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Inferior rectus recession: outcome of surgery

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Abstract

Aim: **Inferior rectus recession (IRR) surgery has been reported to be unstable, and there have been particular concerns about progressive overcorrection. This study reviewed the vertical outcomes following IRR surgery in order to observe post-operative stability.**

Methods: **A retrospective review is presented of all IRR surgery by a single surgeon from January 1996 to March 2006.**

Results: **A total of 42 cases were included, with adjustable sutures being used in 40. The mean follow-up was 9 months. The mean (median) pre-operative vertical deviation in the primary position was 19.8$^{\Delta}$ (20$^{\Delta}$) pre-operatively, reducing to 5.2$^{\Delta}$ (2$^{\Delta}$) at the final post-operative visit. The aim of a small under-correction within the patient's vertical fusion range was achieved in all cases, after adjustment if necessary. By the end of follow-up, 35 (83%) patients retained a satisfactory result, 5 (12%) were over-corrected and 2 (5%) were undercorrected. Twenty-five (60%) remained orthophoric or undercorrected, while 17 (40%) progressed from a planned under-correction to an overcorrection. Overcorrection was significantly more common in thyroid eye disease (TED) patients (12/20) than the non-TED patients (5/22) ($p = 0.014$, chi-square). Three patients (7%) demonstrated progressive overcorrection, all of whom had TED.**

Conclusion: **In this study, aiming for a small under-correction within the patient's vertical fusion range allowed for resolution of symptoms in most cases. TED was more susceptible to overcorrection. Progressive overcorrection did occur, but was uncommon.**

Key words: Adjustable sutures, Inferior rectus recession, Progressive overcorrection, Thyroid eye disease

Introduction

Inferior rectus recession (IRR) surgery has been reported to have unstable results,[1–6] the most commonly reported problem being progressive overcorrection from pre-operative hypotropia to a large hypertropia of the operated eye.[1,3–6] This condition is characterised by an increasingly large reversal of the hyperdeviation associated with reduction in infra-duction of the eye due to marked inferior rectus weakness weeks to months following surgery. This study aimed to review the vertical outcomes following IRR surgery in order to observe post-operative stability with particular regard to progressive overcorrection.

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Materials and methods

A retrospective case-note review was undertaken of all cases of IRR from January 1996 until March 2006 performed by a single surgeon (C. M.). The following variables were looked at: diagnosis, pre- and post-operative angle, length of follow-up, concurrent surgery, use of adjustable or fixed sutures, presence or absence of diplopia in the primary position and the need for further vertical muscle surgery post-operatively.

Records were available for 43 of 45 patients who underwent IRR. One further patient was excluded as they had moved away from the area before post-operative assessment could be performed, leaving 42 cases for analysis. The median age at time of surgery for the study group was 55 years (range 8–79 years); for those with thyroid eye disease (TED) the median age was also 55 years and for those with other diagnoses it was 47 years.

Adjustable sutures were used in all but 2 cases. The 2 patients who had fixed sutures were considered too young (ages 8 and 15 years). All TED patients had inactive disease according to their clinical activity score and all patients had observed stable deviations for at least 4 months before surgery.

Results

The diagnoses are shown in Table 1, with TED being the most common. Five patients had had previous vertical muscle surgery. Concurrent surgery was performed in 18 patients, which consisted of contralateral inferior oblique disinsertion (7), horizontal rectus muscle surgery (5), contralateral superior rectus recession (4), ipsilateral inferior rectus Faden (1) and contralateral inferior rectus

Table 1. Diagnoses of the study group patients

Diagnosis	No. of patients
Thyroid eye disease	20
Fourth nerve palsy	8
Blow-out fracture	3
Other	11

recession (1). The mean follow-up was 8 months (median 3.75 months, range 0.5–47 months). The median follow-up for patients with TED was 4 months and for those with other underlying aetiologies was 3 months.

By the end of follow-up, 35 patients (83%) retained a satisfactory result, having no symptomatic diplopia and requiring no additional prisms or surgery. Seven required further surgery, of whom 5 (12%) were overcorrected and 2 (5%) were undercorrected.

In 17 patients (40%) the planned undercorrection progressed to an overcorrection. This was small and remained within the patient's fusion range in 12 (29%) cases, but was symptomatic in 5 (12%). The mean overcorrection was 7.3^{Δ} (median 4^{Δ}, range 2^{Δ}–33^{Δ}). This was apparent by 1 month post-operatively in 13 of the overcorrected cases (76%), by 3 months in a further 3 (18%) and by 7 months in the last case (6%). Overcorrections were significantly more common in TED patients (12 of 20 (60%) patients) than non-TED patients (5 of 22 (23%) patients) ($p = 0.014$) (Figs. 1, 2). Symptomatic diplopia occurred in 20% (4 cases) of TED patients (overcorrected by 10^{Δ}, 16^{Δ}, 18^{Δ} and 33^{Δ}) and 12% (1 case) of patients with decompensated IV nerve palsy (overcorrected by 7^{Δ}).

For those with symptomatic overcorrection, in 2 (5%) cases the pattern was of mild overcorrection with good inferior rectus function and was remedied by recession of the contralateral inferior rectus. The remaining 3 (7%) patients demonstrated features of progressive overcorrection, with the reversal being associated with marked weakness of depression of the operated eye. This was evident at the 1 month post-operative review in all cases. Re-advancement of the inferior rectus muscle was required in all cases, but also subsequent inferior transposition of the horizontal recti in 2 cases and contralateral IRR in 1 case. All patients with progressive overcorrection had TED.

Thirteen (32%) patients remained undercorrected (mean 13.4^{Δ} and median 4^{Δ}), of whom 11 were within their fusional range in the primary position. Two (5%) required further surgery: further ipsilateral IRR in both instances, for deviations of 8^{Δ} (III nerve palsy) and 40^{Δ} (restrictive hypotropia with multiple previous surgeries). Twelve patients (28%) were orthophoric.

Mean (median) vertical deviation in the primary position for all patients was 19.8^{Δ} (20^{Δ}) pre-operatively, reducing to 5.2^{Δ} (2^{Δ}) of any vertical deviation at the final post-operative visit. The pre-operative vertical deviation was slightly larger for TED patients (mean 22.75^{Δ}, median 21^{Δ}) than for those with other aetiologies (mean 17.18^{Δ}, median 17^{Δ}). The aim of surgery was the same in both groups, i.e. a small undercorrection within the patient's vertical fusion range. This was achieved (after adjustment, if required) in all cases.

Discussion

This study of 42 patients represents the largest series of IRR reported in the United Kingdom and the second largest worldwide.[1] Most series concentrate on the complication of progressive overcorrection of the deviation,[1–5] which is well recognised following IRR surgery, affecting up to 21% of patients and as many as 50% of TED patients.[1,5] Our finding of 3 cases (7% of all cases and 14% of TED cases) may be due to the aimed surgical outcome of undercorrection in the immediate post-operative period.

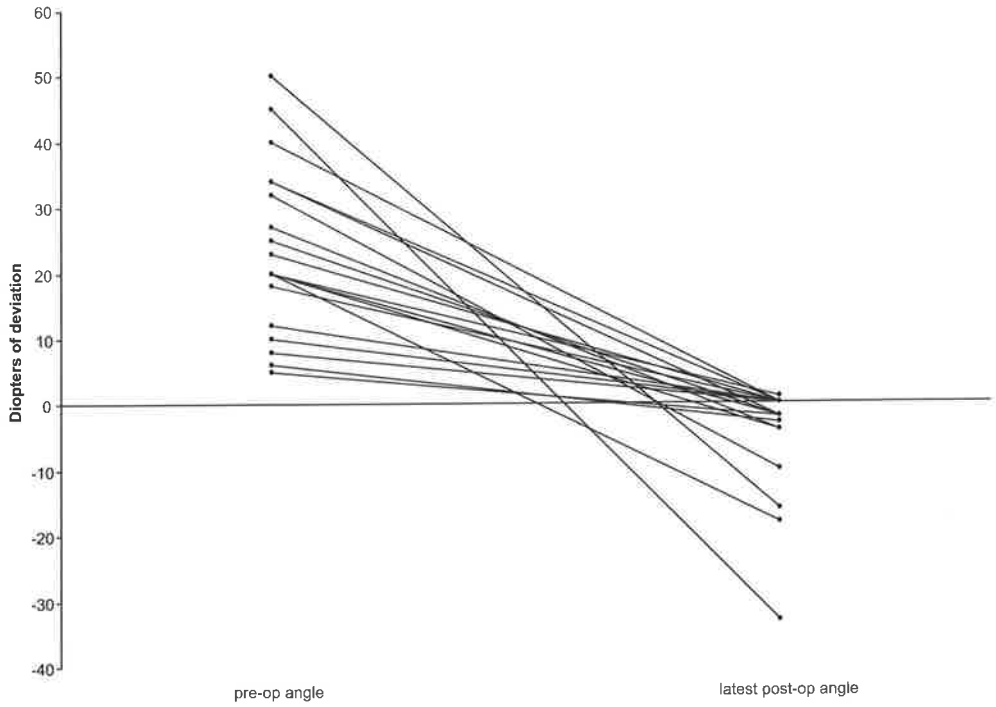

Fig. 1. Pre- and post-operative angles of vertical deviation for the thyroid eye disease patients.

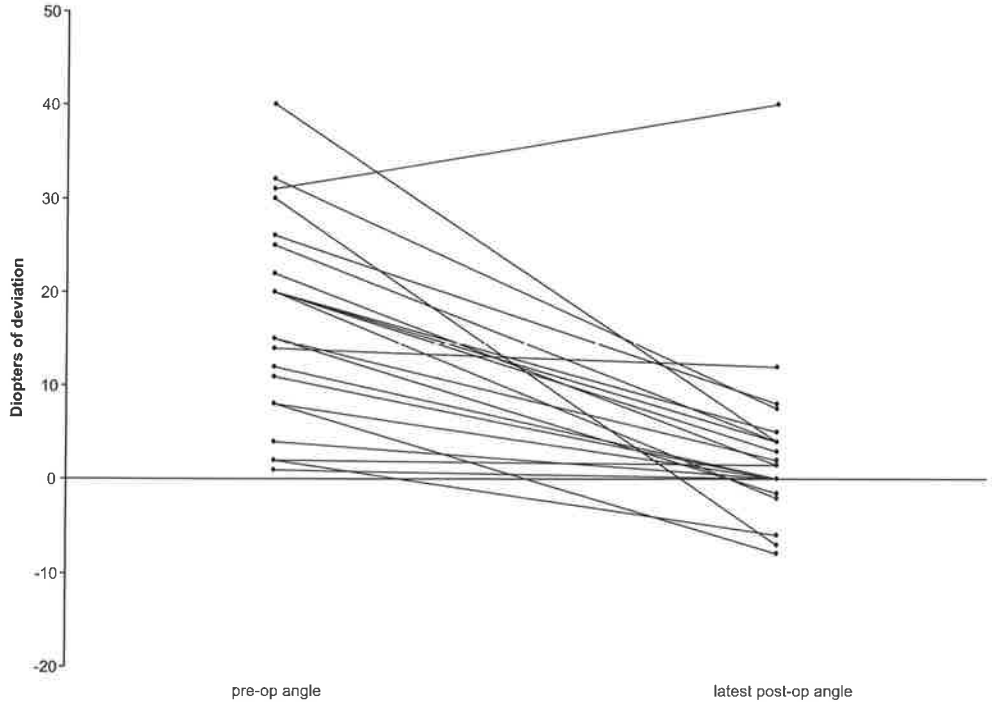

Fig. 2. Pre- and post-operative angles of vertical deviation for the non-thyroid eye disease patients.

Progressive overcorrection has been attributed to anatomical features of the inferior rectus muscle in which attachments fuse it with the inferior oblique via the capsulopalpebral fascia of Lockwood's ligament. This arrangement predisposes to continuous sideways traction on the inferior rectus by inferior oblique action, which is suggested to prevent adequate re-attachment of the recessed inferior rectus to the globe. This causes progressive overcorrection associated with inferior rectus weakness due to slippage of that muscle.[4]

Surgical technique has been examined and progressive overcorrection has been associated with the use of adjustable sutures,[8] because this technique leaves the muscle on a hang-back suture and not firmly fixed to the sclera. The almost universal use of this surgical technique in our patients (they were used in all but 2 cases) has made it impossible to assess whether the use of adjustable sutures was a risk factor. Progressive overcorrection has also been reported after surgery using fixed sutures, suggesting that slippage of the muscle may not be the cause of the problem. In addition, although slippage has been identified on re-exploration of the muscle, this is not universal[2] and alternative theories have been promoted to explain this phenomenon. Excessive fibrosis around Lockwood's ligament has been suggested,[3–5] which explains the time frame of onset more accurately, as scarring tends to develop weeks to months after surgery whereas slippage is usually an acute event in the early post-operative period. During surgical dissection of the inferior rectus, the capsulopalpebral system that unites the inferior rectus, inferior oblique and lower lid retractors becomes disrupted and in the healing phase this area develops scarring. This becomes progressively fibrosed causing weakness of the inferior rectus, which becomes most marked in the field of action of the muscle, i.e. downgaze. This theory is supported by severe scarring and fibrosis being identified in the area of Lockwood's ligament at time of surgical exploration of affected patients.[2,3]

Patients with TED in this series developed overcorrection more frequently than those with other diagnoses, and it was only TED patients who developed progressive overcorrection (3 cases). In TED the orbit is generally tighter than normal due to several muscles being involved in the disease process, albeit to different extents. Ipsilateral superior rectus tightness, even if minimal and not clinically significant pre-operatively, will favour overcorrection.[1,5] This may be more likely when a large degree of proptosis is present, as this increases the resting muscle length, which alters the normal length–tension relationship of the muscle.

It has been suggested that if there is evidence of ipsilateral superior rectus enlargement on imaging, particularly in the presence of significant proptosis, then consideration should be given to recessing both inferior and superior rectus muscles at initial surgery to reduce the risks of overcorrection.[5] Similarly involvement of the contralateral inferior rectus will increase the risk of overcorrection, and if this is evident then the aim of surgery should be an undercorrection.[1,2,5]

Thyroid patients should be carefully assessed for features of active disease as disease progression is also a cause of subsequent overcorrection, and surgery should not be carried out until this is stable and quiet. Some suggest that all TED patients should be treated differently from other diagnostic groups and be intentionally undercorrected to achieve long-term alignment.[2] Progressive overcorrection is not exclusive to TED, however, and has been described in several other

underlying causes of vertical deviation necessitating IRR.[3] This is particularly evident when the IRR has led to unmasking of a bilateral IV nerve palsy, causing post-operative reversal of the deviation.[2] It is, therefore, more likely that this phenomenon is due to an intrinsic abnormality of the anatomy of the inferior rectus muscle rather than due to the underlying strabismus aetiology.

Most patients undergoing IRR have binocular potential, and the aim of surgery is to restore binocular vision. The underlying aetiology of the deviation is commonly associated with an enlarged vertical fusion range due to the chronic, slow development of the deviation. Reversing the deviation post-operatively leads to loss of this compensatory mechanism and subsequent diplopia may result in a 'purposeful' drive to increase the over-correction. Overcorrection is less common in patients undergoing recession of other rectus muscles[1] and this may be due to fewer potentially binocular outcomes. A form of progressive overcorrection is seen in children with intermittent exotropias who are rendered consecutively esotropic. Such children develop a large angle of convergent deviation due to utilisation of their extended negative horizontal fusion range and the drive to avoid diplopia. This tends to occur on a shorter timescale to progressive overcorrection of the inferior rectus and ductions remain full, compared with progressive over-correction of the inferior rectus where the reduction in depression of the affected eye is usually marked. Surgical re-advancement and further resection is not always successful and patients frequently require further surgery to achieve a satisfactory result. This was seen in our series, in which it was necessary to perform inferior transposition of the horizontal recti or contralateral inferior rectus resection in order to regain balanced single vision. Some aspect of the inferior rectus becomes permanently weakened, recessed or lost as part of this clinical setting, which is not remediable by simply reversing the original surgery.

This was a retrospective study and therefore the follow-up time of the patients in our study group varied, and it could be argued that the short follow-up time for some patients was insufficient to detect all cases of progressive overcorrection. Fourteen patients had a follow-up of less than 3 months and 3 of these had evidence of a small overcorrection at time of discharge. Progressive overcorrection usually becomes clinically evident between 4 and 6 weeks after surgery[3] and all cases in this series were evident by the 1 month follow-up. The distressing nature of progressive overcorrection is such that it is very likely that any patient who did develop these features would have re-presented for further management and therefore would have been identified.

We aimed for an undercorrection, within the patient's fusion range in all cases, which led to a long-term satisfactory result in the majority of cases. Overall 83% of patients achieved comfortable single vision. Sixty per cent of the patients in this series remained under-corrected or orthophoric in the primary position and overcorrections tended to be small, did not progress and occurred most frequently in patients with TED. Patients coped well with these small deviations and, by aiming for an undercorrection in the immediate post-operative period, most patients had a successful result. Progressive overcorrection did occur, but was not common and may be attributed to the unique anatomy of this muscle.

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