Müller's muscle–conjunctival resection for upper eyelid ptosis: correlation between amount of resected tissue and outcome

Noa Avni Zauberman,[1] Tal Koval,[2] Micki Kinori,[1] Adham Matani,[1] Mordechai Rosner,[1] Guy Jonathan Ben-Simon[1]

[1]Ophthalmology Department, Sheba Medical Center, Goldschleger Eye Institute, Tel Aviv University, Tel Hashomer, Ramat Gan, Israel
[2]Ophthalmology Department, Tel Aviv University, Meir Medical Center, Kfar Saba, Israel

Correspondence to
Professor Guy Jonathan Ben-Simon, Department of Ophthalmology, Goldschleger Eye Institute, Sheba Medical Center, Tel Hashomer, Ramat Gan 52621, Israel; guybensimon@gmail.com

Received 24 August 2012
Revised 29 October 2012
Accepted 26 November 2012
Published Online First 7 January 2013

ABSTRACT

Aims To explore the relationship between the amount of resected Müller's muscle–conjunctiva (MMCR) and clinical outcome in patients undergoing upper eyelid ptosis surgery.

Methods 49 patients underwent 87 MMCR surgeries. The total areas of the specimen and of MM were measured in pixels.

Results The average percentage of muscle tissue in relation to total excised tissue was 21%. Intraoperative MMC tissue measurements and postoperative improvement in eyelid position (delta marginal reflex distance 1 (MRD_1)) were positively correlated (R=0.427, p=0.09). There was a weak correlation between total areas measured on the histological slides and the intraoperative MMCR values (R=0.3, p=0.057). Total histological areas did not correlate with the delta change in eyelid position or with the amount and percentage of resected muscle tissue and the extent of improvement in eyelid position (delta MRD_1) or final eyelid position (postoperative MRD_1).

Conclusions Post-MMCR improvement in eyelid positions did not correlate with the percentage of MM in the excised tissue. We believe that the mechanism responsible for surgical outcome is plication or scarring of the posterior lamella and not the amount of resected MM. More lift in eyelid position can be anticipated when more tissue is excised by MMCR, and not when more muscle is excised.

INTRODUCTION

Müller's muscle (MM) is a sympathetically innervated upper eyelid muscle that, together with the levator palpebral superioris, elevates the eyelid. The MM resembles smooth muscle, and originates from the levator aponeurosis about 15 mm above the superior tarsus. The MM is adherent to the conjunctiva but easily separable from the levator aponeurosis, and is enclosed in a vascular sheath. The lifting effect of the MM is best demonstrated clinically by the improvement of some ptotic eyelids upon stimulation with phenylephrine (PE) eye drops ('PE test'). MM conjunctival resection (MMCR), originally described by Fasanella and Servat[1] and later modified by Putterman and Urist,[2] has traditionally been performed for correction of mild to moderate upper eyelid ptosis, resulting in improved eyelid height. It is thought that eyelid elevation is achieved by vertical shortening of the posterior lamella, plication or advancement of the MM, and levator aponeurosis and cicatricial changes. The definitive mechanism is still a matter of controversy. The only systematic histopathological study of a large series of excised specimens that might elucidate the mechanisms whereby this operation corrects ptosis was performed by Buckman *et al*[3] who used qualitative measures to grade the amount of tarsus in the specimen and the amount of smooth muscle. This report describes a novel technique for quantitatively measuring the precise amount of resected MM and demonstrates the effect of the amount of measured tissue on the outcome of the MMCR procedures.

PATIENTS AND METHODS

This was a prospective, non-randomised, clinical study including 49 patients who underwent 87 MMCR surgeries by a single surgeon (GJB-S) at the Goldschleger Eye Institute, Sheba Medical Center, Tel Hashomer, Israel during 2008–2009. In bilateral cases, both lids were included. The study was approved by the local institutional review board. Only patients who demonstrated improvement in eyelid position pre-operatively after instillation of PE 10% (positive PE 10% test) were operated on by means of the MMCR technique and included in the study. Eight patients who had a negative PE 10% test result were operated on using a levator advancement technique and excluded from this study. The appearances of all the operated eyelids were documented by standardised pre- and post-operative eyelid series photographs. Patients with a history of prior eyelid surgery were excluded from this study.

All operations were performed by a single surgeon (GJB-S) using the same surgical technique. Briefly, the upper eyelids are first injected subcutaneously with local anaesthetic containing lidocaine 2% and Marcaine 0.5% with adrenaline 1 : 200 000. The eyelid is then everted over a Desmarres retractor to expose the palpebral conjunctiva, and a topical anaesthetic is applied. Three 7/0 silk marking sutures are placed 6–10 mm from the superior tarsal border, depending on the desired outcome, and medial central and lateral sutures are applied. The sutures are used to lift the conjunctiva and the adherent MM. A T-shaped clamp is then applied with the tooth of the clamp blade engaging the marking suture. We use the Putterman clamp (Medetz Surgical Instruments, Dallas, Pennsylvania, USA) in all of these procedures. A double-armed 6/0 Prolene suture is then passed approximately 0.5 mm below the clamp, taking bites of the conjunctiva and MM. The suture is passed in a nasal to temporal direction

To cite: Avni Zauberman N, Koval T, Kinori M, *et al*. *Br J Ophthalmol* 2013;**97**: 408–411.

and back. The external loop on the temporal side is marked with a 4/0 silk suture to prevent cheese wiring of the Prolene suture. An upward facing #15 surgical blade is used to excise the tissue grasped within the clamp by cutting below it and using a metal on metal technique to avoid cutting the Prolene sutures. The skin is sutured by a running 6/0 Prolene suture. Blepharoplasty surgery was routinely performed before skin closure in all the cases reported in this study.

The tissue specimens were fixed in formalin, and the Masson trichrome-stained sections were evaluated for MM content. The strips of tissue were mounted flat on chucks oriented in the same direction (with the epithelium on one side and muscle on the other) and then sectioned parallel to these layers. Two sections of each specimens were chosen for further analysis, from the same depth level of parallel cut (demonstrating the same layers of histological tissue). Morphometric measurements were performed on these sections. Sections without tissue folds were included. Morphometric measurements were performed on two sections of each specimen using an Olympus photomicroscope (Olympus BX51 microscope with Olympus DP71 camera connected) and the Cell D program (Life Science documentation software; Olympus, Hamburg, Germany). First, the total area of the resected tissue was measured by marking the outside borders of the entire specimen and by calculating the total area as expressed in pixels. The area of the MM was then measured using the same technique, and the percentage of the MM within the specimen was extrapolated. All measurements were performed by two senior ophthalmologists (MR and NAZ), and the results were correlated with the clinical results of the marginal reflex distance (MRD) pre- and postoperatively (figures 1–3).

Statistical analysis

The paired samples t test was used to calculate the difference in eyelid position (MRD_1) pre- and postoperatively for each procedure. The Pearson bivariate correlation was used to calculate any relation between the amount of resected tissue, the percentage of MM within the specimen and change in eyelid position (delta MRD_1). Snellen visual acuity was converted to a logarithm of the minimum angle of resolution (logMAR) value. Statistical analysis was performed separately when all cases were included and when only the right eyes of patients with bilateral ptosis were included. Statistical analysis was carried out using Microsoft Excel 2011 (Microsoft Corporation, Redmond, Washington, USA) and IBM SPSS statistics software V.19.0 (SPSS, Inc., Chicago, Illinois, USA).

RESULTS

Forty-nine patients (31 females, mean age 58±19 years, range 20–85 years) underwent 87 MMCRs for upper eyelid ptosis. Thirty-eight patients underwent bilateral surgery. Most patients had an MMCR of 8 mm (average±SD 8.5±1.2 mm, range 4–10 mm). The preoperative difference between the eyelid positions in bilateral cases averaged 0.6±0.9 mm. Ptosis improved in all but two patients: there was a 2 mm increase in MRD_1, from 1.8±0.9 mm to 3.8±1.1 mm ($p<0.005$, paired samples t test). Figure 1 is a representative illustration of bilateral ptosis pre-operatively and following MMCR surgery. The average area of resected tissue (conjunctiva and muscle) as measured in pixels (figure 2) was $4.9\times10^6\pm15.6\times10^6$ (range 0.05×10^6–8.7×10^6). The average total muscle area was $0.34\times10^6\pm0.4\times10^6$ (range 0–1.6×10^6), and the average percentage of muscle tissue in relation to total tissue excised was 21%±19% (range 0–76%). No tarsal tissue was observed in any of the evaluated pathology slides.

The intraoperative measurements (using calipers) of MMCR tissue correlated positively with postoperative improvement in eyelid position (delta MRD_1) ($R=0.427$, $p=0.09$, Pearson bivariate correlation; figure 3A). Although a weak correlation was found between total areas measured on histology slides and during the MMCRs ($R=0.3$, $p=0.057$), there was no correlation between total histology area and the delta change in eyelid position (delta MRD_1). There was a trend towards higher muscle content in larger areas on pathology slides ($R=0.3$, $p=0.07$), but there was no correlation between the amount or percentage of resected muscle tissue and improvement in eyelid position (delta MRD_1; figure 3B) or final eyelid position (postoperative MRD_1).

Similar results were calculated when only one side (right eye) per patient in the bilateral cases was included. MRD_1 improved

Figure 1 Clinical photograph of a 30-year-old female before (A) and after (B) 8 mm Müller's muscle conjunctival resection. This figure is only reproduced in colour in the online version.

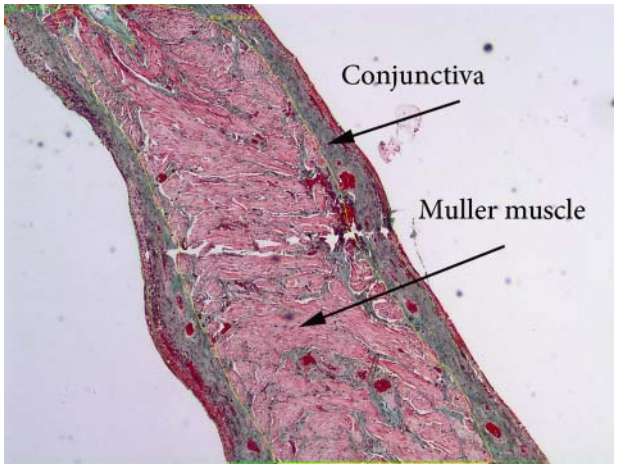

Figure 2 Histology specimen of tissue removed in the Müller's muscle (MM) conjunctival resection stained with Masson trichrome. The image shows marking of the external borders of the specimen, and the total area is given in pixels. The area of the MM is also marked and the area inside the specimen is given in pixels. In this specimen, 72% of tissue resected was comprised of MM. This figure is only reproduced in colour in the online version.

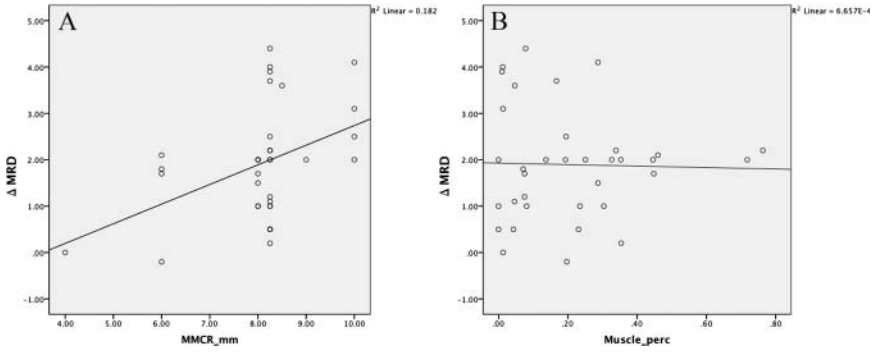

Figure 3 Scatter-gram showing correlation between the amount of Müller's muscle conjunctival resection in mm and the change in eyelid position (delta MRD1) (A), and between the percentage of muscle resected in the specimen and the change in eyelid position (B). MMCR, Müller's muscle-conjunctival resection; MRD, margin to reflex distance; perc, percentage.

from 1.8 (±1) pre-operatively to 3.7 (±1.1) post-operatively ($p<0.005$, paired samples t test). No correlation was found between the total area, muscle area and muscle percentage measured on histology slide and change in MRD_1 after surgery.

Other ophthalmic variables, such as visual acuity, remained unchanged after surgery. No major complications (eg, corneal abrasion, corneal abscess or overcorrection with corneal exposure) occurred during the study period. Two patients had eyelid asymmetry with under-correction on one side following surgery: both were successfully operated on again using repeat MMCR. The mean follow-up time was 4.9±5.3 months (range 2–36 months).

DISCUSSION

The results of our study demonstrate that improvement in eyelid position is related to the amount of resected MM conjunctiva rather than the net amount of muscle within the resected tissue. The mechanism of ptosis repair during MMCR surgery is not fully understood. Beard[4] was among the first to suggest that the levator aponeurosis plays no role in the success of the operation, and proposed that tarsectomy alone was responsible for its success. In 1975, Putterman and Urist[2] tried to prove that the Fasanella–Servat operation corrected ptosis by strengthening Müller's smooth muscle through its resection and advancement and, based on this theory, introduced the original MMCR, the modification of which we use today. There are several nomograms that can be applied to allow titration of the amount excised to the degree of ptosis when using the Putterman-type MMCR.[5–7] It has also been shown that excising 9 mm raises the upper lid to the position produced preoperatively by PE 10% instilled into the upper fornix.[2]

Buckman *et al*[3] reported that 87.5% of their 40 surgical specimens taken from Fasanella–Servat procedures involved tarsus, MM and conjunctiva resections but no MM resections whatsoever, yet the outcomes were equally successful as those with moderate or large amounts of MM resections. Those authors found no correlation between the amount of ptosis correction and the size of the tarsal strip, and concluded that the operation could be successful in all cases of ptosis even when minimal amounts of tarsus are excised.[3] In the current study, patients underwent MMCR rather than Fasanella–Servat procedures, and so no tarsal tissue was excised. It would be reasonable to assume that each 1 mm of tarsus resected is equivalent to a 1 mm change in MRD_1 since the tarsus serves as a scaffold for eyelid tissue. This would not be the case in MMCR surgery.

We believe that the mechanism responsible for the achievement of surgical correction of upper eyelid ptosis in our series is plication or scarring of the posterior lamella and not the amount of resected MM. This is supported by the fact that the greater the amount of excised tissue—and not muscle—in an MMCR (as measured intra-operatively or as calculated post-operatively in histology), the greater the lift that can be anticipated in eyelid position.

The hypothesis that the mechanism by which MMCR alleviates ptosis is independent of MM function has been presented in the past.[8] MMCR has been successfully performed in patients with Horner's syndrome,[9 10] in whom MM is denervated. In Glatt *et al*'s[9] series of six patients with unilateral Horner's syndrome, five patients attained perfect symmetry and the eyelid of the remaining patient was only 0.5 mm higher than the contralateral eyelid. In the presence of a possibly non-functioning MM, the result is most likely obtained via indirect mechanisms of advancement of the levator aponeurosis (terminal end) on the tarsus and posterior lamellar shortening. The same surgery was also performed in patients with blepharoptosis who had no response to the PE test and it was described as being safe and effective.[11]

Blepharoplasty surgery was performed concomitantly in all of our currently reported cases. Brown and Putterman[12] found that a lesser degree of eyelid elevation was achieved postoperatively in patients who underwent concurrent blepharoplasty for any extent of MMCR. Ben Simon *et al*[8] reported achieving a similar improvement in eyelid position in patients who underwent MMCR concurrently with blepharoplasty compared with patients who underwent MMCR alone.

This is the first demonstration of quantitative measurement of the MM. We used the Cell D program which allowed for the precise measurement of resected tissue. Whatever the exact mechanism in ptosis repair in MMCR surgery, it is our conclusion from the results of this study that smooth muscle resection itself may not be required for the success of the operation.

Contributors GJB-S: conception and design; NAZ, TK, MK, AM: acquisition of data; GJB-S, MR, NAZ: analysis and interpretation of data; NAZ, GJB-S: drafting the manuscript; GJB-S: critical revision; NAZ, TK, MK, AM, MR, GJB-S: final approval.

Competing interests None.

Ethics approval Sheba Medical Center approved this study.

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES

1 Fasanella RM, Servat J. Levator resection for minimal ptosis: another simplified operation. *Arch Ophthalmol* 1961;65:493–6.
2 Putterman AM, Urist MJ. Müller's muscle-conjunctival resection. Technique for treatment of blepharoptosis. *Arch Ophthalmol* 1975;93:619–23.
3 Buckman G, Jackobiec FA, Hyde K, *et al*. Success of Fasanella-Servat operation independent of Muller's muscle excision. *Ophthalmology* 1989;96:413–18.
4 Beard C. Blepharoptosis repair by modified Fasanella–Servat operation. *Am J Ophthalmol* 1970;69:850–7.
5 Weinstein GS, Buerger GF Jr. Modifications of the Müller's muscle conjunctival resection operation for blepharoptosis. *Am J Ophthalmol* 1982;93:647–51.
6 Guyuron B, Davies B. Experience with the modified Putterman procedure. *Plast Reconstr Surg* 1988;82:775–80.

7 Dresner SC. Further modifications of the Müller's muscle conjunctival resection procedure for blepharoptosis. *Ophthalmic Plast Reconstr Surg* 1991;7:114–22.
8 Ben Simon GJ, Lee S, Schwarcz RM, *et al*. Müller's muscle–conjunctival resection for correction of upper eyelid ptosis: relationship between phenylephrine testing and the amount of tissue resected with final eyelid position. *Arch Facial Plast Surg* 2007;9:413–17.
9 Glatt HJ, Putterman AM, Fett DR. Muller's muscle-conjunctival resection procedure in the treatment of ptosis in Horner's syndrome. *Ophthalmic Surg* 1990;21:93–6.
10 Yip CC, Foo FY. The role of Muller's muscle-conjunctiva resection (MCR) in the treatment of ptosis. *Ann Acad Med Singapore* 2007;36(Suppl): 22–6.
11 Baldwin HC, Bhagey J, Khooshabeh R. Open sky Muller muscle conjunctival resection in phenylephrine test–negative blepharoptosis patients. *Ophthal Plast Reconstr Surg* 2005;21:276–80.
12 Brown MS, Putterman AM. The effect of upper blepharoplasty on eyelid position when performed concomitantly with Muller muscle-conjunctival resection. *Ophthal Plast Reconstr Surg* 2000;16:94–100.

Müller's muscle–conjunctival resection for upper eyelid ptosis: correlation between amount of resected tissue and outcome

Noa Avni Zauberman, Tal Koval, Micki Kinori, et al.

Br J Ophthalmol 2013 97: 408-411 originally published online January 7, 2013
doi: 10.1136/bjophthalmol-2012-302541