Original article

Comparison between limbal (von Noorden) and para limbal (Santiago) conjunctival incisions for adjustable recessions of horizontal recti

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Abstract

Introduction: Both limbal and para limbal conjunctival incisions are routinely used in strabismus surgery with comparable results however their outcome has not been compared while using adjustable sutures. **Objective:** To compare limbal (von Noorden) and para limbal (Santiago) conjunctival incisions for adjustable recessions of horizontal recti. **Subjects and methods:** Uniocular adjustable recessions (with conventional non adjustable resection) in 24 appropriate patients were performed according to standard slip knot technique. The patients were assigned to the two groups after obtaining an informed consent using systematmic randomization. Twelve patients in first group received the von Noorden incision with bare sclera closure and 12 in the second group received the Santiago's modification of Swan incision with deferred closure. The surgeries were performed by a single surgeon and the adjustments performed after 24 hours. The incisions were studied on the established subjective (pain) and objective (hyperaemia, chemosis, discharge and gap in incision) variables at follow ups of 1st day post adjustment, 2 weeks and 12 weeks. **Statistics:** 'Repeated Measures Anova' test was used for statistical analysis. A p value <0.05 was considered statistically significant.**Results:** The limbal incision was superior to the paralimbal incision on both objective and subjective criteria by 'Repeated Measures Anova' test. **Conclusion:** We recommend using limbal incision and avoiding para limbal incisions while performing adjustable recessions.

Keywords: adjustable recession, conjunctival incision, horizontal rectus, strabismus

Introduction

Predominantly 3 incisions have been described for strabismus surgeries (Sami, 2007). Limbal (von Noorden, 2001) and para Limbal (Swan et al, 1954) are commonly used. Fornix incisions are also popular for better cosmesis but they are technically more challenging and require a well trained assistant (Park, 1968; Prakash et al, 1987). Various studies have been carried out comparing them with conflicting reports (Sami 2007 and Prakash et al, 1987). Several modifications for each technique have been recommended.

Adjustable surgeries although first reported over a century back have been popularized in our times by Jampolsky in 1975.Various advantages and indications have been described for the same (Morris et al, 1992; von Noorden, 2001 and Rosenbaum et al, 2001). It is also agreed by majority that adjustable recessions are more predictable and easier to perform than adjustable resections (von Noorden, 2001; Rosenbaum et al, 2001; Jampolsky, 1979; Metz, 1979) For this

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reason where adjustable surgery is indicated we only perform adjustable recessions, preferring to do a conventional non adjustable resection. Adjustable surgeries have been described with all types of conjunctival incisions, probably depending on the comfort of the surgeon (Prakash et al, 1987, von Noorden, 2001; and Rosenbaum et al; 2001). We have routinely used limbal and paralimbal incisons (with single stage closure), (von Noorden, 1969; and Santiago et al, 1998) for over a decade with satisfactory outcomes in conventional non adjustable surgeries (Figure 1). Here, we report a comparison between these techniques in adjustable recessions. A similar comparison for adjustable sutures has not been done to the best of our knowledge (pubmed and google search).

Subjects and methods

We performed uni ocular adjustable recessions (with conventional non adjustable resection) in 24 appropriatex patients according to standard described slip knot technique (Rosenbaum et al, 2001). The patients were allocated to the two groups after obtaining an informed consent using systematic randomization. Twelve patients in first group received the von Noorden incision with bare sclera closure and 12 in the second group received the Santiago's modification of Swan incision with deferred closure (von Noorden, 1969; and Santiago et al, 1998) The surgeries were performed by a single surgeon (SA) and the adjustments performed after 24 hours. The incisions were studied on the established subjective (pain) and objective criteria (hyperaemia, chemosis, discharge and gap in incision) of a previous study at follow ups of 1st day post adjustment, 2 weeks and 12 weeks (Lee et al, 2011) Patient's subjective discomfort was graded on a scale from 0 to 3 (0, total comfort; 1, minor discomfort; 2, moderate discomfort; 3, severe discomfort) (Apt et al, 1998 and Kim et al, 2003).

Modification of the revised facial pain scale was used for patient and parents ease (Lee et al, 2011; and Hicks et al, 2001). When a subjective determination of comfort was difficult to obtain in children, the parents were asked to provide an estimate. Using slit lamp biomicroscope, we graded the conjunctival inflammation in the recessed muscle quadrant using modified conjuntival inflammatory index (Alio et al 2003; and Ryu et al, 2005) (Table 1), in which hyperemia, chemosis and discharge were rated on a 0 to 3 scale (0, none; 1, mild; 2, moderate; 3, severe). Conjunctival incision healing was also investigated by measuring the largest gap size perpendicular to the incision line (in millimetres) using a slit lamp beam (Apt et al, 1998 and Kim et al, 2003).

Table 1: Conjunctival inflammation grades

	Scales	Values
Conjunctival hyperemia	0	Absent
	1	Mild hyperemia
	2	Hyperemia around the wounds
	3	Hyperemia around the wounds and entire quadrant
Conjunctival discharge	0	Abscent
	1	Small discharge on conjunctiva
	2	Discharge on conjunctiva and cornea
	3	Discharge on conjunctiva, cornea, and eyelid
Conjunctival chemosis	0	Absent
	1	Mild chemosis
	2	Chemosis around the wounds
	3	Chemosis around the wounds and entire quadrant

Statistical analysis

Statistical Analysis was performed on the 5 study factors (pain, hyperaemia, chemosis, discharge and gap in incision) using the 'Repeated measures Anova' test. As this test works best with spherical data we assessed sphericity of the data Huynh-Feldt method. The 12 week follow up data used for comparison between the groups. A p value of less than 0.05 was considered statistically significant.

Surgical technique

Patients selected for unilateral horizontal muscle recession-resection surgery and meeting the criteria for use of adjustable sutures underwent adjustable recession with conventional resection by standard technique under local anesthesia (von Noorden 2001; and Rosenbaum et al 2001). In the recessed muscle a slip knot suture was used which was adjusted after 24 hours of surgery under topical anesthesia. In first group the conjunctival incision was made about 2 mm from limbus with radial cuts (von Noorden, 1969).This

incision was given where the conjunctiva and tenon capsule are fused and straight access to the sub-tenon space is achieved (Calhoun et al, 1987). Marking sutures were used at the edges for easier identification at the end of the procedure (von Noorden, 2001). A buried knot 8-0 vicryl was used for single layered closure. Bare sclera technique with recession of conjunctiva was performed on the recession (adjustable) side to enable access to the muscle sutures (von Noorden et al, 2001). In the second group the conjunctival incision was made approximately mid way between the muscle insertion and the limbus, and parallel to the muscle insertion (Santiago et al, 1998). Access to the sub tenon space was achieved by cutting the tenon. On the resection side the tenon and conjunctiva were closed in separate layers by 8-0 vicryl with buried knots and on the adjustable recession side with a loop suture in 1 layer. The conjunctiva was retracted on the latter side after 24 hours for adjustment and the loop suture finally closed. Both groups were patched after surgery till adjustment and received no patching following adjustment. All patients received topical antibiotic –steroid combination eye drops 6 times a day for 2 weeks then 4 times a day for 2 weeks and twice daily for 2 more weeks.

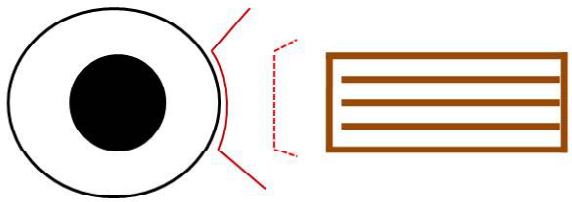

Figure 1: Diagrammatic representation of the 2 incisions. Solid red line represents the Limbal (von Noorden) incision and the broken red line represents the paralimbal (Santiago)incision. The black circle and brown rectangle represent the cornea and horizontal rectus respectively. Note that the paralimbal incision is midway between the cornea and muscle insertion, running parallel to the insertion

Results

The mean age of the patients was 13.4 (range 9-32) years and 14.9 (range 10-37) years respectively. No complications occurred during the surgery or adjustment in any patient. The data at the 12 week follow up are shown in Tables 2 and 3. The data was spherical for all the study variables. A statistically significant difference ($p< 0.001$ with a favorable response to limbal incision) in observations was noted at 12 weeks for all study variables (pain, hyperaemia, chemosis & discharge) except gap in incision ($p=0.457$). The 12 week photographs of all patients are shown in Figures 2 & 3. Thus the limbal incisions were statistically and clinically superior to the paralimbal at 12 week follow up. Both incisions were comparable in terms of gap in incision. Two patients in the paralimbal group had to undergo excision of conjunctival cyst formed at the incision site at 12 weeks.

Table 2: Patient data for limbal incisions at the 12 week follow up (for the score details see methods)

S No.	Pain	Hyper-emia	Chemo-sis	Dis-charge	Incision Gap	Re-marks
1	0	0	0	0	0	
2	0	0	0	0	0	
3	0	1	0	0	0	
4	0	0	0	0	0	
5	0	0	0	0	0	
6	0	1	0	0	0	
7	0	0	0	0	0	
8	1	1	0	0	0	
9	0	0	0	0	0	
10	0	0	0	0	0	
11	0	0	0	1	0	
12	1	0	0	0	0	

Table 3: Patient data for para limbal incisions at the 12 week follow up (for scoring details see methods)

S No.	Pain	Hyper-emia	Chemo-sis	Dis-charge	Incision Gap	Re-marks
1	1	2	0	1	1	Conj Cyst
2	1	2	1	1	0	
3	1	2	1	1	0	
4	1	2	2	1	1	Conj Cyst
5	1	2	0	0	0	
6	1	2	0	1	0	
7	1	2	0	1	1	
8	2	1	1	1	1	
9	2	1	1	1	1	
10	1	2	0	1	0	
11	1	1	0	1	0	
12	1	1	0	0	0	

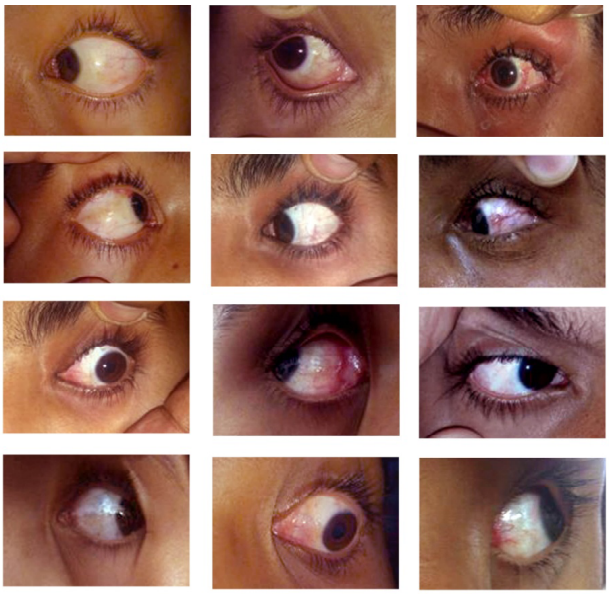

Figure 2: 12 wk Photographs of the recession site of patients in group 1 who received limbal (von Noorden) conjunctival incision note the much lesser hyeremia, chemosis and incision gap compared to Figure 3.

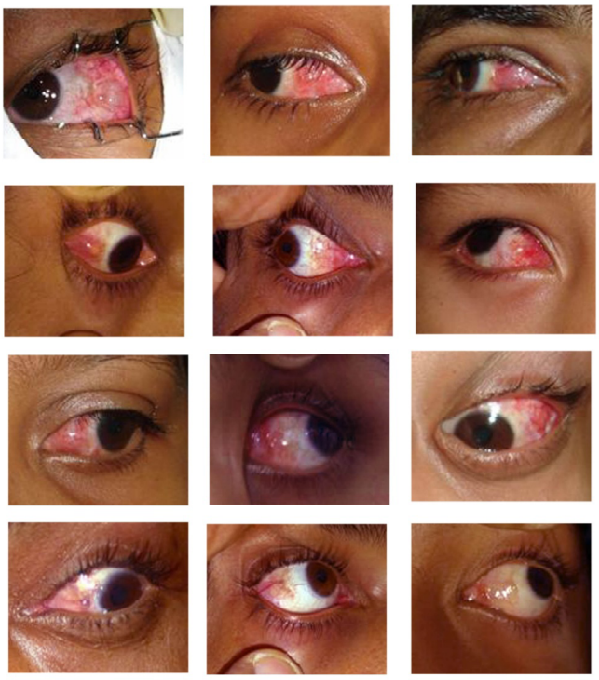

Figure 3: 12 wk Photographs of the recession site of patients in group 2 who received para limbal (Santiago) conjunctival incision. Note the much greater hyeremia, chemosis and incision gap compared to Figure 2.

Discussion

The von Noorden incision permits direct access to the sub tenon space because Tenon capsule and conjunctiva are fused into one layer close to the limbus (about 2 mm). (Calhoun et al 1987) Other advantages of limbal incisions are in re operations in which previous scarring has disrupted the normal anatomic planes that separate Tenon and conjunctiva, in operations in which conjunctival cicatricial changes are associated with restrictive strabismus- making conjunctival recession a consideration and in surgery in very elderly, in which conjunctiva has lost much of its normal elasticity (Sami, 2007; Cole et al, 1962) The disadvantages of limbal incisions include increased risk for irritation from conjunctival sutures, higher risk of conjunctival scarring within palpebral fissure, corneal dellen formation , possible loss of stem cells at limbus, interference with possible future trabeculectomy (from conjunctival scarring) besides the perceived difficulty in post operative adjustment because of incision being far from the muscle insertion (Sami, 2007; Tessler et al, 1975; and Holland et al, 1997). The originally described Swan method places the conjunctival incision behind the muscle insertion and parallel to the limbus (Swan et al, 1954). The conjunctiva is then dissected anteriorly and the Tenon capsule is opened just anterior to the muscle insertion and perpendicular to the conjunctival incision. The major advantages of this incision are its small size, the need for minimal dissection, better exposure and cosmesis in immediate postoperative period as the incision is hidden from the palpebral fissure area. Possibility of irritation, dellen formation etc are also minimal. The disadvantages are inability to perform adjustable procedures, possible injury to the muscle belly and ciliary vessels (Prakash et al, 1987). A modification of this incision recommended for adjustable sutures aims to take care of the latter complications but has possible disadvantages of the Limbal technique including

risk of noticeable scarring (Swan, 1954; Santiago et al, 1998). This incision had been used by us.

We used the same conjuctival incision for resection as we did for recession in each group. We believe and it has also been reported that the two incisions in question are comparable in discomfort and healing (Sami 2007). Hence we safely attribute the difference in results to adjustable recessions. The fornix incision popularized by Park has many potential benefits including better cosmesis and lesser discomfort but is much larger, technically more demanding and requires a well trained assistant specially when combined with adjustable sutures (Parks 1968, Lingua et al and Prakash et al 1987). Ours being a teaching insititute, where postgraduates students assist, we do not use it in day to day practice.

Another popular incision is one described by Prakash located 3 mm from limbus. We find it no different from von Noorden incision in our experience (Prakash et al 1987). The difference in results of conjunctival closure between adjustable and non adjustable techniques may be attributed to the poorer approximation, reopening of adhesions, secondary suturing and larger amount of absorbable suture (hence foreign body reaction) used to anchor the muscle in adjustable technique. Conjunctival inflammation at the time of suture adjustment makes the secondary suturing painful and often less than satisfactory. Moreover we close the tenon separately from conjunctiva in the paralimbal incision when adjustments are not planned; however they were sutured together after adjustments. This less than ideal suturing could be contributory to poorer cosmesis and greater discomfort for the patient.

Conclusion

We recommend using limbal incision and avoiding para limbal incisions while performing adjustable suture strabismus surgery.

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