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When Eyelid Height Is Not Enough: Margin Reflex Distance Is an Incomplete Predictor of Patient Satisfaction Following Aponeurotic Ptosis Surgery

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Abstract

Purpose: Margin reflex distance 1 (MRD1) is widely used as an objective measure of anatomical success following ptosis surgery. However, restoration of eyelid height does not always correspond with patient-perceived surgical success. This study evaluated the relationship between postoperative improvement in MRD1 and patient satisfaction following aponeurotic ptosis surgery and explored the limitations of MRD1 as a predictor of patient-reported outcome. **Methods:** A retrospective observational cohort study was performed using data from a prospectively maintained departmental audit of adult patients undergoing anterior levator aponeurosis advancement at a tertiary oculoplastic centre between January 2017 and October 2022. Unilateral and bilateral, primary and revision procedures were eligible. The primary analysis included 107 operated eyes with complete preoperative and postoperative MRD1 measurements and documented postoperative satisfaction. Associations between change in MRD1 (ΔMRD1) and postoperative satisfaction were evaluated using univariable and multivariable logistic regression. **Results:** The complete-case cohort comprised 107 operated eyes, of which 93 (86.9%) were satisfied and 14 (13.1%) were dissatisfied. Mean postoperative improvement in MRD1 was greater in satisfied than dissatisfied eyes (2.42 ± 1.15 mm versus 1.82 ± 1.27 mm). Each 1-mm increase in ΔMRD1 was associated with higher odds of satisfaction on univariable analysis (OR 1.59, 95% CI 0.95 - 2.67; p = 0.076), but ΔMRD1 was not independently associated with satisfaction after adjustment for age, sex, unilateral versus bilateral surgery, revision status and preoperative MRD1 (adjusted OR 1.25, 95% CI 0.69 - 2.26; p = 0.455). Of 89 eyes achieving postoperative MRD1 > 2 mm, nine (10.1%) were nevertheless

associated with dissatisfaction. **Conclusions:** Greater postoperative improvement in MRD1 was associated with higher patient satisfaction, but objective eyelid height alone did not fully explain patient-perceived success. Outcome assessment after ptosis surgery should combine anatomical measurements with patient-reported outcomes and, where feasible, standardised photographic assessment.

Keywords

Blepharoptosis, Ptosis Surgery, MRD1, Patient Satisfaction, Patient-Reported Outcomes, Levator Advancement

1. Introduction

Acquired aponeurotic ptosis is a common form of adult upper-eyelid ptosis and most often reflects age-related attenuation or dehiscence of the levator aponeurosis. In addition to altering appearance, ptosis may impair superior visual function and quality of life. Surgical correction therefore aims to restore eyelid position while improving both function and appearance [1] [2].

Anterior levator aponeurosis advancement is an established treatment for acquired aponeurotic ptosis. Surgical outcome is commonly quantified using margin reflex distance 1 (MRD1), defined as the distance between the corneal light reflex and the upper eyelid margin in primary gaze. MRD1 is simple to obtain in routine practice and is widely reported alongside symmetry and eyelid contour as an objective measure of outcome [3]-[5].

MRD1, however, captures only vertical eyelid position. Patients may judge the result according to a broader set of features, including symmetry, contour, crease position, visual improvement and overall facial appearance. The BOPSS National Ptosis Survey demonstrated that surgeon-defined objective success and patients' subjective assessment are not interchangeable, while qualitative and patient-reported outcome studies have highlighted functional, appearance and psychosocial benefits that extend beyond eyelid height alone [3] [6]-[8].

The primary aim of this study was to evaluate the relationship between postoperative improvement in MRD1 and patient satisfaction following aponeurotic ptosis surgery in a large single-centre audit cohort. A secondary aim was to identify cases in which objective anatomical improvement and subjective satisfaction diverged, thereby exploring the limitations of MRD1 as a standalone measure of surgical success.

2. Methods

2.1. Study Design

A retrospective observational cohort study was undertaken using data from a prospectively maintained departmental audit of aponeurotic ptosis surgery per-

formed at Leeds Teaching Hospitals NHS Trust, United Kingdom, a tertiary referral centre for oculoplastic surgery. The audit formed part of routine departmental clinical governance and outcome monitoring. Institutional review determined that the project constituted a service evaluation and therefore did not require formal Research Ethics Committee approval under applicable UK governance arrangements. All data were anonymised prior to analysis.

2.2. Patient Selection

The departmental audit included adult patients undergoing anterior levator aponeurosis advancement for acquired aponeurotic ptosis between January 2017 and October 2022. Both unilateral and bilateral procedures and both primary and revision operations were eligible. The audit comprised 135 operated eyes. For the primary statistical analysis, eyes were included only when numeric preoperative and postoperative MRD1 measurements and documented postoperative satisfaction were all available, yielding a complete-case cohort of 107 eyes. Eyes with incomplete MRD1 data or absent postoperative satisfaction documentation were excluded from regression analysis. Because the audit was recorded at eye level, eyes from bilateral procedures were analysed as separate surgical cases.

2.3. Surgical Technique

All procedures were performed using a standard anterior approach levator aponeurosis advancement technique. Following a skin-crease incision, the levator aponeurosis was identified, advanced and reattached to the superior border of the tarsal plate. Intraoperative adjustment of eyelid height and contour was undertaken with the patient awake. Procedures were performed by consultant oculoplastic surgeons or supervised oculoplastic fellows using the departmental technique.

2.4. Clinical Assessment

The audit recorded age, sex, laterality, primary or revision surgery, preoperative levator function, preoperative MRD1, postoperative MRD1 and postoperative patient satisfaction. MRD1 was measured clinically by the treating ophthalmologist as the distance between the corneal light reflex and the upper eyelid margin in primary gaze during routine outpatient examination. Measurements were obtained before surgery and at the routine postoperative review, typically four to six weeks after surgery. Change in MRD1 (ΔMRD1) was calculated as postoperative MRD1 minus preoperative MRD1. Patient satisfaction was documented at routine postoperative follow-up according to the patient's overall assessment of the surgical outcome and was dichotomised as satisfied or dissatisfied for analysis.

2.5. Outcome Measures

The primary objective outcome was ΔMRD1 and the primary subjective outcome was postoperative patient satisfaction. A secondary objective was to identify dis-

cordant cases in which satisfactory anatomical correction, defined a priori in the audit analysis as postoperative MRD1 > 2 mm, was not accompanied by patient satisfaction.

2.6. Statistical Analysis

Analyses were performed at eye level because the departmental audit contained one record for each operated eye. Continuous variables are presented as mean ± standard deviation or median where appropriate, and categorical variables as frequencies and percentages. Univariable logistic regression evaluated the association between ΔMRD1 and postoperative satisfaction. A prespecified multivariable logistic regression model adjusted for age, sex, unilateral versus bilateral surgery, revision surgery and preoperative MRD1. Odds ratios (ORs) with 95% confidence intervals (CIs) are reported. Because revision surgery demonstrated complete separation, a sensitivity analysis excluding revision status was also performed. Exploratory discordance analyses among eyes with postoperative MRD1 > 2 mm used Welch's t-test for continuous variables and Fisher's exact test for categorical variables. All tests were two-sided, with statistical significance defined as $p < 0.05$.

3. Results

3.1. Study Cohort

The departmental audit comprised 135 operated eyes undergoing anterior levator aponeurosis advancement for acquired aponeurotic ptosis. Complete preoperative and postoperative MRD1 measurements together with documented postoperative satisfaction were available for 107 eyes, which formed the complete-case cohort for the primary analysis. Of these, 93 eyes (86.9%) were classified as satisfied and 14 eyes (13.1%) as dissatisfied following surgery (Table 1). The mean postoperative improvement in MRD1 was 2.35 ± 1.18 mm. Eyes in the satisfied group demonstrated a greater mean improvement in MRD1 than those in the dissatisfied group (2.42 ± 1.15 mm versus 1.82 ± 1.27 mm, respectively; Table 2).

Table 1. Baseline characteristics of the departmental audit cohort.

Characteristic	Value
Total operated eyes	135
Mean age, years	67.9
Female sex	58.3%
Bilateral surgery	60.0%
Mean preoperative MRD1, mm	0.98
Mean postoperative MRD1, mm	3.10

Values are presented as mean or percentage, as appropriate. MRD1 = margin reflex distance 1.

Table 2. Postoperative MRD1 improvement according to patient satisfaction.

Patient satisfaction	N	Mean ΔMRD1 (mm)	SD	Median ΔMRD1 (mm)
Satisfied	93	2.42	1.15	2.0
Dissatisfied	14	1.82	1.27	2.0

ΔMRD1 = postoperative MRD1 − preoperative MRD1. The complete-case cohort included 107 eyes with complete MRD1 measurements and documented postoperative satisfaction.

3.2. Association between MRD1 Improvement and Patient Satisfaction

Univariable logistic regression demonstrated that each 1-mm increase in ΔMRD1 was associated with a 59% increase in the odds of postoperative satisfaction (OR 1.59, 95% CI 0.95 - 2.67; p = 0.076). Although the direction of association favoured greater anatomical improvement, the result did not reach statistical significance. In the prespecified multivariable model adjusting for age, sex, unilateral versus bilateral surgery, revision surgery and preoperative MRD1, ΔMRD1 was not independently associated with satisfaction (adjusted OR 1.25, 95% CI 0.69 - 2.26; p = 0.455; Table 3). Revision surgery produced complete separation because all complete-case revision procedures were satisfied, preventing reliable estimation of that coefficient. A sensitivity analysis excluding revision status produced similar findings (adjusted OR 1.51, 95% CI 0.86 - 2.67; p = 0.154).

Table 3. Multivariable logistic regression evaluating predictors of postoperative satisfaction (n = 107).

Predictor	Adjusted OR	95% CI	p value
ΔMRD1 (per 1 mm)	1.25	0.69 - 2.26	0.455
Age (per year)	0.99	0.95 - 1.04	0.796
Female sex	0.53	0.12 - 2.25	0.389
Bilateral surgery	0.60	0.15 - 2.45	0.481
Revision surgery	Not reliably estimable	Complete separation	Not interpretable
Preoperative MRD1 (per 1 mm)	0.83	0.36-1.92	0.656

OR = odds ratio; CI = confidence interval; ΔMRD1 = postoperative minus preoperative MRD1. Revision surgery could not be estimated reliably because all complete-case revision procedures were satisfied, resulting in complete separation.

3.3. Discordance between Anatomical Success and Patient Satisfaction

Among eyes achieving postoperative MRD1 > 2 mm, 89 met the predefined criterion for anatomical success. Nine of these eyes (10.1%) were nevertheless associated with postoperative dissatisfaction. Exploratory analyses demonstrated no significant relationship between discordance and age (p = 0.825), sex (p = 0.506) or

unilateral versus bilateral surgery (p = 1.000). No revision procedures were present within this subgroup, precluding assessment of revision status (Table 4). These findings demonstrate that satisfactory postoperative eyelid height does not invariably translate into a satisfactory patient-reported outcome.

Table 4. Characteristics of eyes with postoperative MRD1 > 2 mm according to satisfaction.

Characteristic	Dissatisfied (n = 9)	Satisfied (n = 80)	p value
Age, years (mean ± SD)	69.6 ± 11.3	68.6 ± 13.7	0.825
Female sex	6 (66.7%)	43 (53.8%)	0.506
Bilateral surgery	1 (11.1%)	16 (20.0%)	1.000
Revision surgery	0	0	Not estimable
Mean ΔMRD1, mm	2.33	2.59	Exploratory

Exploratory analysis of eyes achieving postoperative MRD1 > 2 mm. Welch's t-test was used for continuous variables and Fisher's exact test for categorical variables.

4. Discussion

This study evaluated the relationship between objective eyelid elevation and patient satisfaction following aponeurotic ptosis repair using data from a prospectively maintained departmental audit. Greater postoperative improvement in MRD1 was associated with higher odds of satisfaction on univariable analysis, but the association was attenuated after adjustment and was not statistically significant. Importantly, 10.1% of eyes meeting the predefined postoperative MRD1 threshold for anatomical success were associated with dissatisfaction. Together, these findings suggest that MRD1 alone is an incomplete surrogate for successful ptosis surgery.

This distinction is consistent with the wider ptosis literature. Objective outcome reporting frequently incorporates MRD1, inter-eyelid symmetry and contour [3]-[5] [9], whereas patient-centred studies demonstrate benefits across visual function, appearance and quality of life [2] [6]-[8]. The BOPSS National Ptosis Survey is particularly relevant: patients were often less critical than surgeons when judging outcome, illustrating that objective and subjective definitions of success capture different aspects of recovery [3].

The discordance observed in the present cohort is biologically and clinically plausible. MRD1 measures central vertical eyelid height but does not quantify eyelid contour, crease position, brow position, dermatochalasis, ocular surface symptoms or the patient's expectations. Studies evaluating ptosis outcomes have therefore commonly reported symmetry and contour alongside MRD1, and qualitative work demonstrates that appearance-related and psychosocial considerations can be important to patients [4]-[6].

The findings have practical implications for both counselling and audit. Preoperative discussion should make clear that achieving an appropriate eyelid height is only one component of a satisfactory result. Likewise, departmental outcome assessment should avoid equating MRD1 with patient-perceived success. Validated pa-

tient-reported outcome measures can capture dimensions that anatomical measurements cannot, and recent evidence reviews continue to support the value of health-related quality-of-life assessment after blepharoptosis surgery [7] [8] [10].

Strengths of this study include the use of a prospectively maintained departmental audit reflecting routine clinical practice, a clinically relevant complete-case cohort, and inclusion of both primary and revision procedures. The analysis also directly addresses an important but often implicit assumption in ptosis outcome reporting: that greater anatomical elevation necessarily translates into greater satisfaction.

Several limitations should be acknowledged. This was a retrospective, single-centre analysis and was restricted to variables routinely collected within the audit. Satisfaction was based on routine clinical documentation rather than a validated patient-reported outcome instrument. Analyses were performed at eye level, so observations from bilateral procedures were not statistically independent; this may lead to underestimation of standard errors and should be considered when interpreting the regression results. The number of dissatisfied eyes was small, limiting statistical power and the number of covariates that could be estimated reliably. Revision status produced complete separation in the primary multivariable model. Finally, postoperative photographs were not analysed quantitatively, preventing objective assessment of contour and symmetry as potential determinants of satisfaction. These findings should therefore be regarded as hypothesis-generating and would benefit from prospective validation using patient-level analysis, standardised photography and a validated PROM.

5. Conclusion

Greater postoperative improvement in MRD1 was associated with higher patient satisfaction, but objective eyelid height alone did not independently predict patient-perceived surgical success after adjustment. A proportion of anatomically successful eyes remained associated with dissatisfaction, highlighting the importance of factors beyond eyelid position. Future assessment of ptosis surgery should combine objective anatomical measurements with validated patient-reported outcomes and standardised photographic assessment.

Ethics and Governance

Institutional review determined that this analysis of the departmental audit constituted a service evaluation and did not require formal Research Ethics Committee approval. Data were anonymised before analysis.

Consent for Publication

No identifiable patient images are included in this manuscript.

Data Availability

The data analysed were derived from a departmental clinical audit. Any data sharing would be subject to the host institution's information-governance requirements.

Author Contributions

Christine Safieh contributed to study conception and design, data collection, data analysis and interpretation, and drafting of the manuscript. Gabriella Guevara, George Kalantzis and Bernard Chang contributed to interpretation of the findings, critical revision of the manuscript for important intellectual content, and supervision. All authors reviewed and approved the final manuscript and agree to be accountable for the work.

Conflicts of Interest

The authors report no relevant financial or non-financial competing interests.

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