Gains beyond cosmesis: Recovery of fusion and stereopsis in adults with longstanding strabismus following successful surgical realignment

Tarannum Fatima, Abadan K Amitava, Saba Siddiqui, Mohammad Ashraf

We evaluated recovery of binocularity in 15 chronically strabismic, non-fusing (with neutralizing prisms) adults following successful surgical alignment. We included ≥12-year-olds, with best corrected visual acuity (BCVA) ≥20/60, and excluded those with: anisoacuity >2 lines-Snellen; failed realignment judged by >10 prism diopters (PD) horizontal and >4 PD vertical. Six-week outcomes were: fusion by Worth Four-Dots (WFDT) and Bagolini striated glasses (BSG) and stereopsis by Titmus test and the Netherlands organisation for applied scientific research (TNO) test. Baseline data in medians (range): age 18 (12-40) years, strabismus 45 (19-95) PD, duration 14 (0.5-24) years, 12 females; 12 exotropes, three esotropes; visual acuity was 20/20 in 10, while none had BCVA <20/60. Postoperative strabismus measured 6 PD (range:0-10). By six weeks none suppressed: WFDT findings showed eight fused at distance and 13 at near; and on BSG figures were 10 and 13 respectively. Stereopsis was demonstrated by 13 on Titmus and by 10 on TNO tests. It is concluded that longstanding strabismic adults with good vision can recover fusion and stereopsis following successful squint surgery.

Key words: Adult strabismus, binocularity, fusion, stereopsis

Indian J Ophthalmol: 2009;57:141-143

Institute of Ophthalmology, JN Medical College, Aligarh Muslim University, Aligarh-202 001, India

Correspondence to Dr. AK Amitava, 4/758, Taban Cottage, Friends Colony, Dodhpur, Aligarh 202 001, India. E-mail: ak_amitava@indiatimes.com

Manuscript received: 24.03.07; Revision accepted: 16.05.08

DOI: 10.4103/0301-4738.45505 **- PMID:** 19237789

Apart from cosmesis, adults undergoing strabismus surgery stand to gain from recovery of fusion, stereopsis, expanded field (in esotropia), elimination of torticollis, better psychosocial functioning and enhanced job opportunities.[1] Factors adversely affecting recovery of stereopsis are visual acuity (VA) <20/60 due to any cause, optic neuritis, anisometropia and strabismus. Earlier, surgery was considered beneficial provided patients had good VA and achieved successful alignment. Subsequent reports[2-3] indicated recovery of some fusion[4-5] and stereopsis even in those who had strabismus onset before visual maturity (<nine years).[6] Significant factors predictive of postoperative fusion were the absence of previous surgery, VA ≥20/40, and normal retinal correspondence in exotropes and fusion during prism adaptation, absence of infantile esotropia, and an increase in vertical deviation in esotropes. Duration of misalignment did not predict the recovery of stereoacuity.[7] In acquired strabismus, better stereopsis was achieved if misalignment was of <12 months although patients with longer duration did demonstrate fusion and stereopsis.[8-9]

The aim of the study was to assess the recovery of fusion and

stereopsis after squint surgery in adults with chronic strabismus that demonstrated no binocularity preoperatively.

Materials and Methods

After obtaining ethical approval from the institutional review board, we included patients with constant strabismus, age ≥12 years and best corrected visual acuity (BCVA) ≥20/60 Snellen in the deviated eye, and excluded those with any measurable stereopsis or sensory fusion using neutralizing prisms, anisoacuity (BCVA) >2 Snellen's line or failed surgical realignment. Successful alignment was considered to be ≤10 prism diopters (PD) horizontal and ≤4 PD vertical.

Main outcome measures were fusion (central and peripheral) using Worth Four Dots (WFDT) and Bagolini striated glasses (BSG), and stereopsis, employing the Titmus and the Netherlands organisation for applied scientific research (TNO) tests.

After informed consent, we assessed VA, cycloplegic refraction, BCVA, and performed biomicroscopy and ophthalmoscopy. Stereopsis was considered gross (3000 arc-sec) if the patient passed only the Titmus 'fly' test, coarse: 60-800 arc-sec and fine as 15-60 arc-sec, and true if ≤100 arc-sec.

Results

The demographic details, preoperative and postoperative results are presented in Table 1. Most had a long history of constant strabismus. Large angles (>40 PD) were measured in nine; five had 20-40 PD, while one had <20 PD. Median strabismus was 45 PD (range 18-95) preoperatively and 6 PD (range 0-10) at six weeks postoperatively. Patients 5 and 6 underwent bilateral surgeries.

Postoperative fusion responses are depicted in Table 2. By six weeks none suppressed. Postoperative stereopsis is presented in Table 3. By six weeks, some stereopsis was present in 13 on Titmus

Table 1: Pre- and six weeks postoperative characteristics of adult strabismus patients (n=15)

Age (yrs)/ Gender	Strabismus duration (years)	Spherical equivalent in Diopters RE/ LE	BCVA (Snellen)	Pre- surgical deviation (prism diopter)	Post- surgical deviation (prism diopter)	Post-surgical binocularity		
						Fusion at distance	Fusion at near	Stereopsis (arc-sec)
20/F	19	0/0	RE 20/20 LE 20/20	65AXT	0	Yes	Yes	100
28/F	22	0/0	RE 20/20 LE 20/20	40 AXT	6AXT 2RHT	Yes	Yes	100
25/F	7	0/0	RE 20/20 LE 20/20	65 AXT	10AXT	Yes	Yes	3000
14/F	13	+0.5/+0.5	RE 20/20 LE 20/20	60 AXT	6AXT	Yes	Yes	800
25/M	24	-2.25/-1.25	RE 20/20 LE 20/20	85 AXT	10AXT	No	No	800
12/F	10	+3/+3	RE 20/30 LE20/60	95 AET	6 AET	Yes	Yes	200
22/M	21	0/0	RE 20/20 LE 20/20	40LXT 2RHT	8LXT	Yes	Yes	400
12/F	6	+0.5/0	RE 20/30 LE 20/20	60LXT	0	Yes	Yes	100
25/F	24	+0.5/+0.5	RE 20/20 LE 20/20	18RET 2LHT	0	No	Yes	800
16/F	15	+2/0	RE 20/20 LE 20/20	45RET	6RXT	Yes	Yes	3000
40/F	0.5	-225/0	RE 20/30 LE 20/20	35RXT 8LHT	0	Yes	Yes	Nil
18/F	17	0/0	RE 20/20 LE 20/20	45RXT	0	No	Yes	40
15/F	14	+3.75/+0.5	RE 20/40 LE 20/20	35RXT 6RHT	10RXT 2RHT	No	No	3000
18/M	1	0/-1	RE 20/40 LE 20/20	25LXT	0	Yes	Yes	Nil
15/F	12	0/0	RE 20/20 LE 20/20	55AXT 10RHT	10AXT 2RHT	No	Yes	60

BCVA=Best corrected visual acuity, AXT=alternating exotropia, AET=alternating esotropia, RET=right esotropia, RXT= right exotropia, LXT= left exotropia, LET= left esotropia, RHT=right hypertropia, LHT=left hypertropia, RE= Right eye, LE= left eye

Table 2: Six weeks postoperative responses on the Worth Four Dot test and Bagolini Striated Glasses (n=15)

Response	Worth four dot test		Bagolini striated glasses	
	Distance	Near	Distance	Near
Fusion	8	11	10	13
Diplopia	7	4	5	2
Suppression	0	0	0	0

Table 3: Patients showing stereo-acuity at six weeks postoperatively on Titmus and TNO (n=15)

Response	Titmus: No	TNO: No
Gross	3	6
Coarse	5	1
Fine	5	3
Nil	2	5
Total	15	15

and 10 on TNO tests; while true stereopsis was seen in five on Titmus and three on TNO tests.

Discussion

In our study the majority of adults with longstanding strabismus and no prior binocularity, demonstrated both fusion and stereopsis following successful postoperative alignment. Various studies have reported recovery of binocularity postoperatively in adults.[7-10] Lal *et al.* retrospectively analyzed 21 adults (median age= 59 years) with large angled acquired strabismus and reported measurable stereoacuity in 67% and fine (≤ 60 arc-sec) in 44%.[7] This was irrespective of the duration of strabismus. In Fawcett's series of 23 cases of acquired strabismus, 96% recovered some measurable stereopsis: 70% demonstrating fine stereopsis (≤ 60 arc-sec) on the Titmus circles and 30% on the Randot Preschool stereoacuity test.[8,9] Such excellent results were probably accounted for by a period of binocularity preceding strabismus and/or occasions (due to intermittency) or fields (in incomitancy) wherein fusion was possible. In Fawcett's series a significant proportion regained fine stereopsis when aligned ≤12 months of misalignment as compared to those aligned after >12 months. Age, strabismus type, or pre-surgical sensory fusion did not predict stereopsis. Patients demonstrating pre-surgical capacity for true stereopsis (40-100 arc-sec) were more likely to demonstrate stereopsis postoperatively (P<0.05).

Although recovery is more likely if there has been a period of binocularity during the critical period of visual development, this notion is now being questioned.[1] Moreover, even visually mature patients lose stereoacuity following strabismus.[1] In acquired strabismus following head trauma, the latter may itself disrupt central fusional pathways adversely affecting recovery of stereopsis.[7] Two of our patients who did not recover stereopsis had a history of head trauma (Patients 11 and 14, Table: 1).

Does binocularity improve with time? Lal *et al.*[7] followed their patients for one year and reported continued improvement. However, five of our patients who completed follow-up of one year did not demonstrate further improvement.

Can ≤10 PD of horizontal deviation be considered as successful motor alignment consistent with sensory success (true stereopsis)? Recent research suggests that a horizontal deviation ≤4PD will enable macular fusion (<100 arc-sec) whereas larger angles (5-10 PD) may be just sufficient for binocularity.[11] Interestingly, two of the five patients who showed stereopsis <100 arc-sec had a deviation between 5-10 PD.

Titmus tests consistently yielded a better response than the TNO, although both provide monocular clues. The Frisby test and the new Preschool Randot test are considered more valuable for quantification, but were not available to us.

Our study was not without limitations. It has a small sample of 15 patients which did not justify subgroup analyses. Since 12 of the 15 patients were exotropes, the results may be biased towards them.

Nevertheless, we found that the majority of patients with good vision with non-fusing large angle chronic strabismus can regain fusion and stereopsis after successful surgical alignment. Some may recover true stereopsis. Larger studies need to validate whether better motor alignment yields more favorable results and which tests of binocularity should be considered best. Meanwhile all adults presenting with strabismus should have their eyes aligned promptly for functional gains, namely: fusion and, stereopsis.

References

1. Beauchamp GR, felius J, Stager Sr DR, Beauchamp CL. The utility of strabismus in adults. Trans Am Ophthalmol Soc 2005;103:164-72.
2. Baker JD. The value of adult strabismus correction to the patient. J AAPOS 2002;6:136-40.
3. Mills DM, Coats DK, Donahue SP, Wheeler DT; American Academy of Ophthalmology. Strabismus surgery for adults: A report by the American Academy of Ophthalmology. Ophthalmology 2004;111:1225-62.
4. Mets MB, Beauchamp C, Haldi BA. Binocularity following surgical correction of strabismus in adults. Trans Am Ophthalmol Soc 2003;101:201-5; discussion 205-7.
5. Mets MB, Beauchamp C, Haldi BA. Binocularity following surgical correction of strabismus in adults. J AAPOS 2004;8:435-8.
6. Beauchamp GR, Black BC, Coats DK, Enzenauer RW, Hutchinson AK, Saunders RA, et al. The management of strabismus in adults--I: Clinical characteristics and treatment. J AAPOS 2003;7:233-40.
7. Lal G, Holmes JM. Postoperative stereoacuity following realignment for chronic acquired strabismus in adults. J AAPOS 2002;6:233-7.
8. Fawcett SL, Felius J, Stager DR. Predictive factors underlying the restoration of macular binocular vision in adults with acquired strabismus. J AAPOS 2004;8:439-44.
9. Fawcett SL, Stager DR Sr, Felius J. Factors influencing stereoacuity outcomes in adults with acquired strabismus. Am J Ophthalmol 2004;138:931-5.
10. Eustis HS. Maximizing binocular vision outcomes in strabismus patients. Am J Ophthalmol 2004;138:1044-5.
11. Leske DA, Holmes JM. Maximum angle of horizontal strabismus consistent with true stereopsis. J AAPOS 2004;8:28-34.