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Original Research Article

Comparative evaluation of supra-brow single-stab and conventional fox-pentagon frontalis sling surgery

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Abstract

Background: Ptosis is a condition that can impair vision and affect facial aesthetics. Diverse surgical techniques have been devised for its correction, of which conventional Fox-Pentagon technique is widely accepted for severe ptosis. Supra-brow Single-Stab (SBSS) technique has been devised recently to reduce the number of incisions in the conventional approach.
Aim and Objective: This study was aimed to compare functional and cosmetic outcome of Supra-brow Single-Stab (SBSS) and Conventional Fox-Pentagon Frontalis Sling Surgery
Materials and Methods: 28 eyelids of 24 patients where 20 patients had unilateral ptosis and 4 patients had bilateral ptosis. The patients were divided via Block Randomization into two groups – the study group (A) underwent SBSS, whereas the control group (B) underwent Conventional Fox-Pentagon Frontalis Sling surgery. All patients underwent thorough ptosis evaluation before surgery. The SBSS surgery modified conventional technique by giving a single supra-brow incision while maintaining the basic pentagon-shape. Functional outcomes were assessed in both groups using parameters - margin reflex distance 1, lagophthalmos, and lid closure. Cosmetic grading was done via parameters - lid crease height, lagophthalmos, and presence of scars. All patients were followed up as Day 01, Day 30, 3rd month, and 6th month. The variables were compared and statistically evaluated by t-test and Fisher's exact test analysis using online calculator. Design: Prospective case control study.
Results: The study group and the control group were comparable at all points of time in functional and cosmetic outcomes, the study group faired significantly better than the control group (p-value <0.05), predominantly due to reduced scarring and fewer number of suprabrow scars.
Conclusions: This technique has a simple learning curve, decreased intraoperative bleeding, fewer number of sutures, fewer postoperative scars, and enhanced cosmesis, while retaining the usual advantages and functional results of standard sling procedures. No specific complications were noted.

Keywords: Ptosis, Frontalis sling, Fox pentagon, Silicon sling, Suprabrow Single-stab incision.

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1. Introduction

Ptosis a condition where the upper eyelid descends below the normal position.[1] When the upper eyelid descends to a position lower than the typical range, which is approximately 1.0-2.0 mm below the superior limbus, it is identified as ptotic eyelid.[2]

It can be caused by various factors, including - congenital condition, aging process, muscle weakness, nerve damage or mechanical cause. Ptosis can impact either a single eye or both eyes, giving rise to a range of symptoms, including the obstruction of the visual field and cosmetic issues. Prevalence figures for ptosis are primarily derived from studies specific to certain regions, which have documented rates ranging from 4.7% to 13.5% in adult populations.[3-5] These statistics underscore the common occurrence of this condition across various geographic areas.

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Upper eyelid ptosis may be minimal (1-2 mm), moderate (3-4 mm), or severe (>4 mm) covering the pupil entirely. Treatment of ptosis depends on age of the patient, etiology, laterality of involved eyelids, its severity, function of the levator palpebrae superioris, and the presence of other eye or neurological diseases.

Frontalis sling suspension is a commonly employed surgical procedure aimed at correcting moderate to severe ptosis. Various technical modifications like single pentagon, single-triangle, double triangle, Crawford's technique, rhomboid etc[6-16] and materials like autologous fascia lata, Goretex, silicon rod etc.[15,17] have been described to improve the cosmetic outcome. Fox's single pentagon[6] is the most utilized procedure. The conventional frontalis sling procedure requires three supra-brow stab incisions and two lid incisions, which can lead to fibrosis and multiple scars, potentially affecting the aesthetic outcome. A novel technique, the Supra-brow Single Stab frontalis sling suspension, was introduced by S. Jacob et al.[18] In this study, we compare the anatomical, functional, and cosmetic result of this technique with the conventional method, specifically within the population of Assam, India, to evaluate potential advantages in reducing scarring and improving results.

2. Materials and Methods

2.1. Aims

1. To assess and compare the anatomical, functional, and aesthetic results of the supra-brow single-stab approach versus the conventional fox-pentagon frontalis sling surgery.
2. To evaluate the potential complications linked to both the supra-brow single-stab and conventional fox-pentagon frontalis sling surgery methods.

2.2. Settings and design

1. Place of study: It was conducted at a tertiary care eye institute in Assam, India.
2. Duration of study: One year from May 2023 to April 2024.
3. Study population: Patients of age group 18 years to 60 years, presenting with severe ptosis of either eye at our institute.
4. Sample size: The sample size for the study were 28 eyelids of 24 patients. 20 patients had ptosis in one eye and 4 patients had ptosis in both eyes.

2.3. Inclusion criteria

1. Patients falling in the age group - 18 years to 60 years.
2. All the patients having severe ptosis (>4mm) and poor levator function (<4mm) were included in the study.

2.4. Exclusion criteria

1. Patients with recurrent ptosis.
2. Patients with lagophthalmos, poor Bell's phenomenon, Marcus-Gunn Jaw winking phenomenon or severe dry eye.
3. Patients of myogenic, neurogenic, traumatic and/or mechanical ptosis.
4. Patients having coagulopathy or severe systemic illness.
5. Patients not giving voluntary consent for the study.

The study received approval from the institutional review board, adhering to all principles of the Declaration of Helsinki. Written informed consent was obtained from all participants prior to their inclusion in the study and surgery.

2.5. Randomization method

The patients were divided into two groups - Group A and Group B by Block Randomization. Patients in Group A underwent Single Stab modified method of Fox Pentagon Sling surgery and those in Group B underwent Conventional method of Fox Pentagon Sling surgery. By this method each group had 14 patients who were randomly assigned.

2.6. Patient evaluation and surgical procedure

2.6.1. Pre-operative Assessment:

A thorough ocular examination was conducted, encompassing evaluation of best-corrected visual acuity and slit-lamp biomicroscopy and fundus examination. Ptosis examination was done by evaluating - Preoperative marginal reflex distance 1 (MRD1) and Levator palpebrae superioris (LPS) function was measured by Berke's method by measuring the movement from downgaze to upgaze while negating frontalis muscle function by pressing over the eyebrow and ensuring the head is positioned in the frontal or Frankfort plane recorded in millimeters(mm). Poor LPS was considered when <4mm.[19] Other tests included assessment of the Bell's phenomenon, corneal sensation, Schirmer test, Marcus Gunn jaw-winking phenomenon, examination of ocular alignment, and evaluation of extraocular muscle motility. Ice pack test was done to rule out ocular myasthenia gravis and phenylephrine test done to assess the function of Muller's muscle.

2.6.2. Surgical procedure

Every surgery was conducted under local anesthesia, lidocaine 2% with 1:100,000 adrenaline for lid infiltration. These procedures were carried out exclusively by one surgeon.

A. Supra-brow single stab frontalis sling surgery

Under aseptic condition, pentagon shaped skin-marking was done: two marks 2 mm above the eyelid margin, two marks 2 mm above the brow level, and a single central mark 5 mm from the brow margin at the apex of the pentagon. Single incision of approximately 3 mm in length was made at apex, about 5 mm above the eyebrow. The incision was extended

to make a subperiosteal pocket. Sterile silicone sling material was used for the suspension. The first needle was inserted medially, passing horizontally through the epitarsal tissue and externalized laterally. A minimum distance of 5 mm was maintained between the entry and exit points, ensuring no skin incisions were made. The needle was reintroduced through the lateral incision and guided upwards along a tangential path, briefly passing behind the septum just below the orbital rim. It then ascended toward the upper lateral corner of the pentagon, at the brow level. Without externalizing the needle, its direction was adjusted and guided toward the central supra-brow stab incision, where it exited through the skin. Similarly, the needle on the medial side followed the same pathway, exiting through the central supra-brow incision. Palpation with the left index finger helped gauge the location of the advancing needle tip. To facilitate the externalization of the needle, the central supra-brow incision was slightly adjusted using toothed forceps, which were slid along the advancing needle. The silicone sleeve was inserted through the two needles at either end, and the lid height was adjusted to the desired position. A non-absorbable suture was placed to prevent the sling from slipping. Finally, the silicone sleeve and knots were placed in the subperiosteal pocket, and the single supra-brow incision was sutured with single 6-0 silk suture.

B. Conventional 3-stab frontalis sling surgery

Under aseptic conditions, pentagon shaped skin-marking was done to indicate the locations for the skin incisions: two marks 2 mm above the eyelid margin, two marks 2 mm above the brow level, and a single central mark 5 mm from the brow margin at the apex of the pentagon. The incision was extended to make a subperiosteal pocket. The first needle of the silicone sling was introduced through the lateral eyelid incision, passing horizontally through the epitarsal tissue, and externalized by the medial eyelid incision. The needle was then advanced sequentially in an upward direction, exiting through the respective lateral and medial brow incisions. Next, the needles were again inserted into the same incisions respectively and directed toward the central supra-brow incision, where they were exteriorized. The silicone sleeve was inserted through the two needles at either end, and the lid height was adjusted to the desired position. A non-absorbable suture was placed to prevent the sling from slipping. The silicone sleeve and the knots were then buried subperiosteally. Finally, each incision was sutured with single 6-0 silk suture. This step completed the procedure, ensuring proper positioning and fixation of the sling.

2.6.3. Post-operativeassessment:

The post-operative assessment for both the functional and cosmetic outcome of the two surgical methods was done at - day 1, day 30, at 3 and 6 months after surgery.

For assessing the functional outcome following parameters were checked-

1. MRD 1 scored as: MRD 1 value of 4-5 mm - 02; 1-3 mm - 01 and < 1 mm - 00
2. Lagophthalmos was scored as: No lagophthalmos - 02; any conjunctival exposure - 01 and any corneal exposure- 00
3. Post-operative lid edema was graded as: No to Minimal lid edema - 02; moderate lid edema (extending up to pupil) - 01 and severe lid edema (extending beyond the pupil) + ecchymosis, tenderness - 00

Cosmetic grading was based on objective measurements, including lid crease height, lagophthalmos, and presence of scar, which collectively defined the overall cosmetic outcome of the procedure.

1. Lid crease height was scored as: 4-5 mm - 02; 3-4 mm - 01 and < 3 mm - 00
2. Lagophthalmos was scored as follows: No lagophthalmos - 02; any conjunctival exposure - 01 and any corneal exposure- 00
3. Presence of multiple scars were scored as 0 if present and 2 if absent. Prominent supra-brow scar if present- 0 and scored 2 if absent.

Maximum score was 8, patients were classified as excellent with score 6-8, good with score 4-6 and less than 4 graded as poor.

Pre- and post-operative clinical photographs were obtained for all patients taking due care not to reveal the identity of the patients. (**Figure 1**).

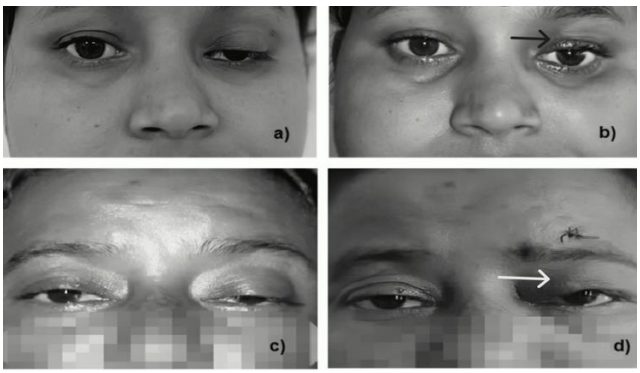

Figure 1: Clinical photograph of study participants of both the Groups. **a and b**): Shows pre- and post-op photograph of a participant in Group A with black arrow showing better cosmetic outcome. **c and d**): Shows pre- and post-op photograph of a participant in Group B with white arrow showing poorer cosmetic outcome.

2.7. Statistical analysis used

The variables were compared and statistically evaluated by t-test and Fisher's exact test analysis using online calculator.

3. Results

The study included 28 eyelids of 24 patients those fulfilling inclusion criteria with age ranging from 18 years to 60 years with mean age of 34.1 + 12.5 years, the third decade being the commonest age-group (**Figure 2**).

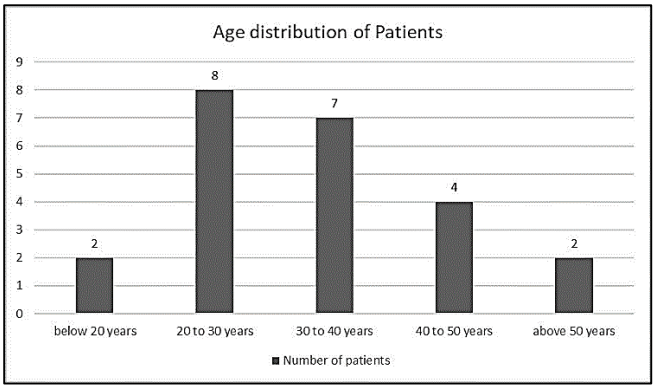

Figure 2: Age distribution of patients included in the study

The study included 14 females (58.3%) and 10 males (41.6%). Group A consisted of 12 patients, with six males and six females, while Group B also had 12 patients, comprising four males and eight females.

For both the groups patients with severe ptosis >4mm dropping of upper lid and poor LPS function <4mm were taken, all were operated by same surgeon.

Average time taken for surgery in group A was 40-45 mins and in group B around 30-35min Functional success was defined by fulfilling following criteria-

1. Satisfactory lid height (MRD at least 3mm)
2. Satisfactory lid symmetry (<2mm asymmetry in MRD)
3. Satisfaction with cosmetic outcome

Functional success was assessed in early and late post operative period by same surgeon on day 1, day 30, 3rd month and after 6th month.

Table 1: Comparison of pre-operative and post-operative MRD 1 between Group A and Group B

Time of examination	MRD 1 value (in mm)	
	Group (A)	Group (B)
Preoperative	-1.33	-2
Day1 post-op	3.7	3.5
Day 30 post op	3.8	3.6
3 month	4.2	3.9
6 month	4.5	4.2

In both the study and control groups, a significant difference in MRD1 was observed in the postoperative period compared to the preoperative period. However, there was no significant change in the average postoperative MRD1 at day 1, day 30, 3 months, and 6 months. When compared the patients in both groups using t-test. In the postoperative follow-up period, the difference in MRD1 values was found to be statistically significant between the two groups (p-Value = 0.0184). Overcorrection, lagophthalmos and dry eye as a complication were not seen in either of the groups. Lid edema was more significant in group A on day 1 due to more tissue manipulation, but was not significant on day 30.

We analyzed the patients and graded them to have excellent, good, and poor cosmetic scores in both groups. In Group A, 11 patients (78.5%) had an "Excellent" cosmetic score, while 5 patients (35.7%) in Group B received the same rating. A "Good" score was noted in 3 patients (21.4%) of Group A and 9 patients (64.3%) of Group B. No patients in either group received a "Poor" score. The cosmetic outcome in Group A was better than in Group B which was statistically significant (P-value < 0.05), indicating superior results in the study group compared to the control group (**Table 2**).

Table 2: Post-operative cosmetic outcome between Group A and Group B

Cosmetic outcome	Group A	Group B
Excellent	11 patients (78.5%)	5 patients (35.7%)
Good	3 patients (21.4%)	9 patients (64.3%)
Poor	Nil	Nil

A postoperative mean elevation of at least 3 mm was observed in 12 patients (85.7%) in Group A and 11 patients (78.5%) in Group B, with no need for surgical revision (**Figure 3**).

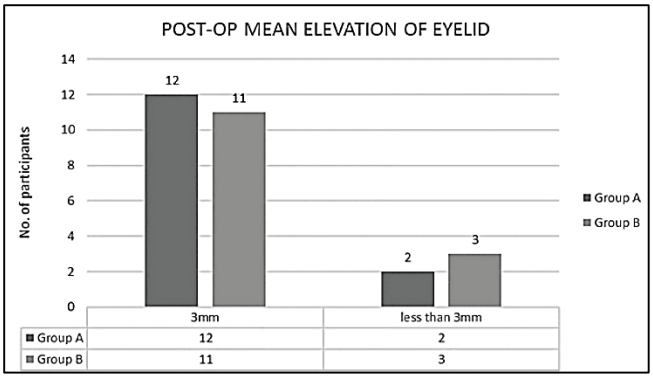

Figure 3: Chart depicting the post-operative mean elevation of eyelid margin between Group A and Group B

Undercorrection was observed in 2 eyes (7.14%) in Group A and in 1 eye (3.57%) in Group B on postoperative Day 1, attributed to lid edema. However, no lid edema was noted in either group during subsequent checkups.

Sling exposure at forehead incision were noted in 2 eyes (14.28%) in group A while 1 eyes in group B (7.14%). No re-exposure was seen after revision surgery.

After 6 months of follow-up cosmetic outcome and scarring was less in group A single stab technique as compared to group B conventional technique.

Both groups showed postoperative cosmetic improvement in patients with absent lid-crease. None of the patients had residual lagophthalmos in either group with no incidence of postoperative exposure keratitis in any of the patient.

4. Discussion

The frontalis sling procedure is the preferred surgical method for treating severe ptosis with having levator palpebrae superioris elevation less then 4mm. In this technique, a sling material is used to strengthen the connection between the eyelid margin and the eyebrow. This connection allows the frontalis muscle to lift the eyelid more effectively, improving both eyelid position and appearance. Common sling placement patterns include the single triangle,[14] double triangle,[15] single rhomboid (Friedenwald-Guyton procedure),[17] double rhomboid (Iliff procedure),[14] double trapezoid (Wright procedure),[18] single pentagon (Fox procedure),[6] and double pentagon (Crawford procedure).[16]

Silicone has been a popular sling material,[15,17] often used with the fox pentagon method. However, the traditional technique can result in increased intraoperative bleeding due to the multiple incisions required. Postoperatively, patients may experience more swelling, and over time, there is a greater risk of visible scarring. While stab incisions within the brow can conceal scars, they may also damage hair follicles, potentially leading to permanent hair loss and unsightly scarring.

A modified frontalis suspension technique, on the other hand, offers better cosmetic outcomes while still delivering the strong functional results of the conventional method. The "single stab" technique implies a minimally invasive approach, which results in less tissue trauma. In our study, we found that there was reduced postoperative pain, and faster recovery times compared to conventional approach as reported by Soosan et al.[18] The procedure typically involves a simpler surgical technique, potentially leading to shorter operating times and decreased risk of intraoperative complications. With fewer incisions and, there is reduced risk of complications such as infection, bleeding, or damage to surrounding structures. Minimally invasive techniques often allow for better preservation of anatomical structures, which may result in better long-term outcomes and lower risk of postoperative complications like mesh erosion or displacement. One of the key benefits of this technique is the ability to avoid excessive incisions, which minimizes bleeding and reduces postoperative swelling and scarring. Furthermore, by preserving the brow's hair follicles, it avoids the risk of permanent hair loss, leading to a more aesthetically pleasing result.

Despite these differences, the modified technique offers a well-balanced option, delivering good visual outcomes with minimal postoperative complications, while maintaining a relatively simple learning curve for surgeons.

5. Limitations of the Study

1. The study was conducted at a single tertiary care eye hospital which can lead to bias.
2. The follow-up period of each patient was six months. A longer follow-up is needed to check long-term outcome of this technique.

6. Strengths of the Study

1. The study was conducted at a premier tertiary care eye hospital where we receive many referrals. Thus, the study population included a diverse patient profile of different age groups and ethnicity.
2. The surgeries were all conducted by a single surgeon which maintained equality in all cases.

7. Conclusions

Supra-brow single stab modification of the conventional frontalis sling surgery features ease of learning, reduced intraoperative bleeding, fewer sutures, less postoperative inflammation and scarring, and improved cosmetic outcomes, while maintaining the functional benefits and advantages of standard sling procedures. These elements distinguish it as an effective and refined approach to ptosis correction surgery.

8. Disclosures

All the participants in this study provided informed written consent. Institutional Ethical Committee of Gauhati Medical College & Hospital issued approval for the study vide MC No. 190/2007/Pt II/April 2023/11 date: 23/06/2023. No animal subjects or tissue was involved.

No financial support was received from any organization for the submitted work.

9. Source of Funding

None.

10. Conflict of Interest

None.

11. Ethical Approval

Ethical No.: 190/2007/Pt II/April 2023/11.

References

1. Leitman MW. Manual for eye examination and diagnosis. 9th ed. Malden, MA: Wiley-Blackwell; 2016.
2. Grob SR, Cypen SG, Tao JP. Acquired ptosis. In: Albert DM, Miller JW, Azar DT, Young LH, eds. Albert and Jakobiec's principles and practice of ophthalmology. Cham: Springer; 2020. p. 1–19.
3. Sridharan GV, Tallis RC, Leatherbarrow B, Forman WM. A community survey of ptosis of the eyelid and pupil size of elderly people. *Age Ageing*. 1995;24(1):21–4.
4. Hashemi H, Khabazkhoob M, Emamian MH, Yekta A, Jafari A, Nabovati P, et al. The prevalence of ptosis in an Iranian adult population. *J Curr Ophthalmol*. 2016;28(3):142–5.
5. Kim MH, Cho J, Zhao D, Woo KI, Kim YD, Kim S, et al. Prevalence and associated factors of blepharoptosis in Korean adult population: the Korea National Health and Nutrition Examination Survey 2008-2011. *Eye (Lond)*. 2017;31(6):940–6.
6. Fox SA. Congenital ptosis: II. Frontalis sling. *J Pediatr Ophthalmol Strabismus*. 1966;3(2):25–8.
7. Kersten RC, Bernardini FP, Khouri L, Moin M, Roumeliotis AA, Kulwin DR. Unilateral frontalis sling for the surgical correction of unilateral poor-function ptosis. *Ophthalmic Plast Reconstr Surg*. 2005;21(6):412–6.
8. Clauser L, Tieghi R, Galiè M. Palpebral ptosis: clinical classification, differential diagnosis, and surgical guidelines: an overview. *J Craniofac Surg*. 2006;17(2):246–54.
9. Leibovitch I, Leibovitch L, Dray JP. Long-term results of frontalis suspension using autogenous fascia lata for congenital ptosis in children under 3 years of age. *Am J Ophthalmol*. 2003;136(5):866–71.
10. Goldberger S, Conn H, Lemor M. Double rhomboid silicone rod frontalis suspension. *Ophthalmic Plast Reconstr Surg*. 1991;7(1):48–53.
11. Dailey RA, Wilson DJ, Wobig JL. Transconjunctival frontalis suspension (TCFS). *Ophthalmic Plast Reconstr Surg*. 1991;7(4):289–97.
12. Baroody M, Holds JB, Vick VL. Advances in the diagnosis and treatment of ptosis. *Curr Opin Ophthalmol*. 2005;16(4):351–5.
13. Ahmadi AJ, Sires BS. Ptosis in infants and children. *Int Ophthalmol Clin*. 2002;42(2):15–29.
14. Takahashi Y, Leibovitch I, Kakizaki H. Frontalis suspension surgery in upper eyelid blepharoptosis. *Open Ophthalmol J*. 2010;4:91–97.
15. Wagner RS, Mauriello JA Jr, Nelson LB, Calhoun JH, Flanagan JC, Harley RD. Treatment of congenital ptosis with frontalis suspension: a comparison of suspensory materials. *Ophthalmology*. 1984;91(3):245–8.
16. Crawford JS. Repair of ptosis using frontalis muscle and fascia lata: a 20-year review. *Ophthalmic Surg*. 1977;8(4):31–40.
17. Friedenwald JS, Guyton JS. A simple ptosis operation; utilization of the frontalis by means of a single rhomboid-shaped suture. *Am J Ophthalmol*. 1948;31(4):411–4.
18. Jacob S, Agarwal A, Nair V, Karnati S, Ashok Kumar D, Prakash G. Comparison of outcomes of suprabrow single-stab and 3-stab incision frontalis sling surgery. *Asia Pac J Ophthalmol (Phila)*. 2012;1(2):91–6.
19. Pauly M, Sruthi R. Ptosis: evaluation and management. *Kerala J Ophthalmol*. 2019;31(1):11–6.

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