

# Strabismus surgery: adjustable sutures—good for all?

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CLINICAL STUDY

## Abstract

**Aims** The role of adjustable sutures in strabismus surgery has mainly been limited to conditions like dysthyroid restrictive myopathy, blow-out fractures of orbit, aberrant regeneration of nerves, and certain other long-standing and complicated squints. In this clinical study, an attempt has been made to analyse the efficacy of adjustable sutures in squint surgery as a routine procedure. We also studied patients' acceptability and satisfaction following this procedure and analysed various factors that may influence the surgical outcome (age, sex, previous surgeries, injections of botulinum toxin, etc).

**Methods** A total number of 443 patients, aged between 13 and 78 years, who underwent strabismus surgery in our department, from January 1996 to January 2000, were included in this study. Of these patients, 141 had surgery with adjustable sutures and 302 patients without adjustable sutures. Surgical results were followed up for a period ranging from 12 to 50 months. The main outcome measure was a need for a reoperation in the two groups. In addition, we also studied patients' satisfaction with regard to final cosmetic appearance or relief of diplopia; percentage change in angle of deviation in two groups, and influence of various factors such as age, sex, previous surgeries, and injection of botulinum toxin on the final surgical outcome. The results were statistically analysed using Levene's test for equality of variances, *t*-test for equality of means, and statistical significance of the results was analysed by calculating *P*-values.

**Results** In total, 8.51% of the patients in the adjustable group and 27.15% in the nonadjustable group needed a reoperation. Surgical results were found to be significantly better in patients who had adjustable sutures in comparison to those who did not have adjustable sutures ( $P < 0.005$ ). Patients' satisfaction and percentage change in angle of

deviation was also much higher in adjustable sutures group. Age, sex, number of previous surgeries, previous injections of botulinum toxin, and type and amount of deviation had no statistically significant influence on the surgical outcome.

**Conclusions** Strabismus surgery with adjustable sutures has a statistically significant better, final result than surgery without adjustable sutures. Patients' satisfaction and percentage change in angle of deviation is also much higher in the adjustable sutures group. As age, sex, number of previous surgeries, previous injections of botulinum toxin, and type and amount of deviation do not influence the final outcome, this type of surgery can be performed in virtually all types of patients.

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**Keywords:** strabismus surgery; botulinum toxin; adjustable sutures; results

## Introduction

The most important problem in strabismus surgery is the inability to accurately predict the outcome of the procedure. An answer to this problem was suggested by an approach that permitted the operated muscle to be adjusted either at the time of surgery or after the surgery had been completed.<sup>1,2</sup> These earlier variations of the adjustable approach were not well accepted due to the difficulty of the technique and to a lack of patient tolerance. In 1975, Jampolsky described a two-stage adjustable technique with surgery under general anaesthesia and adjustment of the ocular position under local anaesthesia later. This was easy to perform and was well tolerated.<sup>3</sup> Variations on this technique have become standard surgical approaches for many strabismus surgeons.

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The two primary indications for the use of adjustable suture techniques in strabismus surgery are (1) cooperative patients when estimation of the postoperative alignment is difficult and (2) cooperative patients with fusion potential when very precise alignment is needed. Strabismus with unpredictable surgical outcomes includes paretic or restrictive strabismus, previous strabismus surgery, very large angle strabismus, and long-standing strabismus with consequent contracture of the extraocular muscles. Strabismus with unexpected findings at surgery also makes the outcome more difficult to predict. This may occur following orbital trauma, or after cataract or retinal reattachment surgery. Finally, patients with small or large eyes, those with aberrant regeneration, or those who are undergoing strabismus procedures not involving the horizontal recti are likely to benefit from an adjustable suture technique.<sup>4</sup>

There are a number of nonrandomized, retrospective studies that suggest the effectiveness of this technique for the treatment of strabismus. However, to the best of the authors' knowledge, this is the largest ever series to compare adjustable suture strabismus surgery with fixed suture strabismus surgery. In addition, the question of patients' satisfaction and factors that may influence the surgical outcome (age, sex, previous surgeries, injections of botulinum toxin, etc) have also been examined.

### Patients and methods

A total of 443 patients (229 men and 214 women), aged between 13 and 78 years, who underwent strabismus surgery, from January 1996 to January 2000 were included in this study. All these patients were offered adjustable suture surgery. Following discussion, some were not keen on the procedure or declined following previous experience during injection of botulinum toxin. In patients who agreed to the procedure, response to injection of botulinum toxin during postoperative diplopia test was a useful guide for the surgeon regarding the suitability of the patient for the adjustable suture technique. A detailed history was obtained from the patients regarding the age of onset and type of original deviation, and any previous treatment received (glasses, surgery or injection of botulinum toxin). In total, 141 patients had surgery with adjustable sutures (Jampolsky technique) and 302 without adjustable sutures. Surgery was carried out under general anaesthesia and patients in the adjustable group had postoperative adjustment of sutures on the same day after recovery from anaesthesia. Adjustment was done following the measurement of angle of deviation and an assessment of diplopia if present. The patients were also given an opportunity to observe their appearance in a

mirror and take an active part in the process of final adjustment. Surgical results were followed up for a period ranging from 12 to 50 months and influence of various factors like age, sex, previous surgeries, and injection of botulinum toxin was studied. The patients were also asked about their level of satisfaction with regard to final cosmetic appearance and elimination of diplopia, if appropriate. This assessment of satisfaction was carried out, in person, by the orthoptist who examined the patients at least 4 months postoperatively. No questionnaire was used and all patients were assessed both after the initial surgery and reoperation (if necessary). Orthoptists carrying out this assessment may not be identifiable as a member of the surgical team. The results were statistically analysed using Levene's test for equality of variances, *t*-test for equality of means, and statistical significance of the results was analysed by calculating *P*-values.

### Results

Of the 141 patients who had surgery with adjustable sutures, 98 (69.5%) required adjustment in the postoperative phase. Of these, 55.1% had a further recession of the adjustable muscle (ie undercorrection) and 45.9% had advancement (overcorrection). In all, 8.51% of the patients in the adjustable group and 27.15% in the nonadjustable group needed a reoperation (Table 1). A total of 84.4% of reoperations in the fixed sutures group were for undercorrections and 15.6% for overcorrections. The adjustable reoperations were all for undercorrection. As regards the level of patients' satisfaction, 96% of patients in the adjustable group were happy with their final cosmetic appearance and 92% reported relief of diplopia in straight ahead and reading positions. The corresponding figures in nonadjustable group were 63 and 62%, respectively (Table 2). The range of change in the angle of deviation in the adjustable group was 59–110% with an average change of 87.5%. In the nonadjustable group, the range of change in the angle of deviation was 15–125% with an average change of 67.3% (Table 3). Surgical results were found to be significantly better in patients who had adjustable sutures in comparison to those who did not have adjustable sutures ( $P < 0.005$ ). Age, sex, number of

**Table 1** Rates of reoperations following surgery with and without adjustable sutures

<i>Surgical group</i>	<i>Total no. of patients</i>	<i>Reoperations required</i>
Adjustable sutures	141	12 (8.51%)
Nonadjustable sutures	302	82 (27.15%)

*P*-value <0.005.

**Table 2** Patients' satisfaction following surgery with and without adjustable sutures

Surgical group	Cosmetic appearance (%)	Relief of diplopia (%)
Adjustable sutures	96	92
Nonadjustable sutures	63	62

**Table 3** Percentage change in the angle of deviation following surgery with and without adjustable sutures

Surgical group	Range of change in the angle of deviation (%)	Average change in the angle of deviation (%)
Adjustable sutures	59–100	87.5
Nonadjustable sutures	15–125	67.3

**Table 4** Levels of significance of various factors

Factors	Significance (P-value)
Adjustable vs nonadjustable sutures	<0.005
Age of patient and final result	0.619
Sex of patient and final result	0.625
Previous botulinum injections	0.219
Previous surgeries	0.882

previous surgeries, previous injections of botulinum toxin, and type and amount of deviation had no statistically significant influence on the surgical outcome (Table 4).

## Discussion

The present study was undertaken to assess the efficacy of adjustable sutures in strabismus surgery, irrespective of aetiology, type of deviation, and previous surgery or botulinum toxin injection. Previous papers recommend strabismus surgery with adjustable sutures in reoperations, parietic squints, and in conditions where a precise surgical outcome is required.<sup>5</sup> Eino and Kraft<sup>6</sup> reported high success rates with adjustable sutures for both primary surgery and reoperations in a series of 109 patients. Rauz and Govan,<sup>7</sup> in a rather small series of eight patients, commented that one-stage adjustable suture surgery should be used in all cases of strabismus surgery when the postoperative result is otherwise unpredictable. Melhuish and Kemp<sup>8</sup> presented a series of 20 patients operated using adjustable sutures and, claiming an 85% success rate, recommended adjustable sutures as a routine technique for all patients to safeguard against the unpredictable nature of standard strabismus surgery. All these case series suffer from the drawback of a very small sample size. Keech *et al*<sup>9</sup>

presented the first big series of 333 patients and recommended adjustable suture surgery in selected horizontal deviations, vertical deviations and complex strabismus problems. However, in this study no attempt was made to study the influence of other factors on surgical outcome nor to analyse whether adjustable suture surgery would be good for all patients irrespective of aetiology and the type of deviation. Broniarczyk-Loba *et al*<sup>10</sup> recommended adjustable sutures in complicated reoperations including paralytic strabismus, large angle strabismus, and thyroid myopathy. Lender *et al*<sup>11</sup> reported long-term symptomatic relief of diplopia, occasionally combined with prismatic therapy postoperatively, in patients with strabismus secondary to thyroid ophthalmopathy.

In the present study consisting of a sample size of 443 patients, we analysed the efficacy of adjustable sutures as a routine surgical procedure during strabismus surgery. We also studied the level of patients' satisfaction following this surgery and influence of factors like age, type and amount of deviation, previous surgeries, and injections of botulinum toxin on final surgical outcome. We found that surgical results were statistically significantly better in patients who had surgery with adjustable sutures. There was no significant influence of age, type and amount of deviation, previous botulinum injections, and previous surgery. We also noted that the level of patients' satisfaction was also higher after adjustable suture surgery. Surgery with adjustable sutures reduces the rate of reoperations in strabismus patients, therefore increasing the cost-effectiveness of this procedure. On the basis of these observations and statistical analysis, we recommend that strabismus surgery with adjustable sutures should be the procedure of choice for all the patients who are fit and willing to cooperate.

## References

- 1 Gruening E. On the operative treatment of divergent strabismus. *Irons Am Ophthalmol* 1891; **6**: 165.
- 2 Chavasse FB. *Worth's Squint or the Binocular Reflexes and the Treatment of Strabismus*. P Blakiston's Son and Co.: Philadelphia, 1939, pp 573–577, 599–602.
- 3 Jampolsky A. Adjustable strabismus surgical procedures. In: Helveston EM (ed): *Symposium on Strabismus*. Transactions of the New Orleans Academy of Ophthalmology, CV Mosby: St Louis, 1978, pp 321–349.
- 4 Jampolsky A. Strabismus re-operation technique. *Trans Am Acad Ophthalmol Otolaryngol* 1975; **79**: 704.
- 5 Broniarczyk-Loba A, Nowakowska O. Own experience with the use of adjustable sutures in various types of strabismus operations. *Klin Oczna* 1998; **100**(5): 305–309.
- 6 Eino D, Kraft SP. Postoperative drifts after adjustable-suture strabismus surgery. *Can J Ophthalmol* 1997; **32**(3): 163–169.

- 7 Rauz S, Govan GA. One stage vertical rectus muscle recession using adjustable sutures under local anaesthesia. *Br J Ophthalmol* 1996; **80**(8): 713–718.
- 8 Melhuish JA, Kemp EG. The routine use of adjustable sutures in adult strabismus surgery. *J R Coll Surg Edinburgh* 1993; **38**(3): 134–137.
- 9 Keech RV, Scott WE, Christensen LE. Adjustable suture strabismus surgery. *J Pediatr Ophthalmol Strabismus* 1987; **24**(2): 97–102.
- 10 Broniarczyk-Loba A, Nowakowska O, Rozyki A. Adjustable sutures in various types of strabismus operations: surgical techniques. *Klin Oczna* 1998; **100**(5): 311–314.
- 11 Lender GT, Scott WE, Kutschke PJ, Keech RV. Long term results of adjustable strabismus surgery for strabismus secondary to thyroid ophthalmopathy. *Ophthalmology* 1992; **99**(6): 993–997.