

Comparison of conventional and Hang-back methods of inferior oblique recession in V-pattern strabismus with inferior oblique overaction

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Abstract

• **AIM:** To compare outcomes of conventional and Hang-back methods of inferior oblique (IO) recession in V-pattern strabismus with inferior oblique overaction (IOOA).

• **METHODS:** Comparative randomized study was conducted consisting of 50 patients, age 6 to 35y having V-pattern strabismus [>15 prism diopter (PD)] with IOOA. They were divided equally in two groups and underwent IO recession, group A by conventional method and group B by Hang-back method. Parameters evaluated were reduction in V-pattern and IOOA, shift in torsion, improvement in binocular status. Success was a residual V-pattern of less than 10 PD at 1y of follow up.

• **RESULTS:** The mean V-pattern preoperatively and postoperatively at 1y was 24 ± 5.4 PD and 4.2 ± 3.51 PD in group A and 23.44 ± 6.44 PD and 5.76 ± 3.8 PD in group B respectively. The mean reduction in V-pattern was 20 ± 6.78 PD in group A and 18.2 ± 5.48 PD in group B. The mean correction of IOOA was 18.48 ± 3.13 PD in group A and 16 ± 2.93 PD in group B. Mean shift in extorsion was 3.08 ± 1.8 degree in group A and 3.72 ± 2.14 degree in group B.

• **CONCLUSION:** Both the procedures achieve a significant and comparable reduction in V-pattern and IOOA. Hang-back recession being a landmark free surgery eliminates the need for intrascleral suturing thereby reducing the risk of scleral perforation with possible postoperative adjustment of muscle. It may be considered as a good alternative for IO recession in patients of V-pattern strabismus with mild to moderate amount of IOOA.

• **KEYWORDS:** V-pattern; inferior oblique overaction; Hang-back recession; conventional recession

INTRODUCTION

P attern strabismus is defined as vertical incomitance in horizontal deviation. The etiology of A and V phenomena has evolved through various hypothesis. The oblique muscle dysfunction has been the most acceptable theory till date^[1-2]. Excessive elevation in adduction occurs due to inferior oblique overaction (IOOA) and is reported in 70% of patients with esotropia and 30% of patients with exotropia^[3]. The primary IOOA is bilateral and of unknown cause, usually associated with infantile esotropia whereas the secondary IOOA is unilateral and is caused by paresis or paralysis of the superior oblique muscle^[4].

As the role of IOOA was established in the etiopathogenesis of V-pattern, the role of inferior oblique (IO) muscle weakening procedures came into play^[5]. Various procedures for IO weakening have been described like myotomy, myectomy, denervation-extirpation, recession, pure antero-positioning and anteronasal transposition^[6-8].

Conventional recession has been the most widely accepted surgery worldwide. Hang-back recession is relatively a safe and effective entity for IO weakening, described by Kumar *et al*^[9] in 2007. It is a landmark free surgery which requires minimal manipulation and has a shorter surgical time. There is a paucity of studies comparing the results of Hang-back recession and conventional method of recession in V-pattern strabismus.

In this study we aim to compare the results of conventional and Hang-back recession of IO in patients with V-pattern strabismus with IO over action in terms of their efficacy and complications.

SUBJECTS AND METHODS

Ethical Approval We conducted a randomized comparative study at a tertiary eye care centre. The study was approved by Institutional Ethics Committee and research adhered to the tenets of Declaration of Helsinki. Informed consent was taken from patients or parents wherever applicable.

The study was carried out from 2016 to 2018. Fifty patients who reported consecutively to the outpatient department, in age group 6 to 35y with significant V phenomena [*i.e.* at least 15 prism diopter (PD) difference between the upgaze and downgaze measurements] and IOOA were included in the study. For allocation of the participants, a computer-generated list of random numbers was used. Odd digits were individually assigned to group A and even digits to group B. The allocation sequence was concealed in sequentially numbered, opaque, sealed and stapled envelopes. Assignment was done by opening an envelope for each patient before the start of the procedure by a member of the surgical team. The preop. and postop. data was evaluated by different investigators who were blinded to the group to which patient belongs. Group A underwent IO recession by conventional method while group B underwent Hang-back IO recession. Patients with IOOA < 10 PD, history of any previous strabismus surgery, restrictive strabismus, neurological instability and presence of nystagmus or any fundal pathology were excluded from the study. A detailed history was taken with emphasis on the age of onset of strabismus, progression, duration, deviation if constant or intermittent, asthenopic symptoms, diplopia, history of any previous treatment, amblyopia therapy or surgery and family history of squint. A thorough preoperative examination was done including unaided and best corrected visual acuity (BCVA) obtained after cycloplegic refraction as per age. Measurement of horizontal deviation was done through prism bar cover test (PBCT) in all nine gazes with the refractive correction both at near (33 cm), distance (6 m). V-pattern was calculated as a difference of horizontal deviation in 25° upgaze and 25° downgaze. IOOA was determined by measuring the hypertropia of the adducting eye using vertical prisms during extreme dextroversion and levoversion and it was graded as trace: 0-9 PD, Grade 1: 10-19 PD, Grade 2: 20-29 PD, Grade 3: 30-39 PD, Grade 4: 40 PD and above^[10]. Globe torsion was measured in both the eyes by fundus photograph taken through Zeiss visucam 500. For analysis of torsion, two horizontal lines were drawn one passing through the centre of the disc and another line passing through the lower border of disc. It was labeled as extorsion—if the fovea was below the lower line. The angle between the horizontal reference passing through geometric centre of optic nerve and a line connecting the fovea with the optic nerve centre was calculated as the angle of extorsion (the optic nerve head-foveal angle)^[11]. Assessment of

binocularity was done by synaptophore (Grade 1: simultaneous macular perception, Grade 2: fusion with some amplitude, Grade 3: stereopsis).

All patients underwent 10 mm IO recession in addition to horizontal muscle surgery as required. This is the amount of IO recession which author normally performs in patients with moderate IOOA (15-30 PD). Our criteria for adjusting the amount of recession depends on the degree of IOOA, with 8 mm recession in cases of mild IOOA and 12 mm recession in cases of severe IOOA. Patients were worked up for local or general anaesthesia as needed. Post operative assessment was done at 1wk, 1, 6mo, and 1y. Success was defined as residual V-pattern of less than 10 PD at 1y of follow up for both the surgical procedures.

Surgical Technique All the surgeries were done by same surgeon. Group A underwent conventional recession of IO by parks method while Group B patients underwent Hang-back recession of IO. Simultaneous horizontal recti surgery was performed according to the amount of horizontal deviation. Initial steps for both techniques were as follows: traction sutures were applied. A fornix based conjunctival incision given in inferolateral quadrant 8 mm from the limbus and Tenon's capsule dissected to identify IO muscle, and the fascial attachments were cut under direct visualization.

Further in Group A A double armed 6-0 vicryl suture was passed 3 mm from the insertion of IO at the anterior border. The muscle was then severed from its insertion 3 mm from the globe. The lateral end of the inferior rectus insertion was visualized with minimum dissection and the anterior end of the IO was attached 3 mm inferior and 2 mm lateral to it followed by conjunctival closure.

Further in Group B Suture was passed 4 mm from the insertion through the width of the IO muscle, with locking bites on both ends. The same suture was then passed proximally 2 mm from the insertion site in a loose fashion forming a loop. The intermediate area between the two suture lines was cut. The proximal part of the severed muscle is then suspended from the distal muscle and the amount of recession to be performed was measured on both arms of the polyglactin 9/0 suture. While the surgeon holds the suture with the help of smooth forceps, the proximal ends of the suture are tied and the proximal portion of the muscle is allowed to retract into its sheath (Figure 1).

Patients were prescribed steroids and antibiotic eye drops along with lubricants post operatively for 6wk. The post operative follow up included assessment of visual acuity, horizontal alignment, measurement of V-pattern and IOOA, improvement in binocularity, shift of torsion and complications if any.

Statistical Analysis Quantitative variables were compared using independent *t* test or Mann-Whitney *U* test (when the

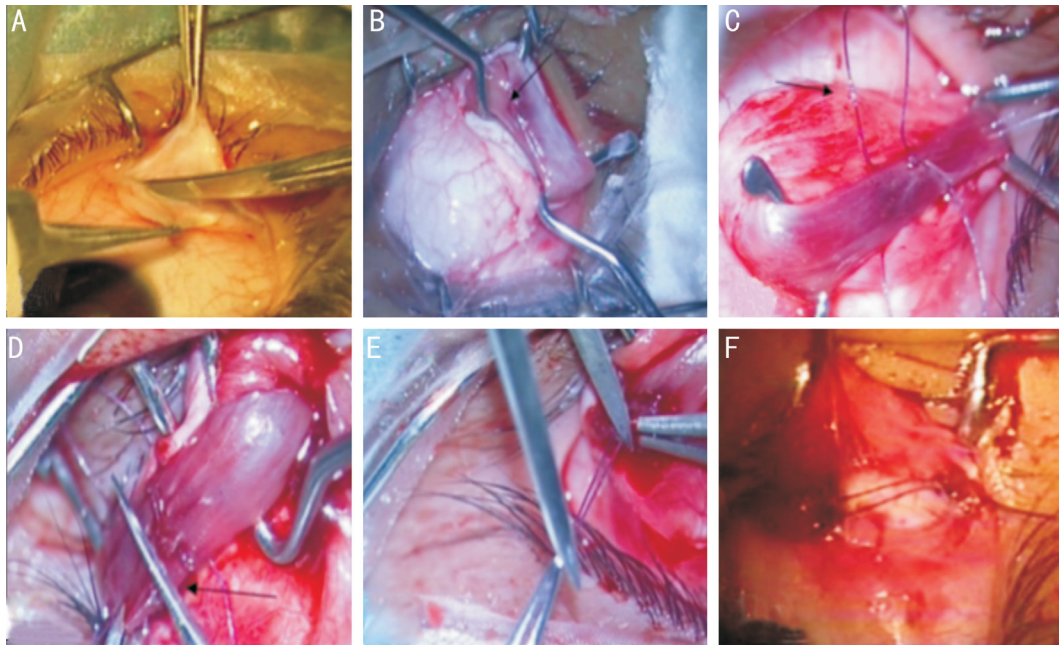


Figure 1 Steps of Hang-back recession A: Inferotemporal fornix based conjunctival incision; B: Isolation of inferior oblique muscle; C: Loops between proximal and distal part of inferior oblique; D: Muscle cut in between the loop; E: Measuring amount of muscle recession to be done on polygalactin 9/0 suture; F: Retraction of muscle back in inferior fornix.

data sets were not normally distributed) between the two groups. Qualitative variables were compared using Chi-square test or Fisher exact test. A *P* value of <0.05 was considered statistically significant. Data analysis was done using Statistical Package for Social Sciences (SPSS) version 21.0.

RESULTS

The comparison of demographic profile between two groups is shown in Table 1. The mean age was 13±6.12y in group A and 12.92±6.62y in group B. Group A had 9 females (36%) and 16 males (64%) and group B had 13 females (52%) and 12 males (48%). The mean logMAR BCVA in group A was 0.22±0.24 in right eye (RE) and 0.2±0.25 in left eye (LE) whereas in group B, it was 0.12±0.19 RE and 0.14±0.16 in LE. Totally 19 (38%) cases were hyperopes and 12 (24%) were myopes, rest 19 (38%) were emmetropic, 27 (54%) were esotropic (90% of amblyopic patients were esotropic preoperatively) and 23 (46%) were exotropic.

Mean V-pattern preoperatively and postoperatively at 1y was 24±5.4 PD and 4.2±3.51 PD in group A and 23.44±6.44 PD and 5.76±3.8 PD in group B respectively. The mean reduction in V-pattern was 20±6.78 PD in group A and 18.2±5.48 PD in group B at 1y follow up (*P*>0.05 between the groups) as shown in Tables 2 and 3.

The mean reduction in IOOA was 18.48±3.13 PD in group A and 16±2.93 PD in group B (*P*>0.05) at 1y follow-up. Table 4 shows comparison of mean preoperative and postoperative IOOA status between the groups. None of the patients had postoperative hypotropia in primary gaze in our study. The mean horizontal deviation preoperatively and postoperatively

Table 1 Comparison of demographic profile of two groups

Data	Group A	Group B	<i>P</i>
Age (y)	13±6.12	12.92±6.62	0.586
Male:female	16:9	12:13	0.254
BCVA (logMAR)			
RE	0.22±0.24	0.12±0.19	0.691
LE	0.2±0.25	0.14±0.16	0.531
Ocular alignment (preop.)			0.777
Esotropes	13 (52%)	14 (56%)	
Exotropes	12 (48%)	11 (44%)	

at 1y was 45.6±11.67 PD and 3.92±6.97 PD respectively in group A and 47.6±6.47 PD and 3.4±4.85 PD respectively in group B.

There was a significant reduction in amount of torsion postoperatively in both the groups (*P*<0.05) as shown in Table 5. Five cases (10%) developed grade 2 binocularity postoperatively (2 in group A and 3 in group B) while only 1 (group A) patient showed stereopsis for near after surgery. Thirty-six (72%) patients were orthotropic after the first surgery (17 in group A and 19 in group B). Of rest 14 cases, 10 were within 10 PD of orthotropia (esotropia or exotropia) and 4 patients had residual horizontal deviation in primary gaze (2 each in groups A and B). There were no cases of consecutive esotropia or exotropia or any other complications.

DISCUSSION

The surgical management of IOOA is based on either weakening the IO muscle by diminishing the muscle tension (myectomy and recession) or changing the vector of mechanical function

Table 2 Comparison of mean V-pattern preoperatively and postoperatively at 1y follow-up between the groups

Group	Mean V-pattern (PD)				Mean amount of correction in V pattern at 1y follow up (PD)
	Preop.	1mo postop.	6mo postop.	1y postop.	
A	24±5.4	3.32±3	3.96±3.3	4.2±3.51	20±6.78
B	23.44±6.44	4.24±4	5.12±4.08	5.76±3.8	18.2±5.48
P	0.698	0.281	0.362	0.198	0.313

Table 3 Comparison of V-pattern preoperatively and postoperatively in esotropes and exotropes between the groups

Mean V-pattern (PD)	Group A		Group B	
	Esotropes	Exotropes	Esotropes	Exotropes
Preop.	25.77	22.08	23.57	23.27
Postop.				
1mo	5	1.5	5.29	2.91
6mo	5	2.83	5.86	4.18
1y	5.31	3	6.57	4.73
Amount of reduction at 1y	20.46	19.08	17	18.5

Table 4 Comparison of mean IOOA between the groups preoperatively and postoperatively

IOOA (PD)	Group A		Group B		P
	Right eye	Left eye	Right eye	Left eye	
Preop.	19.12	18.92	18.28	17.68	0.179
1mo postop.	0.16	0.16	0.48	0.56	0.258
6mo postop.	0.16	0.16	0.64	1.04	0.216
1y postop.	0.64	0.8	1.76	2.08	0.169
Amount of reduction at 1y	18.48	18.12	16.52	15.6	0.276

IOOA: Inferior oblique overaction.

Table 5 Effect of surgery on torsion at final follow-up in both the groups

Torsion (degrees)	Group A		Group B	
	Right	Left	Right	Left
Preop.	18.52	17.64	18.40	18.32
At 12mo	14.12	13.28	13.6	13.8

by moving insertion site. IO recession with anteriorization diminishes muscle tension and changes the functional insertion. Severe IOOA is treated with a full anteriorization to the inferior rectus insertion^[12]. Various studies have compared the outcomes of IO weakening techniques^[13-15].

We did a prospective comparative study, enrolled 50 patients of V-pattern strabismus with IOOA. IO recession 10 mm was done in all patients by conventional method in group A (25 cases) and by Hang-back method in group B (25 cases). Overall, the maximum amount of V-pattern in our study was 35 PD. There was a predominance for esotropia in the primary position, which was consistent with previously reported rates of IOOA in 70% of patients with esotropia^[3].

Recession of the IO is one of the most commonly performed procedures for weakening of the IO. Parks^[16] compared recession, disinsertion, myectomy between origin and inferior rectus, and myectomy at insertion in patients with bilateral IOOA without hyperdeviation and reported recession to be the most effective method for treatment of IOOA. In his

study, the IO was reattached to the sclera in a point 2 mm temporal and 3 mm posterior to the insertion of the IR^[16]. We did conventional recession by similar approach and found the mean reduction in V-pattern of 20±6.78 PD (20.46 PD in esotropes and 19.08 PD in exotropes). The mean reduction in V-pattern by conventional recession as reported by Kamlesh *et al*^[10] was 26.9 PD (25.83 PD in V-exotropes and 19.75 PD in V-esotropes) whereas Taha *et al*^[17] reported improvement from 23.12 PD to 2 PD in V-exotropes and 17.14 PD to 2.28 PD in V-esotropes. Burian *et al*^[18] obtained an average correction of 15.4 PD in V-esotropia and 11.4 PD in V-exotropia whereas Prakash *et al*^[19] obtained a correction of 11 PD in V-exotropia and 9 PD in V-esotropia after bilateral conventional IO recession. The amount of correction obtained in the current study was higher as compared to that reported by Burian *et al*^[18] and Parkash *et al*^[19] in their studies.

Approaching the insertion site of the IO is associated with the risk of injuring the macular area, and for performing a desired amount of recession we have to identify the sclera

landmarks. Due to the difficulties associated, IO recession technique was modified *i.e.* Hang-back recession and further modification (the suspension recession of IO), a technique that avoids the potential risk of approaching the muscle insertion near the macular area, as well as allows muscle recession with the respect of the original anatomical course of the muscle. The mean reduction in V-pattern by Hang-back recession as reported by Kumar *et al*^[9] was 19±2 PD in V-exotropia group and 22±7 PD in V-esotropia group and Taha *et al*^[17] reported 22 PD in V-exotropes and 13 PD in V-esotropes. In our study, in Hang-back recession group, the mean reduction in V-pattern was 18.2±5.48 PD (17 PD in esotropes and 18.5 PD in exotropes). The discrepancy between the Hang-back recession outcomes in the present study as compared to previous study by the author could be due to smaller sample size and patients had undergone both unilateral and bilateral IO recession in latter. We obtained a comparable outcome with an overall 94% (47 cases) success rate (24 cases in group A and 23 cases in group B) showing that both the techniques are equally effective in managing V-pattern between 15-30 PD in such cases.

Kamlesh *et al*^[10] reported a mean correction of IOOA of 23.83 and 19.83 PD in cases of V-exotropia (6 patients) and V-esotropia (4 patients), respectively after conventional recession. Taha *et al*^[17] obtained similar outcomes in their study in V-exotropes (the discrepancy in V-esotropes they concluded was due to small sample size in former). However, in their study better improvement was noticed with the standard recession as compared to Hang-back technique (mean residual IOOA was 0.97 and 5 PD respectively which was statistically significant). However, their study was limited by a smaller sample size and shorter duration of follow-up. Also, no comments about the amount & comparison of drift in V-pattern were made between the groups. In our study, the range of IOOA was 15-28 PD except for 3 cases who had IOOA 30-35 PD. The mean correction of IOOA was comparable between the groups. The drift in residual V-pattern was also not statistically significant (0.88 PD in group A, 1.5 PD in group B) at 1y of follow up. The mean V-pattern postoperatively showed an increasing trend from 1mo to 1y follow up but the difference was not significant ($P=0.87$). The IOOA was of primary nature in all our cases and none of the cases had hypotropia in primary gaze postoperatively.

No difference in alignment was seen in primary gaze at 1wk and at 1y post operative period between the two groups. The mean correction in degree of torsion at 1y follow up in group A was 3.96 in RE and 3.72 in LE whereas in group B it was 3.08 in RE and 3.36 in LE which was also comparable between the groups ($P=0.57$, 0.11 respectively) showing no trending superiority of one technique over the other. There is limited literature on comparative data of torsion change by either technique.

The attainment of binocularity was dependent on the age of onset of strabismus and timing of surgery. Twenty-five patients in our study were <10 years of age. It was observed that early age at surgery and short duration between onset of strabismus and surgery favored the development of binocularity.

Various authors have reported complications like residual overaction, undercorrection postoperative hypotropia, diplopia, adherence syndrome and internal ophthalmoplegia^[20-22]. However, we did not see any complication except for a residual V-pattern in 3 cases (1 in group A and 2 in group B) due to preexisting near higher range for correction from 10 mm IO recession, of IOOA and also for V-pattern of up to 35 PD in these cases.

Hang-back recession is a landmark free surgery which requires minimal manipulation, eliminates the need for intrascleral suturing thereby reducing the risk of inadvertent scleral perforation and snaring of Tenon's capsule. Conventional recession requires extensive dissection for identification of muscle insertion and new insertion point in relation to inferior rectus or lateral rectus. The procedure of intrascleral suturing becomes difficult in children, high myopes and cases with scleral thinning. Also it is difficult to adjust the sutures post operatively if required. Hang-back recession theoretically eliminates these problems, however it is important to take care of vortex vein which can get inadvertently damaged and leads to retrobulbar hemorrhage if precautions are not taken. It may be preferred in children where working space is lesser and the scleral rigidity is low. It also offers a theoretical advantage of intra- or post-operative adjustment of the muscle. Authors conclude that both the procedures are equally effective in managing V-pattern strabismus with IOOA. Hang-back recession method has many added advantages and may be considered a good alternative for IO recession in patients of V-pattern strabismus with IOOA.

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