interesting and somewhat alarming state of affairs (Fig. 5), and a diagnosis of rupture of the bladder was easily made. This was confirmed at laparotomy, as there was a linear tear of the bladder near the dome on the left side. There was no evidence of any associated lower urinary tract obstruction. The laceration of the bladder was repaired, and the bladder was drained with a suprapubic tube. An uneventful convalescence followed. The child is fit and well and is awaiting further urological studies.

**SUMMARY**

A number of unusual lesions affecting the lower urinary tract in children are discussed, including diverticulum of the urethra, duplication of the urethra, diphallus, rupture of the bladder and agenesis of the musculature of the abdominal wall.

**BLEPHARO-SCHISIS CANALICULOTOMY COMBINED WITH DACRYOCYSTORHINOSTOMY**

**AN OPERATIVE PROCEDURE FOR THE TREATMENT OF INFERIOR CANALICULAR DYSFUNCTION**


The term ‘blepharo-schisis canaliculotomy’ is preferred to the broad term ‘canaliculotomy’, which implies the surgical opening of the canaliculus — in most cases the posterior wall. In the ‘3 snip’ operation the canaliculus is opened posteriorly and the triangular posterior section of the lid is removed; this also applies to the other forms of canaliculotomy. When blepharo-schisis canaliculotomy (BSC) is performed, the canaliculus is opened superiorly and the non-ciliated part of the lid is split into two. In this operation this procedure is combined with a dacryocystorhinostomy (BSC with DCR).

Inferior canalicular dysfunction may be due to misplaced or abnormal puncta, or blocking of the canaliculus by atresia, inflammation, neoplasm or a foreign body. This dysfunction may also be associated with an atonic sac, pathology in the nasolacrimal sac and a blocked nasolacrimal duct.

Numerous procedures have been recommended for the repair of inferior canalicular dysfunction:

1. The ‘3 snip’ operation.
2. Intermarginal slitting of the patent medial portion, when the lateral half of the canaliculus is destroyed.
3. Conjunctivo-rhinostomy.
5. Conjunctivo-dacryocystorhinostomy.
6. Removal of the lacrimal gland or cutting of its ducts or afferent nerve supply.

**Physiological and Physical Considerations**

In the passage of tears through the lacrimal apparatus, the following factors have to be taken into consideration:

1. Capillarity of the patent canaliculus.
2. Contractions of the orbicularis muscles, resulting in a pumping effect.

It must be realized that capillarity is part of the wider physical concept known as surface tension. To promote capillary rise — not necessarily vertical rise, but any running of liquid into pores—a small angle of contact between liquid and walls is essential.

In comparing the capillarity of the intact canaliculus with that of the split lid, the former may be regarded as being a capillary tube and the latter as consisting of 2 rectangular surfaces. In both cases the constants are the specific gravity and surface tension of tear fluid, the width of separation of the surfaces and gravity.

**Physical Calculation**

The effect of surface tension acting along the circumference of a canaliculus of diameter 2r and length L, is an upward drawing force of $2\pi rT$. The effect of surface tension acting along the length of a split lid with length L and separation 2r is a drawing force of $2TL$.

$$\text{Ratio of the forces} = \frac{2TL}{2\pi rT} = \frac{\pi r}{2}$$

If $L = 8\text{mm.}$ and $2r = 0.1\text{mm.}$, (the internal diameter of the canaliculus and the width of separation of the split lid respectively), then $\pi r = 3.14 \times 0.05 = 0.157$ approx. 50

It will be seen from the above calculation, that 50 times as much tear fluid will be drawn into the split lid as compared with the intact canaliculus.

**RADIOLOGY**

The technique for this examination is based on the method used and reported by Epstein and Denny. This method entails the dropping of the contrast medium into the eye rather than forceful injection into the lacrimal duct. It is felt that the former procedure is a more
physiological method of investigation and is less likely to lead to a fallacious demonstration of an occluded duct. The contrast medium is often Urografin 76%. It is easily visualized on an image intensifier or closed-circuit television system. Epstein and Denny initially employed a 5-inch intensifier, and registration was by 16-mm. X-ray cinematography. The subsequent use of a 9-inch intensifier precludes the use of cinematography, as detail registration on the 9-inch intensifier is less well defined than on the 5-inch one. Spot filming of 70 mm., however, produces an adequate registration of the contrast medium and at a considerably reduced dosage. The reproductions in this paper are based on 70-mm. registration. Demonstration of the duct postoperatively is usually not possible due to the rapid diffusion of contrast medium into the nasal cavity through the fistula.

Failure to fill the duct in the pre-operative case by the normal physiological method of dropping contrast media into the eye should be followed by cannulization and injection under pressure.

**CASE REPORTS**

**Case 1**
Mrs. W.W., aged 50 years, was first seen on 10 May 1965. She complained of a watering and gummed-up right eye, which had been troubling her for the past 3 years. She had had repeated syringings and probings, without relief of her symptoms. Previous X-rays of the skull were apparently normal. Otorhinological examination could not demonstrate abnormality of the nasal cavities or sinuses.

On 10 May 1965 the lower canaliculus was syringed. Clear fluid was returned through the upper punctum, and no fluid passed into the nasal cavity.

On 14 May 1965 a dacryocystography was performed (M.B.M.D.). After cannulization of the inferior canaliculus, no flow of dye into the sac or nasolacrimal duct could be demonstrated. Reflux into the conjunctiva was demonstrated and cannulization of the superior canaliculus resulted in filling of the sac and free flow through the nasolacrimal duct into the nose. There was a further posteromedial extension of the dye from the sac, suggesting diverticulation.

It could therefore be concluded that (i) the nasolacrimal duct was patent provided the superior canaliculus was cannulated; (ii) there was an obstruction to flow with cannulization of the inferior canaliculus; and (iii) there was a suggestion of diverticulum arising from the posterior and medial aspect of the sac. A diagnosis of inferior canicular dysfunction with diverticulum formation, the latter probably traumatic in origin (i.e. due to repeated probings), was made.

On 21 August 1965 a right dacryocystorhinostomy was performed, using a modified Fasanella technique (described later). With the exception of a Flaxedil sensitivity, the immediate postoperative period was uneventful.

On 7 September 1965 the patient accidentally pulled the upper loop of the polythene tubing and split the non-ciliated portion of the lid, resulting in a canaliculo-blepharo-schisis. The tube was removed 3 days later. On 14 September 1965 the patient was successfully syringed through the stomal opening lying in the medial end of the ‘gutter’. Later she noticed that occasionally when blowing her nose, ‘air went into her eye’. Twenty-one months after operation she describes the operation as a ‘great success’, although she still occasionally experiences ‘air in the eye’ when she blows her nose.

**Case 2**
Mrs. S.J.K., aged 32 years, was first seen at the Eye Department of the Johannesburg Hospital on 28 December 1955. She then complained of watering eyes. In August and September 1963, attempted syringings were unsuccessful and a diagnosis of bilateral blocked nasolacrimal ducts was made.

On 2 November 1963 a successful DCR was performed on the left side. Following this operation, the patient requested that a similar operation be performed on the right side.

A DCR was performed on the right side on 31 October.
After the operation, the patient still complained of a watering right eye. On 21 March 1965 the right canaliculus was probed and a polythene tube was reinserted through the old DCR fistula. This was left in situ for 3 weeks. However, after removal of the tube, epiphora persisted.

On 15 October 1965 a BSC was performed and the polythene tube was again reinserted through the old DCR fistula. The tube was removed after 2 weeks.

Since the last operation, 17 months ago, this patient has been asymptomatic. On 29 April 1966 a dacryogram, as already described by Denny, proved this last operative procedure to have been effective.

**Case 3**

Mr. N.J.F., aged 50 years, was first seen at the Johannesburg Hospital Eye Department on 11 February 1965. He complained of having had a watering right eye for the past 3 years.

On examination, his right upper lid was swollen, and chronic conjunctivitis and an ectropion were also present. Nasolacrimal duct syringing was unsuccessful; pus was returned from the upper punctum. The lower punctum was not in contact with the eye and was pointing directly upwards.

A diagnosis of inferior canalicular dysfunction due to chronic conjunctivitis and an ectropion, was made. On 12 February 1966 a right DCR and BSC was performed. After 2 weeks the patient pulled out the polythene tubing.

On 2 April 1966 a wedge resection of the lower tarsal plate was performed to correct the ectropion.

This man has been asymptomatic for the past year.

**SURGICAL TECHNIQUES**

The technique of dacryocystorhinostomy is well known and will not be described. After the flaps of the sac and nasal mucosa are fashioned, the inferior punctum is dilated with Nettleship's canaliculus dilator. The inferior canaliculus is probed with a No. 2 or a No. 3 Bowman probe. If a stricture is present, this is broken down.

Fasanella described the introduction of a heavy Dermalon thread in dacryocystorhinostomy. This has been modified by the use of polythene tubing* approximately 16 inches long, containing a stylus (see Fig 3). The polythene tubing with stylus is introduced through the inferior canaliculus and is passed through the sac into the dacryocystorhinostomy opening and out through the corresponding nostril.

A Tweedy canaliculus knife, or fine-pointed scissors, is then inserted on the side of the polythene tubing and the canaliculus is split, the whole length being opened in an upward direction and the non-ciliated part of the lid thus being split into two. The upper surface, or non-ciliated margin, presents a slit entrance. The lateral side of the halved lid is demarcated by the vertical part of the canaliculus. The floor consists of a gutter—the remains of the horizontal part of the canaliculus—and the medial side consists of a stomal opening into the nasolacrimal sac.

The stylus is withdrawn from the polythene tubing. The ends of the tubing are taped to the cheek and forehead and a pressure bandage is applied.

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*Salcothene polythene tubing, size No. 1, bore 0.5 mm., wall 0.25 mm. Stylus made by Johannesburg Hospital workshop, length 12 inches.
artery forceps. Sterile saline and antibiotics, with or without cortisone, can then be introduced into the fistulized area by moving the puncture hole about 1 cm. downwards.

**DISCUSSION**

Splitting of the punctum and canaliculus (canaliculotomy) is an operative procedure which has given rise to a great deal of controversy. Bowman, and others, used it as a preliminary manoeuvre to the passing of a probe and as an everyday procedure in cases of epiphora. Critchett and Von Hoffmann removed a permanent portion of the lower lip of the wound, converting the canaliculus into an open gutter.

Simple slitting of the canaliculus, or slitting of the canaliculus in its entirety, has been regarded as a poor procedure by modern ophthalmic surgeons, the reasons being that capillarity is abolished and that these procedures usually lead to stricture formation near the sac.

That the split canaliculus does function has been proven by the radiological method outlined above. If the radiopaque substance is sucked into the lid slit by capillarity, then it is apparent, by applying physical calculation, that this system would have a capillary force of 50 times that of an intact canaliculus.

**SUMMARY**

Three cases, with different causes of inferior canalicular dysfunction, were successfully treated by a new surgical technique involving splitting of the lid combined with dacryocystorhinostomy.

A physical concept is presented, suggesting that the capillarity in the split lid is approximately 50 times that of the intact canaliculus.

A radiological technique is described, supporting the fact that capillarity does take place in the split lid, and proving the results of the surgical technique to be successful in case 2.

We wish to thank the Medical Superintendent of Johannesburg Hospital for permission to publish cases 2 and 3; Miss V. Marting, M.Sc., for determining the physical calculation on capillarity; and Mr. G. Ho of the Department of Ophthalmology, University of the Witwatersrand, for the photography.

**ADDENDUM**

The total number of cases treated by this technique is now 9, of which 8 have been successful.

**REFERENCES**