

RETINAL DETACHMENT AND TRAUMA

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As Parsons succinctly puts it, "The exact mechanism of detachment is not completely understood; indeed, detachment of the retina is still one of the difficult problems of pathology." In other words, since we do not know how a detachment is produced, its relation to trauma must remain vague. Nevertheless, one cannot but be struck how generally the thesis of a traumatic etiology is accepted. For some time I have noted, in examining patients with retinal detachment, how rarely this condition has a traumatic origin, and it is this finding that has led me to review 400 successive cases which I have had the opportunity to examine.

These 400 cases can be classified as follows*:

	<i>Per Cent.</i>	
Myopia.....	202	50
Trauma (direct, 32; indirect, 20).....	52	12
Hemorrhage (vitreous and retinal).....	21	..
Aphakia (extracapsular, 23; intracapsular, 7; dis- cission, 7).....	37	9
Bilateral.....	58	14

The myopias were represented in the groups as follows:

	<i>Per Cent.</i>	
Trauma, direct.....	10 in 32	33
Trauma, indirect.....	15 in 20	75
Aphakia, extracapsular.....	11 in 23	45
Aphakia, intracapsular.....	1 in 7	14
Bilateral.....	32 in 58	55

Myopia was over 10 D. in 25 per cent., from 5 to 10 D. in 43 per cent., and up to 5 D. in 33 per cent. The danger of detachment gradually increases with the degree of the myopia

* These figures do not add up to 400, as the number of hypermetropes was omitted, and in a considerable number of cases the refraction was not listed. The real number of myopes is unquestionably much greater than 202.

up to a certain point, and is greatest between 8 to 16 D. of myopia. Detachments occur with the greatest frequency between forty-five and sixty years of age, when nutritional disturbances occur in the ocular tissues. The incidence of trauma decreases as myopia increases. Direct injury is more frequent in hypermetropic eyes than indirect injury. Spontaneous detachment is the rule in myopia.

It seems reasonable to divide traumatic detachments into those which occur in previously healthy eyes and those which occur in previously defective eyes, and the trauma into direct and indirect. The traumas in this series of cases were of the same nature as are those usually listed in the literature.

Direct injuries are generally the result of blows directly to the eyeball, as with a ball, in blows with a fist, a stone, or other hard substance. They occur principally in the young. Myopic eyes do not preponderate. The types of lesion are the oral tear and the round or giant hole, but the horseshoe-shaped tear is not observed. Though this injury can best be explained by contrecoup, choroidal ruptures and scleral ruptures are apparently caused by different and probably more severe injuries. Perforating injuries are excluded, as the detachment in these results from lesions of the vitreous following hemorrhage or inflammation.

Indirect traumas include severe blows to the head or body, succussion of the head or body, excessive bodily exertion, as in lifting, severe coughing or violent sneezing, and a group of milder injuries, such as rubbing the eyes with the fingers, lengthy motor or railway trips, splashing of the eye with fluids, extraction of teeth, removal of a foreign body from the cornea, and the like. Such injuries are vague in themselves, and the length of time that elapses between the alleged trauma and the onset of the detachment is most indefinite. In my series of indirect traumas the patient's age was generally above forty, the two youngest each being twenty-nine years old. The refraction was myopic in 15, and hyper-

metropic in four. The type of retinal tear was not characteristic, but there were no oral tears.

There can be no question about the traumatic origin of a detachment in young persons with normal eyes who have suffered a severe injury to the eyeball. The indirect injuries, especially the mild ones, are more difficult to explain. To explain the relation that exists between retinal detachment and an indirect trauma a predisposition on the part of the eye is assumed to be present, and it is believed that, in the presence of certain changes in the eye (predisposition), a mild injury or a sudden circulatory disturbance on muscular exertion may be the determining cause of a detachment that is ready to develop, just as the detachment generally develops without trauma.

This predisposition consists in certain changes in the eye which are found in myopic eyes, and which make these eyes susceptible to retinal detachment. Among these changes is cystoid degeneration of the retina, first described by Leber, and later confirmed by Gonin. This occurs in the external plexiform layer, with changes in the pigment epithelium, suggesting that the choroid is also affected. Clinical signs of inflammation are absent, and a local circulatory disturbance must be considered as a factor. Vogt showed that similar changes, due to nutritional disturbances, occurred in the aging eye, and Hanssen demonstrated tears and other changes in the retina in myopic eyes without detachment.

The vitreous also takes part in this degeneration and undergoes fluidification, shrinkage, and detachment. Gonin, in his microscopic study of eyes with retinal detachment, found the vitreous always shrunken from one-third to one-half of its former size, a finding that has been confirmed by others (Lister, Lindner, and Sallmann). The presence of a vitreous detachment has been recognized clinically by several investigators (Benziger, Pillat, Lindner, Sallmann, and Vogt).

Adhesion of the vitreous framework to the retina occurs in healthy eyes at the vitreous base, and has been observed,

on histologic examination, in places where the vitreous is adherent to the retina, where the greatest changes in the retina exist, and where the hole in the retina is situated. Adhesion of the vitreous to the margin of the hole has been observed by Böck on clinical examination with the slit-lamp.

Finally, as the vitreous body was known to move with movements of the eyeball (Best), a number of investigators believed that this movement could easily cause traction of the retina, and if the retina is weakened, a tear results, and conditions necessary for the development of the detachment are present (Leber, Gonin, Lindner, and others).

If the same histologic findings explain the onset of spontaneous and of traumatic detachment, it is impossible to draw a sharp line between these two types. If vitreous movements are accepted as a factor in the causation of a spontaneous detachment, such movements can all the more explain the mysterious happening after an indirect trauma. Therefore, any condition that will produce vitreous movements can cause a detachment in a predisposed eye. Lindner, however, by his experiments, has shown that it is not just a shaking of the eyeball that produces a detachment, but that the force must be of a rotating or whirling nature. The question naturally arises, under what conditions does the eyeball undergo ocular rotation? It has been suggested that in indirect trauma the patient instinctively makes a rapid protective movement of the eyes whereby the vitreous pulls on the upper half of the retina and causes a rupture of the retina.

Krückmann¹ reports the cases of three young emmetropes who were carrying heavy weights. The weights slipped, their bodies straightened out, and the eyes were forced upward and strongly abducted. On the following day a detachment was present in the lower and temporal quadrant. Krückmann explains this by saying that retinal swelling, following sudden ischemia, similarly to brain swelling, is responsible. The location is explained by action of the inferior oblique, which suddenly contracted during the raising of the eyes. This pro-

duced an aspiration of the sclera, with a vacuum action on the retina. This observer also considered the rôle of muscular action in the development of detachment in cases of indirect trauma. The muscles that come under consideration were the two obliques, as these are the only muscles whose insertion on the sclera covers an area in which retinal tissue is situated directly underneath the sclera and choroid. In the cases just described the inferior oblique muscle was regarded as the active factor. This, according to Krückmann, differs from the tears in the retina which occur in the insertional area of the superior oblique in the myopic eye, and is explained by the uneven traction of the superior oblique muscle due to its peculiar anatomic structure and insertion.

Bartels² has drawn attention to the rôle played by the superior oblique muscle in explaining the prevalence of retinal holes in the superior and temporal quadrant.

MacDonald³ suggested that a hydrodynamic phenomenon may cause a detachment of the retina in those who do heavy lifting. Thus, the transmitted intracranial pressure obstructs the central retinal vein, and the excess fluid from the choroidal exudate and central retinal artery collects in the retina and intraretinal space, and a detachment results.

Walker⁴ raises the interesting question as to why detachment occurred in only one eye when the injury was general, and suggested a reason for the frequency of retinal tears in the upper temporal quadrant. The latter this author explained by the statement that the retina and the upper temporal quadrant was under additional mechanical disadvantage, pressure, and vacuum, as the superior oblique muscle was subjected to peculiar punishment, which was greatest in the eye which was acted on most strongly by its superior oblique in the conjugate positions.

Friedman,⁵ in an article on optic nerve traction as a force in producing retinal detachment, spoke of—(1) the movement of the vitreous in rapid movements of the eye as related to the phenomenon of inertia; and (2) pressure on the globe by

the extra-ocular muscles, such pressure being transmitted to the retina. The latter was suggested by the frequency of tears in the region underlying the superior oblique muscle which was constantly being used in all close work. Friedman concluded that all these factors acted on the retina during ocular rotation, and that the value of the stenopaic goggles was sound.

Perhaps when we learn more about detachment of the retina the question of its relation to indirect trauma will be answered. There are still many problems to be solved. With an appreciation of the significance of the retinal hole, other important features may be overlooked. Some investigators, especially Kümmell, assert that it is not the hole alone which causes detachment, but that changes in the hydrostatic equilibrium between the preretinal and retroretinal spaces, from reduction in vitreous pressure, are important as contributing factors and should not be disregarded. Attention has repeatedly been drawn to the fact that many contusions do not lead to detachment, even in myopic eyes, and that detachment is not observed after strenuous gymnastic exercises, in fractures of the skull, or in war injuries; and that, while severe bodily exertions are common, resulting detachment is unusual. Although the cause of the detachment after indirect trauma is so difficult to determine, the subject cannot be dismissed as irrelevant when such careful observers and scientific investigators as Gonin, Vogt, and Jeandelize are firm believers in the rôle of indirect trauma as a contributing factor in retinal detachment. At the same time, most persons will discover a cause for an accident, especially if compensation enters as a factor. A guiding rule in estimating the validity of these cases would be that the exertion must have been greater than the usual one, and that the symptoms of a detachment should follow promptly. Davidson,⁶ who has had a large experience with compensation claims, states that the association of trauma and detachment could be accepted only when the visual disturbance was complained

of within two days after the injury and if the detachment developed before the end of two weeks.

In reviewing these cases of detachment in relation to trauma two other points become apparent and are worth mentioning. The first is the *bilaterality* of retinal detachment. This occurred in 58 cases, about 14 per cent.; myopia was represented in 32 of these, or 55 per cent. This feature of bilaterality is significant and speaks against a traumatic origin. These cases can be divided into bilateral detachment in juveniles and bilateral detachment in myopes and in the aged. While the detachments are symmetric in the young, in myopes and in the aged there is no symmetry. The cause is general, and the important factor is the local condition present in the eye. In all detachment cases a careful examination of the fellow-eye is always important (Sourdille).

The second point is *detachment in aphakia*. This is a subject about which there is still much to learn. At this time I shall refer only briefly to it. Retinal detachment in aphakic eyes is related to trauma only in its widest sense. Like perforating injuries of the eyeball, there are set in motion changes in the intra-ocular structure, especially in the vitreous, which, after a time, lead to detachment. The aforementioned predisposition and the loss of vitreous at operation are undoubted factors, although the quantity of the vitreous loss is not the essential feature.

Detachment was observed in 37 cases of aphakia in which the extracapsular extraction had been performed in 23, the intracapsular in seven, and a discission in seven. No deductions can be drawn from these figures, especially not as to the relative frequency of detachment after extracapsular and intracapsular extractions. Detachment after operations for congenital or lamellar cataract (discission or needling) occurred in six cases, and in one case the operation was performed for high myopia. Shapland⁷ has drawn attention to the frequency of detachment after discission of soft cataract, in a report on 50 cases of detachment in aphakia, of which

22 were needlings for soft cataract. The detachment occurred after an average interval of 24.6 years. In Shapland's series, in 40 eyes with congenital cataract, detachment occurred in 33. The unfavorable prognosis he ascribed to progressive myopia, and there was no result from the operation for the detachment. Foster Moore⁸ was of the opinion that the removal of a lens, whether by extraction or discission, predisposed the patient to the development of detachment of the retina, and this in no negligible degree. Retinal detachment occurred more frequently after the needling operation for soft cataract, and this was due, Moore believed, to the fact that the prospect of life after this operation was so much longer than after the usual extraction for hard cataract. Moore was so much impressed by the unfavorable prognosis of the needling operation in young patients that he doubted the wisdom of removing both lenses for lamellar cataract unless the opacity was so dense that the eye was of little value if this operation was not performed.

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DISCUSSION

DR. MARK J. SCHOENBERG, New York, N. Y.: Dr. Knapp's paper is outstanding on account of the valuable observations he made on a large number of cases, enabling him to draw reliable conclusions. From the historical point of view it may be appropriate to mention that in this country, as far as I know, the first modern method of operation for retinal detachments—I mean that advocated by Gonin—has been performed at the Herman Knapp Memorial Hospital in 1929.

My experience is based on a few hundred cases of retinal de-

tachment which came under my observation in the past fourteen years. To be brief, I shall limit my remarks to a few of the controversial points contained in Dr. Knapp's paper.

The first difficult point to settle is the one concerning the relationship between retinal detachments and trauma. It is important to consider whether the detachment develops only after a direct trauma to the eyeball, or also after an indirect trauma or a so-called "strain."

Taking the history of my patients, I have made a special effort to get minute details about what, if any, accident or unusual happening occurred not only immediately but also weeks before the appearance of the detachment. My intention was to establish whether I was dealing with a condition in which the factor producing it was to be considered as the sole or only as the precipitating cause.

Of course, most of us would consider a direct blow on the eyeball as sufficient reason for the development of a detachment, but many of us would hesitate to believe that a long trip in a wagon or an automobile, or a bump of the head, a fall, a violent jar of the body, a vibratory treatment of the scalp in a barber shop, prolonged reading, a miss with a golf club (hitting violently the ground instead of the golf ball), lifting a heavy weight, attacks of violent sneezing or coughing, strain in constipation, etc., may also be capable of bringing about a retinal detachment. I am glad to see that Dr. Knapp is inclined to believe that there is such a thing as detachment of the retina, developing after an indirect trauma. I have collected quite a number of such complaints from the histories of my own patients, and I feel that in many cases such complaints should not be brushed aside as trifling or unimportant. Indirect trauma may be at times the precipitating cause, in eyes which have been predisposed to retinal detachment by a disease preceding the trauma, like choroiditis, cystic degeneration of the retina, vitreous degeneration, intraocular foreign bodies, and so on. In 9 per cent. of my own cases complications of this sort have been found. In 11 per cent. of the cases the trauma had been direct on the eyeball. In 45 per cent. there was an indirect trauma, a so-called "strain," like prolonged reading, sneezing, coughing, etc. In about 35 per cent. of the cases there was no history of direct or indirect trauma.

The second controversial point to be discussed is the period of latency which intervenes, at times, between a direct trauma and the appearance of signs and symptoms of the detachment. I be-

lieve that in some cases the signs and even the symptoms of retinal detachment appear weeks and even months after the occurrence of the trauma. Some patients might have had vague symptoms, like seeing flashes or spots, but they would overlook mentioning them to the examiner unless carefully questioned.

Among a number of interesting points suggested by the statistical study of retinal detachments, it is worth mentioning that 22 per cent. of my cases had a low degree of myopia (less than -1 sphere); 16 per cent. had bilateral detachments (very close to the statistics of Dr. Knapp, which is 14 per cent.—of these, 11 per cent. were in males, and only 3 per cent. were in females); and that unilateral detachment prevails in the right eye in the male and in the left eye in the female.

. DR. JOHN H. DUNNINGTON, New York, N. Y.: This very interesting paper of Dr. Knapp's is most instructive. The role of indirect trauma in the production of detachment of the retina is most difficult to ascertain. I agree with Dr. Knapp that this possibility cannot be ignored but I am not in complete accord with Dr. Schoenberg, whose list of indirect traumas includes practically everything one might do from sneezing to reading. From the compensation standpoint it is extremely important to make a notation on the absence or presence of a trauma at the time of the initial examination. This prevents embarrassment when the patient several weeks later thinks of some vague indirect trauma he experienced several months prior to the onset of the detachment. It is my opinion that indirect trauma is of comparatively little importance in the production of detachment of the retina. As Dr. Knapp has pointed out, the frequency with which both eyes are affected is a strong argument against the importance of indirect trauma.

DR. JONAS S. FRIEDENWALD, Baltimore, Md.: I would like to comment on one minor statistical aspect of Dr. Knapp's report. In discussing the frequency of detachment in respect to age, Dr. Knapp pointed out that the age group in which detachments are most frequently seen is the one between forty and sixty, which I think corresponds with the experience of all authors. The implication from this that detachment is less of a risk in those over sixty I think is incorrect, because the proportion of individuals in the community as a whole who are over sixty is steadily decreasing, and if one compares in each age group the incidence of detachment with the incidence of survival of the population, as a whole, one

finds the risk of detachment steadily increases with age as the decades go on. The same I think is also true with respect to the incidence of high myopia among retinal detachments. It is quite true that the most frequent record of detachment cases is in the medium degree of myopia, say between 5 and 15 diopters. That does not, however, imply that the risk of detachment for a person with 20 to 30 diopters of myopia is less than that for a person with 10 diopters, since the frequency of this high myopia is much less.

I would like also to comment on the long interval between injury and the onset of symptoms. No doubt in many cases the onset is within a two-week period, but there are cases, I believe, in which a much longer interval exists, and in which the relationship between the trauma and the detachment is at least very strongly implicated. In this respect I can report a case of a boy of fifteen, a hypermetrope, who was working in an orchard, when a peach fell off a tree and hit him directly in one eye, hit him so hard as to knock him out. He was unconscious for a minute or two. He had no visual symptoms following this except during the immediate few minutes of his recovery, until nine months later when he developed a detachment with an extensive disinsertion of the retina. No other injury occurred during the interval, to his knowledge. Such a severe trauma I think cannot be disregarded as a cause of the detachment, even though the interval may be much longer than we ordinarily suspect it should be.

DR. E. V. L. BROWN, Chicago, Ill.: In the matter of traumas and unilateral and bilateral detachments, I think Krückman's observation is interesting. He reported three cases in which young men were carrying heavy weights over their shoulders. The detachments were all in the left eye. All were carrying the heavy loads up inclines, with their heads down, with a lot of congestion in the neck. One was carrying a basket of dishes, one a pig, and the third a sack of meal as I remember it, and Krückman's explanation is that, with the head down this way, when the load over the shoulder shifted the man made a quick motion upward of the left eye and the inferior rectus pulled the sclera away from the choroid and the retina. He emphasized the fact that the eye turns outward as it goes up. The load over the one shoulder explains the unilaterality in his cases of indirect trauma. Dr. Kronfeld, what year was that?

DR. PETER C. KRONFELD: 1932.

DR. BROWN: That was the time of the report, I believe.

DR. KNAPP, closing: In answer to the question raised by the gentlemen who have been good enough to discuss this paper, I am free to confess that the question of indirect trauma is a riddle, and that undoubtedly the length of time before the condition develops may be a very long one; in other words, the latent period is inexact. I had hoped, however, that some of those who have made a special study of the movements of the eye, and of physiology, would tell us something about the involuntary protective movements of the eye: In what way do they take place, and under what conditions, and furthermore, can increased abdominal or thoracic pressure affect the intercerebral pressure, and in this way influence the circulation of the eye?

SO-CALLED PRIMARY RETINAL TUBERCULOSIS

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The pathologic picture presented with this case report is rare and interesting from the ophthalmic viewpoint. Only two other instances in which the retina itself presented the first evidence of tuberculosis are reported in the literature. The use of the term "primary" refers to the eye, as it is not unusual for tuberculosis to invade the retina by direct extension from the uvea.

There is need for a more exact terminology, especially in a case such as this one here reported, in which a careful general examination failed to reveal a tuberculous focus elsewhere in the body. However, it is not suggested that the tubercle bacilli entered the body and lodged only in the retina, but it was here that the only demonstrable lesion was found. It is interesting to note that the two other cases of so-called primary retinal tuberculosis, reported by O'Sullivan and Story¹ and Hancock,² occurred in apparently healthy individuals.

O'Sullivan and Story, in 1899, reported a similar finding in an otherwise healthy woman aged twenty-one years. The vision was lost overnight, only finger vision remaining. In