

PERIPHERAL IRIDOTOMY (CURRAN) IN THE TREATMENT OF GLAUCOMA.

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An experience with this operation including thirty eyes forms the basis of this paper. The technic is described with modifications based on such experience. The theoretic basis for such an operation is discussed, with objections that may be urged to the theory. The paper was read at the Colorado Congress July 29, 1921, but a note embodying subsequent observations is added.

In the Archives of Ophthalmology, March, 1920, p. 131, and again in the Transactions of the Ophthalmic Section of the American Medical Association (1920 p. 75), E. J. Curran of Kansas City, presented a theory of certain forms of glaucoma, with a method of treatment, which in the opinion of the present writer constitutes one of the most important contributions to the subject since the time of von Graefe. His theory, in brief, is that in the majority of cases of quiet chronic glaucoma, and perhaps in acute cases also, the immediate cause of the increase of tension is an interference with the flow from the posterior to the anterior chamber, produced by a too close application of the lens to the posterior surface of the iris. He backs up his belief with approximately 94% of cures in 49 eyes, treated by producing a small hole in the root of the iris either by a peripheral iridectomy or preferably, and in the majority of cases, by a peripheral iridotomy.

In spite of the fact that the operation seems so simple (or perhaps on account of this) and the results so surprisingly good, the papers have hitherto met with practically no recognition; and this, in the present writer's opinion is largely due to the theoretic difficulties which at once arise in the mind, in attempting to reconcile Curran's theories and facts with what we have previously known or believed about glaucoma. These theoretic objections, which Curran does not take the trouble to explain away, seem so important, that in spite of the author's evident sincerity, I am bound to say that at first I took no particular stock in his procedure; and I find that this is the mental attitude of every one with

whom I have talked about it. It was only after seeing, in his clinic, the immediate and wonderful effects which Curran produced by simply cutting a little hole in the iris-root, that I became convinced of its importance.

Since November 15th, 1920, my colleague, Dr. Jas. M. Patton, and I have operated on 30 eyes, in 23 patients, by the Curran method and the results have been so satisfactory that I feel like endorsing Curran's claims without qualification. Twenty-two of these eyes were of the kind which Curran insists are the ones most certainly suited to the operation; that is, they were quiet, distinctly glaucomatous eyes, with tension ranging from 32 to 70 (Schiotz) in which the iris could be distinctly seen to be pushed forward to some extent by the lens. In 17 of these, an apparent cure was effected. That is, the tension dropped to below 23 and remained there with sight and fields as good or better than before the operation. In 4 of these the result was only moderate, the tension going down from 37, 47, 32 and 40 respectively, to 27 in all four. In each of these four eyes the hole in the iris root was very small. Better technic would undoubtedly have given better results. In one of the 22 the result in a practically blind eye was distinctly poor; tension dropping from 44 only to 35, the general condition becoming poorer than at first, on account of severe hemorrhage into the anterior chamber. In 8 eyes in which the iris was not pushed forward at all, the results of the puncture were practically negative or transitory; in 2 of these an Elliot trephining later produced a satisfactory result.

The length of time which has elapsed since the successful operations were

done is, of course, not great; but in the majority, at least 3 months have elapsed without any tendency to a recurrence of increased tension. I have had no experience with peripheral iridotomy in *acute glaucoma*, but Curran has tried it with good results in several acute cases.

OPERATIVE TECHNIC

Curran's description of the technic is literally as follows: "The knife [Knapp's knife needle] was passed thru at the corneo-scleral junction.

pate any difficulty in performing the operation. Practically, however, I find that while therapeutic results are fairly uniform it is very difficult to obtain the same uniformity in the operative results. It is by no means easy nor even possible in all cases, to cut thru the little bridge of iris picked up by the point of the knife; and I have had to be satisfied in a number of cases with two very small holes or even only one. Luckily, however, in the great majority of cases a minute hole seems to do as well as a large one. But this is not

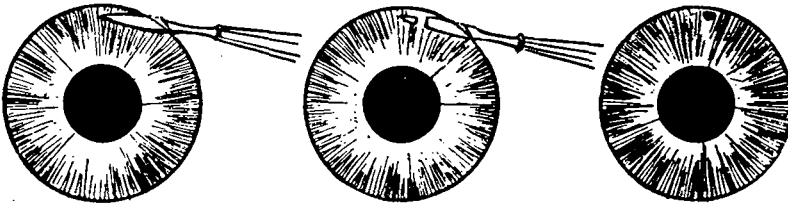


Fig. 1.

Fig. 2.

Fig. 3.

Curran's operation of iridotomy.

Fig. 1. Knife needle entering anterior chamber at corneal margin.

Fig. 2.—Knife needle after puncture and counterpuncture of iris.

Fig. 3.—Hole in iris made by cutting out a fold on needle.

[Fig. 1]. The iris was engaged by the point of the knife, which on further pushing formed a little ruck in the iris, rendering the easy performance of the counterpuncture. The knife was pushed still farther with pressure directed upward, so as to cut the iris transversely, making a hole about 1 mm. in size. Sometimes it was necessary to almost make a counterpuncture in the cornea in order to sever the intervening piece of iris. At times it was found that the first puncture made a hole in the iris sufficiently large and the knife was withdrawn without a counterpuncture in the iris. In cases of long standing, in which there might be an occlusion of the canal of Schlemm, the knife was directed toward the ligamentum pectinatum of the opposite side so that some of these would be cut by the point of the knife with the hope that free drainage into the canal of Schlemm would thus take place."

From the brevity and simplicity of this description one would not antici-

always the case. Where the hole is very small a second operation is more apt to be required; and was required in 5 of the successful cases; and even where the tension remains normal, with a small hole the operator feels less assurance about letting the patient pass from observation, than if the hole is one that can be easily seen.

The reading of Curran's case reports makes it clear that he has met some of these difficulties, and I consider it unfortunate that he has given them so little attention. I believe, therefore, that a page from my own experience may be of use to others. In the first place I could see no reason, from Curran's description, why the bridge of iris should be severed by cutting up, rather than down; and on asking Curran about this his only explanation was that he thought there was less danger of injuring the lens if the cut were made upward. This reason did not seem good to me, so I tried in my first two cases, to cut down; but found that the iris was so elastic that the peri-

phery could be drawn clear down to the center without cutting thru the bridge.

As I could not see how cutting up with a play of only 1 mm. could possibly give a better chance of cutting the bridge, than cutting down with a play of several mm. my enthusiasm for the operation faded rapidly and might have disappeared entirely if it had not been for the suggestion of Dr. Patton, who, after a special trip to Curran's clinic, returned convinced that, generally, where Curran got a complete division of the iris bridge, he did so by pressing the latter against the corneal tissue with the edge of the knife. After this we succeeded in making the proper union of the puncture and counterpuncture in a fair proportion of cases, but by no means always. In his description it may be noted that Curran speaks of being obliged almost to make a counterpuncture in the cornea in order to cut the bridge. It was in thus making a deep counterpuncture that I got the only bad result in my series, on account of the severe hemorrhage above described (See also p. 894).

My impression now is that to be as sure as possible of an ideal result, one should have a Knapp knife needle (not a Ziegler), with a very sharp point and edge, with something of a belly and a blade not longer than 5 1/2 mm. If with this, after making the puncture and counterpuncture in the iris, one will press the blade upward firmly but very slowly against the cornea or sclero-corneal junction, the result is apt to be good. The needle should be introduced subconjunctivally and withdrawn slowly.

FIXATION AND ANESTHESIA. I find that fixation by the superior rectus tendon (if the cut is to be upward) is better than a fixation at any other one point. The ideal fixation would be a double one, by a lateral rectus tendon for the puncture and by a vertical tendon for the vertical movement of the knife. The objection to using double fixation is that it demands more liberal use of the anesthetic; and economy in this direc-

tion is of great importance, because the difficulty of the operation increases with the dilatation of the pupil. To avoid this it is important to give a drop of 1/2% eserine every minute or so, five times before and during the preparation; and to limit the use of cocaine to injecting 3-4 drops of 1% solution, 5/16 to 1/2 inch away from the corneal margin. In addition to this we use a drop of 2% alypin solution (as suggested by my assistant Dr. Nora Fairchild) applied four times to the conjunctiva and cornea before the four minutes thru which the cocaine injection is allowed to act. Where alypin can not be obtained, its place is best taken by a single drop of 2% cocaine followed by three drops of a 2% holocain solution. It is always well, as in a cataract operation, to have the patient come to the table with an empty stomach, so that a general anesthetic can be given if he prove to be unruly. A right handed operator naturally makes the hole in the left eye, above; on the right eye also, the hole can be made above, working across the nose bridge in most patients; but with a high bridge, unless the operator be thoroly ambidextrous, it is better for the right eye, to stand at the head and make the opening below. The reason for standing below, when the iris is to be cut above, is that this enables the operator to see the point of the knife when it passes up under the limbus. When a second iridotomy must be made on an eye, it should be made at the side opposite to the first hole. When any considerable congestion follows the operation, homatropin or even atropin should be used cautiously to prevent adhesions. As Curran insists, it is very important to get the opening as far as possible toward the periphery so that it will not be closed by coming into contact with the surface of the lens. This was well shown in one of my cases in which at the first operation a perfectly good hole was made in the iris, but it was at least 1 1/2 mm. from the periphery; and altho it reduced the tension from 40 to 27 the patient continued to have occasional spells of blurring such as she

had had before the operation. A second iridotomy made only a very minute hole in the iris, but it was well out in the periphery and the blurring has not recurred since it was made, and the tension has remained at about 22.

THEORETIC OBJECTIONS

The objections to Curran's theory and practice which most readily come to mind are these.

1st. If glaucoma is due to resistance to the current from the posterior to the anterior chambers, offered by an abnormal extent or firmness of contact between the iris and the lens, why does not *iris bombé* occur?

2nd. How shall we account for the tension reducing action of myotics, which must increase the extent and firmness of the lens-iris contact?

3rd. Why does not an iridectomy which, when the iris is torn loose at the root, gives the freest kind of communication between the chambers, produce as good results as the iridotomy?

In answer to 1, it may be said that we practically never see *iris bombé* except when the adhesions between the lens and iris are confined to a comparatively small circle near the center. Where there are peripheral adhesions, there is not enough slack left to permit bulging at the periphery. In chronic glaucoma, to be sure, there are no adhesions between the iris and the lens, but the latter is pushed forward by the increased pressure in the vitreous; and that the contact thus produced with the iris is firm enough to cause an overaccumulation behind the root of the latter, can be demonstrated to a certainty by the increased depth of the anterior chamber which can be seen to develop within half an hour, after a successful iridotomy with little or no loss of aqueous.

With regard to the action of myotics, which decrease the tension while increasing the iris-lens contact; I do not believe that this can be explained on the supposition of a direct filtration of aqueous thru the iris root, as Curran has suggested in a verbal communication. No sufficient proof has ever been offered that this takes place, and our

common experience with *iris bombé* argues strongly against it. It seems more rational to assume that while the myotic tends to raise the tension by increased iris-lens contact, this is more than overcome by its effect in freeing the entrance to Fontana's spaces.

The third objection is the most difficult to meet. A well performed iridectomy certainly opens up a free communication between the chambers; and in the light of Curran's work it seems probable that in the numerous cases in which it relieves tension without a filtering scar, this communication is what does the work. Why then, if Curran is right, is iridectomy so notoriously inefficient in chronic cases? And why should a simple peripheral iridotomy or peripheral iridectomy be so strikingly superior in its effects? It seems to me the answer to this objection is that while an iridectomy re-establishes the free communication between the chambers, this communication is too free to produce an essential part of the effect of an iridotomy, namely, the pushing back of the iris-lens system into its proper position, thus freeing the entrance to the spaces of Fontana. After an ordinary iridectomy, the fluid passes without resistance from the posterior to the anterior chamber; but the opening is so free that there is no tendency for the iris to be pushed back. When, on the contrary, a peripheral iridotomy or iridectomy is done, leaving the sphincter and the main portion of the iris intact, the fluid which passes forward thru the peripheral hole pushes the iris back to a depth corresponding to the inflow, until equilibrium is established.

Curran relates one case where after an unsuccessful ordinary iridectomy, he got a permanent reduction of tension by an iridotomy at the opposite side. To explain such a result on Curran's theory, one has to suppose that the space between the iris periphery and the zonula is not always continuous all the way around; and that this may be so is indicated by the occasional case in which a partial *iris bombé* occurs.

It will be noted that the results of a peripheral iridotomy in glaucoma offer the most convincing proof of the incorrectness of Hamburger's idea that there is, generally, a lack of communication between the posterior and anterior chambers, and that the passage of liquid forward from the posterior chamber if it occurs at all, is so insignificant as to be of no consequence.

If this explanation is correct, it shows, together with the favorable effects of miotics, that it is not merely the opening of the communication between the chambers that produces the good results which follow iridotomy, but that the opening of Fontana's spaces is also necessary for the best results. When a successful trephining has been done, the effect on the tension may in part be due to this action of the peripheral iridectomy. But so many trephined eyes remain soft in spite of a continued shallow chamber, it is evident that, with good scleral drainage, the reposition of the iris (i.e., the pushing back of iris and lens) is not essential.

Curran seeks to explain the pushing forward of the lens, in the majority of glaucoma cases, by the supposition that the aqueous secreted in the posterior chamber, meeting with the abnormal resistance to its passage into the anterior chamber, forces its way thru the zonula into the vitreous and thus tends to push the lens forward. This supposition appears to me to be erroneous. Since the normal flow is from the vitreous to the posterior chamber as I demonstrated in rabbits 30 years ago (*Arch. of Oph.* XXI, 179, 186), it seems much more likely that the first step in the process is the occurrence of rather sudden accesses of pressure in the vitreous, which push forward the lens, before the pressure can be equalized by passage of fluid thru the zonula. Then the resistance to passage thru the pupil offered by the increased iris-lens contact leads to the permanent increase of intraocular pressure.

COMMENT.

To grasp the force of the argument that lens-iris contact plays a large part

in many cases of glaucoma, the reader should bear in mind the incontrovertible fact that where a patient with chronic glaucoma and a shallow chamber has a hole of about 1 mm. in diameter made in the periphery of the iris, *with little or no loss of aqueous*, the chamber can plainly be seen to be deeper in the course of half an hour; and the tension, while it may not fall, or may even be higher for a few hours or longer, almost invariably falls to normal in the course of 24-48 hours. If, on the other hand, the chamber be not at all shallow before the operation, in quite a large proportion of cases the fall of tension either does not take place or it is not permanent.

It will naturally take a good deal more time to determine how permanent the results of peripheral iridotomy will be; but even if they do not hold out as well as those obtained by the Lagrange or Elliot operations, there is no doubt in my mind that Curran is amply justified in his claim that even if we could know that a case would eventually need a filtering operation, in some cases the iridotomy would be worth while to reduce the danger of the more serious operation; and where the patient has good sight, but a field limit close to the center, I believe the trial of the iridotomy should be mandatory. The same is true where a strong tendency to ocular hemorrhage has been observed either as the result of operations or by the presence of hemorrhages in the retina. I have had one case in which one eye with retinal hemorrhage was lost from intraocular hemorrhage, setting in several days after a perfectly faultless trephining, where only the direst necessity could compel me to open the other eye freely. In this case (and in a similar one of Dr. Patton's), the peripheral iridotomy has held the tension nearly down to normal; and it should, I believe, be repeated indefinitely if necessary, rather than risk the danger of scleral drainage.

The fact, demonstrated by Curran, that in many of these iridotomized eyes atropin can be used freely is another of the interesting things for which the

reader should consult his original papers but which this paper can not take time to discuss.

CONCLUSIONS.

(1) The results of peripheral iridotomy prove conclusively that in a large proportion of cases of chronic glaucoma; and probably of the acute form also, abnormal iris-lens contact plays an important part.

(2) Nearly all, if not all cases of chronic glaucoma with shallowing of the anterior chamber, can be relieved for many months and probably indefinitely, by making one or two holes about 1 mm. in diameter close to the root of the iris.

(3) The experience of Curran indicates that acute glaucoma, or exacerbations of the chronic form, can also be cured by the same operation.

(4) Where the chamber is deep, the effects of peripheral iridotomy are apt to be negative or not permanent.

(5) Even if the results of the puncture prove to be not permanent, it is so simple that it can be repeated often, with very little strain or danger; and as a preparation for more serious operations it is sure to have a place.

(6) If the favorable results of the operation prove to be permanent, peripheral iridotomy, or some modification acting on the same principle, is destined to displace ordinary iridectomy and the filtering operations from a large part of the field which they now occupy.

(7) The peripheral iridotomy, as proposed by Curran, while very simple and satisfactory in many cases, is by no means easy, nor even possible nor safe to perform in all cases. The substitution of some less simple but more reliable method of making a hole thru the iris periphery, may eventually turn out to be more practical.

[Since the above was written and read, I have had a second bad result from a peripheral iridotomy or an attempt at it. The patient, a woman with only one eye, seemed to be an ideal subject for the operation; but the counterpuncture in the iris could not be made without pushing the knife rather

deeply into the tissues at the angle of the chamber. A sharp hemorrhage into the chamber followed, with quite a severe congestive reaction. The tension was reduced from 32 to 25, but the pupil became adherent and the sight was much reduced. In this case the bridge of iris was not cut thru. I think it probable that the sight will improve considerably. But the case is a sharp reminder that it is not safe to say that the operation can do no harm. It also emphasizes the question whether some other method of making a hole in the iris root, less apparently simple, but capable of greater uniformity in results, may not with advantage be substituted for Curran's iridotomy.

Where everything goes according to schedule, this operation is the simplest and most satisfactory thing imaginable; the knife transfixes the fold of iris and on cutting up and a little forward against the cornea, a nice hole is made; but in other cases, for no apparent reason, the same knife needle will puncture the iris but will fail to make a counterpuncture; either entirely, or until the point is pushed so far up and across that one cannot see just what it is doing. My two bad results have occurred when, in cases of this sort, I have attempted to be sure of cutting thru. Unless Dr. Curran has some new light to cast, I feel like advising that where the counterpuncture in the iris is not readily and evidently made, it is best to give up the attempt to make it and to cut slowly and not deeply against the cornea after the simple puncture of the iris. Whether this procedure will prove to be safe and efficient remains to be seen. If not, it may well be that a puncture, counterpuncture and complete section of iris periphery and limbus with a very narrow cataract knife; or a return to the peripheral iridectomy which Curran tried in his earlier cases, will in the long run be better suited for general practice. The more I see of the operation, the more I am convinced that a knife with a *very sharp* point and edge is the most important factor in its successful performance.