

PERIPHERAL IRIDECTOMY IN CLOSED-ANGLE GLAUCOMA*

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PERIPHERAL iridectomy has become an accepted method of treating closed-angle glaucoma. During the last 4 years we have performed this operation on more than seventy eyes and the results have convinced us that this is one of the safest and most successful of all operations for glaucoma provided that the cases are properly selected. It is the ideal operation for early cases of closed-angle glaucoma where the aqueous outflow has not become obstructed by goniosynechiae, but a detailed analysis of the first 39 cases shows a considerable number of successes in those in which the disease was more advanced, which indicates that this operation should not necessarily be confined to early cases but may sometimes have a place in the treatment of acute and "chronic" "congestive" glaucoma. We have also performed this operation as a prophylactic procedure on eyes with no positive evidence of glaucoma for reasons to be discussed later.

To understand how a peripheral iridectomy can control a closed-angle glaucoma (and thus appreciate the indications for the operation) we must have a clear picture of the sequence of events which causes the rise in ocular tension. This has been very clearly described by Barkan (1938, 1939, 1954), Chandler (1952), and other workers, and has been called the Curran Chandler mechanism.

The essential feature is an abnormal relationship between the iris diaphragm and the lens. Priestley Smith (1891) first drew attention to the now well-recognized fact that, in eyes with congestive glaucoma, the anterior chamber is shallow. The cause of this shallow anterior chamber may be congenital or developmental, associated with hypermetropia or due to an increase in the size of the lens, but whatever the reason the effect is that because the lens is further forward its contact with the iris diaphragm is more rigid so that these two structures can act as a valve hindering the easy flow of aqueous from the posterior to the anterior chamber, and thus causing an increase in pressure in the former.

This increase in pressure causes the periphery of the iris to bulge forward (physiological iris *bombé*), especially when the pupil is semi-dilated and the

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diaphragm consequently lax, so that it may come into contact with the corneo-scleral trabecula and obstruct the aqueous outflow, causing an attack of "congestive" glaucoma. The mechanism is well illustrated by a case described by Miller (1956). A peripheral iridectomy was performed for closed-angle glaucoma, but at the first dressing the eye was found to be in tension. This proved to be due to the fact that the posterior layer of the iris had been left intact, and it was seen herniating through the gap, indicating the increased pressure in the posterior chamber. When the layer was divided the condition was relieved.

It is not suggested that this is the whole story, but merely the anatomical sequence of events which leads to the increase in pressure. Abnormal hypothalamic activity, ciliary congestion, and other neurovascular events must be envisaged to explain the intermittent nature of the disease and its relation to emotional factors.

Any procedure which would prevent the increase of pressure in the posterior chamber would flatten the iris *bombé*, open the angle and prevent the rise in tension.

Curran (1920) suggested the use of a peripheral iridectomy in these cases. Later, Chandler (1952) showed that after a peripheral iridectomy had been performed the angle became wider, and he suggested this procedure as a cure for congestive glaucoma. Since then, an increasing number of surgeons have been performing peripheral iridectomies as a preventive measure in early cases of closed-angle glaucoma before the development of organic changes in the angle. Duke-Elder (1955) considers that, although the basic cause of the disease in some cases is probably neurovascular, the very real possibility of an acute attack is eliminated by peripheral iridectomy. Unfortunately this relatively simple procedure is only successful in cases in which there are no gross organic changes in the angle, and if a large part of the angle is occluded by peripheral anterior synechiae a filtration operation will be necessary to control the tension.

If the iris is in contact with the cornea for any length of time it is liable to become adherent to it, and if, in addition, there is inflammatory reaction or congestion the development of synechiae will be more likely.

An eye may respond to the rise in tension caused by angle block in various ways, but probably the commonest is that the increased pressure causes venous congestion with subsequent liberation of histamine and strangulation so that a typical picture of a congestive attack of an acute glaucoma develops. This frequently occurs without any previous warning symptoms.

Alternatively, the obstruction may become freed spontaneously and the tension may return to normal, but usually further attacks will occur often increasing in severity and frequency until either the patient has an acute attack or the irido-corneal contact becomes permanent in some part or parts of the angle, so that a state of chronic closed-angle glaucoma is reached with permanently raised tension, obstructed outflow, and disc and field changes.

Such an eye may develop an acute attack at any time. At any stage of the disease peripheral anterior synechiae are liable to be formed.

Selection of Cases

The difficulty in selecting the right cases for peripheral iridectomy is due to our inability to estimate with any certainty the condition of the angle, but certain investigations are helpful.

(1) **Gonioscopy.**—Usually these cases have such narrow angles that, even when the eye is examined in extreme miosis, it is impossible to see beyond the last fold of the iris and even when the iris can be seen to be in contact with the trabeculae it is impossible to determine whether it is merely in contact or adherent. If, however, the angle is open although narrow, a peripheral iridectomy will almost certainly be successful.

(2) **History.**—The longer the irido-corneal contact is maintained the more likely are adhesions to develop, so that the duration and frequency of symptoms in the chronic case or the duration of the acute attack may give some indication, but McDonald (1956) suggests that, at least as far as the acute attack is concerned, the duration of the attack is not related to the formation of peripheral anterior synechiae.

(3) **Visual Field Changes.**—The presence of optic disc and visual field changes is considered to be an indication that there is permanent damage to the angle.

(4) **Ocular Tension.**—If this is raised or is even in the upper limits of normal between attacks there must be some permanent obstruction to aqueous outflow. On the other hand a normal tonography reading between attacks, especially if the test is performed when the patient is not having miotics, indicates that the angle is open.

These tests may show the condition of the angle, but one other fact must be taken into consideration before deciding whether a peripheral iridectomy is indicated in any particular case.

Foulds and Phillips (1956) published a series of cases of advanced chronic closed-angle glaucoma apparently cured by peripheral iridectomy, which indicates that such cases may be caused by irido-corneal contact alone without organic adhesions. Some of our own cases seem to confirm this observation.

If we accept that any case of closed-angle glaucoma can be caused by irido-corneal contact alone, the theoretical scope of the operation becomes much wider, as any case of closed-angle glaucoma may be cured by a peripheral iridectomy if the operation is technically practical.

We feel that, instead of being restricted to cases in which at least the greater part of the angle is open and the ocular tension normal, cases, that is, in which the hope of success is very high, this operation should be extended to all cases of closed-angle glaucoma in which there is no definite indication that a large portion of the filtration angle is obstructed by synechiae. This would

mean that a greater number of cases could be relieved by a relatively safe operation, and in the rest the danger of an acute attack would be eliminated; should post-operative follow-up show that the ocular tension is still uncontrolled a filtration operation could still be performed. In these doubtful cases it is a good policy to perform the operation well to the side of the midline to leave an area of undisturbed conjunctiva should a second operation prove to be necessary.

To-day chronic simple glaucoma is often diagnosed by provocative tests and tension readings before the appearance of disc or field changes (especially in the second eye). In these cases we delay surgery as long as the disc and field remain normal, even if medical treatment does not completely control the tension. Therefore in a case of chronic closed-angle glaucoma, when it is obvious that some form of surgery will be necessary, we feel that it is illogical to perform a filtration operation when a peripheral iridectomy will certainly remove the danger of an acute attack and may cure the condition entirely.

We are now in a position to discuss the place of a peripheral iridectomy in all stages of closed-angle glaucoma based on the above survey of the essential features of the disease.

I. Acute Glaucoma.—Peripheral iridectomy will relieve an attack of acute glaucoma just as successfully as a complete iridectomy with the advantage that it is less likely to cause loss of the anterior chamber and the consequent development of peripheral anterior synechiae and lens changes.

It is extremely difficult to perform this operation if the tension is high, as in such cases the whole iris prolapses, and for this reason it is only suitable for those in which the attack has been controlled by medical treatment. Furthermore, we do not recommend this operation if the eye remains very congested, as such an eye frequently develops post-operative iritis and we feel that the larger gap produced by a broad iridectomy is less likely to become occluded by exudate.

In all other cases the operation is as satisfactory as a complete iridectomy in controlling the acute phase. In either operation the final result will depend on the presence of peripheral anterior synechiae—which means that in either case there must be post-operative follow-up for signs of obstructed out-flow.

II. Advanced Chronic Closed-Angle Glaucoma.—These are the cases with permanently raised tension, cupped discs, and field loss, with an angle which appears partially or completely closed. The reason for performing the operation is based on our former evidence suggesting that this condition may be due to iris contact alone; if so, the operation will be successful, but the chance of success is not certain and one must therefore be prepared to perform a filtration operation at a later stage if necessary.

III. Early Closed-Angle Glaucoma.—These are the typical cases of intermittent attacks of haloes and blurred vision with normal tension between the attacks,

or with demonstrable raised tension on occasions only, usually with a positive darkroom test. There is a good chance of a complete cure in this type of case.

IV. Pre-glaucomatous Eyes.—The eyes which we consider to be pre-glaucomatous are those whose fellow eye has had acute or chronic closed-angle glaucoma, but which have shown no evidence of increased tension themselves although they have narrow angles and show a rise of more than 9 mm. Hg in the dark or with a mydriatic test. It may be considered that the operation is rather more of a prophylactic procedure than a curative measure but, taking the view that a positive provocative test means that the diagnosis has been established, we reserve the term prophylactic operation for cases showing no demonstrable evidence of the disease. As we shall see we have found this latter group to be very much smaller than we had suspected. It seems that, when gonioscopy and provocative tests are used, it is exceptional to find no positive signs of glaucoma in the second eye. The success of peripheral iridectomy in this pre-glaucomatous group should be a near certainty.

V. Prophylaxis.—Peripheral iridectomy is performed as a prophylactic procedure on eyes showing no evidence of glaucoma, but whose fellow eye is known to have the disease.

Primary glaucoma has always been recognized as a disease which affects both eyes. Bain (1957), in a survey of 200 cases of acute glaucoma, found that 53 per cent. of the second eyes with and without medical treatment produced some evidence of closed-angle glaucoma, either an acute attack (28 per cent.) or symptoms of chronic congestive glaucoma (20 per cent.). This emphasizes that, after one eye has suffered an attack of acute glaucoma, the fellow eye must be considered to be in great danger even if symptom-free. Miotic therapy is no safeguard as, although cases treated on a miotic showed a fewer number with symptoms, the percentage of acute attacks was the same as in the untreated cases. Miotics in fact may lead to a sense of false security, suppressing symptoms by their effect on the episcleral venous pressure, but still permitting the formation of synechiae and the insidious onset of chronic closed-angle glaucoma. If the second eye produces symptoms the problem is easy; the case is one of early closed-angle glaucoma and should be dealt with accordingly. But there are also cases without symptoms, which are negative to provocative tests, but which nevertheless have an even chance of developing an acute attack whether treated with miotics or not. Even keeping them under permanent observation in glaucoma clinics is of little help, as one can never foretell when an attack will develop. Obviously, factors such as age, the resultant vision in the eye that suffered the acute attack, and the place of residence and occupation of the patient, must be taken into consideration, but there is undoubtedly a good case for performing a peripheral iridectomy on the second eye whether or not it shows any positive evidence of glaucoma, provided the angle is narrow.

It must be realized, however, that the cases in Bain's series had not all been subjected to provocative tests, so that these results may be a little misleading; they do not necessarily indicate that second eyes with negative provocative tests will eventually develop closed-angle glaucoma.

Because of this we are not at present operating on all second eyes even if the factors mentioned above do not contraindicate it, but we are trying to select the cases we feel to be unsafe in spite of negative provocative tests.

Our policy is to examine all these eyes with the gonioscope before and after mydriasis and, if under these conditions a large part of the angle however narrow is seen to be open, the patient is merely kept under periodic observation as an out-patient with no prophylactic miotic therapy. When we find that under either of these conditions the angle is so narrow that we are unable to see beyond the anterior trabeculae, a prophylactic operation is performed. If we find that some of these untreated eyes do develop acute glaucoma in the course of time, this policy will have to be reconsidered.

Present Series of Cases

Acting on our belief in the principles outlined above, we have performed a peripheral iridectomy on over seventy eyes during the last 4 years and the immediate post-operative results have convinced us that this is a satisfactory and safe operation. In some cases sufficient time has not elapsed to assess the efficiency of the operation in controlling the disease, or the likelihood of long-term post-operative complications, but a detailed analysis of the first 39 (performed at least 2 years ago) shows very satisfactory results.

Operative Technique.—It is essential to make every effort to avoid loss of the anterior chamber during the operation, so a small *ab externo* incision is made (Wolff, 1949), 1.5 mm. behind the limbus and only about 3 mm. long. We prevent the globe rotating with a scleral hook inserted 5 mm. from the limbus, and use a No. 11 Bard-Parker blade. The depth of the incision should be vertical through the sclera as an oblique cut may prevent the iris from prolapsing.

As soon as the anterior chamber is entered the posterior lip of the wound is depressed and the iris prolapses. The iridectomy should not be too small as a very small basal opening may be drawn up into the wound and obliterated.

The limbus is massaged with an iris repositor until the pupil is once again round; it is rarely necessary to insert the instrument into the wound to replace the pillars of the iridectomy. In the early cases we closed the wound with a pre-placed suture, but this seems to be unnecessary. The conjunctival flap is sutured, and a drop of 1 per cent atropine instilled.

Possible Complications

(1) In two cases there was blood in the anterior chamber at the end of the operation, but in both it had disappeared by the time of the first dressing. We have had no incidence of post-operative hyphaema to date.

(2) If the iris fails to prolapse when the posterior lip of the wound is depressed, forceps will have to be introduced into the anterior chamber to deliver the iris root. This happened on four occasions and we found that it can be done quite easily by using curved iris forceps with the concave side towards the globe.

(3) Sometimes the ocular tension is raised at the time of operation (this is particularly liable to occur if cocaine drops are used before the patient comes to the theatre). Increased tension is liable to lead to excessive prolapse of the iris so that a complete iridectomy has to be performed.

(4) Loss of the anterior chamber should not normally occur, but may do so if forceps have to be introduced into the wound, although even then it is usually only partial.

Results of Peripheral Iridectomy in the First 39 Cases (Table)

(A) CURATIVE OPERATIONS (32 cases)

(i) *Acute Glaucoma*.—Of the five cases, one had a complete iridectomy because there was a large iris prolapse, and one has a filtering scar. In all five patients the post-operative ocular tension was normal and the angle open. They all have a negative darkroom test and the disease has remained controlled.

(ii) *Advanced Chronic Cases*.—There were only two of these in the first series. In one the angle has become open except for a very small area where there are peripheral anterior synechiae, the ocular tension has become normal, and the disease has not progressed; the raised tension in this case thus appears to have been due to irido-corneal contact alone. The second case was a failure on account of faulty diagnosis. This was a case with raised tension, and with angles that were narrow but open; it was in fact a case of chronic simple glaucoma with narrow angle. A fistulization has now controlled the tension.

(iii) *Early Closed-Angle Glaucoma*.—There were 22 cases sub-divided as follows:

(a) Those with permanently increased ocular tension and congestive symptoms, but normal optic discs and visual fields, and therefore presumably some degree of permanent angle block. There were twelve such cases, and in one a filtration operation was later required to control tension. The remaining eleven are symptom-free with normal tension. The angles have opened up and in nine the darkroom test is now negative.

(b) Those with congestive symptoms but normal ocular tension between attacks. There were ten such cases and all are now symptom-free. The angles are at least 70 per cent. open in all cases. In the five cases in which it has been performed the darkroom test is negative.

In all 22 cases the visual acuity was unchanged post-operatively and there has been no subsequent deterioration.

(iv) *Pre-glaucoma*.—All three cases now have negative provocative tests and open angles and the visual acuity has not been affected by the operation.

(B) PROPHYLACTIC OPERATIONS (7 cases)

All seven cases show wider angles, negative darkroom tests, and no alteration in visual acuity. These eyes are functionally just as efficient as before the operation but the danger of acute glaucoma has been eliminated. It is worth recording that since adopting the policy outlined above we have seen no attacks in fellow eyes.

TABLE
RESULTS IN 39 CASES OF PERIPHERAL IRIDECTOMY

Operative Group	Features of Each Group	No. of Eyes in which Peripheral Iridectomy was Performed	No. of Eyes Considered Satisfactory	Failures
Acute Glaucoma	All settled by acute medical treatment	5	5	0
Chronic Closed-angle Glaucoma	All showed cupped disc with visual field changes	2	1	1
Early Congestive Glaucoma	All had symptoms of halo or blurring or both 50 per cent. showed raised ocular tension and the results of provocative tests were positive in the remainder	22	20	2
Pre-glaucoma	None showed raised tension None had symptoms Provocative tests gave positive results	3	3	0
Prophylaxis	All fellow eyes No evidence of glaucoma	7	7	0

Discussion

The success of any glaucoma operation may be assessed by the following criteria:

- (1) That the disease is controlled.

This means that the tension is reduced to the normal limits, the facility of aqueous outflow is normal or increased, there is no further field loss, the patient is symptom-free, and provocative tests are normal.

- (2) That the structural damage to the globe has been minimal, especially with reference to:

- (a) The development of further obstruction to aqueous outflow in the form of peripheral anterior synechiae.
- (b) Damage to the lens.

- (3) That there has been no deterioration in visual acuity.

Complete success by these standards is often too much to expect from filtration operations and one may be content to control the tension even

though this may lead to further damage to the angle, as often happens after a trephine, or to the development of post-operative lens changes. However, this is not enough when operating on early cases of closed-angle glaucoma as the risk of causing damage to the eyes must be very slight if surgery is to be justified. In our series, peripheral iridectomy has controlled the disease in all but three cases and, as far as we can tell has caused no further damage to any of them, so that we can claim with justification that this is a reasonably safe and worthwhile procedure.

Summary

The mechanism of closed-angle glaucoma and the principles of peripheral iridectomy are described.

The application of this operation to the treatment of the different stages of closed-angle glaucoma is discussed.

The principal points of operative technique are described.

The results of the first 39 cases are analysed. It is concluded that the operation is safe, and that it is a worthwhile procedure in selected cases.

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