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FUNCTIONAL OUTCOMES OF FRONTO-PERIOSTEAL FLAP SUSPENSION IN CONGENITAL PTOSIS: A PROSPECTIVE PILOT STUDY

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ABSTRACT

Objective: To evaluate the functional outcomes and complications of fronto-periosteal flap suspension in severe congenital ptosis with poor levator function.

Methods: A prospective study was conducted at the Department of Ophthalmology, Hassan II University Hospital, Fez, over 6 months, with institutional ethics approval, in accordance with the Declaration of Helsinki. Six patients (8 eyelids) were included after exclusion of one case of Marcus Gunn phenomenon among seven recruited cases. The primary outcome was the improvement in margin reflex distance 1 (MRD1) between preoperative and postoperative measurements; secondary outcomes included improvement in palpebral fissure height (PFH) and complication rate. Statistical analysis was based on the Wilcoxon signed-rank test for paired series.

Results: The cohort included 3 boys and 3 girls (3 to 9 years old), with unilateral ptosis in 4 patients (66.7%) and bilateral in 2 (33.3%). Mean follow-up was 6 months. A significant improvement in MRD1 (+4.62 ± 1.43 mm; p = 0.0078) and palpebral fissure height (+5.25 ± 1.04 mm; p = 0.0078) was observed. A single recurrence (12.5% of eyelids) required surgical revision; no infection, granuloma, or permanent lagophthalmos was reported.

Conclusion: The fronto-periosteal flap with preservation of eyelid dynamics constitutes a reliable and effective autologous alternative to conventional frontalis suspension, limiting the risk of complications while ensuring good functional and aesthetic outcomes in patients with severe ptosis and poor levator function. These preliminary results warrant confirmation through multicenter prospective studies with extended follow-up.

Keywords: Congenital ptosis; Fronto-periosteal flap; Upper eyelid surgery; Frontalis suspension; MRD1

1 INTRODUCTION

Severe congenital ptosis, particularly when associated with poor levator muscle function (< 4–5 mm), represents a major therapeutic challenge. Left untreated, it can lead to visual axis obstruction, amblyopia, refractive disorders such as astigmatism, and significant psychosocial impact. When levator function is adequate, resection or advancement of the levator muscle is generally preferred. However, in cases of poor function, frontalis suspension remains the reference technique, transmitting the action of the frontalis muscle to the upper eyelid.

Several materials have been proposed for this suspension, whether autologous (fascia lata, temporal fascia) or synthetic (silicone, Mersilene, Gore-Tex). Synthetic materials offer technical simplicity and avoid a donor site but are associated with higher rates of infection, extrusion, and recurrence. Autologous fascia lata remains considered the gold-standard material due to its better tolerance and durability, but its harvesting requires an additional donor site, its own morbidity, and a longer operative time, which limits its use in young children.

The fronto-periosteal flap addresses these limitations: it uses local, vascularized autologous tissue directly adjacent to the surgical site, without requiring a distant donor site or a second surgical stage. It thus combines the advantages of autologous tissue — better integration, lower infectious and rejection risk — with those of a local technique, simpler and less morbid than fascia lata harvesting.

While fascia lata or synthetic material suspension techniques are well documented, few studies have thoroughly evaluated the functional outcomes and complication profile of the fronto-periosteal flap in severe congenital ptosis with poor levator function. This technique remains poorly described in the literature, particularly regarding its medium- and long-term impact on eyelid dynamics.

The objective of this study was to evaluate the functional outcomes and complications of fronto-periosteal flap suspension in patients with severe congenital ptosis.

2 MATERIALS AND METHODS

This prospective study was conducted in accordance with the principles set out in the Declaration of Helsinki. The protocol received approval from the institutional ethics committee prior to patient recruitment. Written informed consent was obtained from the parents or legal guardians of each patient, following detailed information on the study objectives, the surgical technique used, and the expected benefits and potential risks associated with the procedure. Patient data confidentiality was maintained throughout the study.

We conducted a prospective study at Hassan II University Hospital in Fez over a period of 6 months. It included 7 cases of congenital ptosis. One patient presenting with Marcus Gunn phenomenon was excluded from the study, bringing the final cohort to 6 patients[16].

All patients underwent a complete, standardized ophthalmologic clinical examination. This included measurement of visual acuity, as well as assessment of margin reflex distances 1 (MRD1) and 2 (MRD2) and palpebral fissure height. Upper eyelid levator muscle function was systematically measured, as was the position of the upper eyelid crease. Bell's phenomenon was assessed in all patients, as was the presence of any lagophthalmos. A phenylephrine (neosynephrine) test was systematically performed to assess the sympathetic component of the ptosis. Screening for pseudoptosis was also systematically conducted to rule out any differential diagnosis. Examination of the ocular surface, including the conjunctiva and cornea, was supplemented by a detailed examination of the anterior chamber and fundus, allowing exclusion of any associated ocular pathology that could influence management or functional prognosis.

2.1 Surgical Technique

The procedure began with marking of the incision along the upper eyelid crease, as well as outlining the frontal flap, measuring 1.5 cm wide by 2 cm long.

A skin incision was made along the upper eyelid crease, followed by incision of the orbicularis muscle. Sub-orbicularis dissection was then carried out inferiorly, exposing the upper third of the tarsus, and superiorly, exposing the superior orbital rim. The supraorbital notch, marking the course of the eponymous nerve, was identified by palpation to guide dissection and avoid nerve injury.

Using a cold blade, an incision was made at the base of the frontalis muscle, at the level of the orbital rim, followed by dissection in the subperiosteal plane. The cleavage plane between the skin and the frontalis muscle was then dissected. Two vertical relaxing incisions were made on either side, allowing individualization of the musculo-periosteal flap.

The frontal flap was finally sutured to the upper third of the tarsus with three interrupted 5-0 Vicryl sutures, passing through Whitnall's ligament.

Figure 1: Preoperative marking of the incision along the upper eyelid crease and outline of the flap.

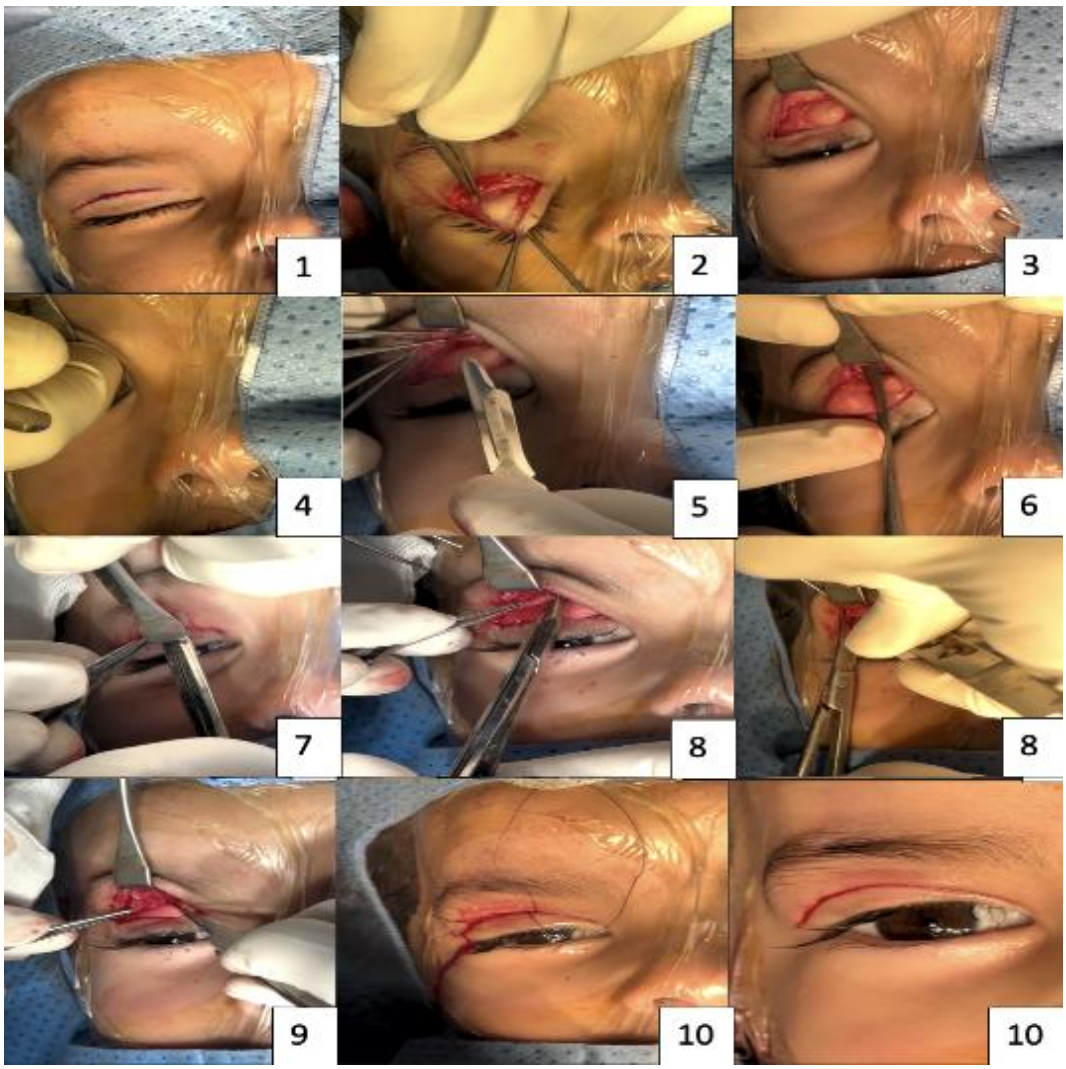

Figure 2: Surgical steps of the fronto-periosteal flap technique.

The primary outcome was the improvement in margin reflex distance 1 (MRD1) between preoperative and postoperative measurements, reflecting the functional success of ptosis correction. Secondary outcomes included improvement in palpebral fissure height (PFH), postoperative complication rate (recurrence, lagophthalmos, infection, granuloma), and the need for surgical revision.

Statistical analysis was performed using the non-parametric Wilcoxon signed-rank test for paired series, suited to comparing repeated measurements in the same subject in a small sample (n = 8 eyelids). This test was used to compare preoperative and postoperative MRD1 and palpebral fissure height (PFH) values for each patient.

3 RESULTS

The study included 6 patients and 8 eyelids, with a mean follow-up of 6 months. Among the included patients, 3 (50%) were male and 3 (50%) were female. Patient age ranged from 3 to 9 years. Ptosis was unilateral in 4 patients (66.7%) and bilateral in 2 patients (33.3%). All patients had a negative neosynephrine test. No pseudoptosis was observed, and all patients had a normal ocular surface and fundus.

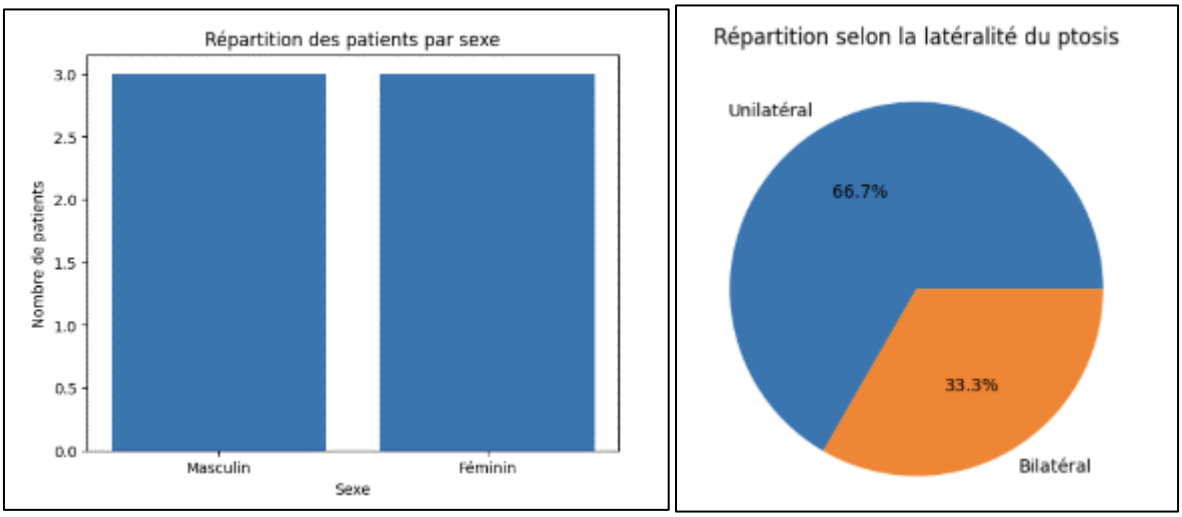

Figure 3: Distribution of patients by sex and laterality of ptosis.

Preoperatively, regarding levator muscle function, 6 eyelids (75%) had levator excursion between 1 and 4 mm, while 2 eyelids (25%) had excursion between 4 and 6 mm. Preoperative margin reflex distance 1 (MRD1) was 1 mm in 4 eyelids (50%), -1 mm in 1 eyelid (12.5%), -2 mm in 2 eyelids (25%), and 0 mm in 1 eyelid (12.5%). Preoperative margin reflex distance 2 (MRD2) was 4 mm in 6 eyelids (75%) and 5.5 mm in 2 eyelids (25%).

The postoperative improvement in MRD1 averaged 4.62 ± 1.43 mm, with the mean value increasing from -0.13 mm preoperatively to 4.50 mm postoperatively. This difference was statistically significant ($p = 0.0078$). Similarly, palpebral fissure height increased by an average of 5.25 ± 1.04 mm, from 2.63 mm to 7.88 mm, with identical statistical significance ($p = 0.0078$). These results confirm a consistent and homogeneous improvement across all operated eyelids.

Table 1: Perioperative evolution of MRD1, palpebral fissure height, and complications by eye.

Eye No.	Age	Side	Preop MRD1	Postop MRD1	Preop PFH	Postop PFH	Complications	Follow-up
1	7	OD	1 mm	5 mm	5 mm	9 mm	None	6 months
2	8	OD	-1 mm	4 mm	2 mm	7 mm	None	6 months
3	6	OS	-2 mm	4.5 mm	2 mm	7 mm	None	6 months
4	4.5	OS	-2 mm	5 mm	1 mm	8 mm	None	6 months
5	10	OD	1 mm	5 mm	5 mm	9 mm	None	6 months
6	10	OS	1 mm	5 mm	2 mm	8 mm	Failure, surgical revision, then no complication	6 months

7	8	OD	0 mm	3.5 mm	2 mm	7 mm	None	6 months
8	8	OS	1 mm	4 mm	2 mm	8 mm	None	6 months

Table 2: Statistical summary of outcome measures (Wilcoxon signed-rank test for paired series).

Variable	Preop mean	Postop mean	Mean improvement	Wilcoxon	p-value
MRD1 (mm)	-0.13	4.50	+4.62 ± 1.43	W = 0	p = 0.0078
Palpebral fissure / PFH (mm)	2.63	7.88	+5.25 ± 1.04	W = 0	p = 0.0078

Regarding complications, only one surgical revision was required (12.5% of eyelids), with no infection or granuloma reported at the end of the 6-month follow-up.

Examples of operated patients, before and after surgery:

Figure 4: Marked improvement in MRD1 with good symmetry between the two eyes.

Figure 5: Palpebral aperture at rest and on forced opening, remaining symmetric during dynamic movements.

Figure 6: Improvement in MRD1 with near-symmetry between the two eyes.

Figure 7: Marked improvement in MRD1.

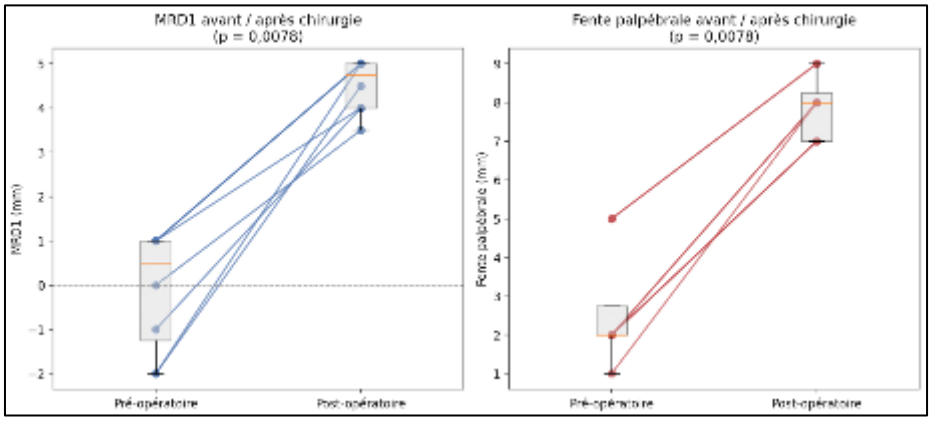

Figure 8: Illustrative diagram of the evolution of MRD1 and palpebral fissure height before and after surgery.

4 DISCUSSION

Surgical management of severe congenital ptosis with poor levator function remains a major therapeutic challenge. Traditional frontalis suspension techniques, whether using autologous or synthetic materials, have demonstrated efficacy but remain burdened by significant complications, particularly related to infectious risk, material extrusion, or donor site morbidity.

Any surgical intervention relies first and foremost on precise knowledge of the procedure to be performed; mastering it, however, equally requires knowing what to avoid. Thus, in this surgery, several technical pitfalls must be anticipated. A skin incision that is too short compromises exposure of the superior orbital rim and makes dissection more laborious. Conversely, excessive subperiosteal dissection risks reducing frontalis muscle action, potentially leading to secondary brow ptosis. Flap sizing must also be rigorous: a flap that is too small under-expresses frontalis action, while one that is too large risks over-expressing it, with a detrimental effect on eyelid dynamics[13]. Finally, to prevent postoperative lash malposition, the sutures connecting the flap to the tarsus must pass through the levator muscle, ensuring an antero-posterior traction that maintains a physiological lash axis.

The use of the frontal flap in ptosis surgery has undergone several technical evolutions, each with its own advantages and limitations, although all converge toward comparable functional efficacy. The initial 'L-shaped' configuration was based on the then-prevailing belief that creating two relaxing incisions exposed the flap to denervation, followed by atrophy and rapid functional deterioration. This hypothesis proved incorrect about a decade later, leading to the continued use, to this day, of the two-incision technique. Subsequently, other variants emerged, notably the fronto-orbicularis-muscle flap, which simplifies and shortens operative time while offering comparable efficacy, albeit at the cost of postoperative eyelid dynamics considered less satisfactory.

These findings align with recent literature data. A series published in Eye journal reported, in patients operated with a combined levator-frontalis flap for recurrent severe congenital ptosis, a consistent postoperative MRD1 improvement, averaging 3.93 ± 0.52 mm at last follow-up — a result consistent with the mean MRD1 improvement observed in our series [2]. Similarly, a Vietnamese retrospective study of 47 patients operated with a modified C-shaped frontalis flap for moderate to severe ptosis with poor levator function reported a predominantly severe and unilateral ptosis proportion, a distribution close to that of our cohort [1].

Regarding non-frontal autologous alternatives, a study of 12 children operated with fascia lata or autologous temporal fascia suspension for severe congenital ptosis showed [10,12], with a mean follow-up of 8 years, good to excellent functional and aesthetic outcomes in the majority of patients, with no recurrence or overcorrection, confirming the long-term reliability of autologous tissues, whether of frontal or fascial origin [3]. More recently, Chinese teams have developed and compared techniques combining conjoint fascial sheath and levator muscle with the frontalis myofascial flap [14,15], aiming to limit postoperative regression of eyelid position observed with fascia-alone suspensions, illustrating a current trend toward combined constructs aimed at optimizing the durability of functional outcomes [4,5].

These various approaches, like our own, converge on several points: frontalis muscle suspension constitutes an effective autologous alternative[6,7,8], avoiding the complications specific to synthetic materials as well as the morbidity of a distant donor site; technical variants (frontalis muscle alone, combined with orbicularis, or combined with the levator) all aim to optimize the dynamic balance between eyelid elevation and closure; and finally, postoperative eyelid dynamics are generally slightly altered, with a minimal risk of transient but almost never permanent lagophthalmos, for a net benefit in palpebral fissure opening [9,11].

4.1 Study Limitations

This study has several limitations worth noting. The small sample size (6 patients, 8 eyelids) limits the statistical power of the analysis and the generalizability of the results; it nonetheless reflects the relative rarity of severe congenital ptosis with poor levator function in our recruitment. The follow-up duration, limited to 6 months, does not allow assessment of the medium- and long-term stability of the functional outcome, nor the risk of late recurrence, unlike some series in the literature with multi-year follow-up. The absence of a comparative group (fascia lata, synthetic materials) within the same study does not allow a formal conclusion regarding the superiority of the fronto-periosteal flap, but only allows our results to be situated relative to published data.

5 CONCLUSION

The fronto-periosteal flap with preservation of eyelid dynamics constitutes a reliable and effective autologous alternative to conventional frontalis suspension in the management of severe congenital ptosis with poor levator function. In our series, this technique achieved a statistically significant improvement in MRD1 (+4.62 ± 1.43 mm; p = 0.0078) and palpebral fissure height (+5.25 ± 1.04 mm; p = 0.0078), with a single case of recurrence requiring surgical revision, and no infection or granuloma across all operated eyelids.

By using local, vascularized autologous tissue directly adjacent to the surgical site, this approach avoids both the infectious and extrusion risks specific to synthetic materials and the morbidity of a distant donor site inherent to fascia lata grafts. These preliminary results, although obtained in a limited cohort with short-term follow-up, confirm the value of this technique as a first-line surgical option, to be validated by multicenter prospective studies with extended follow-up.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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Disclosure of conflict of interest

The authors declare no conflict of interest related to this work.

Statement of ethical approval

This study was conducted in accordance with the principles of the Declaration of Helsinki and received approval from the institutional ethics committee of Hassan II University Hospital, Fez.

Statement of informed consent

Written informed consent was obtained from the parents or legal guardians of each patient prior to inclusion.

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