

No.	Age	Date	Injury	Operation.	Result.	Size.
(21) G. R.	32	12/22/15	L. Wound of cornea; cut of iris. X-ray F. B. in sclerotic.	Repeated magnet.	Lost eye.	4x3x1 mm.
(22) E. W.	51	3/19/17	Macula. L. cornea and iris, cataract. X-ray shows shadow.	Extracted lens. Tried magnet; no result.	X-ray shows no shadow. V = +4.00 +10.00 cyl. ax. 25° = 20/50.	
(23) B. W.	24		L. Wound nasal side of sclera. Lens cloudy. steel removed by Dr. McConachie.	Removed lens. Eye lost.	F. B. embedded in sclerotic.	2x2x1 mm.
(24) L. T.	53	7/14/05	R. Wound nasal side of sclera. Lens cloudy. steel removed by Dr. McConachie.	Removed lens. Eye lost.	Enucleation.	
(25) C. G. S.	36	8/1/19	L. Wound of cornea and sclerotic.	Extraction thru wound.	Irido-cyclitis. Motion.	10x3x4 mm.
(26) P. M.	30	8/23/19	L.	Post. magnet. Ext. and Inf. rectus.	Motion, vitreous, cloudy.	3x2x1 mm.
(27) M. P.	38	1/21/18	R. Center of cornea, cut, cataract.	Repeated magnet, with negative results.	Cataract needling. Light perception.	
(28) G. W.	20	4/15/17	R. Wound of iris above with F. B. in wound.	Incision of cornea. Small iridectomy.	V = 20/30	3½x1x½ mm.
(29) A. B.	49	5/23/18	R. O. D. One mm. from limbus in cornea on temp. side. Hole in iris; F. B. seen in vitreous.	Magnet incision of ciliary body. Conj. suture.	V = c + 0.75 cyl. ax. 90° = 20/20, 9/23/18.	9x5x2 mm.

an attempt should be made to remove every particle of steel if it is lodged within the eyeball. If the eye is lost we advise enucleation, and especially so if the eye still harbors a foreign body.

We are aware that Col. Lister established very definite rules for extraction by the anterior route, for those cases occurring in the B.E.F.; but certainly

our cases of posterior extraction were more satisfactory than those removed by the anterior route, and in none of our cases did we experience the troublesome detachments reported by some. On the other hand this class of cases can not be handled dogmatically, but each case should be carefully studied with the exercise of one's best surgical judgment.

FUNGUS CONCRETION IN LACRIMAL CANALICULUS (STREPTOTHRICOSIS, ACTINOMYCOSIS.)

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One of these rare cases is here reported with review of the previous literature and the difficulties of cultivating and classifying the fungus in question. Read by invitation before the Pacific Coast Oto-Ophthalmic Society, August 5th, 1919.

There are probably some 70 odd cases recorded in the literature of concretion in the lacrimal canaliculi. Only four of these, so far as I have been able to ascertain, belong to North America, all the rest to Europe. In over ten years of clinical work as instructor in the University of California Medical Department, no instance of this condition was met with. Shortly afterwards I came upon the case here reported.

A woman of 40 years presented herself, October, 1912, for a smooth, half rounded, cylindriceddish, resistant, painless prominence, the size of a small bean; about 3.75 by 1.75 mm., situated over the central portion of the course of one lower canaliculus. There is no discharge from the corresponding punctum on pressure. The affection, of slow continuous growth, has been noticed for more than a year. Patient

has had eye drops prescribed for it by several men. To any one having knowledge of organic concretions occurring in the canaliculi the very presence of the little lump is suggestive.

By slitting the canaliculus in the usual manner with a Weber's knife, a dirty, dark greenish, slightly moist, coherent and nonadherent mass was easily removed therefrom in toto; the canaliculus being there somewhat dilated. The incision healed promptly. The small irregularly rounded substance, the size of a small pea, was easily broken up, by slight pressure between the fingers, into several polygonal bodies with smooth facets after the manner of gall stones. Smears from these proved negative regarding bacteria. Unfortunately, no suitable media being obtainable, cultures were not made. Under the microscope the matter showed a dense uniform network of long mycelial growths, with branches and often enlarged endings. Diagnosis—streptothrix.

I here subjoin the report of Dr. Ernst A. Victors, to whom a large part of the mass had been handed: "Plug from canaliculus, made up of a mass of mycelial network in homogeneous matrix, these are in true branches and end in enlarged extremities rather than in hyphae. Gram positive. No sporangium present, and endoplasm contains spores. Endoplasm encased in tubular sheath. This is not septate. Diagnosis,—mold, of the Hyphomyceta family. Type, streptothrix. I have not been able to make out sub-classification, but it is probably *bovis communis* (actinomycosis)."

Dr. Victor's and my judgment are then agreed on the character of the mold as belonging to streptothrix. The importance of making cultures, however, will become sufficiently apparent, I hope, further on.

The earlier records of this condition are by Cesoni (1670), Sanifors (1779) and Desmarres (1842). It was von Graefe (1) who in 1854, first recognized the organic nature of the mass and who drew a classical picture of its clinical appearance based on ten cases of his own. This description has been

added to since, but has not been altered in the main.

The affection has been met with more commonly in women and, with eleven exceptions, only in the lower canaliculus. The theory of being an occupational disease (agriculture) has not become definitely established. Koster, (2) whose report in 1916 on three cases, all in women, and which I believe, is the latest in the literature, also states expressly that none of these patients had ever followed an occupation supposed to render one prone to the disease. Of the mode of its beginning we have no knowledge. Von Graefe observed that the concretions are apt to be denser and smoother toward the punctum, also being there of a darker and more uniform color, i. e. from a dark gray yellow to greenish as against a brighter varying yellow farther away. From this, he argues, we may perhaps conclude that the spores enter from the conjunctiva and the parts nearest the punctum are the oldest. The supposition that the mold is carried upon or preceded by an awn of grain, etc., which, by lodging in the canaliculus or by vulnerating its wall, would establish the beginning of the concretion, has never been proven. Goldzieher (3) has found in one instance an "eyelash in the midst of the concretion, and Schroeder (4) raises the question whether after all, this might not have been an awn. It certainly is remarkable that the spores, if merely sucked into the punctum by themselves, should not be washed out of the canaliculus with the normal flow of tear fluid.

Further, it is very striking that tho the mucous membrane of the inflamed canaliculus is much stretched, its continuity is quite intact and the mass not adherent to its surroundings. There is only one single case recorded in which a loose connection with the walls could be demonstrated (Schroeder, 4).

It is well here to mention the history (Mitvalsky, 5) of a woman, age 65, who having suffered repeatedly from a relapsing dacryophlegmon of both sides with fistula, presented herself with new swelling of left tear sac of

some months' duration. Mitvalsky removed from the sac a dark greenish mass of about almond size. Diagnosis, actinomycosis.

We read in one history (Blessig, 6) that the growth was observed in the course of a peculiar conjunctivitis with milky, sticky secretion, first in one canaliculus, and some months later, after an apparent complete cure, in the other canaliculus of the same eye. The author believes, therefore, that the spores enter from the conjunctiva. Unfortunately, he does not state whether there were any suspicious mycelia, etc., in the conjunctival secretion. There is yet another history (Kastalsky, 7) where, after removal of a concretion from a lower canaliculus, a new one was found after 20 months in the upper of the same eye. In one single instance (Snegirev, 8) concretions were found in all four canaliculi at the same time.

The growth, clinically observed as large as a hazel-nut, but generally much smaller, does not necessarily obliterate the continuity of the canal completely, and it may be possible to wash fluid thru the tear passage from the canaliculus. According to von Graefe, one may be able to palpate along the canaliculus an induration occupying the thickness of the lid, nearly cylindric, solid and but moderately compressible. Anatomically the contents may be found to consist of several bodies instead of but a single one. Accompanying symptoms in the earlier stages are irritation in the neighborhood, such as reddening of caruncle, lower plica semilunaris, canaliculus and conjunctiva covering lid margin, and subjectively those of an angular catarrh, and later a slight partial ectropium and blennorrhoea of the canaliculus with marked irritative swelling of adjacent parts. It is only within more recent years that in two instances, for the first time, purulent ulcerous affections of the contiguous tissues have been observed.

In the one case (Zur Nedden, 9) a chalazion-like prominence on the lower lid presented itself, on eversion, as semispherical with pus shining thru in

parts. In introducing a Weber's knife into the canaliculus resistance was met with so that the resulting slitting was but incomplete. It was found that the canaliculus was in communication with the purulent thickening of the lower lid. After the incision a small quantity of whitish thick pus escaped containing small granular concretions. The rest was easily scraped off. Healing was complete in 8 days. The aerobic culture yielded a streptothrix species.

The second case (Chesneau, 10) is that of a swelling 7 by 4 mm. in the lower lid touching the upper lid and being ulcerated there. Edges of the ulcer were sharp and of vivid red, its floor granulating and of dirty yellow color. After slitting of the canaliculus into the ulcer, a cavity showed containing an atheromatous mass amidst bloody pus. The walls of the emptied cavity appeared irregularly swollen and bleeding easily. There was prompt healing. Examination of the atheromatous material showed actinomyces hyphae. Cultures unfortunately miscarried.

Whilst in the former case a streptothrix proved less harmless than the whole group has heretofore been looked upon—the actinomyces in the second case (even supposing, without a culture, it to be actinomyces hominis s. bovis), as certainly proved not nearly so destructive as in other localities.

In this connection we must mention that it has been claimed in supposed cases of actinomycosis bovis that the reason the growth does not penetrate the wall of the canaliculus is that it lies within an epithelial canal and is surrounded by tear fluid, the latter being of low nutritive value. It has also been stated by Robert (11) that actinomycosis may take a mild course in other parts, more especially the tongue, nose and pharynx. Furthermore, there is a history in Italian literature by Majocchi (12) of a concretion in the duct of Wharton which resembled our concretion. The surrounding tissues had not been invaded. Unfortunately, Majocchi's argumentation for acti-

nomycosis in his case is not very convincing.

Clinically, from the differential diagnostic standpoint, it is to be noted that only very exceptionally other simulating foreign bodies are found in the canaliculi. Mitvalsky (5) had in one case a copious framework of wheat starch granules. This, then, was a case of pure foreign body inflammation. In another case of the same author's, there was found fatty detritus only. Mitvalsky does consider it not impossible, however, that here molds had been present formerly, and had perished. Axenfeld has seen syphilis of the canaliculus show the same appearance as fungus concretion.

As already alluded to, the concretion becomes darker and brown in course of time, and such ones are harder and less easily removed. In some cases calcification occurs. The mass of mold seems finally to die, when we have a calcareous body surrounded by debris. The microscopic examination by Capellini (13) of these later stages is of special interest. It is summarized by Axenfeld as follows: "The concretions contained calcium monophosphat and carbonat. In the sections a dendritic net-like structure was very evidently produced by radially arranged needle shaped crystals. The most peripheral layers of the individual crystalline masses were stained dark brown. The streptothrix elements were no longer visible; still the concretion had probably developed on such an organic basis."

It seems to be a safe conclusion to assume the dacryoliths of former times were nothing but fungus concretions of the various stages.

Whether there is a spontaneous cure we do not know, since all cases reported have been operated on by slitting of the canaliculus. Eversbusch (14) succeeded in preserving the canaliculus in the following way: Gradual dilatation of the lower canaliculus with differently sized probes was followed by syringing of the upper canaliculus with sublimat 1:10,000 aq. dest. et glycerin. aa, with gradually increasing pressure of piston. The fluid

leaving by the lower punctum helped to loosen the concretion which was located near the exit into the sac. By pressing upon the tear-sac and adjacent parts of the lower canaliculus from without thru the skin and from within from the conjunctiva with two Daviel's spoons, the whole contents were squeezed out by way of the lower punctum. After a further syringing Eversbusch carefully cauterized the depth of the cavity with silver nitrat fused to the point of the conical probe.

The greatest interest attaches to the classification of the mold. This will be realized at once from the statement that in one case at least, the fairly conclusive bacteriologic proof has been given, that in a case clinically not differing in the least from the customary picture, *actinomyces bovis* really seems to have been the pathogenic organism. On the strength of that result, the problem immediately faces us,—why should true actinomycosis in this locality prove so perfectly harmless an occurrence, as against its destructiveness in general surgery? The mere fact of its being in an epithelial canal would hardly seem to offer a sufficient explanation. The fact, then, of a highly pathogenic organism eventually forming intra vitam, a macroscopically sharply defined body, that thruout its existence remains detached from its host, offers, without a doubt, a wonderfully fascinating biologic problem.

It will be possible to take up but briefly the histologic and bacteriologic aspects of the subject. For a classical exposé of the whole matter those interested may be referred to Axenfeld's *Bacteriology*.

After having been looked upon at first as favus by von Graefe and as lepto-thrix by Cohnheim, Leber and Waldeyer, and also Graefe later on, Cohn's designation as streptothrix Foersteri (in honor of the late Breslau ophthalmologist) had become the name most used in statistics up to 1894. In that year von Schroeder (15) published his findings as actinomycosis, primarily on account of the ray formation present in the typical globular refractile bodies met with in his two

cases. It must be conceded that the diagnosis of actinomycosis was made here with as much justification as is the case with the general surgeon to whom the microscopic picture is likewise all sufficient, without having recourse to the difficult culture.

Schroeder's communication attracted general attention and a number of cases were thereafter likewise reported as actinomycosis. There has long been a general agreement that *actinomyces hominis* s. *bovis* belongs to the streptothrices, all of which are characterized by their polymorphism. Ray formation may be met with in any of them, but their pathogenicity is very much at variance. If it is preferred to call all ray fungi actinomyces, *actinomyces hominis* s. *bovis* then is one species, and streptothrix another, or rather likely several others, and we may in that sense call the affection actinomycosis.

It would appear more practical, however, to adhere for the present to the term streptothricosis, since Silberschmidt (16) in 1900, first succeeded

by exact culture and experimental work in establishing streptothrices as the cause of the concretions in his cases. The same organism was found conclusively by Axenfeld and Cohn (17). As against these Auerbach (18) in 1902 had positive results in animal experimentation as regards "typical actinomycotic growths." Even in the face of these findings, however, the problem still remains unsolved as to why the clinical picture in this case entirely failed to offer any similarity to true actinomycosis.

In conclusion, let me say that cultures are very difficult to grow. One reason is the great number of other organisms generally present; whilst at the same time streptothrices grow very slowly, as an analogue to the closely related mycobacterium tuberculosis. Axenfeld recommends, therefore, to resort to anaerobic cultivation whereby one frequently would succeed in killing off the accidental organisms. He also recommends acid media. Finally, the age of the concretion tends to militate against success.

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