Research Article / Araştırma Makalesi

Muller's Muscle Conjunctival Resection Surgery: Assessment of The Surgical Outcomes By Using a Novel Method

Muller Kası Konjonktival Rezeksiyon Cerrahisi: Yeni Bir Method İle Cerrahi Sonuçların Değerlendirilmesi

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Abstract: The aim of the study was to analyze the upper eyelid position following the Muller's muscle conjunctival resection (MMCR) surgery by using a more standardized and objective method which was obtained by using the autorefractometer (AR) front monitor image (FMI).**:** Medical records of the patients who underwent either 6 mm or 8 mm MMCR surgery between January 2020 to April 2023 were evaluated. The AR-FMIs were obtained before the surgery and during the follow-up period. The margin reflex distance 1 (MRD1) was measured by using the AR-FMI and ImageJ software. Outcome measures were derived from preoperative and postoperative mean AR-MRD1 values. Out of 34 subjects, 14 underwent 6 mm MMCR surgery and 20 underwent 8 mm MMCR surgery. Mean preoperative AR-MRD1 was 2.1 ± 0.8 mm in the 6 mm resection group, and 2.3 ± 0.7 mm in the 8 mm resection group and there was no statistically significant difference among the groups (p: 0.45). The mean postoperative AR-MRD1 value was higher in the 6 mm resection group when compared with the 8 mm resection group, however the difference was not statistically significant (p: 0.14). The mean AR-MRD1 difference was 1.4 ± 0.2 mm in the 6 mm resection group and 1.1 ± 0.3 mm in the 8 mm resection group, however, the difference was not significant (p: 0.09). According to the upper eyelid position change analysis (which was measured by using an easily evaluable, cost-effective and standardized method), the amount of the excised tissue following the MMCR surgery and final upper eyelid position was not associated directly and the result supported the current literature which propose that, changes in the upper eyelid position following the MMCR is a dynamic process rather than the mechanical process.
Keywords: Muller's muscle, ptosis, autorefractometer.

Özet: Çalışmanın amacı Muller kası konjonktiva rezeksiyon (MKKR) cerrahisi sonrasında üst göz kapağı pozisyonunu oto-refraktometre (OR) ön monitör görüntüleri (ÖMG) kullanarak uygulanan daha standardize ve objektif bir method ile değerlendirmektir. Ocak 2020 ile Nisan 2023 tarihleri arasında 6 mm veya 8 mm MKKR cerrahisi uygulanan hastaların tıbbi kayıtları incelendi. Oto-refrektometre ön monitör görüntüleri cerrahi öncesinde ve takip sürecinde olgulardan alındı. Margin reflex distance 1 (MRD1) değeri OR-ÖMG ve ImageJ proğramı kullanılarak ölçüldü. Başarı ölçüsü preoperatif ve postoperatif ortalama OR-MRD1 değerleri kullanılarak belirlendi. Çalışmaya dahil edilen 34 kişiden 14' ü 6 mm MKKR, 20' si 8 mm MKKR cerrahisi geçirmiş idi. Ortalama preoperatif OR-MRD1 değeri 6 mm rezeksiyon grubunda 2.1 ± 0.8 mm ve 8 mm rezeksiyon grubunda 2,3 ± 0,7 mm idi, ancak gruplar arasında istatistiksel olarak anlamlı değildi (p: 0,45). Cerrahi sonrası ortalama OR-MRD1 değeri 6 mm rezeksiyon grubunda 8 mm rezeksiyon grubuna göre daha yüksek idi, ancak fark istatistiksel olarak anlamlı değildi (p: 0.14). Ortalama OR-MRD1 farkı 6 mm rezeksiyon grubunda 1.4 ± 0.2 mm ve 8 mm rezeksiyon grubunda 1.1 ± 0.3 mm idi, ancak fark istatistiksel olarak anlamlı değildi (p: 0.09). Üst göz kapağı pozisyon değişikliği analizine göre (daha kolay ulaşılabilir, kost-effektif ve standardize bir yöntem kullanılarak ölçülen), MKKR cerrahisi sonrasında eksize edilen doku miktarı ile final üst göz kapağı pozisyonu arasında direkt bir ilişki yok idi ve mevcut literatür ile uyumlu olarak MKKR cerrahisi mekanik bir durumdan çok dinamik bir durumu tanımlamaktadır.
Anahtar Kelimeler: Muller kası, pitozis, otorefraktometre.

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1. Introduction

Ptosis is the term which is used to describe the drooping eyelid and generally require to be corrected surgically for both functional and aesthetical purposes (1). The Muller's muscle and Levator palpebrae superioris are the main upper eyelid elevators and the dysfunction of these muscles result with the ptosis (2). The Muller's muscle conjunctiva resection (MMCR) (posterior approach) surgery is generally used to correct the functional and aesthetical eyelid issues in cases with mild to moderate ptosis (3). In the literature, studies have been conducted to evaluate the factors that could affect the final surgical outcomes following the MMCR surgery and there are studies conducted to evaluate the association between the amount of the excised Muller's muscle conjunctival (MMC) tissue and final eyelid position and a direct association could not be found in these studies (4-7).

Margin reflex distance 1 (MRD1) describes the distance between the upper eyelid margin and the center point of the pupil and it was traditionally used to measure the upper eyelid position by using the manual method (8). In recent years, the digital image analysis method was also commonly used to measure the MRD1 by using the ImageJ software (8, 9). Because the inter- and intra- observer reliability of these two methods are moderate, studies were conducted in an effort to obtain more standardized and objective MRD1 values (10-13). Autorefractometer (AR) is an easily evaluable and cost-effective device which is present in every ophthalmic clinic (14), and the use of the AR to measure the MRD1 was performed by using the autorefractometer front monitor image (AR-FMI) and the validity and reliability of the method was demonstrated before (15).

The aim of the current study was to analyze the final eyelid position (obtained by using an easily evaluable, cost-effective and more standardized method) following the MMCR surgery performed with either 6 mm or 8 mm MMC tissue resection. To the best of the one's knowledge, using the autorefractometer device to evaluate the final eyelid position following the MMCR surgery has not been reported before.

2. Materials and Methods

2.1. Study Design and subjects

A retrospective medical record analyses of patients who underwent bilateral either 6mm or 8 mm MMCR surgery between January 2020 to April 2023 was performed. All operations were made by a single surgeon (DY) at the ophthalmology department of the Dr Abdurrahman Yurtaslan Oncology Training and Research hospital. Informed consent was taken from all patients. This study was approved by the institutional review board and all procedures performed in the study were in accordance with the ethical standards of the institutional review board of the Dr Abdurrahman Yurtaslan Oncology Training and Research Hospital and with the Helsinki declaration and its later amendments or comparable ethical standards.

The data including age, gender, diagnosis, levator function, amount of the MMC (Muller's muscle conjunctiva) tissue excised, preoperative and postoperative AR-MRD1 and past medical history were evaluated. Subjects who had good levator function (above the 10 mm), positive phenylephrine test, mild-moderate involutional ptosis, available pre- and postoperative autorefractometer front monitor images (AR-FMI) with acceptable quality and underwent bilateral MMCR surgery were included to the study. Mild-moderate ptosis was defined as an AR-MRD1 equal to 1.1 to 2.5 mm (6) and standard 6 mm or 8 mm MMCR was performed regardless of the preoperative MRD1 values (4, 16). Exclusion criteria were; previous eyelid surgery, use of botulinum toxin within the 5 moths of examinations, or history of any systemic disease, trauma or usage of the drugs that could alter the measurements. Cases involving tarsal resection were also excluded from this study.

2.2. Obtaining the AR- MRD1

The front monitor image of the autorefractometer (Canon, RK-F1, and U.S.A.) was video-recorded by using a smart-phone camera while the device measuring the refractive error. The screen-shoot of the video-record was taken while the center point of the pupil and the structures of the eye visible clearly on the image (Figure 1). The front monitor image of the autorefractometer was analyzed by using the ImageJ software (U.S. National Institutes of Health, Bethesda, MD. USA) to calculate the AR-MRD1 value. The white-to-white distance (WTW) of the cornea on the operated eye was measured in pixels and it was normalized according to the standard scale of 11.77 mm in men and 11. 64 mm in women. According to this scale, the measurements of MRD1 was converted from pixels to mm (Figure 1).

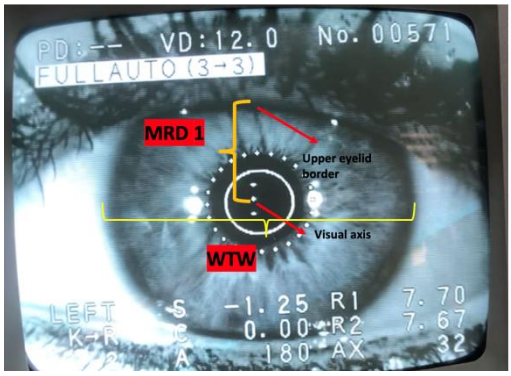

Figure 1. Autorefractometer front monitor image taken by smartphone when the visual axis point was clearly visible; margin reflex distance 1 (MRD1), from optical axis point to the upper eyelid margin. Wide to wide (WTW) distance, the distance between the corneal margins in the horizontal axis and passes through the visual axis point.

2.3. Surgery

All procedures were performed under local anesthesia and upper eyelid was everted over a Desmarres retractor by using a 4-0 traction suture which was placed upper eyelid margin. By using three 4-0 traction sutures the Muller's muscle-conjunctival tissue was retracted 3 or 4 mm from the upper tarsal margin and Putterman clamp was applied with the tooth of the clamping blade engaging the marking- suture. Running 6-0 vicryl (polyglactin 910) suture was placed 1 mm below the clamp, taking bites of the conjunctiva and Muller's muscle and resection of the Muller's muscle conjunctival tissue was performed by using no. 15 surgical blade via a metal-on-metal technique to avoid cutting the suture. A soft contact lens was applied following the surgery for 1 week and topical lubricant eye drop and fix dexametazon / netilmisin combination eye drop was prescribed. At 1st week, 1st month and 6th month visits AR-MRD1 measurements were performed to assess the surgical results (Figure 2).

2.4. Statistical analysis

Continuous variables were analyzed using the Student's t test. The quantitative variables were described as mean, range, and standard deviation. Categorical variables were described as frequencies. The statistical analysis was carried out using IBM SPSS software version 24.0 (SPSS, Inc., Chicago, IL, USA). $P < 0.05$ was considered as significant.

3. Results

Out of 34 subjects who meet the inclusion criteria of the study and included to the study, 14 (28 eyes) underwent 6 mm MMCR surgery and 20 (40 eyes) underwent 8 mm MMCR surgery. During the follow-up period, only 3 subjects experienced mild ocular irritation and

relieved with topical lubricant eye drops. There was no significant difference in terms of the age, gender and follow-up period among the groups. Mean age of the study population was 53.3 ± 8.3 years (range, 30-64 years) and mean follow-up time was 13.9 ± 6.2 months (6-27 months) (Table 1).

Table 1. The demographic and clinical properties of the study groups are given in the table.

	6 mm MMCR group n:14	**8 mm MMCR group n: 20**	**p**
Age (years)	49.4 ± 6.5	51.4 ± 9.1	0.33
Female/male	11/3	17/3	0.23
Follow-up time (month)	13.3 ± 6.5	14.6 ± 6.1	0.24
Pre-op AR-FMI MRD1	2.1 ± 0.8	2.3 ± 0.7	0.45
Post-op AR-FMI MRD1	3.9 ± 0.5	3.6 ± 0.7	0,14
Mean diff AR-FMI MRD1	1.4 ± 0.2	1.1 ± 0.3	0.09

MMCR: Muller's muscle conjunctival resection, AR-FMI: Autorefractometer front monitor image, MRD1: Margin reflex distance 1.

The mean preoperative AR- MRD1 values were compared among the 6 mm and 8 mm MMCR groups, and, there was no significant difference among the groups (p: 0.45). The mean postoperative AR-MRD1 values were compared among the 6 mm and 8 mm MMCR groups, however, the difference was not significant (p: 0.14). The mean difference of the AR-MRD1 was compared among the two excision groups and the 6 mm MMCR group had higher MRD1 value when compared with the 8 mm MMCR group, however, the difference was not significant (p: 0.09) (Table 1) (Figure 2).

Figure 2. The preoperative and postoperative digital images of the patients who underwent MMCR surgery for mild-moderate involutional ptosis. **A)** Preoperative digital image of the patient who underwent 8 mm MMCR surgery with Heiring sign and elevation of the right eyebrow to compensate the ptosis on the right side. B) The worsening of the ptosis on the right side by blocking the frontal muscle contraction manually. C) Postoperative 6th month digital image of the subject. **D)** Preoperative digital image of the patient who underwent 6 mm MMCR surgery. **E)** Postoperative 6th month digital image of the subject.

4. Discussion and conclusion

In the current study, the final upper eyelid position following the MMCR surgery performed either 8 mm or 6 mm tissue resection is evaluated by using an easily evaluable, cost effective and more standardized /objective MRD1 measurement method and according to the results, the final AR-MRD1 value and change of the AR-MRD1 were not significantly different among the excision groups.

In the literature, there are studies, conducted to analyze the association between the amount of the excised MMC tissue and final MRD1 value. Rootman et al. has compared the standardized 7 mm excision of the MMC

tissue with the variable excision nomogram (MMC tissue excision length / desired elevation of the eyelid: 4/1) and evaluated the MRD1 difference among the study groups by using the digital image analysis. According to the results, they did not find significant MRD1 difference among the groups and the authors concluded that, these results supported that there was no direct mechanical mechanism in the MMCR surgery (4). Roelofs et al. also conducted a study in an effort to analyze the effect of the amount of the excised MMC tissue on the final eyelid position. They created 3 groups with fixed 7 mm MMC resection bilaterally, variable resection (4/1 ratio, with lower side underwent greater tissue resection), and tarsectomy (fixed 7 mm MMCR and 1 mm tarsectomy on the lower side of the eyelids) and evaluated the MRD1 by using the digital images of the eyes and ImageJ software. According to the results, the authors found that the amount of the excised tissue and technique used to correct the eyelid position is not a predictor for the postoperative outcomes of the MMCR surgery, and, the authors stated that, changes in the eyelid position following the MMCR is a dynamic process not a mechanical process (16). In another study, Dan et al. evaluated the predictors of the surgical outcome following MMCR surgery and used 4/1 variable resection algorithm by using the digital image analyze with ImageJ software and the final surgical success was compared with the amount of the tissue resected, however, they could not find a significant association (17). In the current study, similar with the literature, despite there was no significant difference in terms of the preoperative mean AR-MRD1 among the groups and measurements were made by using a more standardized measurement method, there was no significant difference of the final AR-MRD1 and AR-MRD1 change among the fix 6 mm or 8 mm excision groups.

In the study conducted by Dan et al. to analyze the predictors of the surgical success following the MMCR surgery, the association between the phenylephrine test and final surgical success was evaluated and the authors did not find significant association (17). Nacaroglu et al. has also evaluated the surgical success rate of the MMCR surgery among the severe and mild/moderate involutional aponeurotic ptosis cases by using digital image analysis of the MRD1 and found higher surgical success rate in phenylephrine test positive cases, however the difference was not significant (6).

There are studies conducted to evaluate the MMCR surgery outcome, however, the MRD1 analyze method was not mentioned. For example, Leung et al. has conducted a multicenter prospective study and evaluated the effect of 2.5% phenylephrine test, amount of the response to the phenylephrine test and excised MMC tissue on the surgical success rate of the MMCR surgery, however, the measurement method was not stated in the paper (18). Similarly, Dryden et al reported the results of the levator-Muller tissue complex resection (the technique described by Morris et al.) surgery for ptosis repair by measuring the MRD1 and stated that, in cases who responded to the phenylephrine test can benefit from the 8 mm and 10 mm resection of the levator-Muller tissue complex, however, the authors did not mention about the MRD1 measurement method in the paper (7).

As mentioned above, in the majority of the studies, the digital photographs of the eyes were evaluated by using the ImageJ software to evaluate the upper eyelid position. Because the measurement of the MRD1 is an essential part for the patient follow-up, surgery planning and academic purposes, there are studies conducted to achieve more standardized and objective MRD1 measurement methods. In those studies; the head position of the patient, examiner and fixation target; the power of the frontal muscle contraction, orbicular muscle contraction, camera flash; the distance between the patient and fixation target were all analyzed and considered to allow for a more reproducible and accurate measurements of the eyelid position (9, 19). Hence, in an effort to achieve more standardized and objective MRD1 measurements, the advanced and expensive ophthalmic devices were used (such as OCT and Orbscan 2) (11-13). In an effort to achieve more accurate and standardized MRD1 measurements by using

an easily available and cost effective device, the autorefractometer was also used and validity and reliability of the method was assessed before (10).

There was a lot of limitations in the current study because of the retrospective design of the study, the study population was small and the amount of the resected tissue was not measured postoperatively.

In summary, the upper eyelid position was evaluated following the MMCR surgery performed either 6 mm or 8 mm MMC tissue resection by using the autorefractometer and according to the results, despite the final MRD1 was higher in 6 mm excision group the difference among the groups was not significant.

In conclusion, according to the upper eyelid position change analysis (which was measured by using an easily evaluable, cost-effective and standardized method), the amount of the excised tissue following the MMCR surgery and final upper eyelid position was not associated directly and the result supported the current literature which propose that, changes in the upper eyelid position following the MMCR is a dynamic process rather than the mechanical process.

REFERENCES

1. Bacharach J, Lee WW, Harrison AR, Freddo TF. A review of acquired blepharoptosis: prevalence, diagnosis, and current treatment options. Eye (Lond). 2021;35(9):2468-81.
2. Cohen LM, Rootman DB. Blepharoptosis Repair: External Versus Posterior Approach Surgery: Why I Select One over the Other. Facial Plast Surg Clin North Am. 2021;29(2):195-208.
3. Allen RC, Saylor MA, Nerad JA. The current state of ptosis repair: a comparison of internal and external approaches. Curr Opin Ophthalmol. 2011;22(5):394-9.
4. Rootman DB, Sinha KR, Goldberg RA. Change in Eyelid Position Following Muller's Muscle Conjunctival Resection With a Standard Versus Variable Resection Length. Ophthalmic Plast Reconstr Surg. 2018;34(4):355-60.
5. Zloto O, Kapelushnik N, Sharon T, Prat D, Leshno A, Ben Simon G. The Effect of Upper Eyelid Muller Muscle Conjunctival Resection Surgery on Lower Eyelid Position. Curr Eye Res. 2021;46(7):949-53.
6. Nacaroglu SA, Karabulut GO, Fazil K, Serefoglu Cabuk K, Kandemir Besek N, Taskapili M. Comparing the outcome of Muller's muscle conjunctival resection for mild/moderate versus severe involutional aponeurotic ptosis. Eur J Ophthalmol. 2021;31(6):3436-41.
7. Dryden SC, Rho JE, Fowler SC, Gannon EW, Houser KH, Fleming JC, et al. Postoperative Clinical Outcomes Using Standard Variables Following Levator-Mullerectomy Advancement Blepharoptosis Surgery. J Craniofac Surg. 2021;32(6):e554-e6.
8. Karadeniz Ugurlu S, Karakas M. Rehabilitation of Eyelid Malpositions Secondary to Facial Palsy. Turk J Ophthalmol. 2017;47(3):149-55.
9. Nemet AY. Accuracy of Marginal Reflex Distance Measurements in Eyelid Surgery. J Craniofac Surg. 2015;26(7):e569-71.
10. Zheng X, Kakizaki H, Goto T, Shiraishi A. Digital Analysis of Eyelid Features and Eyebrow Position Following CO(2) Laser-assisted Blepharoptosis Surgery. Plast Reconstr Surg Glob Open. 2016;4(10):e1063.
11. Boboridis K, Assi A, Indar A, Bunce C, Tyers AG. Repeatability and reproducibility of upper eyelid measurements. Br J Ophthalmol. 2001;85(1):99-101.
12. Ogasawara K. Application of Second-Generation Swept-Source Anterior Segment-OCT in the Measurement of Marginal Reflex Distance-1 (MRD-1). Clin Ophthalmol. 2020;14:635-42.
13. Rufer F, Schroder A, Erb C. White-to-white corneal diameter: normal values in healthy humans obtained with the Orbscan II topography system. Cornea. 2005;24(3):259-61.
14. Kovacic Z, Ivanisevic M, Plestina-Borjan I, Capkun V. [Automatic refractometry, reliability of the determination of type and degree of refraction anomalies]. Lijec Vjesn. 1998;120(6):162-4.
15. Yolcu D, Ozdogan S. A novel method to measure margin reflex distance using the autorefractometer. Int Ophthalmol. 2022;42(4):1241-7.
16. Roelofs KA, Margines JB, Chen T, Goodyear K, Goldberg RA, Rootman DB. Optimizing Management of Asymmetric Ptosis: A Comparison of

Three Posterior Approach Resection Algorithms. Ophthalmic Plast Reconstr Surg. 2023;39(1):72-5.
17. Dan J, Sinha KR, Rootman DB. Predictors of Success Following Muller's Muscle-Conjunctival Resection. Ophthalmic Plast Reconstr Surg. 2018;34(5):483-6.
18. Leung VC, Dupuis JE, Ashraf DC, Idowu OO, Massicotte E, Vagefi MR, et al. Muller Muscle Conjunctival Resection: A Multicentered Prospective Analysis of Surgical Success. Ophthalmic Plast Reconstr Surg. 2023;39(3):226-31.
19. Nishihira T, Ohjimi H, Eto A. A new digital image analysis system for measuring blepharoptosis patients' upper eyelid and eyebrow positions. Ann Plast Surg. 2014;72(2):209-13.

Ethics

Ethics Committee Approval: The study was approved by SBÜ University Dr. Abdurrahman Yurtaslan Ankara Onkoloji SUAM Noninterventional Clinical Research Ethical Committee (Decision no: 2022-05/85, Date: 26.05.2022).

Informed Consent: The authors declared that it was not considered necessary to get consent from the patients because the study was a retrospective data analysis.

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