ORIGINAL ARTICLES—Clinical science

Inferior rectus recession—an effective procedure?

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Abstract

***Aims*—To examine the postoperative stability of inferior rectus recession, with particular reference to the incidence of progressive overcorrection.**

***Methods*—The results of consecutive patients undergoing inferior rectus recession over a 3 year period were reviewed.**

***Results*—21 patients underwent inferior rectus recession, using an adjustable suture technique in all but three cases. In 16 patients additional vertical muscle surgery was performed at the time of the inferior rectus recession. All patients were followed for a minimum of 3 months postoperatively, with a mean follow up of 9.3 months. At the final postoperative visit 11 patients were well aligned, eight were undercorrected, and two were overcorrected. In five of the eight undercorrected cases, the residual deviation was the result of postoperative drift in the direction of the preoperative deviation, following an initially good alignment. Review of the results failed to reveal any factor predictive for this postoperative drift.**

***Conclusion*—The risk of postoperative overcorrection following inferior rectus recession should be considered, but in this study, undercorrection occurred more frequently than overcorrection. The possible reasons for overcorrection and undercorrection are discussed.**

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Recession of the inferior rectus muscle is an established treatment for vertical strabismus.[1] The most common indications are contralateral inferior rectus recession in cases of superior oblique paresis, and ipsilateral inferior rectus recession in cases with limited elevation, secondary to thyroid orbitopathy.

Progressive overcorrection following an initially good postoperative alignment has been reported in some patients undergoing inferior rectus recession.[2–4] It is suggested that the risk of overcorrection is increased in cases of thyroid orbitopathy[3 5] and when an adjustable suture technique is used.[3 6–8]

The results of inferior rectus recessions, carried out over a 3 year period in Southampton, were retrospectively reviewed in order to determine the efficacy of the procedure, and the long term stability of the result.

Patients and methods

The notes of all the patients who had undergone inferior rectus recession by one surgeon (RJM), over the 3 year period from January 1991 to January 1994, were reviewed. Preoperatively, all patients had undergone a full orthoptic and ophthalmic assessment, and any appropriate additional investigations to establish the aetiology of the muscle imbalance. The deviation had been stable for a minimum of 6 months before surgery in all cases. Patients with a postoperative follow up of less then 3 months were excluded from the study.

In all cases a standard inferior rectus recession was performed,[1] with careful dissection of the fascial attachments and check ligaments as far posteriorly as possible, and at least to the level of the vortex veins. One mm of recession was performed for each 3^{Δ} of vertical deviation.[9] The surgical aim was orthotropia, or a vertical undercorrection of less than 4^{Δ} in the primary position, immediately postoperatively. Owing to the incidence of overcorrection reported in cases of thyroid orbitopathy,[3 5] the aim in this group was an undercorrection of 4^{Δ}–6^{Δ} immediately postoperatively. In cases with potential for binocular vision, the aim was to maximise the field of binocular single vision, particularly in the primary position and downgaze, without inducing symptom producing inferior rectus underaction. The procedure was performed using an adjustable suture technique in cooperative patients. Surgery to other extraocular muscles was undertaken at the same time as the inferior rectus recession, where indicated.

Results

Twenty one patients underwent inferior rectus recession. The age range was 7–82 years (mean 37 years). There were 11 males and 10 females. Postoperative follow up ranged from 3 to 27 months (mean 9.3 months)

The preoperative diagnosis was unilateral superior oblique underaction in 13 cases, thyroid orbitopathy in two cases, and a vertical deviation following retinal detachment repair

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Table 1 Summary of results; superior oblique underaction

Case	*Age*	*Diagnosis*	*Previous surgery*	*Indication*	*Surgery*	*Postop adjustment*	*Preop deviation*
1	71	RSO u/a Longstanding decompensating		Diplopia	LIR recess 3 mm (A)	None	RH(T)6 Rexcyclo2
2	38	LSO u/a Longstanding decompensating		Diplopia (R gaze only)	RIR recess 3 mm (A) LIO disinsertion	Advanced	LH8 X6
3	31	RSO u/a Traumatic		Diplopia	LIR recess 4 mm (A) RIO myectomy	None	RH(T)30
4	56	RSO u/a Longstanding decompensating		Diplopia	LIR recess 3 mm (A) RIO myectomy	None	RHT15 R excyclo 5
5	51	RSO u/a Longstanding decompensating		Diplopia	LIR recess 3 mm (A) RSR recess 4 mm (A)	None	LHypoT14
7	26	RSO u/a Traumatic with associated Brown's	RSO tenotomy	Diplopia	LIR recess 3.5 mm (A) RIO myectomy	Recessed/advanced	RHT20 Rexcyclo4
10	11	RSO u/a Congenital		Cosmesis RHT+CHP	LIR recess 4 mm (A) RIO myectomy	None	RHT35 Rexcyclo4
14	65	RSO u/a Longstanding decompensating		Diplopia	LIR recess 4 mm (A)	Recessed	RHT12
16	82	LSO u/a Longstanding decompensating		Diplopia	RIR recess 3 mm (A) LSR recess 4 mm (A)	None	RhypoT20 RET5
17	21	RSO u/a Longstanding decompensating		Diplopia	LIR recess 4 mm (A) RIO myectomy	Advanced	RH(T)16 RX(T)12
19	7	RSO u/a Congenital	RIO recess	CHP	LIR recess 3.5 mm	Fixed suture	RHT16 Rexcyclo5
20	43	RSO u/a Traumatic		Diplopia	LIR recess (A) R Harado Ito	Advanced/recessed	RHT10 Rexcyclo7
21	17	LSO u/a Congenital		Diplopia	RIR recess 3 mm (A) LIO myectomy	None	LHT15

*Measurement in primary position.
(A) = adjustable; RSO/LSO = right/left superior oblique; RIO/LIO = right/left inferior oblique; RMR/LMR = right/left medial rectus; RSR/LSR = right/left superior rectus; RIR/LIR = right/left inferior rectus; RLR/LLR = right/left lateral rectus.

Table 2 Summary of results; thyroid related orbitopathy

Case	*Age*	*Diagnosis*	*Previous surgery*	*Indication*	*Surgery*	*Postop adjustment*	*Preop deviation*
8	46	Limited right elevation and left depression	LIR recess (A) 5 mm RSR recess (A) 5 mm	Diplopia	RIR recess 3 mm (A) LIR readvanced 3 mm (LIR found in expected position)	None	LH(T)16
9	66	Limited left elevation and left abduction	Left orbital decompression	Diplopia	LIR recess 4 mm (A) LMR recess 5 mm (A) RSR recess 5mm (A) RMR recess 4mm (A)	Recessed Recessed Recessed	LHypoT40 LET40

See Table 1 for details of abbreviations.

Table 3 Summary of results; vertical deviation following retinal detachment surgery

Case	*Age*	*Diagnosis*	*Previous surgery*	*Indication*	*Surgery*	*Postop adjustment*	*Preop deviation*
6	34	Limited R depression		Diplopia	LIR recess 3 mm (A)	Recessed	RH(T)8 Rexcyclo5
15	28	Limited L elevation		Diplopia	LIR recess 3 mm (A)	Yes ? direction	LHypoT25

See Table 1 for details of abbreviations.

in two cases. In four cases a vertical deviation was associated with infantile strabismus.

The inferior rectus recession was performed using an adjustable suture technique in 18 cases (86%). Inferior rectus recession was the sole procedure in five cases, while 14 patients underwent additional vertical muscle surgery at the same time as the inferior rectus recession. In eight of these cases this consisted of contralateral inferior oblique weakening. Two cases underwent both horizontal and additional vertical muscle surgery, at the same time as the inferior rectus recession.

Tables 1–4 summarise the preoperative and postoperative alignment, surgical indication, and surgical procedures in each of the patients, categorised by preoperative diagnosis. The final follow up visit, as described in Tables 1–4, is at least 3 months after surgery in all patients, and is the most recent assessment, or, in the case of patients requiring further surgery, the last assessment before the further procedure.

Table 1 continued

*Postop deviation**				*Duration of follow up (months)*	*Further surgery*	*Deviation (after further surgery)*	*Postop comments*
Immediate	*1 week*	*3 months*	*Final*				
Ortho	RH1	Ortho	Ortho	8			BSV all positions
Ortho	X4	X4	Ortho	8			BSV all positions
RHT4	RHT4	RH4	Ortho	8			BSV all positions
RH1	Ortho	X2	—	3			BSV all positions
Ortho	Ortho	Ortho	Ortho	6			BSV all positions
Ortho	Ortho	Ortho	Ortho	7			BSV in primary and downgate
RHT10	RHT10	RH(T)5		3			Patient pleased with cosmesis. CHP resolved
Ortho	Ortho	RH(T)4	RH(T)4	21			Undercorrected prism
E5	E5	RHypoT12	RHypoT12	6			No diplopia Deviation still manifest
Ortho	RH(T)12 RX(T)12	RH10 X8	RH(T)6 RX(T)5	4	LIR recess+Faden (LIR found in expected position)	X2	Undercorrected by 1st op BSV all positions post 2nd op
RHT10	RHT10	RHT16	RHT16	13			CHP improved. Angle unchanged
LH2	LHT6	LHT4	LHT9	19			Overcorrected prism
RH2	RH2	RHT17	—	3	RIR readvanced 2.5 m (Found at 5.5 mm from original insertion) RIO myectomy	RH1	Overcorrection after 1st op BSV all positions after 2nd op

Ortho = orthophoria; E = esophoria; X = exophoria; ET = esotropia; E(T) = intermittent esotropia; XT = exotropia; X(T) = intermittent exotropia; HT = hypertropia; H(T) = intermittent hypertropia; Hypo = hypotropia.
u/a = underaction; o/a = overaction; BSV = binocular single vision; CHP = compensatory head position.

Table 2 continued

Postop deviation				*Duration of follow up (months)*	*Further surgery*	*Deviation (after further surgery)*	*Postop comments*
Immediate	*1 week*	*3 months*	*Final*				
LH6	Ortho	Ortho	Ortho	27			BSV all positions (previous overcorrection)
LHypo2	LHypo2 X2	LH6	LH3 X4	10			BSV all positions

Table 3 continued

Postop deviation				*Duration of follow up (months)*	*Further surgery*	*Deviation (after further surgery)*	*Postop comments*
Immediate	*1 week*	*3 months*	*Final*				
RH1	Ortho	RH1	Ortho	17			BSV all positions
E6	LHypo4	LHypoT20	—	3	LIR recess 3 mm (muscle found at original insertion)	LHypo2	Deviation recurred post 1st op BSV all positions post 2nd op

At the final follow up assessment 11 patients were aligned to within 4^{Δ} of vertical orthotropia in the primary position. Two patients had developed a progressive overcorrection, and eight patients were undercorrected.

Eight patients showed no change in their vertical alignment from the immediate postoperative period until final follow up, a mean of 7.6 months later (range 3–17 months), while in 13 patients there was evidence of postoperative vertical drift. In six patients this was in the direction of the original deviation, by a mean of 11^{Δ} (range 4^{Δ}–20^{Δ}), occurring at a mean of 2.2 months after surgery (range 1 week to 3 months). In five of these cases the drift led to an undercorrection following an initially good alignment, while in one patient (case 19) the drift increased an undercorrection present immediately postoperatively.

The remaining seven patients showed a postoperative vertical drift in the direction away from the preoperative deviation. Two of

Table 4 Summary of results; vertical deviation associated with infantile strabismus

Case	*Age*	*Diagnosis*	*Previous surgery*	*Indication*	*Surgery*	*Postop adjustment*	*Preop deviation*
11	11	L Hypotropia (concomitant) Infantile exotropia	LMR resect LLR recess	Cosmesis	LIR recess 2 mm RSR recess 4 mm (A) RMR resect 4 mm	LIR fixed suture	LHypoT18 LXT9
12	46	L Hypotropia RIO o/a+LIO u/a Infantile esotropia	3 previous procedures (unknown)	Cosmesis	LIR recess 3 mm (A) RIO myectomy	None	LHypoT15 LET8
13	12	L Hypotropia Postop limitation of L elevation Infantile esotropia	RMR recess 5mm RLR resect 5 mm LIO myectomy	Cosmesis	LIR recess 5 mm RSR recess 4 mm (A)	LIR fixed suture	RHT30 RET12
18	19	R Hypotropia (concomitant) Infantile esotropia	RMR recess 5 mm RLR recect 4 mm	Cosmesis	RIR recess 3 mm (A) LSR recess 3 mm (A)	None	RHypoT16 RET8

See Table 1 for details of abbreviations

these patients (cases 20 and 21) showed unmasking of a previously unidentified bilateral superior oblique underaction, with a drift of 7^{Δ} and 15^{Δ} respectively, resulting in an overcorrection in both cases. In the other five patients the mean drift away from the preoperative deviation was 4.6^{Δ} (range 3^{Δ}–6^{Δ}), occurring at a mean of 2.1 months postoperatively (range 2 weeks to 4 months). This drift reduced a residual deviation present immediately after surgery to orthotropia in three cases, reduced an undercorrection in one patient (case 10), and changed a minimal undercorrection to a minimal overcorrection in one patient (case 9). The two patients with thyroid orbitopathy were both in the group who had a postoperative drift in the direction away from the preoperative deviation, by 6^{Δ} in case 8 and by 5^{Δ} in case 9.

Postoperative drift in the direction of the preoperative deviation was the most frequent cause of an unsatisfactory final alignment. Table 5 compares the features of patients showing this drift with those of patients with a stable postoperative alignment.

Discussion

A total of 21 patients underwent inferior rectus recession to correct a vertical deviation. At the final follow up assessment 11 patients were aligned to within 4^{Δ} of vertical orthotropia in the primary position. Two patients developed a progressive overcorrection, occurring respectively at 1 week and 2 months following surgery, while eight patients were undercorrected. In five cases the residual deviation was the result of postoperative drift, occurring at between 1 week and 3 months postoperatively.

A major complication reported following inferior rectus recession is progressive overcorrection,[2 4 5] with an incidence of 21% found by Sprunger and Helveston.[3] In our series only two patients (9.5%) developed an overcorrection. However, this could not be attributed solely to inferior rectus underaction in either case, as in addition to the underaction of the recessed inferior rectus, both patients also showed an apparent unmasking of a previously undiagnosed bilateral superior oblique underaction. These two patients were both minimally overcorrected in the primary position immediately postoperatively, with normal inferior rectus action. In case 20 the overcorrection increased to 6^{Δ} at 1 week postoperatively, and to 9^{Δ} at 2 months. In case 21 the overcorrection increased to 17^{Δ} at 2 months postoperatively. Both patients showed progressive postoperative underaction of the recessed inferior rectus, together with superior oblique underaction on the same side. Thus, both overcorrected patients appeared to have had a masked bilateral superior oblique underaction preoperatively, with unmasking of the contralateral superior oblique underaction postoperatively, together with progressive underaction of the recessed inferior rectus. The relative part played by these two processes—that is, inferior rectus weakness and superior oblique weakness, in contributing to the overcorrection is unclear. It may also be relevant that these two patients were both slightly overcorrected immediately postoperatively, while 18 of the remaining 19 patients in the study were undercorrected or orthotropic following suture adjustment.

The cause of postoperative overcorrection has not been established. Some studies report slippage of the inferior rectus within the sheath[2 8] while others found the inferior rectus insertion in the expected position at the time of further surgery.[3 5] Slippage of the inferior rectus (by 2.5 mm) was found in one of our patients at reoperation (case 21), but no slippage had occurred in a second patient (case 8), referred to us following progressive overcorrection.

The inferior rectus has a unique anatomy in terms of its close relation to the inferior oblique and the lower eyelid retractors.[10] The capsulopalpebral fascia of the inferior rectus muscle fuses with the sheath of the inferior oblique muscle to form Lockwood's suspensory ligament and the lower eye lid retractor. It has been suggested that it is these attachments which cause progressive underaction by holding the newly recessed inferior rectus in place as the eye makes horizontal movements, so preventing it from moving with the eye and delaying reattachment.[3] Kushner has suggested

Table 4 continued

Postop deviation				*Duration of follow up (months)*	*Further surgery*	*Deviation (after further surgery)*	*Postop comments*
Immediate	*1 week*	*3 months*	*Final*				
LHypoT3	LHypoT3 LET12	LXT4	LXT5	15			Patient pleased with cosmesis
LET4	LET6	LET6	LET12	9			LET seen at times
RHT8 RET14	RHT8 RET12	RHT8 RET14	—	3			Patient pleased with cosmesis
LHT4 LET14	LHT4 LET14	RHypoT14 RET12	—	3			Angle same as preop Patient notes better cosmesis

that continuous sideways traction on the inferior rectus by the inferior oblique may lead to muscle slippage by preventing postoperative adherence.[8]

It has been reported that the risk of overcorrection is greater in patients undergoing inferior rectus recession on an adjustable suture, as the muscle is less firmly attached to the globe in the initial postoperative period.[3 6–8] Some authors advocate using a fixed suture technique,[4] or non-absorbable sutures[8] when performing inferior rectus recession. In our series postoperative overcorrection occurred in two cases out of a total of 18 patients undergoing adjustable inferior rectus recession. This suggests that the risks of overcorrection are not outweighed by the advantages of an adjustable technique.

Overcorrection following inferior rectus recession is said to be greatest in patients with thyroid orbitopathy, with a 42% incidence found by Hudson and Feldon,[5] and a 50% incidence by Sprunger and Helveston.[3] There were two cases of thyroid orbitopathy in our group. Neither patient was overcorrected, although case 8 had been referred to us following a previous overcorrection. It is noteworthy that in this case the previously recessed inferior rectus was found, at the time of reoperation, to be in the expected position. Both cases showed a postoperative drift in the direction away from the preoperative alignment by between 5^{Δ} and 6^{Δ}, which emphasises the importance of undercorrection at the time of surgery in these patients. Overcorrection in patients with thyroid orbitopathy may be caused by increased tension in the ipsilateral superior rectus muscle, either as the result of thyroid infiltration, or because of attempts to elevate the eye in the presence of a tight inferior rectus preoperatively.[3] Hudson and Feldon found that the risk of overcorrection was higher in patients with proptosis, and suggested that this may be the cause of increased superior rectus tension.[5] A forced duction test in case 8 (with previous overcorrection) failed to reveal superior rectus restriction, but restriction of the inferior rectus of the other eye was found. This suggests that the initial thyroid infiltration of the inferior recti was bilateral, but asymmetrical. The less affected eye appeared normal on routine clinical examination preoperatively, but caused a reversal of the deviation postoperatively. Helveston suggests assessment of forced ductions on elevation in both eyes, in cases of apparently unilateral inferior rectus restriction,[3] and where resistance to passive elevation of the apparently normal eye is found, bilateral asymmetrical inferior rectus recessions may be considered.

In this series, undercorrection of the vertical deviation occurred more frequently than overcorrection. The undercorrection occurred as the result of a progressive postoperative drift following an initially good alignment in five of the eight cases. The patients with a stable postoperative alignment were compared with those who showed a postoperative drift resulting in an undercorrection. The numbers are too small for detailed analysis, but the factors

Table 5 Postoperative stability; comparison of patients showing postoperative drift in the direction of the preoperative alignment, with patients showing no postoperative drift

	Postoperative drift (in preop direction) (n=6)	*No postoperative drift (n=8)*
Diagnosis:		
Superior oblique underaction	4	5
Vertical deviation following retinal detachment surgery	1	2
Vertical deviation associated with infantile strabismus	1	1
BSV achieved immediately postoperatively	4	6
Inferior rectus recession:		
Mean (mm)	3.4	3.3
Adjustable	5	7
Surgical procedures:		
Inferior rectus recession alone	3	2
Inferior rectus recession plus contralateral inferior oblique weakening	1	4
Inferior rectus recession plus contralateral superior rectus recession	2	2

which might be supposed to influence postoperative stability—for example, binocular status and the use of adjustable sutures, were not obviously different for the two groups.

There are relatively few reports on the stability of the deviation following adjustable suture surgery for vertical deviations, Lee *et al* found a tendency for overcorrection,[11] while Weston *et al* found very little postoperative drift, but where it did occur there was a tendency for undercorrection.[12] Only two of the undercorrected patients in our group have come to further surgery; in one patient the recessed inferior rectus was found in the expected position, but in the other patient the muscle insertion was found at its original preoperative position. The cause of this apparent forward movement of the inferior rectus is not clear. The attachments between the inferior rectus and the lower eyelid retractors are generally linked with muscle slippage, leading to overcorrections; however, there does seem to be some logic in the suggestion that these attachments could tend to pull the newly recessed inferior rectus forwards, resulting in an undercorrection. It may be that some patients undergoing inferior rectus recession should be intentionally overcorrected to allow for postoperative drift in the direction of the preoperative deviation. However, two of the three cases in our series who were slightly overcorrected immediately postoperatively both went on to develop a progressive overcorrection. Our results do not suggest any factors which could be used preoperatively to predict patients likely to develop an undercorrection, and currently we aim for orthotropia in all patients with the exception of those with thyroid orbitopathy.

Inferior rectus recession, combined where indicated with additional vertical muscle surgery, is an effective treatment for vertical strabismus. In our series progressive overcorrection occurred in two cases, but this was not solely the result of inferior rectus underaction in either case, with both patients also showing unmasking of a bilateral superior oblique underaction. Patients with thyroid related orbitopathy should be intentionally undercorrected by 4^{Δ}–6^{Δ} immediately postoperatively to achieve a satisfactory long term alignment. In other cases, while reports of progressive overcorrection should not be forgotten, the possibility of undercorrection should be also be considered. In our series the most frequent cause of an unsatisfactory postoperative alignment was drift back towards the preoperative alignment following surgery. The optimal alignment at the time of postoperative adjustment, in all non-thyroid cases, appears to be orthotropia in the primary position while ensuring that inferior rectus underaction does not occur.

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