MANAGEMENT OF CORNEAL DESCEMETOCELES AND PERFORATIONS*

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INTRODUCTION

THE PURPOSE OF THIS PAPER IS TO REVIEW OUR EXPERIENCE AND PRESENT A SYSTEMATIC approach to the management of large descemetoceles and perforations that required hospitalization. These two conditions, which are the final stages of many diseases affecting the cornea, are seen infrequently in a general ophthalmic practice and are often difficult to treat. Newer techniques have made the management of descemetoceles and perforations easier and have provided ophthalmologists with a wider selection of therapies.

Conjunctival flaps have proven useful, especially in the treatment of descemetoceles in eyes with poor visual potential.^{1,2} Penetrating keratoplasties (PKPs) have been employed in treating corneal perforations and have restored anatomical integrity in most cases. However, the higher incidence of allograft reactions, other postoperative complications, and suboptimal visual results have encouraged a continued search for newer and better modes of therapy.^{3,4}

Autologous or donor tissues have been used for patch grafts in the treatment of perforations. In 1948, Larsson⁵ reported one case describing corneal perforations sealed with a piece of the patient's own sclera and covered with a conjunctival flap, which had had good anatomical and visual results. Dohlman and associates⁶ proposed the use of a thin slice of cornea over an area of perforation, covered with a silicon rubber membrane held in place by overlying sutures, as a good method of restoring the anterior chamber and preparing the eye for a PKP once the inflammation had subsided.

In 1975 Leibowitz and Berrospi⁷ presented the first five cases of desce-

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metoceles treated with hydrophilic contact lenses, which protected Descemet's membrane and allowed cicatrization of the stromal tissue. They suggested this as a good temporizing method in preparation for surgery. Like other therapies, soft contact lenses are not free of complications in the treatment of healthy or diseased corneas.^{8,9}

In the 1960s tissue adhesives and their application in ophthalmology were investigated.^{10,11} It was demonstrated that moisture, inflammation, and necrosis contributed to poor adhesion and that there was normal healing behind the adhesive plug.¹² Different types of cyanoacrylates were found to be increasingly bacteriotoxic in order of decreasing chain length.¹³ Eiferman and Snyder¹⁴ observed also that butyl-2-cyanoacrylate (Histoacryl) had bacteriostatic activity against gram-positive microorganisms.

Recently it has been shown in humans that tissue adhesives can interrupt progressive corneal necrosis, if applied at an early stage in some corneal melting disorders.¹⁵ Tissue adhesives also prove to be relatively well tolerated by the ocular structures.^{10,16}

Webster and associates¹⁷ in 1968 and Boruchoff and colleagues¹⁸ in 1969 reported the first studies on applications of adhesives in the treatment of perforations and leaking wounds. As a result of their studies, they recommended adhesives be used in patients who were candidates for surgery and be avoided in large perforations or when all necrotic tissue could not be removed. Further recommendations regarding clinical characteristics, indications, and techniques of tissue adhesive application, were stressed by Refojo and associates.¹⁹ They recommended the removal of any necrotic tissue, the drying of the field to be sealed, and protection of surrounding tissues from glue application. Some have pointed out that corneal-intraocular structure adhesions, when using adhesives to seal large corneal perforations, were unlikely.²⁰ But this was not the experience of others; to prevent the problem of adhesions of the glue to the intraocular structures, several techniques were proposed in which cyanoacrylate adhesives were used in conjunction with free tissue corneal patches, air, or Healon in the anterior chamber.²¹⁻²³

In a retrospective study of treatment of corneal perforations, Hirst and associates²⁴ found a trend toward the use of tissue adhesives. In their review, they suggested that tissue adhesives should be favored over other therapies because they decrease the need for general anesthesia and have a lesser rate of enucleation (6% with tissue adhesives vs 19% with other techniques). The visual results in the group of patients with tissue adhesives were better (29% obtained vision of 6/60 or better) than those in the group with other treatments (19% obtained 6/60 vision or better).

Later, Weiss and associates²⁵ reported the results of 80 cases of corneal diseases treated with tissue adhesives. Forty-four percent of their patients healed with tissue adhesives alone.

PATIENTS AND METHODS

All in-patients' records with the diagnosis of descemetocoele or perforation, treated in the Cornea Service at Wills Eye Hospital from January 1978 through December 1982, were reviewed. All these patients had been admitted to the hospital for therapy because of large descemetocoeles with threatened perforation, or perforations large enough to suggest the need for PKP. Thus, patients treated in an ambulatory fashion were excluded. These findings were cross-checked for patients with the same diagnosis against the operating room records and the ophthalmic pathology department records. Information from patients who were followed by referring ophthalmologists after our treatment at Wills Eye Hospital was obtained directly through a mailed questionnaire.

The data gathered included age, sex, previous medical or surgical therapy, preexisting ocular diseases conducive to or associated with descemetocoele or perforation, medical or surgical treatment, pretherapy and posttherapy visual acuity, and length of follow-up. The results were also analyzed as to whether a therapeutic or visual success was obtained. We considered a successful therapeutic result to be restoration of the anatomical state of the eye, and a visual success to be a corrected vision of 6/30 or better after therapy. In the case of PKP the incidence of successful and failed grafts was also measured.

METHODS OF THERAPY

When a bandage soft contact lens was used, a plano T, B 4, or O 4 lens (Soflens Division, Bausch & Lomb, Rochester, NY) was preferred in conjunction with any topical or systemic therapy required by the patient.

Isobutyl cyanoacrylate (Histoacryl, West Germany) was employed as tissue adhesive. This was applied under topical proparacaine anesthesia after inserting a Barraquer lid speculum. The epithelium was scraped, the area of descemetocoele or perforation was dried with a cellulose sponge, and the tissue adhesive was applied with either a special applicator (Trihawk International Ltd, Montreal, Quebec) or a blunt metal instrument. This was performed in the office or in the operating room depending on the size of the corneal defect, the age of the patient, and the imminence of a PKP. A bandage soft contact lens was usually placed over the glued area.

Conjunctival flaps according to the technique of Gundersen¹ were usually used. Other types of flaps were less frequently employed.²

Lamellar and PKPs in the absence of perforations were performed with our technique described in an earlier study.²⁶ If a perforation was present and the anterior chamber was shallow or flat, the corneal scissors was introduced through the perforation and directed toward the peripheral cornea where the size of the recipient bed had been marked with a trephine. The button was then removed and a donor cornea 0.2 mm larger was sutured with 10-0 interrupted nylon sutures. If a cataract was present it was removed intracapsularly, although extracapsular surgery is now preferred.

RESULTS

A total of 58 eyes from 55 patients were treated for descemetoceles and perforations in this 5-year period. Each eye treated was considered as a separate case. Two patients had a PKP following tissue adhesive, and another keratoplasty had to be repeated because of further perforation. There were 40 perforations and 18 descemetoceles.

The sex distribution was fairly even with 25 males and 33 females. The ages ranged from 9 to 81 years, with a mean of 51.

Table I illustrates the different diagnostic categories. Descemetoceles and perforations following PKPs, postherpetic keratitis, postbacterial or fungal infection scars, rheumatoid arthritis, and traumatic scars made up the majority. The postkeratoplasty category included perforated grafts that had been performed for fungal infiltrates (2), phlyctenular keratitis (2), keratomalacia (2), chemical burns (2), rosacea (1), and unknown causes (2). A number of smaller categories (including neurotrophic keratitis,

TABLE I: UNDERLYING DISEASE IN 58 CASES OF DESCEMETOCELES AND PERFORATIONS

DIAGNOSIS	DESCEMETOCELE	PERFORATION	TOTAL
Postkeratoplasty	3	8	11
Postherpetic keratitis	3	6	9
Postinfection	3	6	9
Rheumatoid arthritis	3	4	7
Trauma	3	3	6
Neurotrophic keratitis	1	3	4
Cicatricial pemphigoid	0	3	3
Phlyctenular keratitis	1	2	3
Miscellaneous	1	5	6
	18	40	58

TABLE II: PREVIOUS THERAPY IN 58 CASES OF DESCEMETOCELES AND PERFORATIONS

THERAPY	DESCEMETOCELE	PERFORATION	TOTAL
Topical antibiotics	7	16	23
Topical steroids	4	13	17
Bandage soft contact lens	1	3	4
Conjunctival flap	1	1	2
Penetrating keratoplasty	0	2	2
Tissue adhesive	0	1	1

mucin deficiency syndromes, and phlyctenular keratitis) composed the rest of the group.

The different therapies used with these patients prior to consultation are shown in Table II. Topical antibiotics and steroids had been used most commonly. Some patients had received several of these medications for long periods of time.

The visual acuity recorded on admission is shown in Table III. Fifty-three or 91.4% of the eyes had vision of less than 6/60.

Our therapeutic approach is described in Table IV. Twelve of 18 descemetocles (66.6%) and 27 of 40 perforations (67.5%) underwent a PKP alone or in combination with cataract extraction. Of the 39 keratoplasties, 22 remained clear (56.4%) until the conclusion of the study. Seventeen grafts failed: 6 failed because of allograft reaction, 3 developed another perforation, 3 had chronic progressive corneal edema, 2 had persistent epithelial and stromal erosions that required a conjunctival flap, and there was 1 case each of herpetic keratouveitis, stromal vascularization of the graft, and expulsive hemorrhage.

Less frequently, tissue adhesives (5 of 58), conjunctival flap (5 of 58), and bandage soft contact lenses (4 of 58) were used in this series of in-patients.

TABLE III: INITIAL VISUAL ACUITY IN 58 CASES OF DESCEMETOCELES AND PERFORATIONS

VISION	DESCEMETOCELE	PERFORATION	TOTAL
HM - CF*	13	30	43
3/60 - 6/60	3	7	10
6/30 - 6/21	1	1	2
6/18 - 6/15	—	—	—
6/12 - 6/6	1	2	3
	18	40	58

*HM = hand motions, CF = counting fingers.

TABLE IV: MEDICAL AND SURGICAL THERAPY IN 58 CASES OF DESCOMETOCELES AND PERFORATIONS

THERAPY	DESCOMETOCELE	PERFORATION	TOTAL
Penetrating keratoplasty (PKP)	8	18	26
PKP and cataract extraction	4	9	13
Tissue adhesives	1	4	5
Conjunctival flap	3	2	5
Bandage soft lens	1	3	4
Lamellar keratoplasty	—	2	2
Enucleation	1	2	3
	18	40	58

Three eyes were ultimately enucleated because of disorganized ocular contents, expulsive hemorrhage, or endophthalmitis.

Thirty-seven of the patients (63.8%) were followed for more than 1 year and 21 (36.2%) for a period ranging from 6 months to 1 year.

The final best corrected visual acuities at the most recent follow-up visit in the 58 patients are shown in Table V. Eight (44.4%) had vision of 6/30 or better in the descemetoceles group. Seventeen (42.5%) in the perforations group achieved 6/30 or better visual acuity.

DISCUSSION

In this series the underlying diseases associated with descemetoceles and perforations are similar to those reported in previous publications. Although their relative importance in each series may vary, infections appear to be the most important underlying factor.^{24,25,27} The different size and location of descemetoceles and perforations in different series prevent comparison of visual acuity before and after therapy.

TABLE V: VISUAL ACUITY AFTER THERAPY IN 58 CASES OF DESCOMETOCELES AND PERFORATIONS

VISION	DESCOMETOCELE	PERFORATION	TOTAL
HM - CF*	6	18	24
3/60 - 6/60	4	5	9
6/30 - 6/21	3	5	8
6/18 - 6/15	2	2	4
6/12 - 6/6	3	7	10
Enucleation	0	3	3
	18	40	58

*HM = hand motions, CF = counting fingers.

From previous studies as well as this one, it can be observed that some therapeutic approaches such as bandage soft contact lenses, patch grafts, and conjunctival flaps are less commonly used.^{24,27} A conjunctival flap was used in 8.0% of cases by Kenyon,²⁷ 10.0% by Hirst and associates,²⁴ and 8.6% by us. We reserve a Gundersen's conjunctival flap mostly for eyes with no visual potential or for corneas that are diffusely thinned and need reinforcement. Smaller flaps may be employed in peripheral descemetoceles with good results. Conjunctival flaps should not be employed in perforated corneas in eyes with good visual potential since a cystic flap may result, with loss of the anterior chamber and further complications.

The literature shows a definite tendency to use tissue adhesives more often as the initial therapy, in up to 80% of cases of perforations.^{24,27} In our series, glue was used in less than 9% of the cases of perforation, mostly because patients in this series reflect larger perforations and descemetoceles, and were treated as in-patients.

In our hands, tissue adhesives have been more rewarding in the treatment of small descemetoceles or perforations (1 to 2 mm). In larger perforations, especially those with necrotic surrounding tissue, we have chosen a PKP as our initial therapy. In such instances, filling the anterior chamber with Healon or occluding the perforation site with a small plug of corneal tissue may facilitate the application of tissue adhesives without damaging the iris or lens.^{21,23} If aqueous is constantly percolating through a perforation, the adhesive will solidify too quickly, and repeated applications may be necessary. The difficulty in employing adhesives is reflected in the literature by a relatively high incidence of regluing: in one series, a mean of 1.5 gluing episodes was needed; in another, one third of the patients glued required an average of 2.6 total treatments/eye.^{24,25} Depending on the size of the perforation and the amount of tissue necrosis, glue application may have to be repeated several times. If such is the case, and to prevent further inflammation and further complication, a PKP should be considered.

It is also important to remember that complications, including infection, may occur following tissue adhesive application, despite the fact that antibacterial properties have been described in cyanoacrylate.¹⁴

Corneal transplants in perforated corneas are technically difficult, and the possibility of injuring other anterior segment structures is always present. Sealing a perforation with tissue adhesive immediately prior to PKP is a useful alternative. Although the anatomical success in our keratoplasty series was high, only 22 of 39 achieved a clear graft; in contrast, more than 85% of clear grafts were obtained in a previous series from

which all emergency corneal transplants were excluded.²⁸ The incidence of graft rejections was almost four times higher in our series (15.4%) than in the previously described series (4.7%). Still, the PKP remains a good initial therapy or the final therapy when other approaches have failed.

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DISCUSSION

DR JOHN W. MCTIGUE. Corneal thinning and descemetocoe formations are not commonly seen by most practitioners. Even in larger, anterior segment referral centers, this type of clinical problem is encountered, on the average, eight to ten times a year. These cases can be extremely difficult to manage and to merely salvage the eye is, in many instances, an achievement.

Doctor Arentsen, in his fine review of the experience at the Wills Eye Hospital, over a 5-year period, in such cases, points out just how desperate these corneal situations can be. Of the 58 eyes considered in the study, 53% or a full 90%, presented with vision of 20/200 or less. Therapeutic modalities ranging from topical tissue adhesive, conjunctival flaps, and bandage soft contact lenses to lamellar and penetrating keratoplasty improved the vision in approximately 20% of these patients. Of particular note is that the course of treatment improved the vision to the 20/40 or better level in ten patients, and this represented a 300% increase in this category. Seven of these ten patients had already undergone perforation of the cornea, thus the final results are all the more remarkable for restoration of this most sensitive level of vision in this grouping of patients.

The use of tissue adhesive in leaking descemetocoeles and smaller perforations, although not without complication, is becoming increasingly popular. It has been largely credited for reducing the enucleation or evisceration rate in these cases by nearly equal amounts of some 15%, both in the series reported from the Wilmer Institute and in that from the University of Minnesota. In the latter study, the use of tissue adhesives alone provided healing of the corneal defect in close to half the cases. It is of great benefit to be able to perform a definitive keratoplasty after the inflammation which usually attends the acute problem is allowed to subside. The reformation of the anterior chamber by such a technique seems to hasten that resolution and, certainly, enhances the surgical procedure while reducing the long-term postoperative complications. We have had considerable success in small descemetocoeles and those that have slit-like leaks which merely "sweat," with the use of bandage contact lenses. These lenses often allow the thinned area to seal and can promote enough cicatrization to require no further measures.

Reports by Yang (*Arch Ophthalmol* 1982; 100:1272-1274), Gelender (*Arch Ophthalmol* 1982; 100:72-76), and others have noted the tendency for certain

patients who may have underlying collagen vascular disease to thin their corneas and form descemetoceles in the postoperative period. This tendency seems to be enhanced by topical steroids and may well be a part of a tear deficiency state. We have been recently impressed by three such cases. One, a 62-year-old woman, who had scleroderma, underwent uncomplicated extracapsular cataract surgery. The eye showed minimal postoperative inflammation and no corneal changes whatsoever 1 week after surgery. The eye appeared with a deep but undercompensated descemetocele on the second visit, 1 week later. The descemetocele was treated with a bandage contact lens alone and vision remains stable at 20/25 with a small corneal irregularity.

The rapidity of onset of these types of corneal problems causes one to be very concerned about detecting, even predicting, their early development and taking appropriate action quickly enough to prevent the usually debilitating outcomes which occur with large descemetoceles and expulsive types of perforation with their sequelae of chronic complication.

One other category of patients with which we have had rather extensive experience in this regard is the patient with Down's syndrome. A long-standing association with the ophthalmology section at St Elizabeth's Hospital in Washington, and my own practice have allowed for examination and long-term follow-up of some 25 patients with this disorder who have developed corneal problems, primarily severe keratoconus, and cataracts. As these individuals survive longer, they tend to develop rather remarkable corneal thinning and a high incidence of descemetocele formations. We have had much success with lamellar keratoplasty to improve corneal clarity, substance, and contour but these patients also have a much greater incidence of postkeratoplasty thinning and re-perforation. It is very important, in my view, that the Down's syndrome patients, who often now live into their third and fourth decades be evaluated regularly for the possible development of early signs of corneal alterations so that their useful vision can be protected.

I want to congratulate Doctors Arentsen, Laibson, and Cohen for their most instructive presentation and for the opportunity to review it and comment upon it.

DR DANIEL M. TAYLOR. I would like to congratulate Doctor Arentsen on his paper. My comments will be largely supportive.

I have been interested in corneal perforations, melting syndromes, and infected ulcers for some 28 years. This began when, as a young corneal surgeon, a Boston ophthalmologist referred to me a patient with a large herpetic perforation and suggested that I carry out the necessary enucleation locally. Instead of enucleating the eye, I had the audacity to perform a penetrating keratoplasty in an effort to salvage the globe. Penetrating keratoplasty at that time remained a controversial procedure even when conditions were optimal and for the management of a perforated ulcer, was almost unheard of. Twenty-eight years later this patient continues to have a clear graft, the endothelial cell count is over 1000 cells/mm², and the visual acuity is correctable to 20/25. In 1959 I reported this

case and stated that emergency penetrating keratoplasty was the treatment of choice for corneal ulcers, for it immediately eliminated the pathology, restored the integrity of the globe, permitted reformation of the anterior chamber, and prevented the formation of diffuse peripheral anterior synechiae and chronic closed angle glaucoma. I hold the same opinion today.

Doctor Arentsen has ably covered all the other treatment modalities for descemetocles and perforations consisting of corneal glue, soft contact lenses, conjunctival flaps, patch grafts, lamellar grafts, etc. I have certainly tried all these methods over the years with varying degrees of success. In general, these more conservative methods tend to be effective in the management of small perforations (1 mm or less). However, the period of treatment is often prolonged and many eyes will ultimately require a penetrating keratoplasty for optical purposes. In addition, the degree of pathology may be too extensive to permit conservative management. Many of these eyes have diffuse corneal necrosis with large perforations (over 3 mm), melting sloughing margins, with or without infection and/or progression to endophthalmitis. Here, for example, is an eye with an overwhelming *Staphylococcus aureus* infection (SLIDE). The cornea is diffusely necrotic to the limbus with two large perforations at 6 and 12 o'clock (over 6 mm), iris prolapse, and underlying endophthalmitis. This eye can only be salvaged with a total penetrating keratoplasty, lens extraction, and vitrectomy (Ocutome). This slide shows the eye at the end of 1 year. The graft is slightly hazy, but the pressure is normal. A secondary optical keratoplasty will be required. Here is a similar example of treatment resistant pseudomonas infection (SLIDE). The entire cornea and a rim of sclera had to be removed and replaced with a 14 mm corneal/scleral graft combined with a trabeculectomy. Since total grafts almost always opacify, it was necessary 1 year later to perform an inside 8 mm optical graft combined with cataract extraction. Five years after the initial reconstructive surgery, this patient has a clear graft and visual acuity of 20/20 with a contact lens. Here is a similar case demonstration with an alpha-streptococcal ulceration, perforation, and endophthalmitis that was treated in the identical fashion and maintains a clear graft after 5 years (SLIDE).

Other eyes with end stage pemphigus, xerosis, lye burns, etc, have undergone spontaneous evisceration and are pre-phthical. However, even under these circumstances, if light perception remains, it may be possible to salvage the globe through heroic reconstructive surgery. This slide demonstrates a postherpetic zoster melting syndrome with a 10 mm perforation and a totally collapsed globe with loss of over 90% of the vitreous. The remaining scleral shell is carefully stretched out on a fleiringa ring. A small rim of necrotic cornea extending to the sclera is all that remains and the ciliary processes are easily visible in several areas. The retina remains attached and there is accurate light projection but no remaining vitreous. This slide shows the eye 9 months later with a clear total graft with visual acuity of 20/300.

The final slide series demonstrates a one-eyed patient with an end stage perforated lye burn with a collapsed globe. Several total grafts were performed to salvage the globe followed by a 24 mm overlay full thickness lamellar corneal/

scleral graft and trabeculectomy to form a stable bed and finally a through and through keratoprosthesis with overlying periostial graft. This patient is still able to read large print 5 years after the keratoprosthesis insertion.

These case demonstrations were obviously extreme examples that could only respond to heroic reconstructive keratoplasty and multiple procedures. However, even with the small simple corneal perforations and descemetoceles, it is still my opinion after 28 years of experience that a quick penetrating keratoplasty can save a great deal of time and produce the best overall results. I am not opposed to anything that Doctor Arentsen has presented in his paper, but would encourage him to be a little more aggressive with some of his more desperate cases.

DR DONALD J. DOUGHMAN. We have recently had five cases of corneal perforation treated with lamellar keratoplasty in which we used the Hessburg-Baron suction trephine, a new disposable, which is applied to the corneal surface by a suction ring. This trephine was designed specifically for a perforated cornea and certainly indicated in such a situation. However, we like the trephine so much we use it in almost all of our transplants. It allows one to carefully trephine the cornea down to the level of Descemet's membrane. This has been useful in corneal perforations since, I feel, by retaining recipient Descemet's membrane we can prevent post-operative synechia formation to the wound. After removing the host cornea, leaving Descemet's membrane, we put a full thickness viable donor cornea in these deep lamellar beds. Three of the five grafts have remained clear and see 20/50 or better. They have the appearance of a double anterior chamber due to the retention of host Descemet's membrane. This allows us to do a deep lamellar keratoplasty with viable corneal tissue. Patients regain vision and synechiae to the graft edge is prevented by retained recipient Descemet's. I wonder if Doctor Arentsen has had any experience with this trephine and can comment on this approach.

DR ALEXANDER R. IRVINE. I would like to state to Doctor Arentsen that I was surprised to hear such extensive coverage of this problem with no mention of the technique of the small (usually 4 mm) lamellar patch graft, such as Herb Kaufman has taught and used so effectively in Florida. Especially since I see that the next paper coming up on the program concerns glycerine-preserved corneas, and such lamellar patch grafts are the most common reason for which we use glycerine-preserved corneas at the University of California. We find that most small perforations can be fixed with a lamellar patch graft and the beauty of this technique is that, once the lamellar patch graft is done properly, you are through and you don't have problems with glue falling off and needing reapplication, late full thickness graft failure, or anything else. I just wondered if that is a technique that has disappeared from general use. If so, I think it is a shame, for many of these patients end up seeing extremely well, even when it seems that the scar of the lamellar patch comes almost into the visual axis.

DR CLEMENT McCULLOCH. We have had the glue for many years in Canada and so

we've had years of experience with it. For some reason, it may be geographic, we see a lot of corneas melt and over the course of time I have developed a feeling for these cases. The cases show a corneal pit. It is not a bacterial problem. There is a haze in the stroma in front of Descemet's membrane which Doctor Taylor's photographs showed nicely. Putting a little Histoacryl glue on will cause the base of the ulcer to fibrose and become firm, with a nice result. If there is a descemetocele bulging forward and there is no stroma ahead of it, the best thing to do is to put a tiny bit of glue in the pit, which basically protects the eye, then wait a few days until everything seems quiet, and then go ahead and do a keratoplasty. If you don't put the glue in when you do the keratoplasty and are pressing with the trephine, the descemetocele will break, making the operation more difficult. If there is a slit perforation, put the glue on, let the anterior chamber reform, wait a few days until the eye has reestablished itself, and then go ahead and do a keratoplasty. If you have a bare Descemet's and you put the glue on, you may think fibrous tissue has formed behind the glue. I don't think it usually will, when the glue finally falls off the hole will be there.

DR JAMES H. ELLIOTT. I certainly enjoyed the paper Doctor Arentsen presented very much. I had one question and a couple of comments. In my experience with penetrating keratoplasty, there are three poor prognostic categories. The first one is recurrent herpes simplex keratitis where initially the results look extremely good and as you follow these patients 2 to 5 years postoperatively, many have graft rejection with total corneal clouding and a few may have a catastrophic visual result due to perforation and subsequent loss of the eye. The second one is alkali burns of the cornea and the third one is dry eyes. My question, Doctor Arentsen, is, can you expand on these prognostic categories and explain if there is any difference in your results between these three unfavorable categories and the results of your total series of hopeless cases which I recall was about 50%. I've gotten to the point where in treating perforations and descemetoceles in the above three poor prognostic categories, I avoid penetrating keratoplasty almost with a passion.

DR JUAN ARENTSEN. I don't think I have enough time. First of all, I am really happy that I raised so much discussion, and I was really ready to be killed. I was told never to give a paper like this in a conservative society but I can see that some of you are much more radical. Let me answer Doctor Elliott's question to begin. I think that herpes, in our hands at least and in most studies that I know, has a very good prognosis with corneal transplantation no matter what kind of keratitis the patient had, once it has been controlled and the patient is off medications. I have stopped a long time ago doing keratoprostheses in alkali burns. I used to do keratoprostheses in these patients but I have stopped that mostly because of their social environment. I had a patient that I operated on and as he walked out of the hospital someone was waiting for him and that was the end of the prosthesis.

Dry eyes have a good prognosis with keratoplasty, except for those with benign ocular pemphigoid or Stevens-Johnson's; we don't do keratoplasties in those

either. Doctor McTigue showed something very important that we see very often today and that is the use of steroids in dry eyes on patients after cataract extraction. We do so many cataracts today but sometimes we forget to check the Schirmer's test on patients with rheumatoid arthritis who will perforate in a very typical way as shown by Brown many years ago. Down's syndrome patients may have perforations after they develop hydrops and that is another indication for keratoplasty; we didn't have any of these in our series.

Doctor Taylor has to teach me how to be more radical in my surgery and he showed something very important. If we have active necrosis of the stroma, we can spend some time using glue and soft lenses as long as we see that the cornea is healing. Doctor Doughman, who is very well known for his studies in cyanoacrylate described a keratoplasty technique with a newer pneumatic trephine. We don't have this one at Wills Eye Hospital, but a good way to do that for those who don't practice in one of the big hospitals is to mark the cornea with fluorescein and then with the scissors go through the perforation very carefully toward the periphery in the direction of the mark in the epithelium and cut the button. It's hard to do but it can be done. Finally, to answer Doctor Irvine regarding lamellar keratoplasty. Since most of our patients were already perforated and all the descemetocèles were leaking or were very large ones we chose penetrating keratoplasty as our initial therapy. Even if they reject the graft later it doesn't matter as far as vision, if they are peripheral. If it's a very small descemetocèle, yes, a lamellar keratoplasty can be used.