

Outcome of Advancement of Frontalis Muscle Flap for Correcting Congenital Ptosis

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Abstract:

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Aims: To describe the surgical outcome of a new technique, "Advancement of the Frontalis Muscle Flap", for correcting congenital Ptosis with poor levator action. **Methods:** A longitudinal study was performed in a tertiary Eye Hospital in Bangladesh from January 2020 to May 2021. Patients with severe congenital Ptosis with levator function 4 mm or less who underwent the advancement of the Frontalis Muscle Flap were included in this study. Drafted medicolegal consent was obtained from the patient or the patient's guardian. **Results:** Seven patients were evaluated for this study. The eyelid height was significantly improved (p-value <0.0001) after the advancement of the Frontalis Muscle Flap. The eyelid contour and lid crease were improved aesthetically following surgery. **Conclusion:** The advancement of the Frontalis Muscle Flap for managing congenital Ptosis with poor levator function is technically safe, simple, and more physiological with less or no complications.

Keywords: Congenital Ptosis, Poor Levator Function, Frontalis muscle function, Frontalis Muscle Flap, Ptosis correction.

Abbreviation:

MRD1- Upper Eyelid Margin-Reflex Distance,
 MRD2- Lower Eyelid Margin-Reflex Distance,
 LPS-Levator Palpebrae Superioris,
 CSP- Congenital Simple Ptosis,
 SD- Standard Deviation.

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INTRODUCTION

A detailed understanding of the eyelid and Oculo-Facial anatomy, including vascular and neural networks, is critical to safe and successful surgical outcomes. The Upper Eyelid position is a function of the delicate balance between the lid retractors, including the LPS Muscle, Muller's muscle and Frontalis Muscle, and the lid protractors, including the orbital and palpebral part of the orbicularis muscle. The orbicularis muscle is mainly used in forceful lid closure and blinking mechanisms. Both levator muscles are considered yoke muscles and receive equal innervation of the oculomotor nerve^{1,2}. Congenital Myogenic Ptosis may occur due to maldevelopment or dysgenesis of the levator muscle. Instead of normal muscle fibres, fibrous and fatty tissue is found in the muscle belly, diminishing the muscle's ability to contract or relax. Acquired Ptosis may occur from the stretching or dehiscence of the LPS muscle, Oculomotor nerve palsy, Horner syndrome and Autoimmune disorders like myasthenia gravis³. We know that Ptosis is one of the most common eyelid diseases in ophthalmic plastic services. Severe congenital Ptosis not only affects the physical appearance of the eye but also influences functional problems such as visual development. Successful ptosis surgery provides a lid at or just below the limbus in the primary position and moves freely with the globe up and down.

However, when poor levator action is 4 mm or less, Frontalis Brow Suspension has long been accepted as the best technique for managing Ptosis. A suspension material like autologous Fascia lata/ preserved fascia lata/ Allogenic suspension materials like 2-0 Prolene, Aurosling, and Gore-tex attaches the tarsus to the frontalis muscle⁴. If LPS resection can be attempted, then maximal or supramaximal levator resection 20 mm or more should be resected to get the lid position at an acceptable position. It needs more surgical skills and experience. Here, we attempted to describe the

outcome of a new surgical technique, "Frontalis Muscle Flap advancement", to correct severe congenital Ptosis with poor levator action in a few cases.

PATIENTS AND METHODS

A case series study was done in the Bangladesh Eye Hospital and Institute, Dhaka, Bangladesh, from January 2020 to May 2021, including patients with severe congenital Ptosis having poor levator function (4 mm or less) and who were followed up at least 12 weeks after surgery. Congenital Ptosis with fair to good levator function and other causes of Ptosis were excluded from the study.

A thorough clinical evaluation such as the condition of the upper eyelid crease, Lid margin to Corneal reflex distance (MRD1 and MRD2), Lid lag on downgaze, Levator function, Frontalis muscle function, Pupillary reaction, Ocular motility, Bells Phenomenon, Fatigability, Cogan's sign, and Synkinesis were performed for all cases. Statistical analysis was done accordingly, and tests of significance and p-value were calculated using SPSS software.

SURGICAL TECHNIQUES

Before starting the surgery, palpate and mark the supraorbital notch because it is important for the Supraorbital neurovascular bundle and is marked laterally for the temporal branch of the seventh cranial nerve. The lid crease is marked for incision. If the crease is ill-defined, the height of the contralateral eyelid may be measured with caliper's and used as a reference. A single-lid crease skin incision was made rather than double incisions. The best way is sub-orbicularis dissection by Wescott scissors to expose the frontalis muscle; the dissection is carried out superiorly and followed by blunt dissection in the subcutaneous plane above the rim.



Figure 1: Diagrammatic image showing the advancement of the Frontalis Muscle for correcting the severe ptosis with poor levator action. F.M= Frontalis Muscle (Vertical fibres), O.O= Orbicularis Oculi Muscle (Circular fibres)

The dissection should be carried superiorly to approximately 5 mm above the superior orbital rim. The frontalis muscle is identified anterior to the retro-orbicularis oculi fat pad. A strong tooth forceps grasps the frontalis muscle to begin a flap development. Then, the Frontalis flap was advanced (**Fig. 1**) inferiorly and affixed with the superior third of the tarsus by three points @ central, medial, and lateral to maintain the natural lid contour. Finally, Lid-Crease forming sutures are placed medially, centrally, and laterally in an interrupted fashion.

RESULTS

We evaluated seven cases who underwent the advancement of the frontalis muscle flap for managing congenital Ptosis with poor levator function. The mean (\pm SD) preoperative upper eyelid margin to corneal reflex distance (MRD1) was $-2.667 (\pm 0.876)$. The mean (\pm SD) MRD1 after one month of ptosis surgeries was observed, which was $+2.83 (\pm 0.606)$.



Figure 2 (a+b): 1a shows the severe drooping of the right upper eyelid of a six-year-old boy, and 1b shows an elevated right upper eyelid after correcting severe congenital ptosis by the advancement of the Frontalis muscle flap.

The improvement in lid height was statistically significant (p -value <0.0001) in all cases. **Fig. 1 (a+b)** shows the significant improvement of MRD1 after advancement of frontalis muscle flap for managing severe congenital severe ptosis of the right eye.

Table 1: Pre-operative clinical findings of the patients

Sl. No.	Lid Crease	MRD1	LPS action	Frontalis Function	Ocular Motility
Case 1	Faint	-2mm	4 mm	7 mm	Full
Case 2	Faint	-3 mm	3 mm	8 mm	Full
Case 3	Absent	-2.5 mm	2 mm	10 mm	Full
Case 4	Absent	-1.5 mm	1 mm	6 mm	Full
Case 5	Absent	-3 mm	2 mm	8 mm	Full
Case 6	Absent	-4 mm	1 mm	9 mm	Restricted in Up & Down gazes
Case 7	Absent	-2	3 mm	9 mm	Full

Tables 1 and 2 show the preoperative and postoperative results, respectively. The frontalis function preoperatively was satisfactory (≥ 6 mm). Lid lag was reduced in all cases, and the postoperative lagophthalmos was observed in all cases that was minimal (1-2 mm) after one month of the ptosis surgery. Initial postoperative lagophthalmos was significant but diminished over time. There was no overcorrection in the studied cases.

Table 2: Postoperative (after one month) clinical findings of the patients

Sl. No.	Lid Crease	MRD1	PFH	Frontal Hypoesthesia	Lagophthalmos
Case 1	Prominent	+3 mm	9 mm	+	2 mm
Case 2	Prominent	+3.5 mm	10 mm	-	1 mm
Case 3	Prominent	+2.5 mm	8 mm	+	2 mm
Case 4	Prominent	+2.0 mm	8 mm	-	2 mm
Case 5	Prominent	+3.5 mm	9 mm	-	2 mm
Case 6	Prominent	+2.5 mm	8 mm	-	2 mm
Case 7	Prominent	+3.5	9 mm	+	1 mm

DISCUSSION

The Frontalis muscle (FM) flap advancement is China's most common procedure for correcting severe congenital Ptosis²⁻⁵. Potential complications are less than in the other two procedures. Now, we are focusing on Frontalis Muscle Flap advancement. It can be done in patients with severe Ptosis with poor levator function. It can be performed in patients with previously failed levator resection, and it can also be done in association with levator advancement to get optimum results⁶. The Frontalis muscle flap technique is more physiological because it lifts the eyelid through the natural contraction of the muscle, directly transferring the upward traction of the frontalis to the eyelid. Frontalis muscle has no bone attachments, originated from the galea aponeurotic, and medial fibres interdigitate with procerus, intermediate fibres blend with corrugator supercilii, and Orbicularis oculi and lateral fibres also blend with orbicular oculi over Zygomatic process. The frontalis muscle is closely adherent to the dermis of the skin at the eyebrow region but is mobile on the underlying periosteum⁷. Advancement of the Frontalis muscle flap is an effective and simple surgical technique to treat patients with severe Ptosis and poor levator function. However, this kind of operation has not been widely utilized in Europe and the United States because of its large latent separation range, leading to more bleeding and greater trauma than with brow suspension and severe complications such as Frontalis muscle paralysis and frontal hypoesthesia^{8,9}. The mean postoperative degree of the MRD1 was +1.7 mm in the levator resection technique and +2.1 mm in the frontalis muscle flap. The most common complication of levator resection was under correction¹⁰. The mean postoperative amount of MRD1 \pm SD was $+2.83 \pm 0.606$ in this study compared to preoperative MRD1 -2.667 ± 0.876). Preoperative Lid height and levator action are the outcome indicators of levator surgery and Frontalis muscle flap advancement surgery for correcting congenital Ptosis¹¹. The reported article by Liu HP et al. showed 81% satisfactory results of 43 eyelids. A minimal lagophthalmos was noted following surgery⁶. Zhong, M., Jin, R., Li, Q. *et al.* showed 90% successful results of 85 patients after FMF advancement surgery⁹. Another study reported that modified frontalis muscle flap provided a better result, 90% for severe CSP with poor LPS action⁸. Lagophthalmos may occur following frontalis flap advancement but is typically well-tolerated and improves in the months following surgery^{12,13}. In our study, the postoperative lagophthalmos was clinically significant but it diminished over time. The amount of lagophthalmos ranges from one to two mm after one month of the surgery. Dry eye secondary to increased corneal exposure can be treated with frequent application of frequent eyedrops. Other possible complications include recurrent Ptosis, entropion, and ectropion¹⁴. The gross preoperative amount of Ptosis was about 2.7 mm in cases operated by levator resection and 4.0 mm in cases corrected by the advancement of the frontalis muscle flap. Eyelid deformity due to excessive traction was more frequent in the

frontalis muscle flap technique. The primary advantage of frontalis muscle flap advancement over a graft or suture material is that it elevates the eyelid directly by moving the frontalis muscle into the eyelid rather than by graft or suture material^{8,9}. It can be performed in infants and eliminates many risks involved in frontalis sling procedures¹⁵.

CONCLUSION

Frontalis flap advancement is a technically simple, safe, and effective technique for repairing myogenic Ptosis with poor levator action. It can achieve powerful eyelid lifting with minimal tissue trauma. The surgical technique's outcome depends on the patient's preoperative frontalis muscle function.

Conflict of Interest: None

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