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SOME OBSERVATIONS ON THE CAUSATION AND ELIMINATION OF SATTLER'S VEIL*

BY

H. TREISSMAN

LONDON

IN reading this paper, I lay no claim to any new or original theory on the causation of corneal veiling. On the contrary, it is my opinion that there has been too much theorising on this subject and all too little attention paid to the practical side of the subject of fitting with which, I believe, the causes of veiling are inextricably bound up. My aim in this address, therefore, will be to impart my views on the commoner errors in *fitting* which I have found to be constantly present in those cases in which veiling occurs to any appreciable extent. In doing this I shall appear firstly to be departing from the main subject of this paper, namely, corneal veiling; and secondly, to be making an attack on the methods of fitting of certain other practitioners and other types of lenses than moulded lenses. If I convey the latter impression, I offer my apologies in advance and hasten to justify myself on the grounds that, as in all other techniques which aim at precision, there is always a correct and incorrect method of approach.

As a preface to the statements I have to make, I would like to offer some justification for the decided views I hold. I first studied the methods of fitting moulded lenses under Dr. Joseph

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Dallos in 1938. At that time it was not unusual to require as many as 20 fittings and 6 to 12 fitting shells before a satisfactory final lens was obtained. Type-glasses were used as the starting point because the use of negocoll and the methods of moulding in those days gave such unsatisfactory results. Naturally, many prospective contact lens practitioners, finding the moulds so unsatisfactory, and not having had systematic instruction in the methods of modifying and fitting moulded shells, preferred to confine their practice to preformed lenses; and around this latter type of lens, a new and (I think) spurious "science" has grown up. I say this advisedly. Innumerable papers have been read and articles written which have absolutely no *practical* value. The mathematics of contact lenses has been delved into and imposing formulae thrust upon the unfortunate student of the subject, who must surely have formed the impression that he will not be able to fit lenses unless he masters these formulae, which is, of course, quite untrue. There have even been tables and slide-rules devised to give the power of contact lens correction which exactly corresponds to a given spectacle correction, to two decimal places; all this in spite of the fact that vertex distance is by no means the only factor in deciding the contact lens equivalent and that only the very best of technicians can work to such fine limits. It is not uncommon to hear or overhear discussion between contact lens practitioners as to the overall dimensions of the lenses they fit, their attention being directed toward a comparison with the dimensions of one colleague's lenses rather than a comparison of the lens with the eye it is meant to fit. All this I mention to show the unfortunate and deplorable tendency to create the spurious and entirely unpractical science to which I have already referred. Throughout the past ten years I have confined my attention to the fitting of moulded lenses and can now claim to be able to fit these lenses in one or two sessions of actual fitting, and to be able to eliminate corneal veiling in my cases. I therefore trust that I shall not be unduly criticised for the expression of decided opinions on this subject.

Among the theories put forward to explain the phenomenon of corneal veiling by contact lenses are that it is due to:

1. Embarrassment of the limbal circulation.
2. Unsuitability of the buffer solution used—(a) in its crystalloid content and (b) in its pH.
3. Interference with gaseous interchange at the cornea.

The matter of circulatory embarrassment was soon disposed of by providing what was considered adequate limbal clearance. Indeed, in certain quarters, limbal clearance is carried, as a

routine practice, to such an extreme that the bearing area of the scleral portion of the lens is reduced very materially and the optic occupies almost the entire lens. And still veiling occurs. It is hardly surprising, therefore, that the attention of investigators is so steadfastly turned in other directions in an endeavour to solve the problem of misting. It is in this latter departure that, in my view, the mistake lies. Exhaustive research in this country, and by whole teams of investigators in the United States of America, have led only to the conclusion that (1) the pH of the buffer solution undergoes a change towards the acid side by prolonged contact with the cornea (which, incidentally, should never be the case in a well-fitting lens), and (2) that wearers of contact lenses must conduct their own investigations into the optimum solution for their own particular needs. All this is leading exactly nowhere but is serving to make the wearing of contact lenses a subject of ever-increasing burden and complexity, whereas it should, after all these years, have been greatly simplified. The one line of investigation which calls for skill rather than science has been culpably neglected.

With reference to the rôle played by the buffer solution in causing irritation or veiling, or both, it appears to me to be wasted effort to investigate this matter because, undeniably, in a good contact lens the buffer solution should be entirely replaced by the tears in 15 to 20 minutes. This can be demonstrated quite easily and I shall undertake such a demonstration with pleasure whenever called upon to do so.

If the wearing of a contact lens were to cause misting by interference with gaseous interchange, why is misting not present on waking from sleep or after prolonged unconsciousness? I will not dispute the observation that prolonged contact of buffer solution with the cornea results in its absorption of CO_2 and consequent change in its pH. But, as I have already stated, such prolonged contact is certain evidence that the lens is unfit to be worn.

During the past three years I have made careful examinations in my practice of all lenses which have caused misting, and have compared them with those which were known to give rise to little or no veiling. Each lens was carefully palpated as well as examined *in situ*. Many of my colleagues, when handed a lens, will reach into their pockets for a vernier with which to measure the overall diameter and learn absolutely nothing about the lens except that it is larger or smaller than those he is able to fit. When I am handed a lens, I run my finger over the inner surface of the scleral portion and I derive much useful information about the lens and about the practitioner who fitted it. Every one of

the lenses which caused veiling exhibited one or more of the defects which I am about to describe, and when these defects were, for experimental reasons, only partly corrected, there was a partial improvement as evidenced by the ability to be worn for longer periods without misting and with less discomfort. Further correction of the defect led to further clinical improvement, and finally their complete eradication made trouble-free wear possible for twelve hours or longer. I shall now proceed to an account of the ways in which contact lenses may, in fitting badly, give rise to corneal veiling, and I propose first to touch briefly upon preformed lenses.

The original Zeiss-type lens must, of necessity, have a narrow haptic and consequently a small area of actual contact with the eye. Since the stability of a contact lens depends primarily on

the capillary action of the film of fluid between it and the eye, it follows that a lens with a narrow scleral segment will be relatively unstable in accompanying the movements of the eye. It has therefore been, and still is, the custom to keep these lenses tight at the periphery in order to reduce their mobility (Fig. 1). This has the double effect of creating circulatory obstruction and imprisoning the buffer solution so that the original solution may be retained in the precorneal space for the whole period of wear. Its pH is thus liable to considerable change, due to absorption of CO_2 . I am neither supporting nor refuting the suggestion that changes in the pH of the precorneal fluid play any part in veiling, but a stagnant pocket of fluid, in prolonged contact with the cornea, is decidedly unphysiological and is to be avoided, quite apart from the indication it gives of bad fitting.

Now, because of the narrowness of the scleral portion of the Zeiss lens, the method of dry fitting is not easy to apply and

the otherwise less satisfactory fluorescein method must be substituted. I maintain that the fluorescein method, often unreliable, is particularly unreliable at the corneo-scleral junction, and in an effort to avoid fitting a peripherally tight lens and its attendant

consequences, it is a very easy matter to swing to the other extreme and fit a shallow lens (Fig. 2). Clinically the results may be identical with those described above, except that the zone of circulatory embarrassment is moved to the corneo-scleral junction and impairs not so much the circulation itself as the process of

drainage of the corneal fluid into the bloodstream. The effect on the cornea will be much the same and stagnation of the precorneal fluid also occurs. It may be argued that the final limbal clearance given by the technician will eliminate this, but it serves only to move the ring of contact a fraction farther out.

Let us now pass on to consideration of moulded lenses and turn our attention first to a study of the plaster cast obtained from an average good mould (Fig. 3). The corneal portion and a

zone 5 to 8 mm. wide immediately surrounding it will be a fairly accurate representation of the corresponding parts of the eye. But in the vast majority of cases the peripheral part of the cast will show elevations caused by folds of the conjunctiva of the fornices. Even when special measures are taken to avoid such folds, and the resulting cast appears to be free from them, careful inspection under oblique illumination will reveal some elevation at the periphery. There is likewise a very constant narrow elevation immediately around the corneal portion. The almost constant presence of this annular eminence, which has no visible counterpart on the eye itself, is of the first importance in the study of corneal veiling, for it can only be produced by heaping up of the conjunctiva in this region, and it indicates that either by swelling or by mechanical movement of the conjunctiva, or both, there is a noticeable tendency for the conjunctiva to move towards the limbus even in the very short time and very light pressure involved in the taking of a mould. This matter will presently be mentioned more fully. Before the plaster cast is sent to the technician, it should, of course, be modified to remove the elevations and restore continuity with the normal curve of the more central portion of the cast, both in the antero-posterior plane and in the frontal plane, making due allowance for the usual prominence found in the upper temporal quadrant, and for the upper and lower nasal "shoulders" consequent upon the more or less sudden transition from a lesser to a greater steepness of the scleral curve on the nasal side. If modification of the plaster cast is skilfully and adequately carried out, there is no reason why a shell made from it should need more than smoothing on its inner surface to effect successful fitting. The arrival at this happy stage in one or two sessions of fitting should not be the result of a fluke, nor need it provide occasion for celebration. It should and can be a consistent occurrence. The usual failing is to remove too little or none at all of the redundant plaster surface, and then to assume that the resulting shell is ready for finishing.

An inadequately modified plaster cast will yield a shell like that illustrated in Fig. 4. That portion of the shell between A and B or between C and D will follow the contour of the eye, whilst beyond B and D the shell will stand away from the eye. Now, the pressure of the lids on the loose periphery of the shell will cause heavy contact in the accurately fitting circum-corneal zone. We are now faced with two alternatives. If the periphery is very loose, the plaster should be further modified and another shell requested. If, on the other hand, the periphery is not very loose, the correct curve can be extended throughout by grinding

away the more central zone of the shell. This has the double advantage of saving a second shell and of reducing the *corneal* clearance created by the technician when the inner corneal surface was given a uniform radius of curvature. The process of grinding down the inner scleral surface must be carried *right through to the margin of the corneal portion*. Usually this is

not done, and the result is that an annular "lip" (Fig. 5, L, L₁) remains so close to the corneo-scleral junction, when the lens is *in situ*, that no blanching is seen, nor will it be revealed by the use of fluorescein. It can, however, be discovered by passing the finger over the inner surface *from the periphery towards the centre* (a lip can always be felt if the finger is passed in the reverse direction), and by the process of dry fitting. Again, it may be argued that the lip will be removed when the limbal transition is made by the technician, but this is not necessarily so. If the lip is wide, as it might easily be, polishing the limbus will merely move the summit of the lip farther out (compare Figs. 6 and 7).

The effect of retention of this annular lip is, amongst other things, to set up the identical set of circumstances already

described in connection with preformed lenses, namely, circulatory embarrassment and stagnation of the precorneal fluid. Compare Figs. 8 and 9. With a well-fitting lens there should be capillary clearance over the whole of the surface (except where there is limbal clearance), and the capillary film of fluid should be in a constant process of replacement by the tears, so that the physico-chemical relationship between the cornea and the precorneal fluid is as near the normal as it could possibly be with a lens *in situ*. If, on the other hand, the lens has a "lip," as in Fig. 9, the first effect will be to cause the lens to stand off, and capillary clearance no longer exists anywhere. Later, pressure of the lids causes indentation of the eyeball, circulatory obstruction and closure of the precorneal space, so that the precorneal fluid stagnates. So consistently have I found this set of circumstances when veiling was present that, for ease of reference, I would like to name it. I would like to call it "**choked cornea**," The term is hardly less scientific than "choked disc," and I feel that the two conditions are not entirely dissimilar in their pathology despite their different aetiology.

There is yet another way in which "choked cornea" may be induced, even when no annular lip is present. Let us suppose that a lens has been completed which fits the eye perfectly, and in which there is limbal clearance which, at the time of final fitting, is considered adequate. And let us suppose also that the patient's conjunctiva is thick (as often happens) and tends to swell

readily with every stimulus. We have already seen that the mere insertion of the moulding shell into the conjunctival sac causes slight heaping-up of the conjunctiva around the cornea. Whether this is the mechanical shifting due to the very slight pressure involved, or due to swelling in reaction to the foreign body, is

immaterial, because both these factors are present when the lens is worn. But if these factors, operating for several minutes, can cause sufficient heaping of the conjunctiva in this situation to be seen easily on the mould and plaster cast, how much more so will it occur after one or two hours of heavier pressure? The important point is that the conjunctiva *does* swell very con-

siderably in many patients after a period of wear which varies with the individual case. It first becomes compressed against the scleral part of the lens, cutting off circulation of the tears through the precorneal space. It then spreads outwards and inwards, the latter movement filling up the limbal clearance and, probably, raising the pressure in the precorneal fluid. Later still, pressure of the conjunctiva on the globe will embarrass

the limbal clearance (compare Figs. 9 and 11). So once again we find all the requirements for the inducement of choked cornea. This will not be discovered unless the wearer is seen when the lenses are being worn and have been worn for a sufficient length of time to set up these conditions. It will not be readily discovered

even then unless the lens is lifted carefully from its seat without actually removing it from the eye. To remove the lens straight away in order to re-insert it with fluorescein will mean the loss of all the evidence. If the wearer attends without having worn the lenses for the time requisite to set up misting, and the

lenses are inserted at the time of examination, nothing at all will be found to account for the veiling, and the practitioner's attention will once again be directed towards consideration of the suitability of the buffer solution. The unfortunate patient will be sent away with yet another bottle of buffer solution to start the process of self-investigation *de novo*. Or recourse may be had to fenestration

as an easy way out of the difficulty. What an admission of bewilderment and failure this is!

It is my firm conviction that the set of circumstances to which I have referred as "choked cornea" is primarily responsible for setting up corneal veiling, and that the varying degrees of severity experienced are dependent on whether one or more defects are present in any given case. My conclusions may be summarised as follows:

Corneal misting is due to:

- (a) Annular pressure on the globe by a "lip" or by excessive swelling of the conjunctiva.
- (b) Stagnation of the precorneal fluid, especially when there is excessive corneal clearance.

When (a) is present, (b) is present also, and the result is veiling and intolerance.

- (c) Excessive corneal clearance alone, *i.e.*, in the absence of any other defect, may cause veiling without discomfort because complete replacement of the precorneal fluid by the tears is a much slower process than when a capillary film of fluid is present. The fluid is thus exposed to absorption of CO_2 to a greater extent than would otherwise be the case.

This paper would not be complete without some reference to fenestration. I have no personal experience of fenestration in my cases because I have not had to resort to it. But I have, on many occasions, discussed it with colleagues, and have examined patients wearing fenestrated lenses. It would appear that in the early days of fenestration this procedure was applied to cases of severe and early veiling and, as is the case with all new and spectacular measures, the results were so startling that it was soon adopted by many as a routine practice. It is not surprising that such a simple method of overcoming the most difficult problem which besets contact lens fitters should soon become universally adopted. It served, however, more than any other single factor, to divert attention from the main subject of fitting, for if fenestration eliminates both veiling and discomfort, what else matters very much? This was followed by a fallacious line of reasoning. If one fenestration is good, two must be twice as good. And before very long we were to see or read of lenses with as many as twelve fenestrations, and what began as a contact lens ended by looking something like the top of a sugar castor. It was even stated that the tears would enter the precorneal space through certain openings and leave it *via* others. All that appeared to be missing were the sign posts which would ensure that the tears would follow the prescribed route! Such is

the nonsense which has been spoken, written and practised in the sphere of contact lens fitting. Obviously, when conditions illustrated in Figs. 9 and 11 exist, the drilling of a hole at the limbus will relieve the stagnation of the precorneal fluid and a certain amount of the circulatory embarrassment. Two or more holes will relieve the circulatory obstruction more effectively. But fenestration does not eradicate the underlying defects; on the contrary it diverts all attention from them and, in addition, introduces other evils hardly less distressing to the wearer than the misting. Add to all this the reluctant admission that fenestration does not always entirely eliminate veiling and we have all the data necessary to assess its true value. I now feel entirely justified in my persistent refusal to introduce this measure into my practice.

I will end this paper with a plea for more rationalism. Contact lens fitting primarily is an art and to a much less extent a science. To obtain, as nearly as possible, uniformly satisfactory results, one must fit lenses as *large as possible* consistent with free movement of the eye and this means moulded lenses, with capillary clearance *everywhere* except for adequate limbal clearance. This cannot be learned even from the finest text-books, but calls for patience and training under good supervision. There's the rub. So many prospective practitioners cannot, for economic or other reasons, take the necessary instruction, not realising that, once mastered, the technique of fitting this type of lens is so simple and satisfactory that they would not subsequently fit any other type. But it is so much easier, at first, to fit preformed lenses by following written instructions in a book, and the results are at least as good as those obtained with "moulded" lenses as fitted by the uninstructed. So we find that almost all contact lenses nowadays are either the Zeiss type (these are, surprisingly enough, still being supplied to patients!) or unsatisfactorily fitting "moulded" lenses, or the hybrid "modified" preformed lenses. Learned papers are read which are of academic value only, and a spurious science is growing up which is leading exactly nowhere. The reputation of contact lenses is, so far as the wearing public is concerned, rapidly going downhill, as it appears already to have done in the U.S.A., where all these unfortunate tendencies have been further complicated by the inherent dislike of any procedure calling for individual attention, and where the urge to mass-produce has given rise to the cone lens, the special curve lens and now the corneal lens. All these have had or will have their day, until it will no longer be possible to sustain the extravagant claims made for them. Only the properly fitted moulded lens will continue to give comfortable trouble-free wear and to maintain its well-earned reputation. It has been argued that these

lenses are too expensive to be available to the mass of prospective wearers and that some less expensive lens is needed. This argument is raised in support of the makeshift lenses which I condemn. My reply is that these lenses are no less expensive, either because their cost cannot or *will* not be reduced. It appears to me that the only way of making satisfactory moulded lenses available at the minimum cost is to have as many practitioners as possible who are trained to fit these in the minimum number of sessions of actual fitting. One could not hope to mass-produce dentures in order to reduce their cost. Why should we expect to achieve this in the realm of contact lens work?

Summary

Corneal veiling must not be treated as an isolated symptom but is inevitably bound up with the subject of fitting. It is due to defects in fitting which give rise to circulatory obstruction of varying degrees of severity, or to stagnation of the precorneal fluid, or to both. Stagnation of the precorneal fluid alone will give rise to slight veiling without intolerance, the veiling being usually only noticed in artificial light. When combined with circulatory embarrassment, veiling is more severe and is accompanied by irritability and intolerance. The remedy lies in correcting or avoiding the defects, not in relieving their consequences by drilling holes in the lens. All the untoward symptoms associated with contact lenses, veiling included, can be avoided by bringing the practice of fitting out of the academic and theoretical clouds down to solid earth.

A PRELIMINARY NOTE ON A NEW METHOD OF FIXING CORNEAL GRAFTS

BY

C. A. PITTAR

AUCKLAND, NEW ZEALAND

I DID not intend to publish this small work until I had sufficient cases to demonstrate its usefulness or otherwise. With the present lack of donor grafting material in New Zealand, however, opportunity for these operations is infrequent; and as the method appeared so successful in the cases I have done, I decided to make this preliminary note.

In 1941 this method first occurred to me while considering the