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## Glaucoma simplex : medical versus surgical treatment

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GLAUCOMA SIMPLEX  
MEDICAL VERSUS SURGICAL TREATMENT

Senior Thesis by

C. H. L. Stehl

June 1934

Glaucoma Simplex: Medical versus Operative Treatment

- I. Introduction
- II. Definition and History
- III. Etiology
- IV. Diagnosis
- V. Medical Treatment
- VI. Surgical Treatment
- VII. Conclusion

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Since antiquity the question of glaucoma has puzzled and fascinated the most astute minds in the medical profession. Numerous theories and methods of treatment have been invented, offering best only palliative means for temporary relief. After centuries of painstaking efforts by many brilliant observers the ophthalmologist is still unable to check permanently the blindness to which the victims are doomed. (1) The classification of glaucoma is also dimmed of its definiteness by differences in opinion. Some authors believing that glaucoma simplex is rare and that the inflammation is not looked for with enough care by the operator. Glaucoma has two main divisions; Primary, and Secondary. We shall subhead as follows:

- I Primary or idiopathic glaucoma
  - A. Acute congestive
  - B. Chronic congestive
  - C. Chronic non-congestive or simple (Simplex)
- II Secondary glaucoma
  - A. To other eye disease
  - B. Trauma-chemicals, injury, etc.

I shall delve into the relative merits of treatment methods of chronic non-congestive glaucoma or glaucoma simplex. I do not promise a solution to the pandemonium of therapeutic measures or the localization of the best operative procedure.

No unlike most medical histories we find our first footprints in the 1300 year trek of glaucoma to the present in the writings of

the father of Medicine--Hippocrates. A Greek word "Glaucos" meaning greenish color was modified by him into glaucoses (2) to be referred to diseases of the eye wherein the pupil lost its transparency and became greenish or white. He did not distinguish between cataract and glaucoma and he likely did not recognize the condition until late in the disease. Writers of the early Christian era first made the distinction that these were not the same. (3) They recognized some as being amenable to operations while there were not. The former were called "suffusions" by them while the later bore the stigmata of Hippocrates: Glaucomata. It was Galen in the second century who said (3) that the pain was caused by overfilling of the eyeball. He also noted that such patients saw halos around lights. The science of Galen prevailed with other writers of the early period of the Renaissance until Andreas Vesalius 1514 (4) who revealed by his dissection of the eye that the anterior humor of the eye did not resemble the white of an egg but was of a watery nature. It was evident however that none of these patriarchs of medicine has even struck upon the nature of the condition. They were merely widening the gap between glaucomatous and cataractous eyes. Rollinck (5), 1656, more than a hundred years after Vesalius localized cataract to the lens. He stated its true position within the lens rather than a falling over the lens of an inspissated humor. This obviously placed glaucoma in a realm of its own; a realm of unknown cause, unknown pathology and unknown treatment. Such a position of mystery

was not to remain unchallenged by an awakening world, particularly the province of science, for several decades later the private physician of Louis XIV died with blindness incurred from glaucoma (7) (6). This Physician Bourdelot willed that his eyes be enucleated after death and studied. Brisseaud dissected them and found the lens clear. He found some opacities of the vitreous, however, and considered this the site of the disease. This discovery meant the lens was not the offending causative. Guerin of Lyons (1769) writes (3): "when the vitreous humor is in too great abundance the pupil is dilated to its fullest extent and has almost lost its elasticity. Such patients complain of a deep dull pain at the back of the eye which extends sometimes to the front of the head. If all the remedies of that sort of hydropia have been without success one comes to puncture of the eye in the sclerotic." Guerin prescribe treatment and tried to explain the cause of the hardness of the eyeball to the fingers as noted by J. Platner nearly 25 years before.

Plenck (1783), Beer (1817), and Fabini (1831) (7) dwelt on the vitreous as the source and deplored the prognosis. And it was not until Mackenzie 1831 (5.2) that glaucoma was definitely associated with hypertonicity of the eyeball. Many theories arose as to pathology and etiology but the discovery of the ophthalmoscope by Hermann Von Helmholtz (1851) marked the direction of efforts in the proper channels of pathology. Five years later Heinrich Muller made an anatomical demonstration of cupping of the papilla in glaucoma (2) followed in a year or so by Weber and Forster who accurately diagnosed the condition

with the aid of the ophthalmoscope. Donders and Von Graefe discovered the arterial and venous pulse in glaucomatous eyes and the production of the arterial pulse in normal eyes by pressure (3). In 1862 Bowman attempted to classify the pressures of eyes designating the tensions at 1 plus, 2 plus, 3 plus, and 1 minus, 2 minus, and 3 minus. Tonometers were attempted but their construction and usage combined such inaccuracies that it was not until 1910 that Shiotz made a usable model. Though Mackenzie had suggested and used paracentesis 30 years before, it was not until Von Graefe discovered that iridectomy offered indisputable relief to the glaucomatous eye did our prognosis in this dreaded disease appear better. Albrecht Von Graefe (2), (7) got good results but was chagrined in his failure to explain how and why his thousands of iridectomies on patients got results. Hirschberg says (7) "The iridectomy was for Von Graefe what 'Faust' was for Goethe; not unlike Alexander the Great, Von Graefe achieved the admiration of the world at the age of thirty. Such is the privilege of genius. In this respect he was like, Mozart William Pitt, Napoleon, and Semmelweis. How remarkable his powers of observation must have been to enable him to point out in his first publications that the prospect of success is in direct proportion to the promptitude with which the operation for glaucoma is performed." In close relationship with Von Graefe is de Wecker (3), who strenuously fought the rising tide of opposition which threatened at one time prematurely to engulf his masters valuable work. De Wecker has higher claim still on our admiration, for it was he who practically introduced Stellwag's

sclerotomy and it was he who first realized what von Graefe only dimly apprehended namely, the value of filtering scar. His objective to create such a filtering scar thru the coats of the eye was not realized by him but his dream was an inspiration of many to follow.

If the numerous opinions of different writers on glaucoma are reviewed, it will be found that each endeavors to demonstrate that glaucoma is produced by some special factor which he favors, and that all manifestations associated with the disease are made subservient to this favored cause. Thus, some writers invoke purely anatomic causes, (13) as for instance, those who explain the pathology of glaucoma as associated with unusually small eyes, with special conformation of the anterior chamber and iridocorneal angle or with the changes that occur in the size of the lens as the result of age, etc.

Others claim that glaucoma results from different anatomopathologic lesions, such as local and general arteriosclerosis, with vascular lesions (atheroma, endophlebitis and periphlebitis), peripheral synechiae closure of Schlemm's canal, (8) sclerosis of the ligamentum pectinatum, primary degeneration of the optic nerve, etc.

Magitot and Bailliart (9,8) say that when the sympathetic is sectioned the result is vasodilation and resulting hypertension and stimulation the opposite. A counter view is taken by Bistis (10) Manvlesca (11) who attributes value of gynergea to paralyzing of sympathetic nerve and also by Margolin (12).



According to still other writers, glaucoma results from purely functional disturbances observed in connection with vasodilatation and a subsequent increase in the quantity of aqueous humor due to different causes, with dysfunction of the endocrine glands, (8) (9) with physicochemical phenomena due to osmotic interchanges between the blood plasma and the intra-ocular fluids, with changes of metabolism and with engorgement of the vitreous and lens which has, (16) as a mechanical effect, compression of the iris against Schlemm's canal and obstruction of the intraocular circulation, producing hypertonia, etc. (14) Many other theories could be presented, but they may be found in the writings of research workers and in the recent publications of well known pathologists, as well as in textbooks devoted to the special pathology of the eye.

From the biologic standpoint, the eye is one the most highly differentiated organic structures in the body. Considering, also, the complexity of the phenomena associated with the execution of the most simple function in any part of the body, it seems puerile to conclude that glaucoma is due to one factor only. (13) From the eclectic point of view, no one case or group of cases can explain the generality. One cannot fall into the logical error of reasoning from the particular to the general. In searching for the pathologic basis of glaucoma it would seem more logical to consider the many factors that are associated and that work together to maintain normal function. When one or more of these factors is altered, equilibrium is still maintained by the compensatory mechanism that substitutes for the deficient functioning of some or the excess functioning of

others. It is only when the changes in the factors are so extreme that the limit of possible compensation is passed that the pathologic state is established. Thus it is not by the exclusive influence of any one factor that the glaucomatous state is brought about, but through the association of many factors which ordinarily work in unison to maintain the perfect functioning of the whole organism.

In all cases of this kind it is well known that glaucoma is the expression of a diseased organ in a diseased body, and that, of course, the entire system will be affected. There is a deficiency in the functioning of all the different organs, with a counterbalancing compensatory mechanism throughout the whole body. Here again one observes the complexity of biologic phenomena. One infers that the sufficiency of some organs tends to maintain the normal organic formula until the equilibrium is broken and descendent, and that when a point is reached in this descent at which the formula cannot be reestablished by the organism itself without the influence of foreign intervention, the progressive premature lowering of all the organic complex proceeds until death intervenes. This explains presenile glaucoma.

Therefore, the outline to follow in cases of glaucoma is to discover, by careful examination, the deviation of the entire organism from the normal formula, from the normal standpoint of the whole; then to treat the local symptoms, which of themselves threaten the life of the organ, such as the hypertension of glaucoma, which leads to loss of vision.

There is a widely prevalent impression that glaucoma is a difficult disease to diagnose. This belief is supported by the fact that, from every land in which modern medicine is practised, the complaint is still heard that patients suffering from an increase of intra-ocular pressure are frequently treated wrongly, or not at all. No country seems exempt from such mistakes. They are reported from Great Britain and the rest of Europe, from Canada, America, Australia, and Asia. There are few ophthalmologists in large practice who cannot recall quite recent cases in their own experience in which a patient has lost an eye, or even both eyes, in this melancholic and deplorable way. It is said that a generation ago, a distinguished British ophthalmic surgeon stated at a medical meeting, that he felt strongly disposed to take the front page of a leading professional journal and to advertise on it in large letters the leading signs and symptoms of Glaucoma, in the hope of directing the attention of the profession to the danger of overlooking this very serious condition when it occurred in everyday practice. Years have rolled by, and a new generation of medical practitioners fills the places of the men of that era, but it may be questioned whether the mistakes this critic lamented have become any less frequent. When we remember that glaucoma is to be classed among the emergencies of surgical practice, that, as a rule, the diagnosis of an average case is extremely easy, and that the standard of professional knowledge and of professional training has gone up by leaps and bounds during the last 25 years, we are forced to pause and ask ourselves in surprise and wonder for an explanation of a phenomenon

so world-wide and so persistent. Is glaucoma, after all a condition whose manifestations are so subtle and recondite as to require for its correct diagnosis the skill and experience of a highly trained specialist? There are undoubtedly cases to be met with in which the most careful discrimination is demanded, cases which patient, prolonged observation alone will unravel, and on whose diagnosis able and experienced surgeons may reasonably differ. No one will dispute their existence, but they are few and far between. In the great majority of instances the diagnosis of glaucoma is written large for any medical man to read. So much so that at first sight a mistake would appear to be unpardonable, until we remember the conditions under which the modern medical practitioner works. The wonderful advances of medical science have made a vast difference in his mental equipment; he has to be a highly educated man, far in advance of his predecessor of a generation ago. But in the increase of his knowledge, and in the enormous breadth of the field he has to keep in view, lie his dangers, so far as glaucoma is concerned. He must be a physician, a surgeon, a gynaecologist, and obstetrician, an ophthalmologist, a toxicologist, a pathologist, a bacteriologist, and an expert in many another field besides. The result is that he has so much to think of, and to remember, that he is in danger of overlooking those things with which he is not in constant touch. He knows the signs of glaucoma well; and if for any reason he is on the look out for this condition, he will certainly not miss it when he meets it in his practice. But it is a fact, which applies to

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all alike, that men only see clearly those things which they have been trained to look for, and which they expect to meet with. The sailor discovers a coast-line in the grey haze which the landsman has only interpreted as a cloud on the horizon; the engineer looks down on a distant town, and takes note of the factories it contains, by the observation of phenomena which escape his lay brother; the surgeon recognises the stigmata of hereditary disease in his companion of the railway carriage; and so on with all the other professions. Our point is that the very existence of glaucoma, as a pathologic entity, with which he may have to deal in his very next patient, is crowded out of the thoughts of many a medical man. It is not that he does not know of it, or that he has forgotten its symptoms, but that the bare possibility of its existence has been relegated to the background of his mind, owing to the infrequency of its occurrence in his practice. Nowhere is the saying more true that "fore-warned is fore-armed."

It is the usual practice of text books to draw a distinction between the so-called prodromata of glaucoma and the attack itself (17). In spite of the fact that this time honored custom has been handed down from early writers and included in modern textbooks it is not expedient to make such distinction. Once an eye, shows signs of glaucoma, even though those signs are nothing more than transient mists, rainbows around lights, and ill-defined headaches and pains in or around the eye, which were reported as prodromal signs, that eye is definitely glaucomatous and to hold any other opinion is to bury

one's head in the sand. In glaucoma simplex the patient experiences very little pain early. Loss of vision and halo around lights may be the only subjective symptoms. Upon examination such eyes present a loss on the nasal field, increased tension most pronounced in the morning, and loss in visual acuity tests. Later in the course of the disease one finds a progressive loss of vision, which is best preserved in the central area, a dilated pupil and the typical glaucomatous cupping, previously mentioned signs are exaggerated usually. If a medical man will remember in every case of failure of vision call it due to increased tension of glaucoma simplex until proved otherwise he will not have to reproach himself for cases missed in early diagnosis. Let no one call this paragraph on diagnosis sufficient. It is not intended to wholly cover that phase. This dissertation should adequately impress the value of correct diagnosis as well as instigate curiosity into learning of the human element of variation of symptoms and their value as can be obtained only from the perusal of the several works on diagnosis.

The treatment of glaucoma is yet unsettled. Proof of this is the innumerable methods both medically and surgically. These protean methods of taking care of glaucomatous eyes have numerous advocates who offer their good results in support; then in opposition some ophthalmologist of equal rank gives clinic data of its failure. This diversity permeates the surgical and medical treatment of glaucoma.

The more common therapeutic approaches will be evaluated.

Medical treatment

- I. Miotics--Eserine and Pilocarpine
- II. Glaucosan, epinephrine and related compounds
- III. Ergotamine tartrate or gynergen
- IV. Osmotic treatment
- V. Sympathetic nerve and calcium
- VI. Massage and miscellaneous

Miotics: are substances producing contraction of the pupil.

There are several such drugs used but the two most commonly used in Ophthalmology are physostigmine or eserine and pilocarpine. Most authors advise individualization of the strength used in glaucoma.

It is advisable to use only such concentration as will maintain miosis. This strength will have to be increased because of tolerance.

It should be kept as low as possible to prevent cramping of the circular muscle. These drugs are also mildly irritant to the

conjunction and scler. Posey (10) recommends eserine grains one tenth to the ounce with increase of the drug compensating the need.

Patients soon get to use grain one to the ounce. A good perscription for this is as advised by Dr. Stokes (17):

Acidi Borici GR.XV

Aquae Distillatae q sad. oz I

Sig. gtt. I in each eye T. I. D.

Put up in this mildly antiseptic media makes it les irritating to the conjunction. Posey (18) advises pilocarpine in twice the strength of eserine.

Eserine may also be applied in an ointment to be used when retiring. This gives effect during the night. The pharmacodynamics of these two substances is obscure. "Useful Drugs" published by the American Medical Association says both physostigmine and pilocarpine stimulate the parasympathetic nerves. (19) Bailliart and Natlif (20) believe that pilocarpine, eserine, and histamine are sympathetic paralyzers. The contraction of the pupil from whatever cause it may be produces a greater iris surface for absorption as well as pull the iris away from the posterior surface of the cornea and obstructing the filtration angle. It keeps the canal of Schlemm open. The vascular ciliary body is kept freer from mechanical congestion when the iris is taut. Friedenwald in his studies (22) considered physostigmine and pilocarpine as possessing the power of causing arteriolar constriction. The beneficial effect of thus decreasing capillary pressure in relation to the edema of the ciliary body is clear. He did not opine if the action were direct on the vessels or secondary thru the nervous mechanism. The possibility of sympathetic paralysis as supposedly caused by the named miotic affecting the vasomotor apparatus of the eye will be discussed. The value of miotics is placed highly by Basso (21) who reports several cases where Pilocarpine was used for months and the eye returned to and remained normal. However, he does not place implicit faith in them. He thinks operation in early cases expedient. Eserine is considered the best single non-operative method of treatment by Wright and Mayor (32) even though they were writing on the value of the adrenalin pack. They consider



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non-operative methods valuable but eliminates of mechanical relief of hypertension. The effect of miotics is often made more viable by the use of some other measures. These will be mentioned in discussion of them. Glaucoan, Aminoglaucoan, Epinephrine, and Histamine come in one category. Epinephrine is Levorotary, Glaucoan as devised by Hamburger is dextrorotary. Both of these mydriatics, Glaucoan acting like epinephrine. These are isomeric compounds. (23) Amino-glaucoan is very powerful and is miotic in action. Gifford says it is Histamine. Epinephrine had been used previously but because of the mydrinasis and systemic effect its use was limited. Hamburger then produces an isomere to it and found it dextrorotary. It did not produce the general reaction that adrenlin did so it was thought perhaps a valuable drug was found. Hamburger in 1930 was still supporting it but was cognizant of the fact that untoward results were occurring with its use and tried to remedy it (24). The drug was heralded at first almost as a specific but occasionally an acute exacerbation of hypertension would be precipitated (27). Some accepted it as sufficient treatment, Daily and Daily (25); and Rauh (26) while many authors used it only ad adjunct to other treatment. (27) (23)(28) Parker (29) tried it in 9 cases and found no favorable cases and one with an acute rise in tension. Duke Elder (30) finds the glaucosaus not dependable; might be of value in some cases where other miotics had become ineffective. Because of its potential power to produce hypertension it has been abandoned by many. Hamburger himself in a later article (31) acquiesces to the

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irritation of the drug he recommended in 5%, 7%, and 10% solution five years previously. In this one he advocates a histamine mixed with dextrose to ameliorate its toxicity. Adrenlin or better epinephrin, is usually applied in the form of a pack; (32) a cotton pledget is soaked in a 1:1000 of adrenlin and placed in the fornix of the eye anesthelized by Holocain and left in the fornix for 5 minutes. This is of great value in controlling eyes preoperatively. However the general systemic reaction must be watched for. It has been used with good results by Wright (32) Green (33) and Port (34). It reduces pressure in most cases when applied properly and often becomes the activator of miotics grown ineffectual. Parker (29) treated 12 cases with subconjunctival injections of epinephrine with permanent results in one eye and temporary reduced tension in a majority of the others. Histamine has been mentioned in regard to Hamburger's work (31). It is considered by most men to be too powerful and too highly irritant (30) (23).

Ergotamine tartrate was first recommended for the treatment of glaucoma by Theil who reasoned that the increased tonus of the sympathetic nerve would be counteracted by the drug. Ergotamine tartrate or gynergen is thought to paralyze the sympathetic nerve endings (35) (36). The drug has been used with a fair degree of success. It has not been as universally tried as Glaucozan but the results so far point to its favorable use. Glavan (37) says it produces bradycardia, in glaucoma simplex. He found it of some value in inflammatory glaucoma and even in absolute. Werner tried

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it by subcutaneous injections (38) and did not get any remarkable reactions on the pressure. He later tried it in subconjunctival injection (39) and got better results. Out of 18 cases 14 had a reduced tension. He found the tension shortlived and the best results in glaucoma simplex. Gupeeff (35) used it by mouth and subconjunctivally; Manvlesca (36) gave 6 tablets of 1 mg. of Gynergen per day by mouth. Its administration by mouth or subconjunctivally seems to aid in lowering tension of glaucomatous eyes particularly the type we have in question.

Osmotic tension manipulation and its effect on diffusable fluids is not a treatment of the last decade. In 1903 Loeper reported on 17 cases treated with good results in 12. In 1914 and 1915 Hertel treated a series by injecting 200 cc. of 10% salt intravenously. Eight years later Pletnerova of Moscow reported favorably on 20 cases. In this country Weekers and Sansum (41) treated cases by hypertonic solutions of salt and glucose respectively. Duke Elder (40) treated 4 cases with favorable results. He believes this treatment is good in conjunction with miotics to tide over a case when inconvenient to operate. It minimized danger of explosive hemorrhage and makes diagnosis easier by relieving acute symptoms such as a cloudy cornea making observation more easily done. Lambert and Wolff (42) using 150-300 c.c. of 5% NaCl solution intravenously got a drop in all 9 of their cases. It was a short lived drop but they considered it a good preoperative measure. The action of these hypertonic solutions is to take up

fluid by dialysis and this hasten fluid removal. The purging of teneral treatment would have similar effect. Some authors think that the permeability of the capillaries is disrupted in glaucoma and test this by the "Trinkversuch" test. Lobeck (43) co-worked with Seidel; Wegner and also Schmidt (44) worked on this test and the results in patients with glaucoma. Their findings are of little value in the field of ophthalmology because the presence of other vascular disturbances in such as the kidneys etc. can not be ruled out. Schmidt particularly draws conclusions without basis. The aforementioned conclusions arrived at by several authors is one that is well to remember in regard to osmotic therapy. That is its value in preparation for an operation.

The role of the sympathetic has been alluded to in previous medicaments and their action. The interrelation of calcium and the sympathetic is a pharmacological fact. Internist prescribe calcium in sympatheticotonic types. Lagrange believed that (46) at the base and at the beginning of every glaucoma there is an intervention of the sympathetic nerve or if one wants to be less precise, of the secretory nerve." Bailliart and Natlaf have shown that glaucomatous patients are sympatheticotonic types, a fact which explains the lowering of intraocular tension by miotics which are sympathetic paralyzers. Further proof lies in the theories of formation where in hypersecretion is thought due to irritation of the secretory nerves. The vasodilation of the eye from sympathetic stimulation (50) would hasten dialysis and cause

hypertension. Theil of Berlin (47) pointed out that irritation of the sympathetic nerve increases the intraocular tension, and that paralysis of the sympathetic decreases the tension. It was he who advised Gynergen as a drug in this state. de Schweinity affirms these sympathetic phenomena (48). Gouterman (49) did much on calcium and sympathetic interrelation to the eye. He gives clinical and experimental proof of calcium deficiency and proves the value of calcium therapeutically. He quotes:

Weekers (1912)	3 cases	Results good
Groland (1917)	1 case	Result good
Alt (1919)	12 cases	Results favorable
Abadie (1929)	Years trial	Results favorable
Author (Gouterman)	6 cases	5 definite & 1 Possibly aided

Margolin (12) employed the sympathetic control as the basis for their diathermy treatment. They had favorable effect in the 13 cases which they reported.

I have left until last therapeutic measures that should go hand in hand with the aforementioned five methods of treatment. We must check our patients for focal infections and clear these up. We must warn them against constipation and improper removal of wastes, we must cut down the abuse from alcohol, the grosser indulgences of wrong dietary; we must insist on regular hours and sufficient sleep. We must countermand overwork, worry, excitement, and exhausting recreation. Massage the mentioned casually by many ophthalmologists should be used more than is prevalent. The best massage is that done

with the fingers (51). The tension of an eye can be quickly and sensibly reduced by digital manipulation, and the patient can be taught to perform the simple movements for himself. These are two in number. The first consists in placing the tips of the two index fingers on the upper lid over the globe and pressing with each finger in turn in the direction of the center of the eye. The movements should be slow at first and more rapid later, as the operator acquires skill and the patient toleration. The period of massage must be short at first and should be extended to 30 or 5 minutes, at least three times a day.

Medical treatment is hard to maintain for any prolonged period in the case of miotics since the average chronic case will neglect his medication or have it result in an infection. The effect on the glaucomatous process soon wears off. There are cases where miosis has been maintained for many years but no small number of cases have been held to non-operative treatment too long and the patient's eyesight forfeited. The moment that non-operative treatment shows evidence of failing to hold the disease in check, the time has come for surgical interference. This holds true for any of the modes of medical attack. De Wecker's statement of miotics holds true for all: "If miotics have never cured a case of glaucoma, they have prevented many glaucoma patients from being cured." Non-operative treatment usually does not stop the etiological processes it merely allays the symptomatic hypertension; to thoroughly acquaint the patient with the dangers of progression in the disease and the necessity of return for observation. To tolerate neglect and slovenly examinations is to invite disaster to human eyesight.

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The importance of surgical treatment of glaucoma has been referred to previously when studying medical treatment. Not unlike the non-operative treatment the surgical treatment is even still more discussed. No end of theories, new operations and operative results have flooded the literature of the last decade. Eyes have been benefited and mutilated by these divers attempts to get an ideal procedure. The operations of the pioneer surgeons of the eye have been copied, modified, combined, and abused. These pioneers such as Von Graefe, de Wecker, Mackenzie and Bowman are frequently plagiarized and no credit given them. Those who have read, or who will read patiently, what these giants of the past had to say on the clinical side of the subject, are bound to rise from their task in a chastened and humble frame of mind. It is true that so far as concerns pathology, these makers of ophthalmic history were dimly groping their way toward the light of a day which has since broken so fully, that the youngest student may learn and clearly understand the facts toward which von Graefe faintly stretched his faltering hands; but when it comes to clinical observation the ablest surgeon of the twentieth century may gratefully and profitably learn from the men whose names are but an honored memory.

To copy the step by step technique of the various operations lies not within the confines of this paper. An attempt will be made to state the basic principle involved in each operation with the theoretical or actual justification of the procedure. The surgical means of treating glaucoma will be discussed from the following skeletal plan.

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- I. Sclerotomy & Sclerectomy
  - II. Iridectomy
    - Von Graefe
      - Peripheral
      - Broad.
  - III. Trepphine
  - IV. Iris Inclusion
    - Iridencleisis
    - Iridotasis
  - V. Combinations
    - Sclerecto iridectomy--Lagrange
    - Sclerecto iridectomy (wedge) Herbert
    - Sclerecto iridectomy (Punch forceps)
    - Trepphine & Iridectomy--Elliot.

Sclerotomy--meaning the puncture of the scleral coat of the eye is a simple procedure but not often employed. Friedenwald (52) recommends posterior sclerotomy as a preparatory step in other operations and as a procedure of less danger. Elliot shares the opinion of most authors is advising against its use since the amedioration of symptoms causes the patient to postpone a permanent operation. Its use in glaucoma simplex is without basis. Sclerectomy the seldom done alone as such is the chief acting mechanism of many other combined operations such as the Lagrange, Holth, Herbert and even the Elliot trephine.



Iridectomy; the first operation for the relief of glaucoma to be of much avail and one that today is without equal for usefulness. Von Graefe the founder and de Wecker its defender used it with good results. They did not know the reason it worked so often yet their technique is not to be criticized. They performed a broad iridectomy thereby reopening the filtration angle besides getting absorption from the cut iris. Few surgeons there are today who have not used it and few there are who have not attempted to improve on it. Parker, (62) using it reports 60% benefited and 30% the same while 10% are made worse. The Green eye clinic of San Francisco (63) noticed their results of iridectomy declining in their 15 years study of cases so they modified from the large to the small peripheral iridectomies. They used it however in connection with trephine. Their results after the change were 90% good results. L. Post (64) describes an operation he uses with favorable results. 80%. Elliot in his book (51) thinks the operation of high value and as having no pier in the flood of operations in modern literature.

The trephine is an operation not expedient to use in chronic non-inflammatory glaucoma. Its employment with iridectomy serves as the basis of Fergus and Elliots operation. Iris inclusion operations are used by some modern men and deplored by many others. Lagrange in his reasoning that led to the introduction of his operation found that in certain iridectomies had a filtering scar. He therefore tried to produce an iris free filtering cicatrix (51)

Thus it is evident he tried to avoid iris incarceration. Parsons (53) says: "It is not justifiable deliberately to leave a knuckle of iris in the wound when doing an iridectomy, as has been advocated." In 1903 Herbert reported 130 operations of iris inclusion. In 1908 he still advocated it but soon abandoned it for other procedures. Holth advocated it in 1907 but in 1909 brought forth the punch forceps. The most emphatic denouncement of iridencleisis and iridotaxis is that of Elliot (51) in his book page 494 where we quote: "It seems strange that a procedure which is so obviously unsound can find any advocacy at the present time. Much as the author desires to avoid any suspicion of intolerance or bigotry, he feels that there are certain operative methods which are seriously entertained today, which stand self-condemned at the bar of modern pathology and surgery. The effort to produce entanglement of iris in a scar is, in his opinion, one of such." Personal communication with Dr. Stokes (17) is in accord with Elliots opinion. He considers them as surgically unsound. Whitehead considered it unsound and wouldn't use it (54). Alligned on the other side are not a few men. In this side we can obtain clinical data. Those who oppose the operations do not do them and hence have no cases to report. Not a few of these have clinically experience to substantiate their contention of its unsoundness. Bell (55) admits of its surgical unsoundness but concludes from his clinical results that it cannot be condemned. Gjessing (56) (57) is an enthusiast and reports over 200 cases with a better than 83%

result. Records can be found where Holth again in 1930 (58) described his technique again and advocated it. He seems unstable in his opinion as to a desirable operation. Blaickner (59) used it with only moderate results. Primary Glaucoma is effectively treated by iridencloisis as stated by Weckers and Hubin of France (60). Lofgren reporting from the University eye clinic at Helsing (61) of 532 operations gives only a 78% immediate result and 68% late result. Of various authors with case reports of value the percentage results of tension, visual fields and vision were averaged to give a final per cent success of the man's report. Averaging the results of 7 such reports involving iris inclusion on more than 400 eyes gives and 81% benefit to the patient.

The various sclerecto iridectomies came into being at much the same time. Lagrange brought forth his epoch-making operation in may 1906. He snipped off a small bit from the scleral flap and this defect produced a filtering scar. This, he and others have changed in details. Lt. Col. H. Herbert in Dec. 1906 first did his wedge isolation operation. He later produced various modifications which he called the small flap operation, the triple flap operation, and the metal rod operation. In May 1909 the punch forceps was first used. Preceding this 5 months Fergus did the first scleral trephine with which he soon combined iridectomy to avoid prolapse of the iris into the wound. The end of that year brought forth a report from Major Elliot on 50 eyes he had operated upon since August by means of the corneo scleral trephine. He

too combined iridectomy for the above reason. These operations have been used by ophthalmologists over the entire world good and bad results have occurred depending much on the finesse and technique employed. Lagrange's technique has been adopted and favorably reported upon by Van Ghoz (65) of Budapest. Duverger and Velter (66) use the Lagrange operation mentioning 4 special procedures. They consider it the best surgical treatment. They report on 150 operations with 93% fistulization and decreased tension. Elliotts operation is followed religiously from the classical description of the founder by Parrot (67) who also gives the various indications when it is useful. He recommends it in chronic glaucoma especially. Cirincione likes iridectomy in glaucoma but states it is insufficient in advanced cases of chronic glaucoma. Here he preferred corneo scleral trephine with complete iridectomy. Col. Elliot himself answers questions and criticisms in a recent article where he also includes helpful preoperative treatment and enumerates fine points that mek for more successful results. The choice of operative procedure after a perusal of the literature of the last 6 years has not been clarified. Rather the diversity of opinion seems to make the matter harder to decide. To individualize each patient is always perogative and then the advice of Bell (69) de Grosz (70) Knapp (71) who all voice the opinion of Dr. John E. Weeks who said; "Whatever method the operator can use with confidence is the best method of him," is an evasive yet not unwise conclusion to come to.

Generally speaking, barring anatomical variation of eyes, depth of anterior chamber and other variables, cases seen early with good vision, only slightly impaired fields, and what appears to be merely coaption of the iris to the cornea should receive miotics. If there is a progression of damage to the eye or uncontrolled tension the classical operation of von Graefe-iridectomy is the one of choice. However trephine or other filtering operations are in order if the vision has been moderately damaged and with decreasing fields. Here iris manipulation and iridectomy is not always sufficient. If however the patient is seen late in the disease with tubular and impaired vision, with central visual fields operation should be done only with extreme caution and not without warning to the patient and his folks that he may lose his sight from the operation.

Glaucoma remains the bete noir of eye diseases. (72) Of few other maladies are we so ignorant. Is it caused by excessive secretion or defective excretion? If drainage is at fault, is it in Schlemm's canal, in the conreal endothelium or in the corneal epithelium?

Is it from a chemical change in the aqueous or the vitreous? Is it a disease of blood vessels, lymphatics, or a disturbance of metabolism? We do not know.

We have pulled hard and strained heavily, but traveled a short way since the time of von Graeffe. Fuch says glaucoma is never cured and he reminds us that though treatment may afford precious relief for a time, the day of disaster is certain if the patients survive

many years. In review of this ex cathedra statement by the dean of our specialty, what seems the safest attitude? The first advice of Hippocrates was "Do no harm."

Three drugs, and only three, are accepted by men of all nations as dependable in delaying the progress of glaucoma in a large percentage of cases. Their use involves no risk if we can keep close check on the cases.

Sixty different surgical operations with no one and no four or five accepted by all operators are positive proof that the ideal one has not been devised.

Recently some of the best surgeons of the Pacific Coast urge the advantages of the smallest possible trephine opening. Another distinguished authority from the Chesapeake regards most failures as due to the small size of the trephine employed.

Some writers advise that success can come only from a permanent filtration scar. Another of equal success acclaims that we must effect drainage without weakening the coats of the eyeball.

One writer explains his own success by his skill in removing every shred of iris tissue from the operative wound. Some recent authors agree that the condition sine qua non of a successful issue lies in the presence of small iris shreds which become incarcerated in the filtration wound.

The contradictions and confusions suggest the anecdote of a stupid student who heard von Graeffe talk daily for weeks on the subject. As he went to say good-bye to the old man, he asked:

"Professor von Graeffe, what is the best treatment for glaucoma?",  
to which the old man replied: "Refer the case to your most promising  
rival."

When success smiles we proudly acclaim the advantage of the  
method employed; when failure frowns, we subconsciously wish we had  
chosen a different operation.

What is the choice operation in any particular case? The one  
you can perform with most skill. The answer to this question has  
been forcibly suggested by a remark of Dr. Riach, of San Diego:  
"The secret of success lies in the finesse of technic rather than  
in the choice of operation."

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