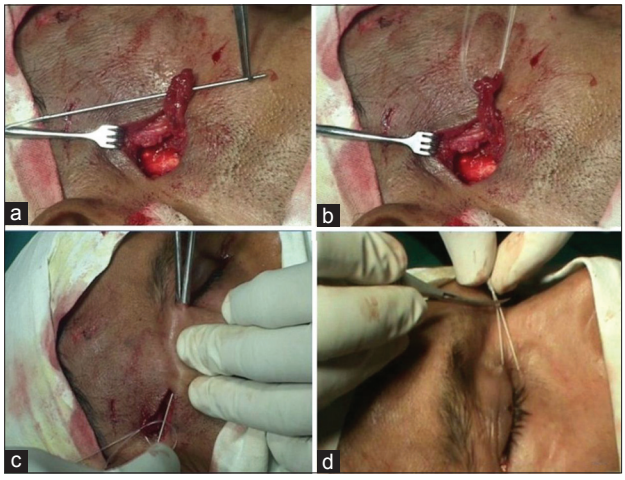

Figure 2: (a) Double armed silicone sling needle being passed through muscle end. (b) Silicone sling passed through the muscle end. (c) Sling being passed through the lateral canthal area. (d) Slings brought out through an incision at medial canthus

Figure 3: (a) Preoperative. (b) Postoperative

pre- and postoperative 3rd month was 7 mm ($P < 0.0001$). There was a significant reduction in palpebral aperture postoperatively [Table 1]. The mean (SD) preoperative vertical palpebral aperture was 12.05 (1.12) mm, which reduced to 10 (0.94) mm at day 1 of surgery and 10.35 (1.08) mm after 3 months of surgery [Fig. 5]. The difference of means of palpebral aperture at pre- and postoperative day 1 was 2.05 mm ($P = 0.0002$). The difference of means of palpebral aperture at pre- and postoperative 3rd month was 1.7 mm ($P = 0.001$). As defined by the success criteria, undercorrection was noted in two patients after the surgery. The gap remained the same (at 1st day and 3rd month) in one of the two patients (1.5 mm), but since there was no exposure nothing was done. The gap increased in one patient from 1 mm at day 1 of surgery to 2.5 mm at 3rd month of follow-up; and since there

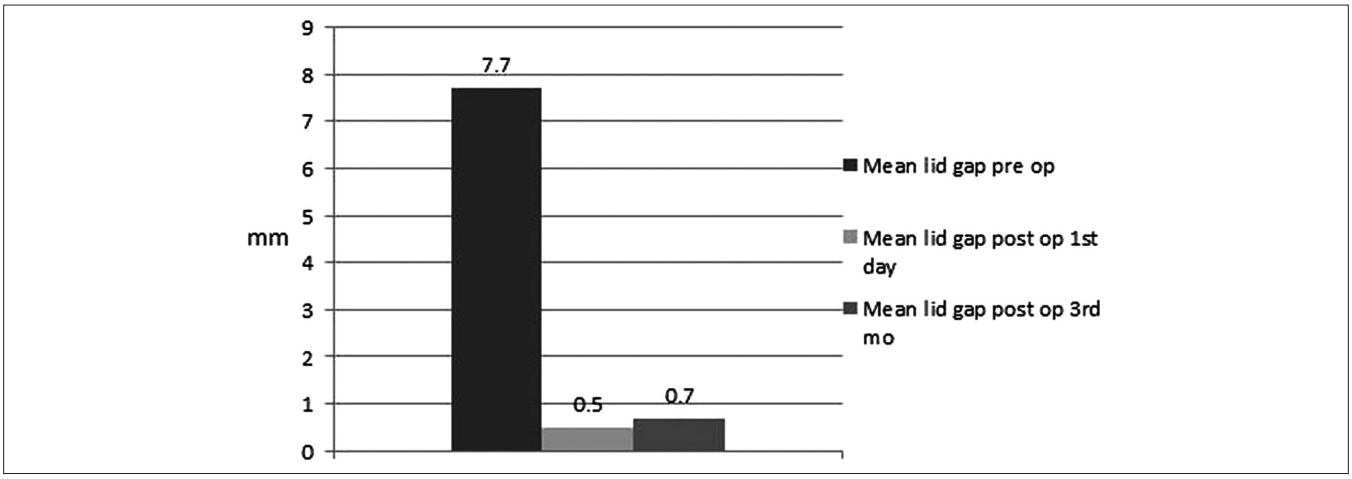

Figure 4: Comparison of mean pre- and postoperative lid gaps in millimeters

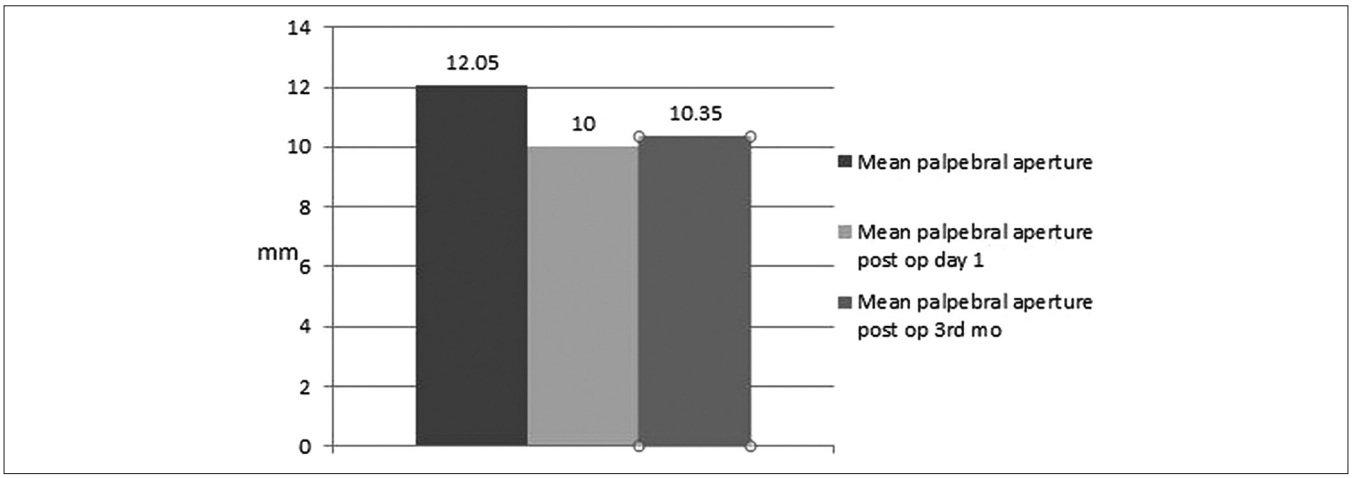

Figure 5: Comparison of mean pre- and postoperative palpebral apertures in millimeters

Table 1: Patient data

S.No	Age	Sex	Lid gap during eye closure of affected eye in mm			Palpebral aperture of affected eye in primary gaze in mm			Palpebral aperture of normal eye in primary gaze in mm
			Pre op	Postop day 1	Postop 3rd month	Preop	Postop day 1	Postop 3rd month	
1	54	M	7	0.5	0	11	9.5	9.5	9
2	43	M	8.5	1.5	1.5	14	10.5	11.5	10.5
3	57	M	6.5	0	0.5	11.5	9.5	9.5	9.5
4	40	F	8	0.5	0.5	12.5	11	11	10.5
5	49	M	8.5	0	0	12	9	9.5	9
6	40	M	7.5	1	2.5	12.5	11	12	11
7	59	M	9	0.5	0.5	13.5	11.5	11.5	11
8	38	M	8	0	0.5	11	9	9.5	9.5
9	52	F	7.5	0.5	0.5	12	10	10.5	10.5
10	47	M	6.5	0.5	0.5	10.5	9	9	9.5

was corneal exposure, retightening of the sling was required. The corneal condition improved in five out of six patients who had exposure keratopathy preoperatively.

Discussion

Different methods have been described for correction of lagophthalmos. Two techniques which are widely accepted as major treatments for paralytic lagophthalmos following facial nerve palsy are lid loading and temporalis muscle transfer. Lid loading with gold implants is simpler to perform, but results in disruption of the tear film and irritation of the conjunctiva due to delayed closure of eyelids.[9] Similarly; migration, extrusion, and ptosis have also been reported after gold implantation.[10] It can also produce foreign body reactions. On the other hand, TMT restores active movement to paralyzed eyelids with high rates of success. Furthermore, no nerve or muscle is sacrificed, scar is hidden in hair bearing area. Several publications have reported the outcome of this procedure, but have recommended further improvements in the operative procedure.

Classic Gillies turnover technique has significant disadvantages like unesthetic hollowing of temporal fossa, an obvious bulge over zygomatic arch, loss of excursion of muscle due to turnover, and extensive difficult dissection; thus requiring high surgical skills.

McLauglin's technique needed intraoral dissection. Undue tension of fascial fixation may lead to unesthetic asymmetrical eyelid fissure.

Soares and Chew (1997) in their study on TMT in 51 patients of lagophthalmos due to leprosy, reported that the average lid gap preoperatively on light closure was 7.3 mm which was reduced to 3.2 mm on final follow-up, but complications like ectropion and ptosis were encountered in few eyes.[11] In our study there were no such complications.

Qian *et al*., (2004) compared long-term results of modified TMT with the Johnson's procedure in correction of paralytic lagophthalmos due to leprosy. The modifications were omitting the fascial strip in the lower eyelid to avoid postoperative ectropion and fixing the fascial strip of the upper eyelid to the middle or inner margin of the tarsal palate depending on the degree of the lagophthalmos to avoid possible ptosis of the upper eyelid. They observed 58.5% success rate with Johnson's TMT procedure, while 87.1% success rate in modified TMT. The postoperative ectropion and ptosis were much higher in the Johnson's TMT group than in modified TMT group.[12]

Miyamoto *et al*., (2009) in a retrospective study for the analysis of the success of TMT for the treatment of paralytic lagophthalmos observed complete eye closure in 78.7% patients.[13]

Ashfaq and Bhatty (2011) in a study reported that seven out of eight patients of paralytic lagophthalmos operated with TMT achieved satisfactory eye closure with resolution of epiphora and corneal irritation.[14]

Das *et al*., (2011) evaluated the success of TMT using palmaris longus or fascia lata in achieving the full lid closure in patients of lagophthalmos due to leprosy and concluded that 85% eyes could achieve full lid closure with no measurable gap (0 mm).[15]

The outcomes of the above mentioned modifications are similar to our study, but the additional advantage with our procedure is that no fascia lata sling dissection has to be carried out. Silicone slings are commonly available and also economical to use. Our surgical procedure is easier to perform than previous techniques and the surgical time is greatly reduced with significantly reduced morbidity to the patient. Moreover, there were no significant postoperative complications with our procedure. As with any reconstructive procedure adjustments should be checked carefully on the operating table so that the proper eyelid contour is maintained.

To conclude, modified TMT with silicone sling is a valuable technique for correction of lagophthalmos in long standing facial palsy. It is less extensive and so has less morbidity and is well-tolerated and can achieve good functional and cosmetic results.

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