

## AN EVALUATION OF CRYOEXTRACTION AFTER 700 OPERATIONS

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Six years of experience with cryoextraction in over 700 operations convinces me that cryoextraction is the operation of choice for the removal of cataracts in adults. A comparison of my results obtained using the cryoextractor with those obtained prior to 1961 using the forceps and erisophake demonstrates conclusively that cryoextraction is simpler, safer and superior to the time-honored methods.

The superiority of the cryoextractor over the erisophake or forceps is in its mechanical advantage in grasping and holding the cataract. The greater strength of the hold upon the cataract with the cyroprobe is readily made obvious when the breaking point of an ice-column is compared with the breaking point of the lens capsule <sup>1</sup>. The breaking point of the intralenticular ice mass at a temperature of -30° C., produced by the cryoextractor is more than 1,000 grams, while the breaking point of the capsule held by the erisophake or forceps is 7.5 grams... a ratio of 130 to 1. With this powerful hold upon the cataract obtainable with the cryoextractor the surgeon can safely apply more traction to remove a cataract than has been heretofore possible. The cyrosurgeon who feels relatively secure against capsular rupture has substituted traction for counter-pressure and has thereby radically modified and simplified the operation for the removal of cataracts.

### *Absolute indications for Cryoextraction*

The ophthalmologist who does not choose to discard time-honored methods for all cataracts must certainly consider cryoextraction in those instances when it is unquestionably the superior method as in removing an intumescent cataract.

Three other conditions in which cataract cryoextraction is superior to the older methods are: (1) when the vitreous covers a subluxated lens; (2) when vitreous presents itself immediately after the cornea has been sectioned; and (3), when a cataract is to be extracted from a highly myopic eye with liquified vitreous. Because of the interposing vitreous in the first two conditions, it is difficult to grasp the cataract with forceps or the erisophake, but with the cryoextractor the surgeon simply brushes the vitreous aside enabling application of its tip to the cataract to produce fusion and then the cataract is lifted out. In the third instance, cryoextraction without counterpressure minimizes the possibility of vitreous loss.

### *Principles and Technique of Cryoextraction*

To qualify for performing cryoextractions, the ophthalmologist must meet three basic requirements. First he must familiarize himself with the cryoextractor of his choice. Second he must develop sufficient skill by using it on experimental animals or cadaver eyes. And lastly, he must observe cryoextractions performed by an experienced cryosurgeon. Further, it is highly desirable that initial cryoextractions be performed with a wide iridectomy to minimize the possibility of iris freezing.

The technic of cryoextraction uses the same preliminary procedures as those employed in the conventional methods. When a complete iridectomy has been performed, the surgeon merely lifts up the cornea with one hand and with his other hand applies the tip of his cryoprobe to the superior portion of the cataract (Fig. 1). In the round-pupil extraction an assistant raises the cornea while the surgeon retracts the iris out of harms way and to expose the superior portion of the cataract and uses his free hand to apply the tip of the instrument.

At this stage of the operation the two most serious complications peculiar to cryoextraction may occur, namely freezing of the cornea and the iris. \*

As soon as fusion occurs between the cataract and the tip of the cryoprobe, (and this can be verified both tactilly and visually) the surgeon raises the superior portion of the cataract above the rim of the iris thus breaking the corresponding zonular attachments. When resistance is no longer encountered the surgeon proceeds to slide the cataract out of the eye. Moderate zonular resistance requires lateral and medial rotation of the cataract. Extreme resistance necessitates additional rotations in the clockwise and counter-clockwise directions. If all of these maneuvers should fail, then the surgeon resorts to mechanical or enzymatic zonulolysis.

\* vide infra.

## CRYOEXTRACTION

If enzymatic zonulolysis is used at this stage of the operation, the surgeon thaws the tip of the instrument and separates it from the cataract. After using alpha chymotrypsin in the usual manner; he cools the instrument to the proper temperature; reapplies it to the cataract and then proceeds to extract the cataract.

After the cataract has been removed by cryoextraction the final steps of the operation are the same as used in the older methods.

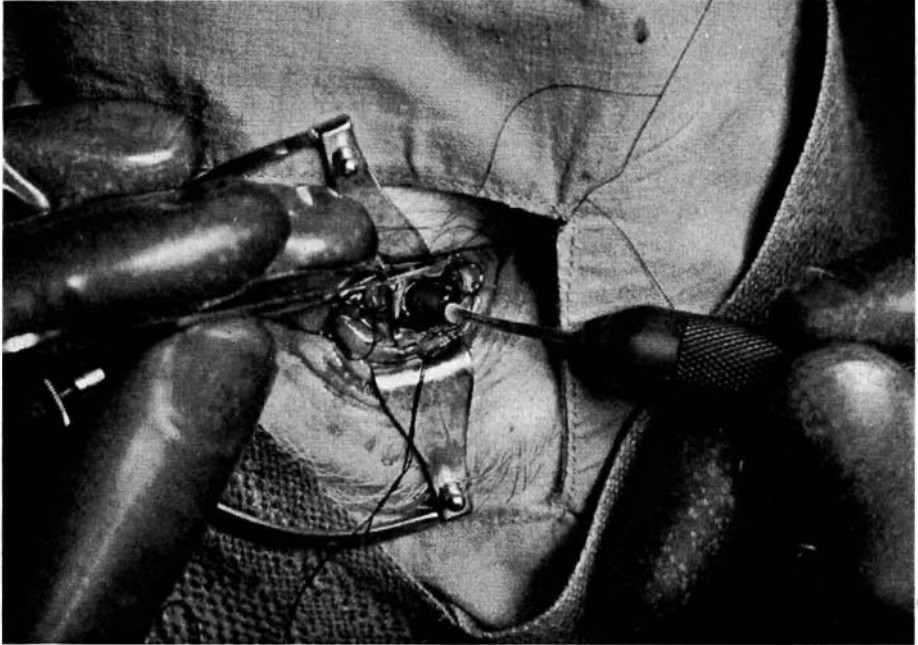


Fig. 1

The cornea is raised with forceps in one hand and the Bellows' cryoextractor is applied to cataract with the second hand.

### *Complications*

The complications that are mainly feared by cryosurgeons and which some ophthalmologists inexperienced with cryoextraction state as their reasons for opposing this new method are freezing of the cornea, iris, conjunctiva and sutures. In my series of 700 cryoextractions there were 6 cases in which a part of the iris was frozen, 1 case in which a small area of the cornea became involved, 8 instances in which sutures became adherent to the emerging probe or cataract

and not a single instance of conjunctival involvement. These complications by themselves had no perceptible influence on the successful outcome of the operations. In my opinion, the fear of freezing damage as a result of cryoextraction is greatly exaggerated. Instead, the ophthalmologist who has properly prepared himself to perform cryosurgery will find not only the risks and dangers of freezing trauma to ocular tissues are insignificant, but also will find the rewards are great.

### *Iris Freezing*

The complications most feared by ophthalmologists is iris freezing. Adherence of the iris to the cryoextractor usually occurs when the surgeon in applying the tip to the cataract accidentally includes a portion of the iris. The most frequent location for this mishap is that part of the iris concealed from view by the shaft of the instrument; this mishap occurs most often when round pupil extraction is performed with inadequate retraction of the iris. To avoid this complication, the surgeon must make certain that the iris is properly retracted and that the tip of the instrument does not touch the iris. Iris adherence and freezing can also occur if there is a delay in the withdrawal of the cataract fused to the cryoextractor. Under such circumstances the ice mass formed in the lens extends to reach the undersurface of the iris. This complication can be avoided by lifting the superior portion of the lens above the rim of the iris immediately after the cataract has become adherent to the cold tip.

If iris freezing does occur it usually manifests itself when the surgeon attempts to extract the lens. At this point, the adherent iris bulges out along with the cataract. The surgeon discontinues traction immediately to avoid iridodialysis. He separates the instrument and the adherent iris by thawing with a stream of saline or by activating the defrosting mechanism in those instruments supplied with such a unit. After thawing, the surgeon excises the frozen portion of the iris (especially if the contact has been a lengthy one), converting a peripheral iridectomy into a complete iridectomy. If the contact has been brief, excision of the involved iris is not necessary, because the minimal iridal reaction does not in itself, influence the outcome of the operation. This mishap should not deter the surgeon from once again applying the cold tip of the cryoprobe to the cataract and continuing with the cryoextraction.

### *Freezing of the Cornea*

Corneal complications occurring with cryoextraction are frequently mentioned by opponents of this method. In reality cryoextraction actually reduces the number of corneal complications. By eliminating the tucking of the cornea, an essential

procedure in the tumbling operation, striate keratitis and other evidence of endothelial trauma are rare complications of cryoextraction.

In over 700 cryoextractions only a small section of one cornea was frozen. In this freak accident the assistant released the cornea too soon and because the cryoextractor was an early model and was poorly insulated, a 1½mm area of the posterior surface of the cornea became adherent to it. The cornea was immediately thawed by a stream of saline. During the post-operative course cracks and folds were observed in the frozen area of the cornea. It eventually healed with no scarring and with 20/20 visual acuity. Freezing the cornea during cryoextraction can only occur either by a gross error of applying the tip of the cryoprobe to the undersurface of the cornea or by releasing the cornea before the cryoprobe with the adherent cataract passes through the corneoscleral opening. Even if the latter event should occur, it is doubtful that the cornea would freeze to the newer and better insulated instruments.

#### *Freezing of the Conjunctiva and Sutures*

Accidental freezing of the limbal based conjunctival flap or sutures is a minor complication. Such freezing usually occurs at the time when the instrument with the cataract fused to it emerges from the corneoscleral opening. If the conjunctiva or sutures should become adherent to the cryoprobe before the cataract is completely emerged, then traction must be halted and the undesirable fusion thawed. If the sutures become adherent after the cataract has been completely extracted, the adherent sutures are separated simply by freezing them by thawing before tying.

Critics of cryoextraction who mention the danger of freezing damage to the deeper structures of the eye, i. e. vitreous, choroid or retina are apparently unaware of the reported gradient temperature studies. These studies verify that it is impossible with modern cryoextractors to freeze beyond 1 to 2 mm into the lens substance and therefore, freezing damage to the deeper structure of the eye simply does not occur when cryoextraction is properly performed (<sup>2</sup> and <sup>3</sup>).

Retinal detachment has also been cited as occurring more frequently following cryoextraction. However, statistics prove that retinal detachment occurs in 0.25% of the patients following cryoextractions and in 2.5% after conventional extractions <sup>4</sup>. In my series there were six retinal detachments, or less than 0.9%.

Because of the reduced incidence of capsular rupture and retained lenticular material when using cryoextraction, postoperative infections are rare, (1 in 700). Secondary membrane formation requiring discission as well as phakogenic uveitis glaucoma and hypersensitization are complications that have been almost completely eliminated.

*COMMENT*

As the ophthalmologist a generation ago was reluctant to accept the intracapsular method of extraction, so today the ophthalmologist is wary of the cryo extraction method. In both instances, this can be explained by the understandable antipathy to give up the old and familiar for the new and the unknown. Alexander Pope's advice applies in surgery as in language and fashion, "the same rule will hold; alike fantastic, if too new or old. Be not the first by whom the new are tried, nor yet the last to lay the old aside" <sup>5</sup>.

Cryoextraction is no longer confined to the laboratory but is an important addition to the armamentarium of the clinical ophthalmic surgeon. Critics concede that it is of special value in removing cataract in difficult cases; this suggests that it is indeed a simpler and safer procedure in treating all adult cataracts. Certainly those ophthalmologists who too frequently rupture the lens capsule would benefit by the reduced incidence of capsular breakage and its sequelae when using the cryoextractor. They will be well rewarded and delighted to find that cryoextraction makes fewer demands upon their physical and mental resources and that this new method gives them a greater certainty of a successful outcome. Finally, the superiority of cryoextraction is attested by the fact that no ophthalmologist, to my knowledge, once he had become proficient in cryoextraction has discontinued its use to resume the older methods.

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