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Retrospective Analysis of the Effect of Hering's Law on Outcomes of Surgical Correction of Ptosis

Er Pan, PhD,* Jiangang Yu, BD,* Shengchang Zhang, MS,* Yunfei Nie, MS,* and Qin Li, MD†

Introduction: Several factors may influence aesthetic outcomes of ptosis surgery, especially in patients with asymmetrical ptosis. We retrospectively assessed the effect of Hering's law on surgical outcomes of patients with asymmetrical ptosis.

Methods: Patients with mild to moderate asymmetrical ptosis (N = 300) who underwent advancement or plication of upper eyelid aponeurosis between January 2014 and July 2016 were enrolled. Fifty patients (group A) underwent surgery without taking into consideration the impact of Hering's law. Of these, 35 patients with unilateral ptosis (subgroup A1) underwent standard surgery on the contralateral side, whereas 15 patients with bilateral ptosis (subgroup A2) were first operated on the milder side followed by the more severely affected side.

In 250 patients (group B), surgery was performed taking cognizance of the implications of Hering's law. These included 100 patients with unilateral ptosis (B1) and 150 with bilateral ptosis (B2). Difference in bilateral palpebral fissure symmetry by less than 0.5 mm was considered as satisfactory outcome.

Results: Duration of postoperative follow-up ranged from 3 to 24 months. Satisfactory outcomes were achieved over 60% of patients in group A (A1, 60.6%; A2, 66.67%) and in 96% of patients in group B (B1, 95%; B2, 96.67%). Patients with unsatisfactory outcomes underwent repair according to Hering's law after 3 months and obtained good results.

Conclusions: Application of Hering's law may improve outcomes of corrective surgery in patients with asymmetric ptosis.

Key Words: Hering's law, asymmetric ptosis, upper eyelid aponeurosis

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Patients with ptosis usually require surgical correction of the unaesthetic eyelid. Correction of blepharoptosis and achievement of bilateral symmetry of eyelids is necessary to achieve aesthetic outcomes. However, difference in the palpebralis strength between the 2 sides affects surgical outcomes. The upper eyelid aponeurosis surgery usually causes an increase in lid height at the ptotic side over the contralateral side. Approximately, 17% of patients experience decrease in contralateral eyelid height by greater than 1 mm.¹ Therefore, achievement of bilateral symmetry of eyelids is challenging.

The Hering's law implies that the eyes cannot focus on the same target unless the bilateral extraocular muscles simultaneously receive equal nervous impulse.² The effect of Hering's law is observed in the palpebralis muscle function.³ The nervous impulse that augments the strength of muscles on the ptotic side also has an equivalent effect on

the contralateral eye, which manifests as a compensatory increase in strength of levator palpebrae superioris on the contralateral side. The effect of the nervous impulse attenuates when the ptotic eye is covered by hand or is treated by drugs, which results in the drooping of the contralateral upper eyelid. Generally, it is only thought significant when the contralateral upper eyelid decreases by greater than 1 mm or Hering's phenomenon is elicited. However, some scholars considered that any change or decrease greater than 0.5 mm is meaningful.²

Although several methods are used to correct mild to moderate ptosis, patient satisfaction with surgical outcomes with respect to binocular symmetry is typically difficult to achieve. In this study, we retrospectively compared the effect of application of Hering's law in a study involving 300 patients with mild to moderate ptosis. The objective was to provide new insights that may aid operative planning and improve aesthetic outcomes in these patients.

MATERIALS AND METHODS

Clinical Information

All patient photographs used in the article are duly approved for publication purposes by the respective patients. A total of 300 patients (20 men and 280 women; mean age, 30 [18–45] years) with mild to moderate asymmetrical ptosis who had undergone advancement or plication of upper eyelid aponeurosis between January 2014 and July 2016 were enrolled. The patients were divided into 2 groups, which were further divided into 2 subgroups.

Fifty patients in whom surgery was performed without taking into consideration the impact of Hering's law were included in group A. Of these, 35 patients with unilateral ptosis underwent standard surgery on the contralateral side (group A1), whereas 15 patients with bilateral ptosis were first operated on the milder side followed by the more severe side (group A2).

In 250 patients, surgery was performed taking cognizance of the implications of Hering's law; these patients were included in group B. One hundred patients had unilateral ptosis and underwent surgery at 0.5 to 1 mm lower than the eyelid on the unaffected side (subgroup B1), whereas 150 patients with bilateral ptosis first underwent correction surgery at the more severely affected eye at 0.5 to 1 mm lower than the corneal limbus and followed by that at the contralateral eye.

All patients underwent complete ocular examination and exhibited positive Bell's sign. Ptosis caused by jaw winking syndrome, myasthenia gravis, or sympathetic nerve were excluded. Presence of Hering's phenomenon was tested before surgery.

Operation Method

The bilateral blepharoplasty line was drawn before surgery according to the laxity of the cutis. Patients received 1% lidocaine with 1:200,000 epinephrine local infiltration anesthesia and periorbital nerve block. The skin was incised, and orbital septum was exposed by blunt dissection of the orbicularis oculi muscle. Next, the orbital septum fat was pushed up to expose the upper eyelid aponeurosis. After release

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Reprints: Qin Li, MD, Department of Plastic Surgery, General Hospital of Guangzhou Military Command of PLA, Guangzhou 510010, China. E-mail: liqinl@163.com.

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of the fibrous tissue, the aponeurosis was clipped and the tarsal plate exposed.

Upper eyelid aponeurosis folding was performed in patients with mild ptosis, whereas upper eyelid aponeurosis advancement was performed in those with moderate ptosis. The operation was performed based on the standard that 4 mm shortening of musculus levator elevates the eyelid by 1 mm. The actual shortening or the extent of folding was performed based on the intraoperative observation. The surgical correction height was at the line tangential to the corneal limbus or 1 mm below the corneal limbus. The operation was performed under local anesthesia, and the patient was asked to open the eyes to observe the symmetry. The lower orbicularis oculi muscle of the incision was fixed to the tarsus or to the tissue anterior to the tarsus at the corresponding height; the left orbicularis oculi muscles on the upper and lower incision were then sutured to form double eyelids.⁴

Postoperative Treatment

Patients with slight hypophasis were treated by routine oculentum and eye drops to protect the eye till closure of the palpebral fissure was achieved.

Statistical Analysis

The pupil exposure distance was measured on the median line of the bilateral pupils during subsequent visits or from head up photographs. Palpebral fissure height difference less than 0.5 mm was considered as satisfactory. All patients were followed up for at least 3 months. All statistical analyses were performed with IBM SPSS 22.0 software (SPSS, Chicago, Ill). Between-group differences were assessed by Pearson χ^2 test. $P < 0.05$ was considered as statistically significant.

RESULTS

Duration of postoperative follow-up ranged between 3 and 24 months (Fig. 1). The satisfaction rate in group A was better than 60% (57.14% in subgroup A1 and 66.67% in subgroup A2), whereas that in group B was 96% (95% in subgroup B1 and 96.67% in subgroup B2; Table 1). In patients with unsatisfactory outcomes, such as pupil exposure difference larger than 0.5 mm, repeat surgical repair based on Hering's law was performed after 3 months and good results were obtained.

DISCUSSION

With an increase in aesthetic consciousness and requirements, the application of Hering's law has gradually received more attention in the correction of ptosis. Bodian⁵ reported that about 10% patients may experience contralateral ptosis because of Hering's law unless bilateral ptosis surgery is performed. Thus, effective application of Hering's law in asymmetric ptosis is of great significance.

TABLE 1. Comparison of Satisfaction With Surgical Outcomes

Group	Satisfaction		Total	χ^2	P
	No	Yes			
A1	15 (42.86%)	20 (57.14%)	35 (100%)	29.44	<0.001
B1	5 (5%)	95 (95%)	100 (100%)		
A2	5 (33.33%)	10 (66.67%)	15 (100%)	21.56	<0.001
B2	5 (3.33%)	145 (96.67%)	150 (100%)		
A	20 (40%)	30 (60%)	50 (100%)	60.00	<0.001
B	10 (4%)	240 (96%)	250 (100%)		

Data presented as n (%).

Whether the Hering's phenomenon should be taken into consideration to determine the need for bilateral ptosis operation is controversial. Zoumalan and Lisman⁶ opted for bilateral surgery since 10% to 20% unilateral ptosis patients elicited a Hering's phenomenon in preoperative test. Nemet⁷ adopted bilateral operation based on preoperative Hering's phenomenon and intraoperative contralateral upper eyelid changes. In the present study, the satisfaction rate in group B1 (patients with unilateral ptosis in whom the Hering's law was taken into consideration) was significantly higher than that in group A1. The results indicate that Hering's law should be taken into consideration in patients undergoing corrective surgery for unilateral ptosis irrespective of positive Hering's phenomenon.

There are several methods to assess the existence of Hering's phenomenon; these include improving test, cover test, and phenylephrine test. However, their specific detection opportunity is still controversial. Improving test is most widely used for ptosis detection, whereas there is little consensus on the supporting time of upper eyelid.^{3,6,8-10} Cover test is the most sensitive of the 3 methods, whereas the reported cover time has varied from 15 seconds to 5 minutes.^{6,11} Phenylephrine test observes the Muller muscle contraction using 2.5% dehydrogenated adrenaline hydrochloride, while the waiting time is still uncertain.¹² In addition, all of these methods cannot be applied under all conditions by all ophthalmologists. Therefore, we did not examine Hering's phenomenon in the present study.

For patients with asymmetric ptosis, bilateral correction achieved symmetric results in 97.8% of patients with positive Hering's phenomenon, whereas it was only 76.6% in the staged operation group.¹³ In the present study, patient satisfaction rate in group B2 was 96.67%, as against only 66.67% in the group A2. However, in some reports, the change in contralateral eye position among patients with positive Hering's phenomenon was not significantly different from those with negative Hering's phenomenon.¹⁴

Palpebralis function detection is an important factor in the diagnosis of ptosis, although its correlation with Hering's phenomenon has



FIGURE 1. The clinical performance of unilateral and asymmetric ptosis. A, Unilateral ptosis before and after surgery. B, Asymmetric ptosis before and after surgery.

seldom been investigated. Nemet¹⁵ did not find any association between Hering's phenomenon and palpebralis function in a study of 35 patients with congenital ptosis. In a study by Lai et al,¹⁶ only 17.6% of patients with unilateral ptosis who had poor palpebralis function exhibited a positive Hering's phenomenon. Up to now, the relationship between palpebralis function and the Hering's phenomenon is not clear. Therefore, in the present study, we did not classify the subjects based on lack of palpebralis function. However, our results showed that application of Hering's law was not affected by the palpebralis function, which can be used by ophthalmologists for reference.

Several studies have refuted any significant influence of Hering's law on ptosis correction. In a study by Zoumalan and Lisman,⁶ only 10% to 20% of patients exhibited a Hering's phenomenon. Similarly, Erb et al¹⁴ found no obvious impact of the Hering's phenomenon on the change in position of the contralateral eyelid. Several factors may affect the evaluation of the Hering's phenomenon, such as the underlying pathology, measurement, and dominant eye phenomenon. For instance, Lepore¹⁷ did not find any significant change in the position of the contralateral eyelid with use of Hering's phenomenon contraction test and cover test in 21 patients with unilateral or asymmetric ptosis. Further in-depth investigation is needed to better evaluate the role of Hering's law in ptosis operation.

In conclusion, the influence of Hering's law on the bilateral eye homeostasis should be taken into consideration in ptosis operation design. Application of Hering's law in asymmetric ptosis correction may help achieve aesthetic outcomes and improve patient satisfaction.

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