Master's Thesis

Prediction of Postoperative Lid Height after Frontalis Suspension Using Autogenous Fascia Lata for Pediatric Congenital Ptosis

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JEJU NATIONAL UNIVERSITY

August, 2010

선천성 안검하수 환아에서 자가대퇴근막을 이용한 이마근 걸기술 후 눈꺼풀 높이의 예측

지도교수 배 종 면

김 창 염

이 논문을 의학 석사학위 논문으로 제출함

2010년 8월

김창염의 의학 석사학위 논문을 인준함

심사위원장 ____ 인

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제주대학교 대학원

2010년 8월

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A thesis submitted in partial fulfillment of the requirement for the degree of Master of Science

2010. 8.

This thesis has been examined and approved.

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Date 24 June 2010

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ABSTRACT

Frontalis suspension surgery is commonly used and very effective treatment for congenital ptosis, especially in patients with poor levator function. However, it is difficult to predict lid height after the surgery, because in the majority of cases, surgery for pediatric congenital ptosis is performed under general anesthesia and therefore, the lid height cannot be adjusted by the open-and-close method in unconscious status. The studies about the desirable lid position during the frontalis suspension surgery and the influencing factors on the postoperative change in lid height are not enough and many surgeons primarily rely on their experience in determine the amount of lid elevation during the surgery. In this study, we observed the change of the palpebral fissure after frontalis suspension using autogenous fascia lata for pediatric congenital ptosis and intended to predict postoperative lid height by assessing the factors influencing the change in lid height following the surgery.

Present study is retrospective, observational case series of 54 pediatric patients with congenital ptosis who underwent frontalis suspension using autogenous fascia lata performed under general anesthesia from 2002 through 2005 with a minimum of 6 months of follow-up. The amounts of lid elevation during the surgery and that of postoperative change in lid height were assessed until 6 months postoperatively by review of photographs and medical

records. The amount of lid elevation for adjusted lid height was measured from two different baseline lid heights and each amount of lid elevation was compared with the amount of real change in lid height after surgery.

The postoperative lid height was stabilized 3 months after surgery. And the amounts of lid elevation during the surgery were 5.91±1.21 mm without considering anesthesia induced lagophthalmos and 3.51±1.00 mm with considering it. The amount of real change in lid height before and after 6 months following surgery was 3.24±1.14 mm. The preoperative palpebral fissure (p=0.002) and anesthesia induced lagophthalmos (p<0.001) were statistically significant factors influencing postoperative lid height. In patients with preoperative palpebral fissure ≥ 4 mm or anesthesia induced lagophthalmos < 3 mm, postoperative lid heights were lowered than adjusted levels.

In this study, we found that the postoperative lid height would be more accurately predicted with adjusting lid height from the baseline allowing for lagophthalmos under general anesthesia during frontalis suspension and preoperative palpebral fissure and anesthesia induced lagophthalmos have influence on postoperative lid height.

Key words: congenital ptosis, frontalis suspension, lagophthalmos, postoperative lid height

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Introduction

Frontalis suspension surgery, which was first introduced by Payer (*Payer E, 1909*) and Wright (*Wright WW, 1922*), was popularized by Crawford, and numerous modifications in the technique and the materials used have been made (*Crawford JS, 1956, 1977; Wagner RS, et al., 1984; Wasserman BN, et al., 2001; Berke RN, 1959*). It is very effective and one of the most commonly used surgical procedures in patients with congenital ptosis who have poor levator muscle function (LF).

However, almost the whole case of congenital ptosis surgery in children is performed under general anesthesia, which makes the postoperative outcome unpredictable because intra-operative adjustment is not possible in unconscious patient and the lid contour including fissure height in anesthetized condition is quite different from that in conscious state due to the influence of anesthetics and muscle relaxants. In other words, postoperative under- or over-correction is common problem in the surgery for congenital ptosis performed under general anesthesia. Thus, many surgeons feel difficulties in determining the amount of correction in lid height and it is quite challenging to determine the guidelines in adjusting lid height when performing ptosis surgery under general anesthesia. Many surgeons consider

patient's LF and degree of ptosis to determine the amount of correction in the surgery; however, they rely on their experience as well.

The purpose of this study is to observe the change of the palpebral fissure (PF) after frontalis suspension using autogenous fascia lata and to elucidate the factors influencing the postoperative change after adjustment of lid level during the surgery under general anesthesia. Studies on the factors influencing the postoperative change in lid height can supply the standard guideline for determining the amount of lid correction in frontalis suspension for pediatric congenital ptosis and give better postoperative results.

Materials and Methods

1. Design

This is a retrospective, non-comparative, single-surgeon (SYL) case series including 80 eyes of 54 consecutive patients with pediatric congenital ptosis.

2. Participants

All patients underwent frontalis suspension using autogenous fascia lata under general anesthesia between January 2002 and December 2005. Both unilateral cases with 28 patients and bilateral cases with 26 patients were recruited in this study. The study also included 9 patients who underwent the surgery combined with medial epicanthoplasty.

Patients with following conditions were excluded from the study: neuromuscular disease such as cerebral palsy or cranial nerve paralysis, blepharophimosis, Marcus Gunn jaw-winking synkinesis, strabismus, amblyopia, history of previous eyelid surgery and less than 6

months of follow up.

3. Measures

All patients with ptosis were examined on following assessment items and our study was accomplished from the database. Along with a detailed history of their ptosis, the patients underwent complete ophthalmic examinations, ascertaining the type of ptosis suffered, the degree of ptosis by measurement of PF and preoperative LF. We measured the amount of lagophthalmos which developed under the general anesthesia, in here called 'anesthesia induced lagophthalmos', and PF after adjustment of lid height during the surgery with caliper.

Patients were examined at 1 week, 1 month, 3 and 6 months after surgery and photographed with digital camera to analyze the progressive change of lid height after they had given informed consents. The patients were asked to place a circular tape with a diameter of 8 mm at the middle of their glabella or forehead, which was used as a guideline in the analysis (Figure 1). Skilled doctors took the front side photographs of patients in the primary position as making certain that the patient's Frankfort's line was a straight horizontally. Actual size of PF could be calculated by the ratio of photographed fissure

height to the size of the guideline circular tape.

We analyzed the difference between the amount of lid elevation during the surgery and that of real change in lid height after surgery.

4. Determining the baseline

To measure the amount of lid elevation during the surgery, it was necessary to set the preoperative baseline lid height because lagophthalmos was noted in many patients under general anesthesia. We measured the amount of lid elevation during the surgery from two different baselines; one is at the level of eye closed completely, which indicated baseline PF is zero (BLO); the other is at the level of anesthesia induced lagophthalmos (BLG) (Figure 2).

5. Surgical technique

All patients underwent the surgery under general anesthesia by endotracheal intubation, which was induced and maintained by same medications, ketamine hydrochloride and

sevoflurane. Atracurium besylate was used as muscle relaxant. The surgical method was based on the modified technique of direct tarsal and frontalis fixation using autogenous fascia lata introduced by Spoor and Kwitko (*Spoor TC, et al., 1990; Chen TH, et al., 1997*).

The incision line was marked at 4 to 5 mm above the lid margin and a small strip of pretarsal orbicularis muscle was excised to expose the anterior surface of the tarsal plate. Incisions in the forehead were made approximately 1 to 2 mm above the medial and lateral one third of the eyebrow. Two harvested fascia strips from distal thigh were secured to the anterior tarsal surface in the medial and lateral one third of the eyelid with 6-0 nylon sutures. They were passes in a deep plane to the orbital septum, pulled up through small suprabrow incisions, and sutured to frontalis muscles with 6-0 nylon sutures at the desired lid height. After closure of the brow incision subcutaneous layer, skin incisions at the upper eyelid and brow were closed using 6-0 fast absorbable gut sutures (*Yoon JS, et al., 2009*).

6. Statistics

6.1 Definitions

We defined the difference between PF at 6 months after surgery and preoperative PF as Δ PF and therefore, Δ PF means the amount of real change in lid height after surgery. The amount of lid elevation during surgery was expressed as adjusted lid height (AH). AH_{BLO} and AH_{BLG} express AHs when baseline is set at the BLO and BLG, respectively.

The main outcomes, the differences between the amount of lid elevation during the surgery and real change of PF after surgery, were defined as Diff. The Diff was calculated as Δ PF minus AH, so negative Diff means that the real change of lid height at 6 months after surgery was smaller than the amount of lid elevation during the surgery, and positive Diff means that the postoperative real change of lid height was larger than the adjusted one during the surgery.

The formulas are also given in Appendix.

6.2 Statistical analysis

Postoperative PF changes were assessed by paired t-test. Simple linear regression analysis was used to examine that which could estimate Δ PF better between AH_{BLO} and AH_{BLG}. The univariate analysis was done to find the potential factors influencing the Diff by

Wilcoxon signed-rank tests. Then the factors were re-categorized and analyzed according to clinical and statistical significance based on the univariate analysis. After confirming normality of the Diff, multiple linear regression analysis was done to evaluate the factors influencing postoperative lid height. All statistical tests were two-sided with α-level of 0.05, and were performed using SPSS version 13.0 (SPSS, Inc., Chicago, IL).

Figure 1. The measurement of palpebral fissure by photograph analysis; the known sized circular tape was used as a guideline in the analysis.

A: Preoperative photograph in patients with bilateral ptosis and brow elevation.

B: Photograph taken 3 months postoperatively.

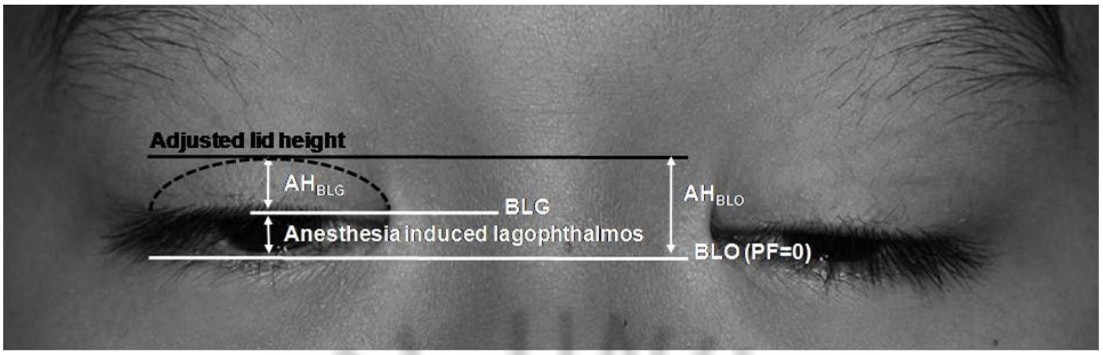

Figure 2. Two baseline lid heights to measure the amount of correction during the surgery.

AH_{BLO} and AH_{BLG}: adjusted lid height (= the amount of lid elevation during the surgery) when baseline is set at the BLO and BLG, respectively

BLO: baseline lid height when palpebral fissure (PF) is 0 mm

BLG: baseline lid height allowing for anesthesia induced lagophthalmos

Results

1. Patients' characteristics and anesthesia induced lagophthalmos

The demographics of the study population are summarized in Table 1. There were 80 eyes of 54 patients, ranging from 3 to 14 years of age (mean, 5.59 years) and 74% of male gender. Combined surgery involved medial epicanthoplasty in 11% of cases. Preoperative PF and LF were 4.37±1.25 mm and 2.67±1.28 mm, respectively. The mean follow-up time was 13.83 months (range, 6-48 months).

Anesthesia induced lagophthalmos was noted in 75 eyes (94%) and their distribution is as follows; 2 eyes with the lagophthalmos < 1.0 mm, 18 eyes (1.0 mm ≤ lagophthalmos < 2.0 mm), 22 eyes (2.0 mm ≤ lagophthalmos < 3.0 mm), 24 eyes (3.0 mm ≤ lagophthalmos < 4.0 mm) and 9 eyes (4.0 mm ≤ lagophthalmos ≤ 5.0 mm). The amount of lagophthalmos in those eyes was 2.57±1.09 mm and there was no significant difference between both eyes of the patients with bilateral ptosis (p=0.650). Three eyes of unilateral ptosis and 2 eyes of 2 patients with bilateral ptosis showed no lagophthalmos (Table 2). Anesthesia induced lagophthalmos had statistically significant positive correlation

with preoperative PF (Pearson correlation coefficient = 0.337, p=0.002), but no correlation with preoperative LF (p=0.371).

Table 1. Patients' characteristics

Race	All Koreans
Age (years)	5.59 ± 2.31
Gender (M:F) of Patients (n = 54)	40 : 14
Gender (M:F) of Eyes (n = 80)	59 : 21
Unilateral : Bilateral (No. of eyes)	28 : 52
Combined medial epicanthoplasty (No. of eyes)	9
Preoperative PF (mm)	4.37 ± 1.25
Preoperative LF (mm)	2.67 ± 1.28
Anesthesia induced lagophthalmos (mm)	2.41 ± 1.22*
Follow-up duration (months)	13.83 ± 10.27

Represented as mean ± SD (standard deviation) or ratio.

M: male, F: female, PF: palpebral fissure, LF: levator function

* Included 5 eyes with no anesthesia induced lagophthalmos.

Table 2. Patients' characteristics according to presence of anesthesia induced lagophthalmos

Anesthesia induced lagophthalmos		Present	Absent (each case)		
Unilateral ptosis	Age (years)	4.96 ± 1.95	6	6	3
	Gender (M:F)	19 : 6	M	M	F
	Preoperative PF (mm)	4.26 ± 1.21	3	2	3.4
	Preoperative LF (mm)	2.50 ± 0.96	2	1	2.5
	Lagophthalmos (mm)	2.34 ± 1.02	0	0	0
Bilateral ptosis	Age (years)	6.02 ± 2.45	3		4
	Gender (M:F)	36 : 14	M		M
	Preoperative PF (mm)	4.55 ± 1.24	3 (3.5*)		4 (3*)
	Preoperative LF (mm)	2.81 ± 1.44	2 (5*)		3 (2*)
	Lagophthalmos (mm)	2.68 ± 1.11	0 (3*)		0 (2*)

Represented as mean ± SD (standard deviation) or ratio.

M: male, F: female, PF: palpebral fissure, LF: levator function

* Fellow eye of the same patient.

2. The postoperative changes of PF over time

The chronological change of PF and Diff were shown at Table 3 and Figure 3. The PF showed trend of significant increase from 6.94 mm at 1 week after surgery to 7.61 mm until 3 months postoperatively (p<0.001 between PFs at 1 week and 1 month postoperatively, p<0.001 between 1 month and 3 months postoperatively) and thereafter, the lid height was stabilized (p=0.914 between 3 months and 6 months postoperatively).

Table 3. The postoperative changes of palpebral fissure over time

	PF (mm)	*p*-value between each postoperative PF and PF at postoperative 6 months*
Preoperative	4.37 ± 1.25	
Postoperative 1 week	6.94 ± 1.11	< 0.001
Postoperative 1 month	7.47 ± 1.05	0.002
Postoperative 3 months	7.61 ± 1.03	0.914
Postoperative 6 months	7.61 ± 1.04	

Represented as mean ± SD (standard deviation).

PF: palpebral fissure

* Paired t-test.

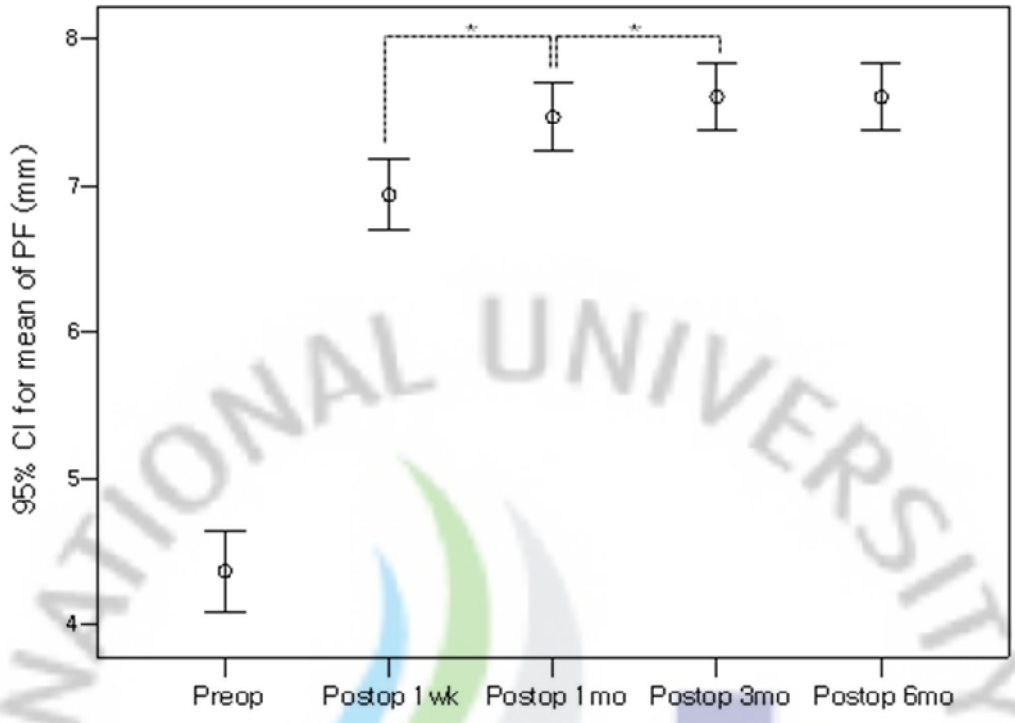

Figure 3. The chronological change of the palpebral fissure.

PF: palpebral fissure, preop: preoperative, postop: postoperative, wk: week, mo: month(s)

* Statistically significant changes (p<0.001).

Each bar charts plot the mean and 95% CIs (confidence intervals).

3. Comparison of two preoperative baseline lid heights

The AH_{BLO} and the AH_{BLG} were 5.91±1.21 mm and 3.51±1.00 mm, respectively and the Δ PF was 3.24±1.14 mm, which was more close to the AH_{BLG} (Figure 4). In addition, explanatory powers (R^2) of AH_{BLO} and AH_{BLG} for predicting Δ PF were 0.101 and 0.323 from simple linear regression analysis, respectively (Table 4). Therefore, we thought that setting baseline lid height with BLG was more accurate than that with BLO in predicting postoperative lid height. From this point, we evaluated the lid height from the BLG as baseline.

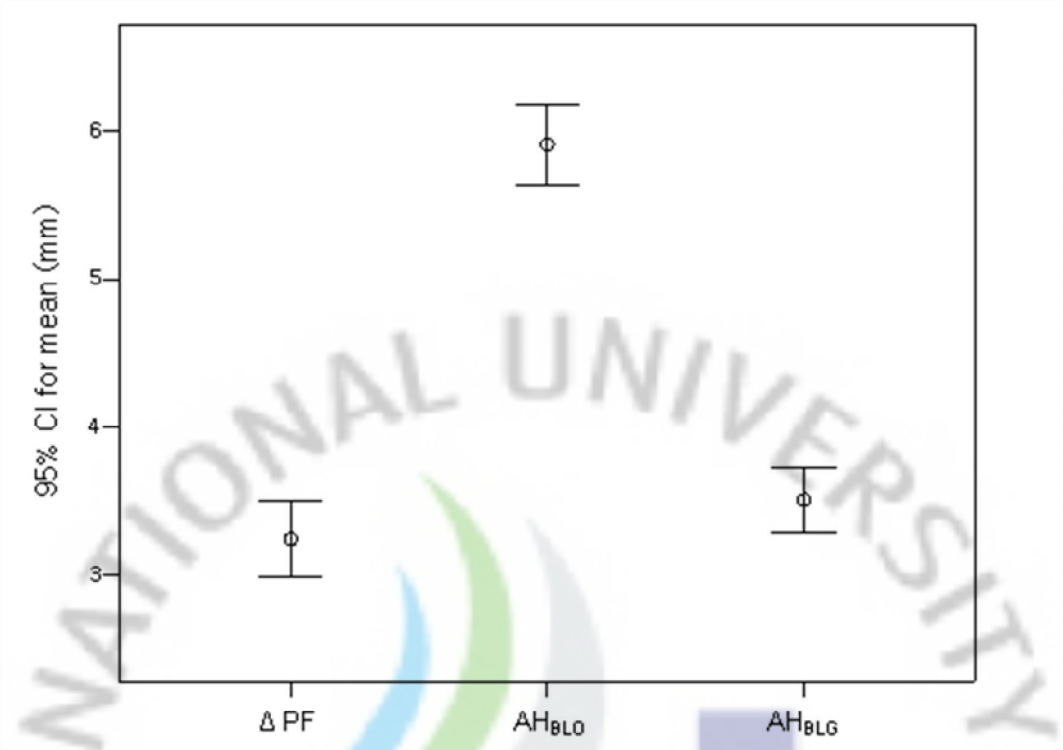

Figure 4. The amount of real change in lid height after 6 months following surgery and the amount of lid elevation during the surgery.

Δ PF: the amount of real change in lid height after surgery (= PF at 6mo after surgery – preoperative PF, PF: palpebral fissure)

AH_{BLO} and AH_{BLG}: adjusted lid height (= the amount of lid elevation during the surgery) when baseline is set at the BLO and BLG, respectively

Each bar charts plot the mean and 95% CIs (confidence intervals).

Table 4. Each explanatory power of two preoperative baseline lid heights for predicting changes of lid height after 6 months following surgery

Baseline as	Adjusted R^{2*}
Lid height when PF = 0 mm (BLO)	0.101
Lid height allowing for anesthesia induced lagophthalmos (BLG)	0.323

PF : palpebral fissure

* Linear regression analysis.

4. Preoperative PF and anesthesia induced lagophthalmos as the factors influencing postoperative lid height

The Diff was -0.27 mm [95% C.I. -0.49 mm, -0.05 mm] in whole eyes. Statistically, the real lid height change after 6 months following the surgery showed significant difference from the amount of lid elevation during the surgery (p=0.019), however, the difference was only 0.27 mm. The univariate analysis showed that gender (p=0.003 for female), combined medial epicanthoplasty (p=0.048 for absence of combined medial epicanthoplasty), preoperative PF (p=0.042 for 5 mm ≤ PF < 6 mm), preoperative LF (p=0.024 for 3 mm ≤ LF < 4 mm), anesthesia induced lagophthalmos (p=0.014 for 2 mm ≤ BLG < 3 mm) could be potential factors influencing Diff (Table 5). The factors were re-categorized based on statistical and clinical significance for the multivariate analysis (Table 6). Multiple linear regression analysis with adjusting for gender, combined medial epicanthoplasty, preoperative PF, preoperative LF and anesthesia induced lagophthalmos showed (We confirmed the normality of the variable 'Diff', data not shown) preoperative PF (p=0.002) and anesthesia induced lagophthalmos (p<0.001) were statistically significant factors and preoperative LF (p=0.050) was marginally significant one influencing postoperative lid height. In cases of preoperative PF ≥ 4 mm or anesthesia induced lagophthalmos < 3 mm, the real heights of

lids after surgery were 0.3 to 0.4 mm lowered than the elevated lid height during the surgery per 1 mm difference from preoperative PF of 4 mm or anesthesia induced lagophthalmos of 3 mm (Table 7).

Table 5. Results of univariate analysis on the Diff

		No. of eyes	Diff (mm)	*p*-value between Δ PF and AH_{BLG} *
Age (years)	age < 4	15	-0.20 [-1.00, 1.00]	0.841
	4 ≤ age < 5	13	-0.50 [-1.05, -0.15]	0.116
	5 ≤ age < 6	16	-0.40 [-1.40, 0.38]	0.078
	6 ≤ age < 7	14	0.00 [-0.43, 0.23]	0.683
	7 ≤ age	22	-0.30 [-1.05, 0.60]	0.269
Gender	Male	59	0.00 [-1.00, 0.60]	0.233
	Female	21	-0.50 [-1.00, -0.05]	**0.003**
Laterality	Unilateral	28	-0.05 [-1.18, 0.40]	0.175
	Bilateral	52	-0.35 [-1.00, 0.38]	0.090
Combined	Yes	9	-0.50 [-1.05, 0.30]	0.233
epicanthoplasty	No	71	-0.20 [-1.00, 0.40]	**0.048**
Preoperative	PF < 3	7	1.00 [-0.90, 1.00]	0.307
PF (mm)	3 ≤ PF < 4	18	0.50 [-0.63, 0.73]	1.000
	4 ≤ PF < 5	27	-0.40 [-1.00, 0.30]	0.078
	5 ≤ PF < 6	18	-0.50 [-1.20, 0.33]	**0.042**

	6 ≤ PF	10	-0.55 [-1.63, 0.08]	0.123
Preoperative	LF < 2	9	0.40 [0.10, 1.00]	0.123
LF (mm)	2 ≤ LF < 3	36	-0.30 [-0.98, 0.38]	0.111
	3 ≤ LF < 4	20	-0.85 [-1.48, 0.23]	**0.024**
	4 ≤ LF	15	-0.30 [-1.00. 0.40]	0.258
Anesthesia	BLG < 1	7	-1.10 [-1.10, 0.10]	0.061
induced	1 ≤ BLG < 2	18	-0.40 [-0.78, 0.48]	0.319
lagophthalmos	2 ≤ BLG < 3	22	-1.00 [-1.43, -0.23]	**0.014**
(mm)	3 ≤ BLG < 4	24	0.10 [-0.28, 0.83]	0.191
	4 ≤ BLG	9	0.00 [-0.75, 0.40]	0.889
Total		80	-0.27±1.00 [-0.49, -0.05]†	0.019‡

Diff = Δ PF – AH_{BLG}, represented as median [25%, 75%] (†as mean ± SD (standard deviation) [95% confidence interval])

PF: palpebral fissure, LF: levator function, BLG: baseline lid height allowing for anesthesia induced lagophthalmos

Δ PF: the amount of real change in lid height after surgery (= PF at 6mo after surgery – preoperative PF)

AH_{BLG}: adjusted lid height (= the amount of lid elevation during the surgery) when baseline

is set at the BLG

* Wilcoxon signed-rank test, ‡Paired t-test.

Table 6. Results of univariate analysis after regrouping of the eligible factors for influencing the Diff

		No. of eyes	Diff (mm)	*p*-value between Δ PF and AH_{BLG} *
Gender	Male	59	0.00 [-1.00, 0.60]	0.233
	Female	21	-0.50 [-1.00, -0.05]	**0.003**
Combined epicanthoplasty	Yes	9	-0.50 [-1.05, 0.30]	0.233
	No	71	-0.20 [-1.00, 0.40]	**0.048**
Preoperative PF (mm)	PF < 4	25	0.20 [-0.65, 1.00]	0.587
	4 ≤ PF	55	-0.40 [-1.00, 0.30]	**0.002**
Preoperative LF (mm)	LF < 3	45	0.00 [-0.70, 0.50]	0.491
	3 ≤ LF	35	-0.50 [-1.40, 0.30]	**0.012**
Anesthesia induced lagophthalmos (mm)	BLG < 3	47	-0.60 [-1.10, 0.20]	**0.001**
	3 ≤ BLG	33	0.00 [-0.40, 0.60]	0.309

Diff = Δ PF – AH_{BLG}, represented as median [25%, 75%]

PF: palpebral fissure, LF: levator function, BLG: baseline lid height allowing for anesthesia

induced lagophthalmos

Δ PF: the amount of real change in lid height after surgery (= PF at 6mo after surgery – preoperative PF)

AH_{BLG}: adjusted lid height (= the amount of lid elevation during the surgery) when baseline is set at the BLG

* Wilcoxon signed-rank test.

Table 7. Results of multiple linear regression analysis for factors influencing change in postoperative fissure height after frontalis suspension using autogenous fascia lata

	β	*p*-value
Gender	-0.175	0.089
Combined epicanthoplasty	0.113	0.279
Preoperative PF	-0.322	**0.002**
Preoperative LF	-0.204	**0.050**
Anesthesia induced lagophthalmos	-0.404	**< 0.001**

PF : palpebral fissure, LF : levator function

Adjusted for gender (male→0, female→1), combined epicanthoplasty (yes→0, no→1), preoperative PF (PF < 4 mm→0, 4 mm ≤ PF→1), preoperative LF (LF < 3 mm→0, 3 mm ≤ LF→1), Anesthesia induced lagophthalmos (BLG < 3 mm→1, 3 mm ≤ BLG→0, BLG: baseline lid height allowing for anesthesia induced lagophthalmos).

Discussion

Autogenous fascia lata is considered to be a “living suture”, which may provide a longer lasting repair of ptosis (*Crawford JS, 1956, 1977, 1982; Wagner RS, et al., 1984; Wasserman BN, et al., 2001*). Wasserman and associates reported 4.2% rate of recurrence using autogenous fascia lata, whereas, 51.4% rate of recurrence using banked fascia lata (*Wasserman BN, et al., 2001*). Suspension with synthetic material such as Prolene, Mersilene mesh, Gore-Tex (expanded polytetrafluoroethylene) and Supramid (nylon polyfilament) is considered a temporary procedure as they carry a high rate of recurrence (*Wagner RS, et al., 1984; Wasserman BN, et al., 2001*). Most surgeons agree that autogenous fascia lata is the material of choice for frontalis suspension with superior cosmetic results compared with all other materials, a smaller rate of recurrence, and longer lasting effect, especially for pediatric congenital ptosis.

The conscious patient may be brought to a sitting up position to help judge the lid height during ptosis surgery. However, it is difficult to predict lid position precisely in unconscious patient, since it cannot be adjusted by the open-and-close method. And the lid contour and height in unconscious state are quite different from those in awakened state.

A few methods of adjusting lid height have been proposed in levator resection in congenital ptosis, such as Berke's method. This method is quite useful in patients with an LF of 5–10 mm and the ideal eyelid position on operating table is based on the specific LF preoperatively (*Berke RN, 1959*). Beard (*Beard C, 1966, 1981*) and Callahan (*Callahan A, 1972*) determined the amount of levator resection required by taking both the margin-reflex distance (MRD)-1 and LF into consideration. Carraway reported that 4 mm of levator resection for every 1 mm of ptosis had been successful in management of ptosis (*Carraway JH, et al., 1986*). McCord determined the amount of resection by adding 3 mm to the amount of ptosis to be corrected (*Chen W PD, et al., 2004*).

In frontalis suspension for pediatric patients under general anesthesia, the method of lid height adjustment could be variable by the rule of each surgeon. The experience of the surgeon tends to play a large role in the decision of lid height adjustment during the surgery. McCord recommended surgeon to place upper lid margin slightly higher than one wished it to be postoperatively either by traditional or modified Crawford technique using fascia lata (*McCord CD Jr, et al., 1995; Nesi FA, et al., 2001*). Nerad usually pulls fascia superiorly until the lid margin is at limbus (*Nerad JA, 2001*). Chen recommended surgeon to place lid position at desired level in patients with LF 3-4 mm, at 1 mm above desired level in those with LF 0-2 mm, and at 1 mm below desired level in those with LF 5 mm (*Chen W PD, et al.,*

2004). In the report by Leibovitch *et al*, the eyelid was adjusted to a position 1 mm below the superior limbus in bilateral cases and in unilateral case, symmetry with opposite side was also considered in patients less than 3 years of age (*Leibovitch I, et al., 2003*).

As far as we know, there is a lack of studies about the desirable lid position during the frontalis suspension surgery and the influencing factors on the change in lid height following the surgery, according to the variable suspension materials including autogenous fascia lata. The main focus of this study is an analysis of factors influencing postoperative change in lid height after correction of congenital ptosis using autogenous fascia lata under general anesthesia.

We used objective measurement of preoperative ptosis level and PF height after surgery by photograph analysis. All patients underwent frontalis suspension using autogenous fascia lata under general anesthesia by one surgeon, and with same anesthetic medications to minimize the various effects of drugs.

According to a study on the change of PF height after frontalis suspension using Gore-Tex and Ethibond (polybutylate-coated braided polyester), the PF exhibited a trend to be stabilized after 3 months following surgery (*Bajaj MS, et al., 2004*), and our study showed similar results. Those indicated that follow up during 6 months postoperatively in this study was enough to evaluate final lid height. The gradual elevation of lid height until 3 months

postoperatively was possibly resulted from decreasing postoperative tissue swelling and contracture of the grafted fascia lata.

The lagophthalmos can result from general anesthesia. The motility for closing eyes needs not only a relaxation of the levator palpebrae muscle, but also an active contraction of the orbicularis oculi muscle which keeps the eyes closed (*McNab AA, 2005*). During normal sleep, lid closure is maintained by the tonic contractions of the orbicularis muscle. It has been reported that lagophthalmos was noted in 4.6% of normal individuals during sleep (*Kirwan JK, et al., 1997; Fuchs A, et al., 1948*), however, 59% of healthy adult patients undergoing general anesthesia failed to have complete eyelid closure (*Batra YK, et al., 1977*).

Therefore, there is a problem to set the baseline level, from which we measure the amount of lid elevation during the surgery. Comparing BLO and BLG as baseline, ΔPF was more similar to AH_{BLG} and AH_{BLG} had more explanatory power to predict ΔPF than AH_{BLO}. These findings indicate that surgeons should consider the anesthesia induced lagophthalmos when determining the amount of lid elevation during the surgery for frontalis suspension in congenital ptosis. For example, to elevate 3 mm of lid height in ptotic eye with 2 mm of anesthesia induced lagophthalmos, PF should be gapped about 5 mm during the surgery.

Preoperative PF and anesthesia induced lagophthalmos were observed to have

statistically significant influence on the Diff in this study. In case of eyes with PF ≥ 4 mm or BLG < 3 mm, the postoperative real lid height would be lowered than the expected one by 0.3 to 0.4 mm per 1 mm difference from preoperative PF of 4 mm or anesthesia induced lagophthalmos of 3 mm. Preoperative LF was marginally significant factor influencing the postoperative lid height. However, the result that in case of eyes with LF ≥ 3 mm postoperative lid height was lowered than adjusted one during the surgery did not support the rule in adjusting lid height according to LF proposed by Chen (*Chen W PD, et al., 2004*). One of possible reasons of this discrepancy could be the variance of LF. Since the precise measurement of LF is difficult in uncooperative children, surgical guideline according to LF might be hard to apply to practice. Also, small amount of difference in LF could not have statistical and clinical significance in patient with poor LF. In any case, it could be unfair to predict the postoperative outcome by LF alone even with a prudent surgical design.

It is quite interesting that in cases of relatively large PF, postoperative lid height would be lowered than the adjusted level during the surgery. We think that the child with ptosis has compensation of eyelid and brow elevation by frontalis muscle for lid drooping, so preoperative PF is overestimated than the real PF. After ptosis surgery, the compensation effect would disappear and postoperative lid height is lowered than the desired one. In the outcome evaluated by photograph analysis, brow elevation was frequently seen and

disappeared after surgery (Figure 1). In cases of small PF, on the contrary, the patient gives up compensation, so the postoperative lid height would come almost at the desired level.

In this study, it seems clear that anesthesia induced lagophthalmos has a significant effect on the postoperative surgical outcome. However, we cannot suggest any reason why postoperative lid height could not reach to the expected height in group of less amount of anesthesia induced lagophthalmos.

In conclusion, this study suggests new method to adjust the lid level by quantitative analysis of PF during and after frontalis suspension using autogenous fascia lata in congenital ptosis.

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Appendix

Formulas for major variables

1. Δ PF = PF at 6 months after surgery – preoperative PF

   PF : palpebral fissure

2. Diff = Δ PF – AH

   PF : palpebral fissure

   AH : adjusted lid height

Abstract in Korean

이마근 걸기술은 선천성 안검하수, 특히 눈꺼풀 올림근의 기능이 좋지 못한 환자의 치료에 흔히 시행되는 아주 효과적인 수술방법이다. 하지만, 대부분의 소아 선천성 안검하수 수술은 전신마취 하에서 시행되고, 따라서 수술 중 환아로 하여금 눈을 뜨게 하여 눈꺼풀 틈새의 크기를 맞출 수 없어 술 후 눈꺼풀 높이를 예측하기가 어렵다는 문제가 있다. 그럼에도 불구하고 이마근 걸기술 시 눈꺼풀을 얼마나 올리는 것이 적절한지, 술 후 눈꺼풀 높이에 영향을 미치는 요인들이 무엇인지에 대한 연구는 부족하며, 많은 술자들은 수술 시 그들의 경험에 상당부분 의존하여 눈꺼풀 올림양을 결정하고 있다. 이에 본 연구를 통해 선천성 안검하수 환아에서 자가대퇴근막을 이용한 이마근 걸기술 후 눈꺼풀 틈새의 크기변화를 관찰하고 술 후 눈꺼풀 높이에 영향을 미치는 요인들을 분석하여 술 후 눈꺼풀 높이를 예측하고자 하였다.

본 연구는 2002년부터 2005년까지 자가대퇴근막을 이용한 이마근 걸기술을 시행 받은 54명의 선천성 안검하수 소아환아를 대상으로 술 후 최소 6개월 이상 경과 관찰한 자료를 후향적으로 분석한 관측연구이다. 수술 중 눈꺼풀을 올린 양과 술 후 6개월까지 눈꺼풀의 실제 높이 변화를 사진과 의무기록을

통하여 검토하였다. 술 중 눈꺼풀을 올린 양은 분석과정에서 설정한 두 가지 기준치로부터 각각 측정하였고 술 후 실제 눈꺼풀 높이 변화량과 비교하였다.

눈꺼풀의 높이는 술 후 3개월째 안정화되었다. 술 중 눈꺼풀 올림양은 전신마취 후 발생하는 토안을 고려하지 않았을 때 5.91±1.21 mm, 토안을 고려하였을 때 3.51±1.00 mm 였으며, 수술 6개월 후의 실제 눈꺼풀 높이 변화량은 3.24±1.14 mm 였다. 술 전 눈꺼풀 틈새의 크기 (p=0.002) 와 전신마취 후 발생한 토안 (p<0.001)이 술 후 눈꺼풀 높이에 통계적으로 유의한 영향을 미치는 것으로 나타났는데, 술 전 눈꺼풀 틈새의 크기가 4 mm 이상이거나, 전신마취 후 발생한 토안이 3 mm 미만인 경우 술 후 실제 눈꺼풀 높이가 수술 중 목표로 한 위치보다 낮았다.

이 연구를 통해 이마근 걸기술시 전신마취 후 발생하는 토안을 고려하여 눈꺼풀을 올려 위치시키는 것이 실제 술 후 결과 예측을 좀 더 정확하게 할 수 있으며, 환자의 술 전 눈꺼풀 틈새의 크기와 전신마취 후 발생하는 토안의 정도가 술 후 눈꺼풀 높이에 영향을 미침을 확인할 수 있었다.

주요어 : 선천성 안검하수, 이마근 걸기술, 토안, 술 후 눈꺼풀 높이

감사의 글

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사랑하고 존경하는 부모님께 이 논문을 바칩니다.

2010년 6월

김 창 염