Title

Infrabrow Excision Blepharoplasty for Dermatochalasis Patients Can Improve Headache and Stiff Neck as well as Ptosis Repair for Aponeurotic Blepharoptosis Patients

Author

Kosaku YAMAMICHI M.D.[1,2]; Satoshi TAKAGI M.D., Ph.D.[2]; Akiko ETO M.D.[2]; Hiroyuki OHJIMI M.D., Ph.D.[2]

1. Affiliation

Department of Plastic and Reconstructive Surgery, Fukuoka Sanno Hospital, Fukuoka, Japan

2. Affiliation

Department of Plastic, Reconstructive, and Aesthetic Surgery, Faculty of Medicine, Fukuoka University, Fukuoka, Japan.

Abstract

Purpose: Dermatochalasis and aponeurotic blepharoptosis patients may complain of headache and stiff neck. The purpose of this study is to compare the differences in the symptom severity of headache and stiff neck between dermatochalasis patients who underwent infrabrow excision blepharoplasty and aponeurotic blepharoptosis patients who underwent levator advancement.

Methods: A two-center retrospective case control study was performed from April 2012 to December 2016, in which a total of 127 Japanese patients were enrolled. The patients included 67 dermatochalasis patients (age 68.3 ± 9.6 years) who underwent infrabrow excision blepharoplasty and 60 aponeurotic blepharoptosis patients (56.4 ± 12.4 years) who underwent levator advancement. We evaluated the severity of headache and stiff neck using a self-reported numeric rating scale (NRS) before and after surgery. Upper eyelid position (UEP) and eyebrow position (EBP) were measured using our in-house-developed software “Image Rugle” and digital photographs before and after surgery.

Results: Before surgery, the dermatochalasis group experienced tension-type headache with a score of 5.24 and stiff neck with a score of 5.60 on the NRS. Both symptoms improved after infrabrow excision blepharoplasty to scores of 0.96 ($P < 0.001$) and 1.96 ($P < 0.001$), respectively. Before surgery, the aponeurotic blepharoptosis group experienced headache with a score of 5.49 and stiff neck with a score of 6.34 on the NRS. Both symptoms also improved after levator advancement to scores of 1.01 ($P < 0.001$) and 2.28 ($P < 0.001$), respectively. The UEP was significantly elevated, and the EBP was significantly lower after surgery in both groups. Preoperative UEP was significantly lower in the aponeurotic blepharoptosis group than in the dermatochalasis group. In the aponeurotic blepharoptosis group, a statistically significant negative correlation was observed between headache change and UEP change (Spearman rho, −0.33, $P = 0.035$). No statistically significant correlation was observed between changes in the symptoms and in the UEP/EBP in the dermatochalasis group.

Conclusions: The results of this study suggest that infrabrow excision blepharoplasty for dermatochalasis can improve headache and stiff neck and can also cause the UEP to

be elevated and the EBP to be lowered. These findings were similar to those obtained following levator advancement for aponeurotic blepharoptosis.

Key words; dermatochalasis, aponeurotic blepharoptosis, infrabrow excision blepharoplasty, levator advancement, headache, stiff neck

Correspondence to

Hiroyuki OHJIMI M.D., Ph.D.

Department of Plastic and Reconstructive Surgery, Fukuoka University School of Medicine, 7-45-1 Nanakuma, Jonan-ku, Fukuoka 814-8180, Japan.

E-mail: ohjimi@fukuoka-u.ac.jp

TEL: 092-801-1011 (ext. 2391)

Introduction

Dermatochalasis is a common age-related upper eyelid change caused by redundant skin drooping over the upper lid margin, and its frequency of onset increases with age. The condition is more likely to be observed in Asians than in Caucasians due to the thicker upper eyelid skin; more pretarsal, suborbicularis fat; and less prominent supraorbital rims[1]. Blepharoplasty to remove redundant skin at the supratarsal fold is a common surgical procedure[2,3]. However, this technique has some drawbacks for Asians, such as a long scar, discrepancies in skin thickness, and prolonged recovery time[4]. Infrabrow excision blepharoplasty was developed in recent years to overcome these drawbacks [4,5].

Dermatochalasis affects the patient's visual field, similar to aponeurotic blepharoptosis. Dermatochalasis and aponeurotic blepharoptosis patients complain of a feeling of weight in the upper eyelid. Headache and stiff neck have been reported as symptoms associated with dermatochalasis in recent years[6~10]. For aponeurotic blepharoptosis patients, headache was reported to improve with aponeurotic repair[6,9]. Aponeurotic blepharoptosis is caused by dehiscence of levator aponeurosis from tarsus

or thinning of it due to upper lid aging-related changes, and external levator advancement and Muller muscle conjunctival resection are common surgical forms[11]. It has also been reported that headache in dermatochalasis patients similarly improved with blepharoplasty [9]. However, there have been no studies on infrabrow excision blepharoplasty for dermatochalasis patients to examine the influence on headache and stiff neck.

The purpose of this study is to evaluate the changes in headache and stiff neck in dermatochalasis patients and the effect of infrabrow excision blepharoplasty on these symptoms and to compare the results with those obtained following levator advancement for aponeurotic blepharoptosis patients. We also assessed the correlation between changes in headache, stiff neck, upper eyelid position (UEP), and eyebrow position (EBP).

Patients and Methods

A two-center case control study was conducted on 127 Japanese patients. The patients included 67 dermatochalasis patients treated with infrabrow excision

blepharoplasty and 60 aponeurotic blepharoptosis patients treated with levator advancement from April 2012 to December 2016 at the Department of Plastic and Reconstructive Surgery, Fukuoka University Hospital and Fukuoka Sanno Hospital in Fukuoka, Japan.

Patients who complained of peripheral visual field impairment due to dermatochalasis without aponeurotic blepharoptosis and required skin resection width of 10 mm or more were indicated for infrabrow excision blepharoplasty. Patients who complained visual field loss with aponeurotic blepharoptosis and required skin resection width of less than 10mm were indicated for levator advancement. The patients who underwent simultaneous bilateral surgery were included, and the patients who underwent unilateral surgery were excluded. Obvious secondary headache was ruled out by a neurosurgeon based on the criteria specified by the international headache society[12]. Patients with a history of neurologic disorder, trauma, systemic disease, musculoskeletal disorder, blepharospasm, previous eyelid surgery, or botulinum toxin injection, as well as those who underwent reoperation, simultaneous surgery for external

levator advancement and infrabrow excision blepharoplasty, eyelid surgery for cosmetic purposes, the patients whose images were with poor quality have been also excluded.

The subjects consisted of 93 women and 34 men, with an average age of 62.7 ± 12.5 years old. Sixty seven patients (134 eyelids) who underwent infrabrow excision blepharoplasty for dermatochalasis (average age 68.3 ± 9.6) were classified as Group 1, and 60 patients (120 eyelids) who underwent levator advancement for aponeurotic blepharoptosis (average age 56.4 ± 12.4) were classified as Group 2.

This study was approved by the Ethical Review Boards of Fukuoka University Hospital (ethical review no. 2017M155) and Fukuoka Sanno Hospital (ethical review no. FS-255).

Surgical methods

Infrabrow excision blepharoplasty[4] for dermatochalasis and levator advancement[13,14] for aponeurotic blepharoptosis were performed under local anesthesia. Both procedures were performed on bilateral eyelids simultaneously.

For the infrabrow excision blepharoplasty, the skin incision line started at 3–5 mm lateral of the medial brow margin to approximately 10 mm lateral of the brow tail. Only

the skin under the eyebrow area was removed. Orbicularis oculi muscle resection and fixation to the periosteum were not performed.

For the levator advancement, the levator aponeurosis was identified and dissected free from the tarsus and Müller muscle underneath. The levator aponeurosis was advanced and reattached at three points one third of the distance from the upper tarsal border using 6-0 absorbable polydioxanone suture.

Evaluation of headache and stiff neck severity

The severity of headache and stiff neck was evaluated with the 11-point NRS[15]. The scale ranged from 0 (no pain) to 10 (pain as bad as it could be). Data were collected through interviews at the time of consultation or telephone calls based on the patients' self-report before surgery and between 3 and 12 months after surgery.

Measurement of upper eyelid position and eyebrow position

We used the Image Rugle for Eyelid software (Medic Engineering Corporation, Kyoto, Japan; http://www.rugle.co.jp/) to measure the UEP and EBP[16].

Each patient's face was photographed using a digital camera while the patient was in a sitting position before surgery and between 3 and 12 months after surgery. The patients were instructed to maintain a neutral facial expression, and the camera was kept at a distance of >60 cm. The digital images were transferred to the software on a personal computer.

For UEP, the distance between the upper eyelid margin and the corneal inferior border of the corneal longitudinal diameter was presented in %. For EBP, the distance from the inferior margin of the eyebrow to the corneal inferior border of the corneal longitudinal diameter was presented in %[15,16] **[Figure 1].**

Statistical analysis

Statistical analysis was performed with SPSS Statistics version 24.0 for Windows (IBM Corp, Tokyo, Japan). The measurement data were expressed in mean ± SD, and the normality of the probability distribution was examined using the Kolmogorov–Smirnov test. Quantitative data between the two independent groups were analyzed using the two-tailed t-test and Mann–Whitney U test. The qualitative data were

analyzed using chi-squared test and Fisher's exact test, and the significant level was set to $P < 0.05$. In addition, bivariate correlation analysis was performed with these parameters.

Results

Demographics

In this study, 67 dermatochalasis and 60 aponeurotic blepharoptosis patients, for a total of 127 patients, were enrolled. Data was collected between 3 and 12 months after surgery. The mean follow-up period was 6.2 ± 4.0 months after surgery. The number of women who underwent levator advancement for aponeurotic blepharoptosis (Group 2) was significantly higher than those who underwent infrabrow excision for dermatochalasis (Group 1). The average age in Group 2 (mean age 56.38 ± 12.5 years) was also significantly lower than that in Group 1 **[Table 1]**.

Frequency of headache and stiff neck in both groups

Preoperatively, the frequency of headache and/or stiff neck was higher in Group 2 than in Group 1 (Group 1, 76.1%; Group 2, 93.3%, $P < 0.05$). This was due to a

difference in the frequency of headache (Group1, 37.3%; Group 2, 71.7%, $P < 0.001$). On the other hand, stiff neck occurred at nearly the same rate in both groups (Group 1, 73.1%, vs. Group 2, 86.7%, $P = 0.078$). **[Table 1].**

After surgery, the frequency of headache and/or stiff neck decreased in both groups (Group 1, 76.1% to 61.1%, $P = 0.093$; Group 2, 93.3% to 71.7%, $P < 0.01$). The decrease was due to a reduction in the frequency of headache in both groups (Group 1, 37.3% to 19.4%, $P<0.05$; Group 2, 71.7% to 41.7%, $P<0.01$). There was little contribution of stiff neck for the reduction in the frequency of headache and/or stiff neck (Group 1, 73.1% to 58.2%, $P=0.101$; Group 2, 86.7% to 66.6%, $P<0.01$) **[Table 1] (Fig. 2).**

Severity of headache and stiff neck in both groups

The severity of headache and stiff neck was evaluated using a patient-reported 11−point NRS.

Preoperatively, 25 and 49 patients in Group 1 (n = 67) complained of headache and stiff neck, respectively. The mean ± SD of the headache score was 5.24 ± 1.59, and the score for stiff neck was 5.60 ± 2.22 **[Figure 3].**

Preoperatively, 43 and 52 patients in Group 2 (n = 60) complained of headache and stiff neck, respectively. The mean ± SD of the headache score was 5.49 ± 2.28, and the mean ± SD for the stiff neck score was 6.34 ± 2.28. Between group 1 and group 2, there were no significant differences in the symptom severity for headache and stiff neck preoperatively (preoperative headache score: P = 0.621, preoperative stiff neck score: P = 0.109) **[Figure 3].**

After surgery, both the headache and stiff neck scores significantly decreased in both groups. The mean headache score decreased to 0.96 ± 1.06 (P < 0.001) and 1.51 ± 1.87 (P < 0.001) in Group 1 and Group 2, whereas the mean stiff neck score decreased to 1.96 ± 1.86 (P < 0.001) and 2.28 ± 2.03 (P < 0.001), respectively **[Figure 3].**

Correlation between symptom change and anatomical position change of the upper eyelid and the eyebrow

The preoperative UEP for Group 2 was significantly lower than that of Group 1. UEP was significantly elevated after surgery in both groups. There was no significant difference in postoperative UEP between the two groups **[Table 2]**.

There was no significant difference in preoperative EBP between the two groups. EBP significantly lowered in both groups after the surgery. There was also no significant difference in postoperative EBP in the two groups **[Table 3]**.

We analyzed the correlation between the severity of headache and stiff neck and the anatomical position of the upper eyelid and the eyebrow in both groups. Correlation analysis of two variables revealed a statistically significant negative correlation between the change in headache and change in UEP in Group 2 (Spearman rho, −0.33, P = 0.035) **[Figure 4]**. There was no significant correlation between other variables (change in UEP and change in headache in Group 1; Spearman rho, −0.149, P=0.477, change in UEP and change in stiff neck in Group 1; Spearman rho, −0.125, P=0.399, change in EBP and change in headache in Group 1; Spearman rho, −0.22, P=0.3, change in EBP and change in stiff neck in Group 1; Spearman rho, −0.2, P=0.164, change in UEP and change in stiff neck in Group 2; Spearman rho, −0.55, P=0.739, change in EBP and

change in headache in Group 2; Spearman rho, 0.086, P=0.168, change in EBP and change in stiff neck in Group 2; Spearman rho, −0.07, P=0.677).

Case presentation

Case 1 A 64-year-old female underwent infrabrow excision blepharoplasty for dermatochalasis. At 6 months after surgery, the headache score improved from 6 to 2 and the stiff neck score from 7 to 2. UEP improved from 69.3 to 84.5, and EBP declined from 260 to 229.1 [**Figure 5**].

Case 2 A 48-year-old female underwent levator advancement for aponeurotic blepharoptosis. At 6 months after surgery, the headache score improved from 8 to 2 and the stiff neck score from 9 to 2. UEP improved from 48.1 to 86.4, and EBP declined from 274.5 to 229.5 [**Figure 6**].

Discussion

Few studies have investigated the relationship between age-related upper eyelid changes and symptoms, such as headache and stiff neck, and the relationship has

not been sufficiently clarified[6,8-10]. In particular, infrabrow excision blepharoplasty is a relatively new surgical procedure, and there have been no studies examining how the severity of headache may change before and after infrabrow excision blepharoplasty. Further, there have been no studies examining how the severity of stiff neck may change before and after infrabrow excision blepharoplasty. This study has revealed the possibility that infrabrow excision blepharoplasty for dermatochalasis patients improve the severity of headache and stiff neck after surgery, similar to external levator advancement for aponeurotic blepharoptosis patients.

Tension-type headache is the most common type of primary headache, though the mechanism remains unclear[13]. Various surveys have demonstrated that the lifetime prevalence rate of tension-type headache in the general population is 30%–78%, which severely influences the social economy[13]. In relation between ptosis and headache, Matsuo et al.[6] reported that the visual analog scale score for chronic tension-type headache for an aponeurotic blepharoptosis patient was improved after aponeurotic repair. They hypothesized that the improvement of tension-type headache is accompanied by desensitization of mechanoreceptors in Muller's muscle following

surgical aponeurotic fixation. Mokhtarzadeh et al.[8] reported that headache improved after blepharoplasty, aponeurotic repair, and brow ptosis correction in patients with chronic headache and superior visual field disorder. They stated that chronic headache is improved upon improvement of the disorder of the superior visual field, and the headache supports patient decision-making for surgery. Further, in the study by Simsek et al.[9], the severity of tension-type headache in patients treated with blepharoplasty and aponeurotic repair improved after surgery in both groups, similar to the results of the present study. The authors pointed out that tension-type headache could be a functional surgical indication for blepharoptosis.

Unlike headache, the pathogenesis for stiff neck is varied and influenced by multiple factors, such as sex, occupation, and psychological and social factors[17, 18]. Therefore, most of the pathologic conditions are unclear, and there is a category named "neck pain unknown origin"[17, 18]. A general population survey revealed that the annual prevalence of neck pain is 27.1%–47.8%[17]. In recent years, elucidation of the risk factor and the relationship with quality of life has become a problem from the viewpoint of the medical economy and labor conditions[17, 18]. In previous reports, some researchers

suggested that stiff neck can be caused by blepharoptosis or visual field disorder[8,10,19-21]. Sugamata et al. [10] reported postoperatively improved stiff neck after treatment with infrabrow excision blepharoplasty for patients with dermatochalasis. Shapiro[19] suggested that tension on the lower back muscles is caused by maintaining the posture to correct head tilt due to asymmetrical eye positions, and Williams et al.[20] reported that neck tenderness was recognized in approximately 50% of ocular torticollis patients. Bohnsack et al.[21] pointed out that severe blepharoptosis may be accompanied by back pain due to a chin-up head posture and ocular torticollis. In the present study, the mechanism that improves stiff neck after surgery was not proven, but the possibility that pericranial muscular tension can be relieved by visual field loss correction and that improvements in cephalic presentation and posture contribute to the mechanism was suggested. In the future, stiff neck may be recognized as one of the impairments in age-related upper lid changes, as well as headache.

The present study also showed that preoperative symptom frequency was lower in the dermatochalasis group than in the aponeurotic blepharoptosis group. After surgery, the symptom frequency decreased in both groups. The decrease in the symptom

frequency in both groups was attributed to improved headache. Based on these results, we considered that detachment of the levator aponeurosis may be dominantly involved in headache development. Furthermore, a statistically significant weak negative correlation was observed between changes in UEP and changes in headache in aponeurotic blepharoptosis patients, which was similar to the study by Simsek et al.[9] The present study results indicated that the greater the improvement of the visual field, the greater the improvement of headache in aponeurotic blepharoptosis patients. In the compensatory phase of aponeurotic blepharoptosis, in order to maintain a sustained effort keeping the eyes open, fronto−occipital muscle contraction always occurs. Hence, the association with headache is presumed to be prominent in aponeurotic blepharoptosis. By contrast, the present results showed no correlation between change in UEP and change in headache in dermatochalasis patients. One possible reason for this is that the continuity of the levator aponeurosis and the tarsus is maintained in dermatochalasis patients.

It has already been reported in the past that the EBP droops after blepharoplasty and aponeurotic ptosis repair, which agrees with our results[10, 22-25]. The present study

revealed that the EBP also lowered after infrabrow excision blepharoplasty. The authors speculated that the lowering of the EBP after blepharoplasty is caused by a reduction in the stimulus for frontalis contraction. In the present study, there was no correlation between a change in the EBP and changes in headache and stiff neck. The change in the EBP was relatively small at about 10% of the preoperative value and may have been affected by changes due to make up and shaving. The thickness of the skin and the degree of excess skin covering the lid margin may also have affected the self-reported symptom severity of headache and stiff neck.

This study included some limitations. Since the severity of headache and stiff neck is subjective, objective evaluation is impossible. Psychological or social factors and occupations that can influence the severity of headache and stiff neck were not excluded. Moreover, the results were not compared with those obtained from patients without blepharoptosis or dermatochalasis.

Conclusions

The results of the present study suggested that infrabrow excision blepharoplasty for dermatochalasis can improve headache and stiff neck and can also elevate the UEP and lower the EBP. These findings were similar to the results obtained following levator advancement for aponeurotic blepharoptosis.

Conflicts of interest

The authors declare no conflict of interest.

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Legends for Figures

Figure 1 Measuring upper eyelid position (UEP) and eyebrow position (EBP) using "*Image Rugle for Eyelid®"*.

Plot of the corneal margins (red ＋). When the margin of the cornea in the image consists of more than three points, the corneal ring, corneal center, and corneal longitudinal diameter are estimated automatically. The value of UEP and EBP is displayed (blue arrow; UEP, orange arrow; EBP). For UEP, the distance between the upper eyelid margin (white ＋) and the corneal inferior border of the corneal longitudinal diameter was presented in %. For EBP, the distance from the inferior

margin (white ＋) of the eyebrow to the corneal inferior border of the corneal longitudinal diameter was presented in %.

Figure 2　Symptom frequency of headache and stiff neck in both groups

Abbreviations: pre, preoperative; post, postoperative; HA, headache; HA/SN, headache and/or stiff neck; SN, stiff neck; no, neither headache nor stiff neck

Figure 3　Change in headache and stiff neck

Abbreviations: NS, not significant; NRS, numerical rating scale; pre-op, preoperative; post-op, postoperative

Figure 4　Correlation between change in headache and change in upper eyelid position (UEP) in Group2 (aponeurotic blepharoptosis patients)

Figure 5　Case 1. Preoperative photograph of 64-year-old female with dermatochalasis (left) and postoperative photograph 6 months after infrabrow excision blepharoplasty

(right). At 6 months after surgery, the headache score improved from 6 to 2, and the stiff neck score improved from 7 to 2. UEP improved from 69.3 to 84.5, and EBP decreased from 260 to 229.1.

Figure 6 Case 2. Preoperative photograph of 48-year-old female with aponeurotic blepharoptosis (left) and postoperative photograph 6 months after levator advancement (right). At 6 months after surgery, the headache score improved from 8 to 2, and the stiff neck score improved from 9 to 2. UEP improved from 48.1 to 86.4, and EBP decreased from 274.5 to 229.5.