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ORIGINAL RESEARCH

A Comparison of Superior Visual Field Defect in Single Eyelid Population with and without Compensatory Brow Elevation

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Abstract

Background: Single eyelid is a unique characteristic in East and South-East Asian. Narrow palpebral fissure with compensatory elevation of eyebrows is common in this group. This study aims to demonstrate the correlation between superior visual field defect and MRD1 without lifting of the overhanging skin (MRD1w) in single eyelid population.

Methods: Fifty healthy single eyelid volunteers were included. Outcome measurement included visual acuity, MRD1w, MRD2 and superior 64-point screening test visual field. MRD1w measurement and visual field testing with suppression of frontalis muscle were also performed.

Results: A total of 38 visual field results from the right eye of 38 subjects were analyzed. Twelve fields were excluded due to high false negative error results. There were 22 female and 16 male subjects. The mean MRD1w was 2.25 +/- 0.99 mm and the superior visual field at the 90-degree vertical meridian was 45.34o +/- 4.88o. There is a positive correlation of MRD1w and superior 90-degree vertical meridian visual field ($r = 0.64$, $p < 0.0001$). The mean superior visual field with frontalis suppression was significantly lower when compared to subject natural brow position (40.17o +/- 7.84o, $p < 0.0001$).

Conclusions: Superior visual field defect in single eyelid population is correlated to MRD1w value. Compensatory brow elevation might alleviate symptoms but surgical correction for functional purpose should also be considered.

Keywords

Blepharoptosis, Visual field defect, Eyelid crease

Introduction

East and South-East Asian eyelids have unique characteristics. The most obvious characteristic is the absence or very low eyelid crease and smaller palpebral fissure. The prevalence of single eyelid in Asia vary by country and range from 20-60% [1,2]. In single eyelid, a shorter vertical and horizontal palpebral fissure is usually evidenced due to redundant skin overhang in the eyelid margin, lower marginal reflex distance 1 (MRD1) and presence of the epicanthal fold. Compensatory elevation of eyebrows is common in this group and result in forehead line and wider distance between eyelid margined and eyebrow. An automated perimetry is an eye examination instrument to systematically test the visual field. It can be used to document a functional surgical purpose in blepharoptosis correction. Several studies reported superior visual field defect in congenital and senile blepharoptosis but no study has performed the visual field test in young healthy single eyelid subjects. Evidence of comparable degree of vision functioning compromised in this group should certified corrective surgery as well. This study aims to demonstrate the correlation between superior visual field defect and MRD1 without lifting of the overhanging skin (MRD1w) in young Asian single eyelid population.

Methods

Following Institutional Review Board approval, 50 healthy single eyelid volunteers were included into the study. The study was conducted at King Chulalongkorn Memorial Hospital during March to May 2015. Study subjects were between 18-35 years old with no history or clinical evidence of previous eyelid surgery, glauco-

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ma or glaucoma suspected or other diseases that potentially affect visual field.

After informed consent was obtained, eyelid examinations were performed, and digital photographs were taken. Subject characteristic data collected included age, gender, Snellen visual acuity, MRD1w, MRD1w with frontalis suppression, MRD2, levator function, presence of epicanthal fold and permanent forehead line. The MRD1w measurement was performed without upper eyelid skin lift and was a distance between the corneal light reflex to the lowest skin margin. The MRD1w was first measured at the subject natural brow position. The frontalis muscle was then suppressed with investigator finger to measure MRD1w with frontalis suppression. The brow at rest position was determined by having subjects close their eyes to eliminate compensatory brow elevation. The elevator function is estimated by measuring the upper eyelid excursion, from downgaze to upgazed with frontalis muscle function suppression with digital pressure. The superior visual field test was performed with Carl Zeiss Humphrey Field Analyzer (HFA II, model 750i) using the superior 64-point screening test program. Each subject performed the test twice, one with and one without frontalis suppression, in random order. Subjects with unreliable visual field results were excluded.

Only visual field test results from the right eye of each subject was selected for analysis. Descriptive statistics were used to assess baseline characteristics and degree of superior visual field defect. Pearson correlation was used to show the correlation between MRD1w and superior visual field. Differences in all parameter measurements between with and without frontalis suppression were recorded in mean +/- SD. Significance of differences between group means were determined by using the descriptive statistic pair t-test. All statistical tests were two tailed and statistical significance was defined as $p < 0.05$. All statistical analysis was carried out using the SPSS for Windows software version 17.0. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Results

A total of 38 visual field results from the right eye of 38 subjects were analyzed. Twelve visual fields were excluded due to high false negative error. Of those, 16 were male and 22 were female with an average age of 24.04 years. Subject baseline characteristics are summarized in Table 1. The mean MRD1w and MRD1w with frontalis suppression was 2.25 +/- 0.99 mm and 1.38 +/- 1.27 mm, respectively. The epicanthal fold was present in all subjects. The average visual field test time was 3.04 minutes.

Table 1: Single eyelid subject baseline characteristics.

Baseline characteristics	
Sex	
Female	22 (57.89%)
Male	16 (42.11%)
Age	24.04 +/- 4.82 years
Forehead line	5 (13.56%)
Bell phenomenon	38 (100%)
Palpebral fissure	6.62 +/- 1.34 mm
MRD1w	2.25 +/- 0.99 mm
MRD1w with frontalis suppression	1.38 +/- 1.27 mm
Levator function	13.55 +/- 2.36 mm
Epicenthal fold	
Severity	
mild	11 (28.95%)
moderate	21 (55.26%)
severe	6 (15.79%)
Type	
Tarsalis	22 (57.89%)
Palpebralis	16 (42.11)

MRD1w marginal reflex distance 1 without lifting of the overhanging skin.

Table 2: The mean superior visual field at 90° meridian according to each MRD1w value. Fractional percentage decrease in superior visual field was calculated using 50° as the normal value.

MRD1w (mm)	Number of eyes	Superior visual field 90° meridian (degree)	Fractional percentage (%)
≤ 0 mm	1	31.67	63.34
1 mm	7	41.90	83.80
2 mm	11	44.08	88.16
3 mm	10	47.84	95.68
4 mm	2	48.65	97.3

The mean superior visual field at 90-degree vertical meridian was 45.34o +/- 4.88o. Nasal field area is shown to be smaller than temporal field. The mean superior visual fields at 90-degree meridian according to each MRD1w value are shown in Table 2. There is a positive correlation of MRD1w and superior visual field at 90-degree meridian ($r = 0.64$, $p < 0.0001$). The mean superior visual field with frontalis suppression was significantly lower when compared to subject natural brow position (40.17o +/- 7.84o, $p < 0.0001$).

Discussion

A large percentage of East and South-East Asians are single eyelid. Several studies proposed that the causes of absent or lower eyelid crease include thicker soft tissue layer esp. orbicularis oculi muscle and submuscularis fibroadipose tissue (SMFAT), weaker dermal extension of levator aponeurosis, and lower fusion point of orbital septum and levator aponeurosis [3-5]. However, none of those theories have been universally accepted

and current evidence suggests multiple factors are responsible for eyelid crease formation. The small vertical palpebral fissure in single eyelid is due to lesser MRD1 and redundant skin overhang the eyelid margin. We observed small vertical palpebral fissures in single eyelid and wider distance between eyebrow and eyelid margin due to compensatory brow elevation. Subconscious elevation of eyebrow due to superior view obscuration in young single eyelid group has been noted but no study performed automated visual field testing to detect superior visual field defects in this group of subjects.

MRD1 values vary among different ethnic groups (African American, Asian, White, Latino) with the lowest mean MRD1 of 3.8 +/- 1.1 mm in Asian [6]. A wide range of ethnicities exist within Asia, all with their own individual unique eyelid characteristic. Within Asian populations, Chinese showed the lowest mean MRD1 value of 2.8 mm (range 2-3.5 mm) [7]. Lee, et al. reported a significantly lower mean MRD1 in single eyelid when compared to double eyelid [8]. Our study shows a lower MRD1w value when comparing to all previous studies due to two factors. First, our value is not a true MRD1. Our MRD1w is the distance from the pupillary light reflex to the lowest skin margin, not the eyelid margin. We intentionally used this value as it represents subject's actual pupil-lid position in everyday life. Second, the lower MRD1w value was caused by selection bias. Our single eyelid subjects with small palpebral fissure wanted to check their superior visual field and volunteered to participate.

From a national survey of ASOPRS members, 87.4% perform preoperative visual field testing prior to blepharoplasty and blepharoptosis repair. Humphrey superior 64-point screening test program perimetry is the most commonly used algorithm [9]. Normal visual field testing is described as 60 degrees superior and nasal, 70 degrees inferior and 100 degrees temporal to fixation [10]. Our study shows 45.34o +/- 4.88o mean superior visual field at the 90-degree vertical meridian. The lower than normal superior field is obviously due to the lower MRD1w. The MRD1w value also shows a positive correlation with the superior visual field. A previous article using specially designed contact lenses to simulate blepharoptosis reported 8 degrees of superior visual field loss with each mm difference of level of opacification [11]. We found 3 degrees of field loss with each mm lower of MRD1w. The effect was not linear and more field loss per each mm was observed with lesser MRD1w. Previous articles quantitating visual field loss in senile blepharoptosis and dermatochalasis showed a higher degree of field loss in the superotemporal quadrant [12]. However, in the young single eyelid group, characteristics of lower superonasal field comparing to superotemporal field was noted. A presence of the epicanthal fold at the medial canthal angle area should be responsible for the lower field. Noteworthy, the epicanthal fold is presented in all of our single eyelid subjects. Most single eyelid subjects with superior field defect subconsciously use their frontalis muscle to compensate field loss. In young subjects, elevation of the eyebrow is less noticeable due to lack of forehead line. Attention on the distance between eyebrow and eyelid margin is useful in this group. The mean MRD1w value in this study decreased significantly with frontalis suppression. The statistically significant different superior visual field defect was also noted. In aponeurotic blepharoptosis patient, forehead wrinkles or hyperactive frontalis muscle can be found with prolonged compensation and causes senile appearance. Five subjects demonstrated permanent forehead line which is unusual in the young. Currently accepted functional indications for surgery in blepharoptosis and dermatochalasis are: MRD1 of 2 mm or less, superior visual field loss of at least 12 degrees or 24%, downgaze ptosis impairing reading and other close-work activities, a chin-up backward head tilt due to visual axis obscuration, symptoms of discomfort or eye strain due to droopy lids and central visual interference due to upper eyelid position [13]. In our study, there were 19 subjects (47.5%) with MRD1w of 2 mm or less and 3 subjects (7.5%) with more than 12 degrees of visual field loss. None were aware of their visual field loss and no one reported symptoms associated with visual impairment. We propose same functional indications to perform double eyelid surgery in this group especially when superior visual field deficits are documented. There are a few limitations of this study. Firstly, MRD1w measurement could be inaccurate. This value is dynamic and is affected greatly by subject attention. During visual field testing, some subjects might elevate their brow higher than their natural position, making visual field test results better than expected. We excluded 12 subjects due to this high false negative error. These subjects performed well initially but later had poorer visual field results. From our observations, their palpebral fissure decreased as their frontalis muscle became fatigued and a variability of the force from frontalis suppression during visual field testing could also cause erroneous in the result. Secondly, static perimetry may be less sensitive when compared to kinetic perimetry in finding visual field loss in blepharoptosis patients [13]. Thirdly, a roof and floor effect resulted from the visual testing technique. The upper limit of the visual field-testing scale in Humphrey Field Analyzer was 49.98 degrees, not 60 degrees. Nevertheless, only 14 subjects (36.84%) were able to reach the highest at 49.98 degrees.

Conclusion

In conclusion, a superior visual field defect in single eyelid population is correlated to MRD1 value. Compensatory brow elevation might alleviate symptoms but surgical correction for functional purpose should also be considered.

Acknowledgements

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