British Journal of Ophthalmology, 1986, **70**, 623–629

A study to assess the value of Dacron slings in the management of squints which are not amenable to conventional surgery

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SUMMARY Loops of non-absorbable sutures were used to extend the recession of the horizontal recti in 27 patients. All patients had horizontal squints and were considered unsuitable for conventional recession/resection procedures. The technique is described and the results are evaluated.

Certain patients present difficulties in the surgical management of their squint. These patients may be divided into four main categories. (1) Patients who have an unsatisfactory residual deviation, where both medial recti have been maximally recessed (5–6 mm) in convergent squint, or both lateral recti maximally recessed in divergent squint. (2) Patients with an unacceptable residual deviation, where the squinting eye has already had maximal conventional muscle surgery and it is considered unwise to operate on the fellow eye when this eye is the only eye with good vision. (3) Patients who have not had previous surgery but whose angle of squint is so large that it cannot be corrected by a conventional recession/resection procedure on the squinting eye and the fellow eye is the only eye with good vision. (4) Certain cases of paralytic squint where a very large angle of correction is required.

These were the criteria for the type of surgery performed on the 27 patients included in this series.

There is a limit to the position the horizontal recti can be recessed beyond which the action of the muscle is jeopardised, resulting in unwanted significant restriction of ocular movement. Marginal myotomy, though rarely used as a primary procedure, is often the operation chosen to weaken the appropriate muscle. Marginal myotomy has, however, been described by Von Noorden as a crippling procedure, reducing the number of contractile fibres, and, should overcorrection occur, he states that it is a 'nearly insurmountable surgical complication'.[1] Furthermore the operation is difficult to quantify.[2]

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A number of alternative approaches have been described. Nolan[3] has suggested a muscle lengthening operation, a modification of that described by Gonin in 1911.[4] Mittleman and Folk[5] suggested recessing the muscle beyond the conventional 5–6 mm to a point 13·5 mm from the limbus. Chavasse[6] used electrocoagulation across the muscle width to render the anterior portion non-contractile and so weaken its action, and Morales *et al.*[7] lengthened muscles with a silicone implant. In the event of a persistent convergence excess esotropia Von Noorden performed a Faden operation (posterior fixation suture) with good results.[2]

Gobin[8] described the use of Dacron slings to obtain large recessions. We have adopted this technique and found it to be safe and effective; it has many advantages over the aforementioned procedures.

Patients and methods

Twenty-seven patients who had undergone a recession of one or more of their horizontal recti with 3–4 mm loops of non-absorbable suture were assessed. There were 17 males and 10 females. Their age at the time of surgery ranged from 2 to 60 years, mean 19 years. Seventeen patients had surgery for concomitant esotropia, seven for concomitant exotropia, and three for paralytic squint. Twelve of the 24 patients with non-paralytic squint had already had maximal surgery (rectus recessions of more than 5 mm) on both eyes; nine of the 24 had already had maximal surgery on their squinting eye and the fellow eye was their only good seeing eye; three had not had previous surgery but had large deviations and only

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one eye with good vision (the deviation was so great that it could not be corrected by conventional recession/resection surgery to the one eye). The majority of the cases (67%) each having had previous squint surgery with poor cosmetic results, were referred from other units to one of the surgeons (RT).

All patients had orthoptic assessments before and after surgery. Table 1 summarises the findings and surgical procedures. Patients who had previously been discharged were recalled for up-to-date assessment, and where possible the degree of limitation of movement was assessed by the maximal excursion of the eye as measured on the synoptophore, as in the method described by Urist[9] except quantified more accurately.

The operation was performed by a standard limbal approach and the muscle identified. 5/0 Dacron sutures were used to secure the muscle and it was then divided from its insertion. The suture needle was passed through the sclera the requisite number of millimetres from the previous insertion, and from this point the muscle was allowed to slip backwards 3 mm and the suture tied. Thus the muscle could retract backwards from the new insertion on a 'Dacron sling' (Fig. 1) in a manner similar to that described by Gobin.[10]

In 23 of the cases the recession was combined with a resection of the ipsilateral antagonist (except case 21, where a bilateral lateral rectus recession was employed with a Dacron sling to recess the right lateral rectus). In the remaining four cases (1, 4, 15, and 23) only a recession with a Dacron sling was performed.

Results

Most of the patients achieved an excellent cosmetic result. The mean change in angle was 38 prism dioptres (PD) for near and 33 PD for distance, ranging from 4 PD to 105 PD. Three cases (25, 26, 27) had paralytic squints, but the Dacron sling procedure was only part of the surgical management planned. If these three cases are excluded, the mean change in angle was 37 PD for near and 33 PD for distance. Case 19 was initially improved, but at the last assessment the angle of squint had returned to around the preoperative value. Further surgery was offered but declined. Case 6 had an original sling procedure that corrected 35 PD for near and 53 PD for distance, but the results of the secondary sling were much less, correcting 10 PD and 4 PD for near and distance respectively.

Follow-up ranged from 1 month to 7 years, with a mean of 1 year 10 months.

Muscle function tests showed some weakness of

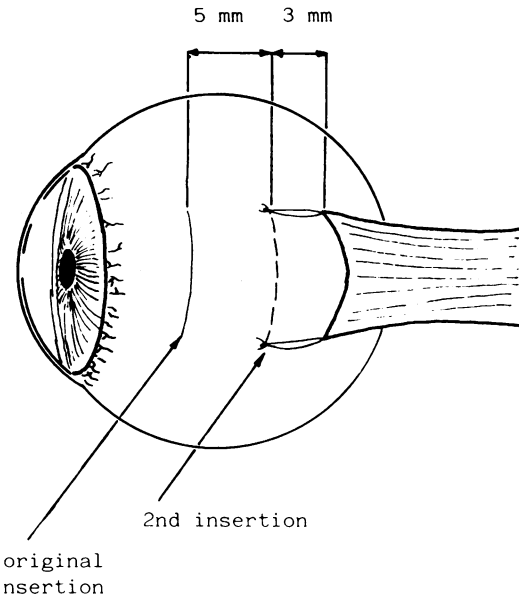

Fig. 1 *Recession with Dacron slings on which the muscle retracts backwards 3 mm.*

action in most of the cases, though this did not affect the cosmetic appearance. Medial rectus action in esotropias had a postoperative range of 25° to 40° with a mean of 33° and lateral rectus function in exotropias a range of 30° to 40° with a mean of 36° (Table 2).

Discussion

The definition of a good cosmetic result is somewhat arbitrary. Marshall Parks[11] aims for a postoperative angle of 15 PD of esotropia or less in cosmetic convergent squint surgery. All but one of the esotropias in this study were less than 15 PD postoperatively and would thus qualify as a success. Exotropias are often more noticeable, and a smaller residual angle should be sought. It is obvious from Fig. 2 that the majority of divergent squints had a less than favourable result, though most were cosmetically satisfactory.

The Dacron sling technique compares very favourably with the procedures used by other workers (Table 3). Mittleman and Folk[5] in recessing the medial rectus to 13·5 mm from the limbus reduced the angle to less than 15 PD in 18 out of 19 (95%) cases. However, all the patients had esotropias and only one a preoperative angle greater than 40 PD. Of the 18 esotropias in this series 17 (94%) were less than 15 PD postoperatively (the failure being in a sixth nerve palsy), and 10 had a preoperative angle greater than 45 PD.

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Table 1 *Surgical details, length of follow-up, and prism cover test results*

Case no.	*Age at surgery (years)*	*Previous surgery*	*Operation*	*Preoperative deviation (prism dioptres)*	*Postoperative deviation (prism dioptres)*	*Follow-up*	*Comments*
*1	12	1 RMR recess. 6 mm, RLR resect. unknown 2 LMR recess. 6 mm, LLR resect. unknown 3 RMR recess. 3 mm on Dacron sling+CR	LMR recess. 3 mm on sling	N 40 ET D 16 ET	N 4 ET D 2 XT	2 months	
*2	21	RMR recess. 3·5 mm, RLR resect. 5 mm	RMR recess. 1 mm+3 mm sling RLR resect. 6 mm	N 45 ET D 50 ET	N 12 ET D 4 ET	4 months	
*3	37	1 RMR recess. 5 mm 2 RLR resect. 10 mm 3 RLR recess. 8 mm	RMR recess. 3 mm on sling RLR advanced 4 mm	N 35 ET D 25 ET	N 10 ET D 4 ET	13 months	
*4	26	Bimedial rectus recess. 4 mm	RMR recess. 2 mm+3 mm sling	N 60 ET D 60 ET	N 14 ET D 14 ET	6 years 4 months	
*5	11	1 Bimedial rectus recess. 5 mm 2 RLR resect. 7 mm 3 LMR myotomy, LLR resect. 8 mm 4 RLR resect. 3 mm	RMR advanced 1 mm+3 mm recess. on sling	N 30 ET D 30 ET	N 18 XT D 14 XT	7 years	
*6	7	1 Bimedial rectus recess. 6 mm 2 LMR recess. 3 mm on sling	LMR recess. 3mm on new sling LLR resect. 5 mm	N 20 ET D 12 ET	N 10 ET D 8 ET	4 years	Sling found surrounded by new tendon
7	8	1 LMR recess. 4 mm, LLR resect. 3 mm 2 RMR recess. 5 mm, RLR resect. 4 mm 3 LMR recess. 3 mm, LLR resect. 5 mm	RMR recess. 3 mm on sling RLR resect. 4 mm	N 53 ET D 45 ET	N 2 ET D 10 XT	3 years	
*8	18	RMR recess. 4 mm, RLR resect. 4 mm	RMR recess. 3 mm on sling RLR resect. 5 mm	N 35 ET D 25 ET	N 8 ET D 8 ET	2 years	Right visual acuity perception of light
*9	4	LMR recess. 5 mm	LMR recess. 3 mm on sling	N 25 ET D —	N 8 XT D —	2 years	Left congenital cataract. Distance result missing
*10	31	1 RMR recess. 9 mm 2 LMR recess. 5 mm, LLR resect. 6 mm 3 RLR resect. unknown	RMR advanced 3 mm+3 mm recess. on sling+CR, RLR resect. 7 mm	N 53 ET D 51 ET	N 16 ET D 6 ET	5 months	
*11	20	LMR recess. 5 mm, LLR resect. 5 mm	LMR recess. 3 mm on sling LLR resect. 4 mm	N 45 ET D 45 ET	N 4 XT D 6 XT	15 months	Left visual acuity perception of light
*12	6	1 LMR recess. 5 mm, LLR resect. 9 mm 2 RMR recess. 5 mm, LLR resect. 9 mm	LMR recess. 3 mm on sling LLR resect. 4 mm LIO+RIO myectomies	N 35 ET D 45 ET	N 14 ET D 14 ET	6 months	
*13	39	Bimedial rectus recess. 6 mm	LMR recess. 3·5 mm on sling LLR resect. 7 mm	N 50 ET D 57 ET	N 4 ET D 10 ET	5 months	
*14	23	Bimedial rectus recess. 5 mm	LMR recess. 3 mm on sling LLR resect. 4 mm	N 35 ET D 25 ET	N 6 ET D 6 ET	2 months	Left visual acuity counting fingers

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Case no.	*Age at surgery (years)*	*Previous surgery*	*Operation*	*Preoperative deviation (prism dioptres)*	*Postoperative deviation (prism dioptres)*	*Follow-up*	*Comments*
*15	9	1 RMR recess. 5 mm, RLR resect. 8 mm 2 LMR recess. 5 mm, LLR resect. 7 mm 3 RIO myectomy	RMR recess. 3 mm on sling LMR recess. 3 mm on sling	D 35 ET D 20 ET	N 6 XT D 4 XT	2 years	
16	2	None	RMR recess. 5 mm+3 mm sling RLR resect. 8 mm, RIO myectomy	N 90 ET D —	N 15 XT D—	1 month	Congenital iridocorneal dysgenesis. Too young for distance measurements
17	29	None	LMR recess. 5 mm+3 mm on sling +CR, LLR resect. 9 mm	N 90 ET D 90 ET	N zero D zero	2 months	
18	11	None	LLR recess. 6 mm+3 mm on sling LMR resect. 5 mm	N 70 XT D —	N 12 XT D —	8 months	Left visual acuity PL. Distance result missing
19	33	RMR resect. 6 mm, RLR recess. 8 mm	RLR recess. 3·5 mm on sling RMR resect. 5 mm	N 30 XT D 30 XT	N 40 XT D 35 XT	7 years	Initial improvement. Refused further surgery
*20	28	LMR resect. 5 mm, LLR recess. 6 mm	LLR recess. 3 mm on sling LMR resect. 5 mm	N 65 XT D 50 XT	N 30 XT D 30 XT	1 year	
21	7	1 RMR recess. 5 mm, RLR resect. 5 mm 2 Exploration RLR. Fibrosis to IO. RLR recess. 4 mm 3 RLR fibrosis to IO recess. 4 mm RMR advanced 5 mm	RLR recess. 4 mm on sling LLR recess. 5 mm	N 8 XT D 14 XT	N 4 ET D 6 ET	3 years	Preoperative restriction of right adduction, hence fourth operation
*22	20	LLR recess. 9 mm, LMR resect. 7 mm	LLR recess. 4 mm on sling+CR LMR resect. 5 mm	N 60 XT D 85 XT	N 20 XT D 45 XT	2 months	Left traumatic cataract and densely amblyopic
*23	10	1 Bimedial rectus recess. 2 LMR advanced 3 LMR resect. 2 mm+advanced to 5·5 mm from limbus 4 LLR recess. unknown	LLR found 13 mm from limbus Recess. 3 mm on sling	N 70 XT D 70 XT	N 55 XT D 55 XT	2 months	Further surgery. Left MR resect. 7 mm. LLR explored, sling in situ. Conjunctival recess. Postop. N 6 ET D 4 XT
*24	28	LLR recess. 6 mm, LMR resect. unknown	LLR recess. 3 mm on sling+CR LMR resect. 5 mm	N 45 XT D 35 XT	N 40 XT D 30 XT	6 months	Looks cosmetically better than results suggest
25	24	None	RMR recess. 5 mm+3 mm on sling RLR resect. 10 mm	N 90 ET D 100 ET	N 35 ET D 40 ET	6 months	R VI palsy. Six months later LMR recess. 5 mm+Faden procedure+LLR resect. 7 mm. Postop: N 20 ET D 30 ET
26	7	None	RLR recess. 5 mm+3 mm on sling +CR, RMR resect 6 mm	N 70 XT D 65 XT	N 63 XT D 57 XT	5 years	Congenital III N palsy. Initially good result. Further surgery refused
27	60	None	RMR recess. 5 mm+3 mm sling RLR resect. 10 mm	N 60 ET D 70 ET	N 14 XT N 10 XT	1 month	Bilateral VI N palsy. Diabetic.

Cases. 1–17 esotropias, 18–24 exotropias, 25–27 paralytics.
*Referred from another consultant. Recess.=recession. Resect.=resection. R=right. L=left. N=near. D=distance. MR=medial rectus. LR=lateral rectus. IO=inferior oblique. ET=esotropia. XT=exotropia. PL=perception of light. CR=conjunctival recession.

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Table 2 *Degree of postoperative eye movement as measured on synoptophore relating to the muscle having had the sling procedure*

Case no.	*Degree of movement (°)*	*Case no.*	*Degree of movement (°)*
1	L add 29	15	–
2	–	16	–
3	R add 40+	17	–
4	R add 36	18	L abd 36
5	R add 38	19	R abd 32
6	L add 28	20	–
7	R add 32	21	R abd 40+
8	R add 30	22	–
9	–	23	L abd 35
10	R add 38	24	L abd 40
11	–	25	–
12	–	26	R abd 30
13	L add 29	27	–
14	L add 25		

add=Adduction. abd=Abduction.

The postoperative angle is not the sole criterion of successful surgery, as restriction of eye movement may be cosmetically unacceptable. Recessing the muscle to the anatomic equator produces some limitation of movement, and marginal myotomy is said to be superior because it maintains the muscles arc of contact with the eye. Despite these claims, Mittleman and Folk[5] say that 'whatever procedure is performed in a situation where maximal surgery has been carried out, limitation of movement will occur'. When either procedure is combined with a resection, the amount of limitation of movement is increased. Gobin claims that a Dacron sling maintains the muscle's arc of contact with the globe[9] and found that the gap between tendon and insertion became bridged by fibrous tissue by which the tendon became attached to its new insertion. Logically the cut end of the muscle would be expected to become attached posteriorly to the sclera (as is believed to occur in adjustable sutures) and negate the effect of the sling, but in two cases (6 and 23) in which the previous Dacron sling was explored no apparent adhesions were found behind the anterior insertion of the suture. The sling was found to be surrounded by a new tendon of connective tissue, supporting Gobin's experience. To account for these findings we can only suggest that, when the eye is moved into the field of action of the muscle, the cut end is held away from the globe by virtue of its position behind the equator and possibly prevented from adhering to the globe

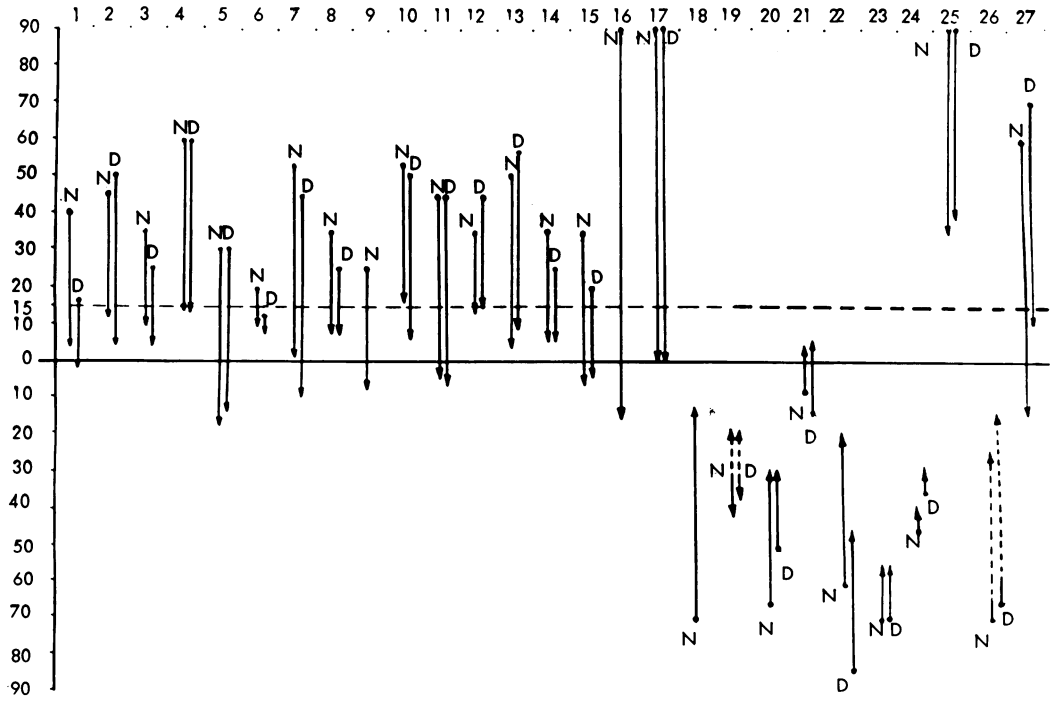

Fig. 2 *Plot of patient versus change in squint angle in prism dioptres (preoperative angle: solid circle, postoperative angle: arrow head; N=near; D=distance; dotted line=initial result).*

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Table 3 *A comparison of the various techniques used following previous squint surgery*

Author	*Procedure*	*No. of patients*	*No. of patients with postoperative angle less than 15 prism dioptres*	*Follow-up (average)*
Mittleman *et al.*[5]	Recession to 13·5 mm	19*	18	2 years 3 months
Helveston and Cofield[12]	Marginal myotomy	6†	4	9 months
Nolan[3]	Muscle lengthening	7*	3	10 months
Zak and Morin[14]	Marginal myotomy	5*	1§	7 years
Clark *et al.* (this series)	Dacron sling	21‡	15	1 year 11 months

*All esodeviations.
†Two eso and 4 exodeviations.
‡Fifteen eso and 6 exodeviations (six excluded as no previous surgery).
§Criteria of success less than 10 prism dioptres, as cases were infants.

(Fig. 3). It would be unwise of us to be dogmatic on this issue in view of the limited number of re-explorations (two cases), but whether or not the cut end of the muscle does become reattached posteriorly the postoperative muscle action remained acceptable.

The maximal rotation of the globe is about 50° for both the medial and lateral rectus,[13] and after recession/resection surgery it is usually reduced to 25–30°[5]. In none of the patients in our series was the measurement less than 25°. In 11 cases where the assessment of muscle action on the synoptophore was not possible there was no gross restriction of eye movement. This compares well with Mittleman and Folk's[5] series. Of the six cases reported by Helveston and Cofield[12] two had gross restriction of eye movement (less than 11°), two had 'slight restriction' (no measurement given), and no comment was made on the remaining two. In the series by Nolan[3] information is lacking on this aspect.

It is difficult to quantify the amount the sling procedure contributed to the change of angle following surgery in 21 out of the 27 patients (excluding the paralytics), as all these patients had had previous surgery, and part of the corrective procedure always involved removal of any fibrous tissue and in some cases conjunctival recession. However, in three cases no previous surgery had been undertaken, and in these cases of virginal squints (16, 17, 18) the average correction for distance and near vision for the convergent squints was 90 PD and that for the exotropia (case 18) was 70 PD. The surgeon (RBT) normally expects a maximal recession/resection procedure to achieve 50 PD for near and distance vision for a convergent deviation, and therefore we can assume that the sling contributed to a further 40 PD of correction. Equally for the exotropia this would be expected to correct 45 PD without the sling, and therefore the sling contributed in the region of 25 PD. A muscle lengthening procedure can correct 25–35 PD[3] and recessing to the anatomic equator corrects 20 PD[5] (more if combined with a resection). Thus the sling procedure compares well with these operations.

The operation is safe, as the suturing to the sclera is close to the equator with good visibility, while recession behind the equator, particularly after previous squint surgery, may be extremely difficult. No complications were encountered in any of our cases. It has advantages over other techniques, such as muscle lengthening, because of its simplicity, and it does not restrict the eye movement as much as a myotomy or a recession to the equator, especially

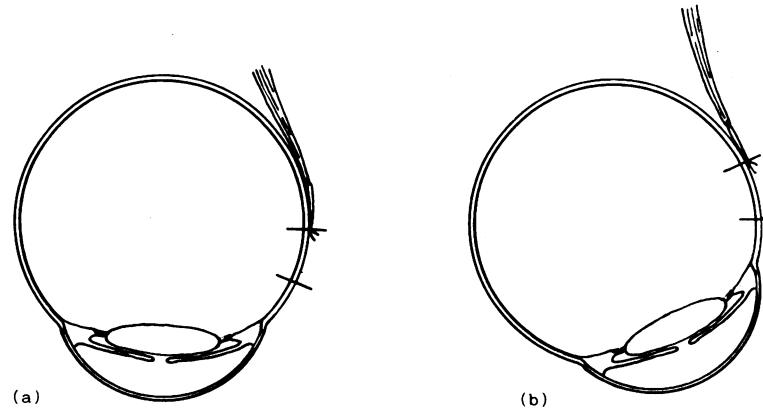

Fig. 3(a) *The eye in the primary position.* (b) *The eye position when the muscle contracts. The cut muscle end is remote from the globe.*

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when the latter is combined with a resection. The procedure is also reversible, or secondary loops can be added should any further recession be necessary. However, in our one case (case 6) the effect of the secondary loop was considerably less than the angular correction produced by a primary sling procedure.

CONCLUSION

Twenty-seven patients are reported who had surgery by means of loops to extend the recession of horizontal recti in cases thought unlikely to respond to conventional squint surgery. It is thought that this procedure should be considered for (1) residual squints that have had maximal surgery to both eyes; (2) residual squints that have had maximal surgery on one eye and it is unreasonable to operate on the fellow eye; (3) where an ordinary recession is impossible owing to previous retinal surgery or thin sclera.

We are indebted to Miss Elizabeth A Wreyford for secretarial help, and Mr C Mody for photographic assistance.

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Accepted for publication 6 December 1985.

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