Efficacy of Temporalis Muscle Transfer for correction of lagophthalmos in leprosy

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Summary

Objectives: Temporalis Muscle Transfer (TMT) is a surgical technique used to correct lagophthalmos in leprosy patients. We have evaluated the degree of success of TMT in achieving full lid closure, which is important in preventing damage to the cornea.

Subjects and Methods: A retrospective study was carried out on 69 patients who had TMT done, at one centre, on 101 eyes during the period of 1998–2009. Lid gaps on direct gaze and with both gentle and forced closure, as well as voluntary muscle testing of eye lid closure, were assessed using standard measuring techniques by a qualified physiotherapist. Associated problems due to lagophthalmos were recorded both pre- and post-operatively. Data were abstracted on to a special proforma and subjected to statistical analysis using SPSS.

Results: On completion of post-operative physiotherapy, 85% of the eyes could achieve full lid closure with no measurable gap. The mean (SD) lid gap on forced closure was 4·8 (2·8) mm pre-operatively and 0·2 (0·5) mm at the end of the in-patient stay. The mean (SD) lid gap on gentle closure was 7·9 (2·6) mm preoperatively and 2·4 (1·8) mm post-operatively. The mean (SD) vertical inter-palpebral distance, during straight gaze, was reduced from 12·6 (1·6) pre-operatively to 9·8 (1·2) post-operatively. Exposure keratitis cleared in 16 of 27 eyes (60%) and Epiphora cleared or improved in 31 eyes.

Conclusions: It is concluded that the TMT is a successful option (cosmetically and functionally) for correction of lagophthalmos.

Introduction

Lagophthalmos is a well known complication in leprosy due to the involvement of the seventh cranial nerve resulting in incomplete closure of the eyelids. The ocular morbidity as a consequence of lagophthalmos was recently studied and findings revealed significantly higher morbidity regardless of sex or type of leprosy or deformity.1
Temporalis Muscle Transfer for paralytic lagophthalmos, which was first proposed by Gillies\(^2\) and later developed by Deutinger et al.\(^3\) and by Andersen\(^4\) has been one of the most common treatment modalities for paralytic lagophthalmos, the other being tarsorraphy, which has a high rate of recurrence and complications as quoted by Antia\(^5\) and Soares.\(^6\) In a retrospective outcome analysis in Japanese patients, Miyamoto et al.\(^7\) carried out temporalis muscle transfer on 95 patients with established facial paralysis and concluded that, if this procedure is performed properly, strong eye closure can be obtained. In a study from Nepal, Soares & Chew in their study (of 51 eyes) on TMT done in patients between 1963 and 1995 concluded that the success rate was quite high, though there were some complications.\(^6\) The outcomes seem to depend not only on the surgical skills but on possible complications in the surgical procedure.\(^8,9\) Several publications have reported on the outcome of this procedure and have also made recommendations on further improvements in operative procedures.\(^10,7,8\)

Skilful operative procedures should not only result in better repair of the problem physically but also make the facial appearances presentable.\(^11\) There are other options such as gold weight implants,\(^12\) but TMT procedures which are affordable, with the improvements in surgical techniques and better assessment of patients’ problems, should be practised widely to benefit more patients.

In this paper we present our experiences at a leprosy referral centre in Northern India using improved techniques and the more patient-acceptable TMT, on 101 eyes with facial nerve involvement due to leprosy.

**Subjects and Methods**

The Leprosy Mission Community Hospital at Naini, Allahabad district in Uttar Pradesh India manages many leprosy patients.\(^13\) During the year 2009 more than 3000 new leprosy patients were registered amongst a total of about 20 000 treated for leprosy and its complications in the out-patient department (OPD). Of these more than 170 came for ocular morbidity including lagophthalmos.

All patients seen with lagophthalmos were considered for TMT. Patients with a history of reactions should have been off steroids and reaction-free for 3 months before being offered TMT surgery. Correction of established lagophthalmos has been a priority, to protect the eye from further damage; TMT is done at the earliest even if the patient has not yet completed multi-drug therapy. This paper reports a retrospective analysis of 69 cases treated by TMT during the period 1998–2009.

Temporalis Muscle Transfer (TMT) has been a popular surgical procedure for correcting lagophthalmos, with significant improvement in the cosmetic, functional and social well-being of the affected leprosy patients. Prior to surgery, affected people went through physiotherapeutic assessments and were given necessary pre-operative physiotherapy which is explained in detail below. Corneal sensation was examined, but its absence was not a criterion to change the surgical procedure. Exposure keratitis was assessed clinically by observation for the reduction in corneal transparency at the exposed parts of the cornea both pre- and post-operatively. The operative procedure is completed in under an hour, after which the patient is kept admitted in the wards for 6 weeks to recuperate after surgery, allowing tendon healing and post-operative physiotherapy. When being sent home, the patient is advised to come for regular, periodic follow-ups, after 1 month, 3 months, 1 year and 5 years.
All the patients underwent the same surgical procedure done by the same surgeon, pre- and post-operative physiotherapy were performed by same team of therapists.

SURGICAL TECHNIQUE

A modification of Johnson’s Method$^{14,15}$ is used at TLM Naini. The entire procedure is done under local infiltration of Xylocaine. An approximately 7 mm thick tendinous bundle of the temporalis muscle is anastomosed to the palmaris longus or fascia lata graft using Brand’s method.$^{16}$ The graft is split into two slips of equal thickness (if unequal, the thicker one is used for the upper lid).

An 8 mm incision is made over the medial canthal ligament close to the bridge of the nose and the ligament dissected carefully. We tunnel the upper lid slip a few mm away from the lid edge and the lower lid slip along the edge of the lid for better cosmesis by appropriate overlapping of the lower lid by the upper eye-lid.

The two slips are passed under the medial canthal ligament with the right angled clamp; the lower slip from below upwards and the upper slip from above downwards to avoid tenting of the skin by the slips. This differs from the method of Soares et al.$^6$ The two slips which have been passed below the medial canthal ligament are brought above it and sutured to each other and the canthal ligament with 5-0 silk, twice, keeping the knots at opposite ends. A final stitch is taken through the periosteum of the nasal bone, where the medial canthal ligament is inserted, through both the fascial slips, thereby anchoring the slips firmly.

These steps avoid or reduce the post-operative complications of

(a) Medial migration of the slips i.e. epicanthal fold giving a ‘Mongoloid’ appearance.
(b) Tenting of the slips at the medial palpebral region.
(c) Risk of Post-operative stitch abscesses.

The patient is kept on a liquid diet for 10 days, followed by semi-solids for another 10 days. Normal diet and post-operative physiotherapy is commenced from the 21st day.

PRE-OPERATIVE PHYSIOTHERAPY MANAGEMENT

The aim of preoperative physiotherapy is to strengthen the temporalis muscles. This was achieved by asking the patient to chew on a piece of micro-cellular rubber (MCR) or chewing gum. It is important for the patient to understand that he/she will always need to clench the jaw voluntarily to make his eyelids close so that they lubricate and protect the cornea. Practising this in front of the mirror is helpful to get the visual feedback on how to achieve closure of his/her eyelids after surgery.$^{17}$

POST-OPERATIVE PHYSIOTHERAPY MANAGEMENT

From the 21st post-operative day, the muscle re-education programme is started: training the patient to use the newly-transferred muscle for voluntary eye closure and ‘think-blink response’. Patients are put on a normal diet to regain pre-operative strength in the temporalis muscle. If the patient encounters difficulty in contracting the temporalis muscle, Surge Faradic electrical stimulation is given, and then gradually withdrawn when adequate muscle activity is re-established. When the patient is ready to go home, self-care is reinforced.
All patients who had TMT during the period of 1998 to 2009 are included in this paper. The demographic and clinical profiles of 69 patients (101 eyes) are shown in Table 1.

The lid gap, pre and post-operatively assessed are given in Table 2.

The mean (SD) lid gap on gentle closure was 7.9 (2.6) mm pre-operatively and 2.4 (1.8) mm on completion of post-operative therapy. The mean (SD) on forced closure was 4.8 (2.8) mm pre-operatively and 0.2 (0.5) mm when the patient was sent home after completion of the physiotherapy regimen. The results showed that 85% of the eyes could achieve full lid closure (zero lid gap) at the end of post-operative physiotherapy. The mean (SD) vertical interpalpebral distance, during straight gaze, was reduced from 12.6 (1.6) mm pre-operatively to 9.8 (1.2) mm post-operatively ($P < 0.001$).

Those who returned for examination were compared, at each follow-up, with those who failed to return. Chi-square tests of similarity of basic demographic and pre-operative clinical features between the two groups at each follow-up were statistically not significant.

Associated ocular complications were reduced after TMT as presented in Table 3.

Table 4 compares this series with three other studies for the percentage of eyes that achieved complete lid gap obliteration during forced closure, when the patient is ready to go home. Only patients with 0 mm lid gap are included in the 85%.

Table 1. Demographic and clinical profile of 69 patients

<table>
<thead>
<tr>
<th>Patients</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>Age Mean (SD) years</td>
<td>39.2 (13.5)</td>
<td>33.4 (15.2)</td>
<td>38.6 (13.7)</td>
</tr>
<tr>
<td>Duration of lagophthalmos (in months) – Mean (SD)</td>
<td>42 (53)</td>
<td>25 (34)</td>
<td>40 (51)</td>
</tr>
<tr>
<td>Bilateral lagophthalmos</td>
<td>28</td>
<td>4</td>
<td>32</td>
</tr>
<tr>
<td>Unilateral lagophthalmos</td>
<td>33</td>
<td>4</td>
<td>37</td>
</tr>
</tbody>
</table>

Table 2. Mean (SD) of lid gap (in mm) during gentle and forced closure at preoperative, postoperative and follow-ups

<table>
<thead>
<tr>
<th></th>
<th>Pre operative</th>
<th>Post operative</th>
<th>Review 3/12</th>
<th>Review 1 Year</th>
<th>Review 5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N=101</td>
<td>N=101</td>
<td>N=68</td>
<td>N=43</td>
<td>N=21</td>
</tr>
<tr>
<td>Gentle Closure</td>
<td>7.9 (2.6)</td>
<td>2.4 (1.8)</td>
<td>2.8 (2.3)</td>
<td>2.2 (2.3)</td>
<td>1.9 (1.9)</td>
</tr>
<tr>
<td>Forced closure</td>
<td>4.8 (2.9)</td>
<td>0.2 (0.5)</td>
<td>0.3 (0.7)</td>
<td>0.2 (0.6)</td>
<td>0.3 (1.1)</td>
</tr>
<tr>
<td>Vertical Interpalpebral gap (during straight gaze)</td>
<td>12.6 (1.6)</td>
<td>9.8 (1.2)</td>
<td>9.9 (1.2)</td>
<td>9.8 (1.3)</td>
<td>9.9 (1.4)</td>
</tr>
</tbody>
</table>
Patients with lagophthalmos suffer from a loss of the blink reflex/response in the affected eye, leaving the eye vulnerable to a host of insults. Partial or complete paralysis of the orbicularis oculi muscle, disruption of the lacrimal pump and tear flow, upper lid retraction and the unopposed pull of gravity on the lower lid contribute to corneal exposure, an increased risk of exposure keratitis, corneal ulceration, loss of vision and disfigurement. Management of eyelid closure in these patients must therefore focus on restoration of the effects of the blink reflex/response, preventing exposure and dryness of the cornea. Brief descriptions of the physiotherapy management before and after surgery are given to focus on the critical importance of this aspect.

Different methods have been described for correction of lagophthalmos such as tarsorrhaphy, sling procedure, gold weights, palpebral spring, magnets and variations of Temporalis Muscle Transfer. Using the transposed temporal muscle is superior to the other methods. Several investigators have improved on this procedure and suggested alternatives that enhance the outcomes. Deutinger et al. presented a method for correction of lagophthalmos that combines static support with dynamic function, where the anterior part of the temporal muscle has been transposed. Chewing was not impaired and closure of the eye could be performed independently from chewing. Terzis et al. used a segmental temporalis transfer, the ‘mini-temporalis’ in 31 patients to augment the function attained with neural microsurgery, and concluded that the use of mini-temporalis transposition in

<table>
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<th>Table 3. Impact of TMT on ocular complications (number of eyes)</th>
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<tr>
<td>Cornea</td>
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<tr>
<td>Exposure Keratitis</td>
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<tr>
<td></td>
</tr>
<tr>
<td>Opacity</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>Epiphora</td>
</tr>
<tr>
<td>Mild</td>
</tr>
<tr>
<td>Moderate</td>
</tr>
<tr>
<td>Severe</td>
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<tr>
<td>Total</td>
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**Discussion**

Table 4. Comparing lid gap closure with other studies

<table>
<thead>
<tr>
<th>Percentage of eyes that achieved complete obliteration of lid gap at the time of completion of physiotherapy</th>
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<tbody>
<tr>
<td>TLM Naini (2011) (n = 101 eyes, 69 patients)</td>
</tr>
<tr>
<td>Soares D &amp; Chew M Lepr Rev 1997 (n = 51 eyes, 35 patients)</td>
</tr>
<tr>
<td>Weber et al. Lepr Rev 1992 (n = 33 eyes, 22 patients)</td>
</tr>
<tr>
<td>Ranney &amp; Furness Ind J Lepr 1973 (n = 54 eyes, 42 patients)</td>
</tr>
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</table>
association with facial nerve microsurgery as a valuable alternative to free muscle transfer in selected cases.

There are only a few publications reporting evaluation of effectiveness of TMT in leprosy-affected patients. Hence, there is a need to review and improve the procedures in the light of current therapy with MDT, advancement in surgical techniques, physiotherapeutic changes and environmental improvements.\(^6,18\) At this centre, details of all patients over the past few years have been meticulously recorded at our centre to enable detailed retrospective analysis. There was no bias in this sample as all patients with established lagophthalmos were offered TMT as the first choice of treatment and all patients who had TMT at our centre have been included in the analysis.

As mentioned in a few studies, patients’ satisfaction was high and allowed the operated patients to have better social acceptance and therefore less stigma.\(^{11,10}\)

Temporalis tendon transfer by this modification of Johnson’s method is a relatively easy procedure to perform that has distinct advantages compared with other forms of lid correction. The procedure described here uses a small bundle of the temporalis tendon and though invasive, does not require sophisticated equipment or magnification, so can be performed at a peripheral hospital in surgical camps by a trained surgeon. Thereby access for the community is improved. It has simple modifications which give excellent results in terms of closure of the lid gap, protection of the cornea, reversal of corneal inflammatory changes, re-establishing tear flow and eliminates the facial asymmetry typically produced by lagophthalmos. The modifications prevent the late occurrence of an ‘epicanthal fold’,\(^5\) stitch abscesses (zero), unsightly muscle bulges or tenting fascial slips; 85% of the eyes achieved complete obliteration of the lid gap on completion of physiotherapy. These were six eyes with a maximum lid-gap of 2 mm, the other 10 eyes had 1 mm. The six with a gap of 2 mm were reviewed; three of them had pre-operative ectropion and all had high eye-hand-foot (EHF) scores (6,7,10,10,12,12) indicating multiple deformities. There were no other similarities in terms of duration, pre-operative lid gap, physiotherapy compliance etc. Two of the patients had undergone bilateral TMT with complete closure achieved in the opposite eye.

Four eyes had pre-operative ectropion which was corrected by a wedge resection, simultaneously with the TMT procedure. At the final assessment a total of eight of the 101 eyes had mild ectropion (these eight were operated during 1999 to 2002).

Eight of the patients had corneal anaesthesia and TMT was offered to them as a better operative choice when compared to Tarsorrhaphy.\(^6\) Epiphora cleared in seven of them and exposure keratitis reversed in all the four who had it pre-operatively. Lid gaps were also corrected completely from the pre-operative values of 8·5 mm (gentle closure) and 5·9 mm (forced closure).

**Conclusions**

TMT is a cosmetically-preferred procedure to correct lagophthalmos when a lid gap exists on forced closure, and can be used even if corneal sensation is lost. Apart from correcting the lid gap, it corrects the epiphora and has helped to reverse exposure keratitis. The method described here, which gives an excellent cosmetic closure, can be done in small peripheral surgical camps, close to the community, by a trained surgeon.
Acknowledgements

We thank the staff in the physiotherapy department, medical records department and operation theatre as well as the ward staff for their co-operation and compassionate services. Thank you to the patients for their co-operation during the procedure and physiotherapy as well as travelling long distances for follow-up.

References