Punctal and intra-canaliculocclusion - a guide for the practitioner

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Introduction

In 1995 the College of Optometrists resolved that the use of punctum plugs should be considered as part of normal optometric practice. This tutorial will both review these procedures and provide guidance on their use and is adapted from Barnard (1996).

The group of conditions loosely called "dry eye" is commonly encountered in optometric practice with patients complaining of symptoms such as a feeling of dryness, a gritty or foreign body sensation and paradoxically, watering eyes. The latter probably occurs as the lacrimal gland is stimulated by the discomfort produced by the deficiency of "background" tears.

The causes of "dry eye" are many and complex, and it is not possible in this short paper to review the various aetiologies or methods of diagnosis. However, punctum and intracanaliculocclusion is only appropriate for certain patients with aqueous abnormalities and it is important that a correct diagnosis is made to allow selection of suitable patients for the procedure.

For example, a common cause of tear lipid deficiency is meibomian gland dysfunction secondary to staphylococcal blepharitis. The bacteria produce enzymes which break down the lipid surface of the tears. When examined with the slit lamp biomicroscope there may a fast tear break up time together with superficial punctate epithelial staining inferiorly particularly in the 4 and 8 o'clock positions as well as corneal infiltrates. The use of plugs in such a case would be inappropriate and contraindicated because a possible contributory cause of the dry eye is a bacterial infection which requires treatment. On the other hand, for example, in keratoconjunctivitis sicca associated with Sjögren's syndrome (dry eye, dry mouth and arthritis) there may be a band of corneal and conjunctival staining with rose Bengal and fluorescein in the absence of lid margin disease.

The practitioner should therefore obtain an understanding of the differential diagnoses and management/treatment strategies for the various tear anomalies encountered in practice before incorporating punctum or
intracanalicular occlusion techniques into routine practice. For a review of tear anomalies and their management the reader is referred to Catania (1995).

Permanent closure of a punctum can be carried out by injuring the tissue to produce scarring. Beetham (1935) introduced surgical occlusion of the punctum using electrocautery as a therapy for aqueous tear deficiency. Other methods include electrodesiccation or simple excision. Cautery and electrodesiccation produce tissue destruction with minimal bleeding. Argon laser may also be used to produce precisely positioned burns. Somewhat surprisingly, the occlusion produced by all these techniques may not last indefinitely, with recanalisation sometimes occurring. (Tuberville et al., 1982).

In 1961, Foulds described temporary canalicular occlusion with dissolvable gelatin implants as a prognostic procedure prior to surgical occlusion of the puncta, and in 1975, Freeman described a punctum plug for prolonged but easily reversible occlusion of the puncta.

**Effects of occlusion**

There have been a number of studies to examine the effects of occlusion. In patients with keratoconjunctivitis sicca punctual occlusion reduces corneal surface staining (Tuberville et al., 1982; Willis et al., 1987). It may be that this decrease in ocular surface disease was due to a decrease in tear osmolarity (Dohlman, 1978), a hypothesis subsequently supported by the findings of Gilbard (1985).

In a retrospective examination of the effect on dry eye disorders of punctual occlusion using Freeman silicone plug insertion, a significant decrease in tear osmolarity was found together with a reduction in Rose Bengal staining in 75% of the eyes examined (Gilbard et al., 1989).

Willis et al (1987) occluded all four punta of eighteen patients (fourteen women and four men) with aqueous-deficient dry eye who were unhappy with their treatment. The patients ranged in age from 26 to 83 years (median age 59 years). Two patients had rheumatoid arthritis, two had reduced unilateral tearing following resection of an acoustic neuroma, and the remainder had keratoconjunctivitis sicca. Four of the patients extruded plugs from the punctum within two weeks of insertion but all four reported improvements in symptoms until the plugs extruded. Eleven of the fourteen patients (79%) who retained plugs improved subjectively. All were able to reduce their dependency on topical therapy but not cease it completely. Abnormalities in impression cytology persisted 6 weeks after plug placement for each of the eleven patients. The patients reported an additional benefit. Even allowing for the cost of the punctum plugs the reduced dependency on artificial tears produced considerable financial savings for these patients.

Thirty-five patients with chronic dry eye were treated with Freeman punctum plugs by Fayet et al., (1990). This excellent study was particularly interesting in that whilst occlusion was only carried out unilaterally, the fellow eye underwent simulated insertion in an attempt to provide some degree of control
for placebo effect. The aetiologies of dry eye for these subjects included Sjögren’s syndrome, drug induced dry eye, and filamentary keratitis. In all cases it was intended to occlude both the superior and inferior puncta of the right eye, but in some cases only the inferior punctum was occluded because of the greater difficulty in inserting the plug in the superior punctum. Subjective improvement in symptoms was more marked after occluding the two puncta on the treated side (77%) than the other side (placebo) (17%). A significant improvement in Rose Bengal staining and for Schirmer test results was also shown.

Castillo et al (1994) carried out a quantitative comparison of conjunctival and eyelid microorganisms in dry eye patients before and after punctal occlusion and compared the results with the findings in normal aged matched patients. The number of colony forming units was significantly increased (p>0.05) prior to punctal occlusion when compared to post-occlusion and to the normal controls.

It is important to note that occluding one punctum will not reduce tear drainage by 50%. This is because the pump action produced by the blink will cause additional drainage to occur via the other canaliculus. Indeed, Fayet et al., (1990) cited Royer et al., (1983) as reporting that cicatrical stenosis caused by trauma in otherwise normal eyes does not necessarily cause epiphora because of an increased drainage via the homolateral canaliculus. Dohlman (1978), referring to cautery, suggests that it is important to occlude the homolateral punctum to obtain satisfactory treatment of dry eye syndromes. Fayet et al., (1990) reported that the results following occlusion of both puncta on the same side were better than those following occlusion of one punctum only. They concluded that, having decided to carry out the procedure, immediate double unilateral occlusion should be carried out. They suggested that occlusion of one punctum on one or both sides should be reserved for cases when insertion in the upper punctum is difficult.

However, this author would suggest a more conservative step-by-step approach as will be seen later in this discussion.

For the interested reader, further discussion relating to tear drainage mechanisms may be found in Jones (1957), Maurice (1973) and Doane (1981).

**Punctum and intra-canicular plugs**

**Clinical indications for punctum and canalicular occlusion with plugs**

Plugs may be considered for patients with chronic dry eye (particularly aqueous deficiency), in the absence of infection or other pathology in which the patient's symptoms are not adequately controlled with tear supplements. This may include contact lens wearers. Patients must be made aware that if the plugs prove beneficial they may not completely replace other treatment such as the regular use of tear supplements.
Other uses

a) Prophylactic stabilisation or enhancement of tear film prior to refractive laser procedures.
b) To enhance efficiency of topical ocular therapeutics (e.g. glaucoma therapy).
c) To prevent drainage of drugs (e.g., beta blockers) into the nasolacrimal system.
d) A modified version of a silicone plug incorporating a central open channel has been produced for attachment to silicone tubing enabling a canalicular stent to be inserted into a lacerated canaliculus. This combination may then be used to bridge the laceration, providing unobstructed outflow of tears during healing.

(d) A plug is available to keep the punctum patent form patients with chronic epiphora (Austen, 2000).

Contraindications

Contraindications include:

- Allergy to bovine collagen (temporary plugs)
- Allergy to silicone
- Infective conjunctivitis
- Dacryocystitis
- Inflammation of the eyelid
- Epiphora

Side effects

Although the risk of infection is minimal once the plugs have been properly inserted, patients should be made aware of such risks before they agree to the procedure. The patient must be advised to consult the practitioner if any discomfort, pain, erythema or swelling occurs following the procedure. Transient minor discomfort is normal for a few hours following any of the procedures.

Maguire & Bartley (1989) reported complications with a smaller sized Freeman plug. In three patients these plugs migrated into the canaliculus. If using Freeman type plugs, care must be taken in ensuring the correct size plug is inserted.

Types of plug

There are two broad categories of plug: -

(a) Collagen plugs
These are “temporary” and generally dissolve over 4 to 7 days. As such they are useful for diagnostic and prognostic purposes. There are also slower dissolving plugs available.

Plugs are available in a range of diameters (0.2mm, 0.3mm, 0.4mm, 0.5mm, and 0.6mm) and lengths (a "standard" 2mm and a shorter 1.6 mm). They are packaged in quantities of six. The two “spare” may be utilised as additional inserts in the inferior puncta.

**Procedure for collagen implantation**

Before contemplating punctum or intra-canalicular occlusion a full eye examination and tear assessment (for example, biomicroscopy, fluorescein and Rose Bengal staining, Tearscope®, Schirmer test) should be carried out. The results of these tests are important for follow-up comparisons. Other tests and clinical indicators are in clinical use and may aid in the differential diagnosis of tear component deficits.

The practitioner should be satisfied that the patient has not obtained satisfactory symptom relief by using artificial tears, ocular lubricants or other interventions and that the tear deficiency is at least in part aqueous in nature.

Once the practitioner has decided that punctum plugs are a clinical option the following the procedure should be explained to the patient. If both eyes are "dry" it useful to carry out the procedure on one eye to allow the patient and the practitioner to compare its effect.

White et al., (1989) examined lacrimal drainage using a scintigraphic technique and found no significant difference between the superior and inferior canaliculi. As it tends to be easier to insert a plug into the inferior punctum than the superior, if only one punctum is to be occluded it is recommended that the practitioner choose the inferior.

- Check the corneas and conjunctiva using diagnostic stain prior to inserting the plug(s).
- Examine the puncta with the biomicroscope. The punctum may be viewed by partly evert ing the lid toward the examiner. With a little experience the practitioner will be able to assess the size of the punctum.
- Insertion of collagen plugs can usually be carried out without the use of anaesthetic. However, if desired, the punctual region can be anaesthetised. This is most easily carried out by instilling one drop of benoxinate hydrochloride 0.4% or other topical anaesthetic into the conjunctival sac and waiting for the drug to drain via the puncta. Alternatively, a cotton wool tipped applicator soaked in anaesthetic may be held for 30 seconds against each punctum. If the punctum is
small it may be dilated by gently inserting and rotating a fine stainless steel dilator just into the punctum or choose a small diameter plug.

- Generally a 0.3mm size is a useful diameter as a starting point. The procedure may be safely carried out by pulling the lid away from the globe and instructing the patient to look to the temporal side. This will reduce any risk of accidental trauma to the cornea.

- Grasp the collagen implant with fine forceps towards one of its ends and after inspecting it under the microscope for any irregularities insert the other end into the punctum. Positioning of the punctum with the other hand by manipulating the lid will help. Release the plug from the grip of the forceps the tip of which may then be used to gently push the plug down until it disappears completely. Alternatively, the punctum dilator may be used as a utensil to push the plug beyond the punctum opening. After insertion, the force of the blink and direction of tear flow may cause the implant to migrate further into the horizontal canaliculus. Once wet, the plug will swell to twice its original diameter.

- Repeat the process for the other punctum as required. Remember, occluding one punctum does not reduce tear drainage by 50% as one might expect.

- The instillation of a single drop of an antibiotic eye drop is of little benefit. If there are indications for prophylactic antibiosis a full course of topical antibiotics should be prescribed.

- The patient should be reviewed after one to two weeks. If the patient reports resolution of symptoms and/or there is clinical evidence of resolution of signs, then the use of "permanent" silicone plugs may be considered.

The author has noted that some patients report a continued resolution of symptoms weeks after insertion of these plugs. There are a number of possible reasons for this. Firstly, a possible placebo effect. Secondly, it is possible that the enhancement of tear quantity during the period of occlusion may enable resolution of chronic epithelial cell or epithelial basement membrane disturbances. If this latter hypothesis is correct then may be useful to assess the patient a few weeks after occlusion with collagen plugs before considering silicone punctum or intra-canalicular plugs. A third possibility is that the collagen plug precipitates a stenosis of the canaliculus.

(b) silicone plugs

These are "permanent" in that they do not dissolve. However they can be removed if necessary. They do not need to changed at regular intervals and need only to be replaced if they dislodge. There are two main categories of silicone plug for dry eye:

(1) Punctum plug e.g., Freeman plug (Eagle vision™); Oasis Soft
Whichever type of silicone plug is used, the author prefers a conservative approach of plugging one punctum per eye, reviewing after a week, and if necessary using a collagen plug in the other punctum before deciding to proceed to a second silicon plug. Proceeding directly to plugging both superior and inferior puncta can lead to epiphora (see Case Study).

**Insertion of silicone punctum plugs**

- Following topical anaesthesia, the optimum size of plug may be determined by a punctal gauging system such as that produced by Eagle Vision. Careful choice of plug size will reduce the chance of plugs falling out (Reidy, 1997).
- This consists of two instruments each having a gauge tip on each end. One instrument has a 0.5 mm diameter gauge tip on one end and a 0.6 mm diameter tip on the opposite end. The other instrument offers 0.7 mm and 0.8 mm gauge tips. Too small a gauge size will encounter little or no resistance upon entering the punctal opening whereas too large a gauge size will offer too much resistance both entering and exiting the punctal opening. The proper gauge size will moderately flex the punctal ring when both entering and exiting the punctal opening.
- Most manufacturers produce their plugs on pre-loaded applicator tools in various sizes (e.g., 0.5mm, 0.6mm, 0.7mm and 0.8mm). The punctum should then be dilated. The applicator with the pre-loaded plug is inserted into the punctum until the dome head is seated on the surface of the punctum, the release button pressed and the applicator withdrawn.
- The procedure is repeated for the other puncta as required.

**Disadvantages of silicone punctum plugs**

- These plugs may be extruded. Willis et al (1987) reported that 22% of their patients (4 out of 18) showed extrusion of punctal plugs within two weeks of placement. However they commented that 3 of these patients did not require dilation of the puncta before insertion. This suggests that the plugs were of too small a size. It may be worth noting that changes in design improvements since these reports may produce greater stability.
- Some patients may report minor lid discomfort. However, the latest versions produced by various manufacturers reportedly reduce lid sensation.
Advantage of silicone punctum plugs compared to intracanalicular plugs

- The presence or otherwise of a punctum plug in the punctum is apparent.
- In the event of unwanted side effects they can be removed easily with forceps.

Insertion of silicone intra-canalicular plugs

- The punctum should be inspected to determine the optimum plug size. Patients with large puncta should receive the 0.5mm plug and patients with smaller puncta should be fitted with the 0.3mm plug (Lacrimedics Inc™). The punctum should be anaesthetised.

- Following remove the insertion stilets from the sterile packaging the practitioner separates one stilette. The length of the stilette should be shortened to a manageable and stable working length by pulling it through its Styrofoam holder.

- The lid is everted to bring the punctum into view. The author prefers to carry out the procedure under the magnification afforded by a slit lamp but it is possible, and indeed favoured by some practitioners, to proceed using more simple magnification.

- The stilette is then positioned vertically above the punctum and the plug is inserted until the collapsible bell is resting on the punctum.

- The stilette is then rotated so that the plug is pointing nasally along the canaliculus. This straightens the angle between the vertical and horizontal canaliculi.

- The stilette is gently advanced so that the collapsible bell eases through the punctal opening.

- The plug should be advanced further 2 mm – 3 mm nasally. The bell will reopen inside the canaliculus.

- The stilette is then withdrawn leaving the plug in place. The force of the blink and direction of the tear flow will cause the plug to migrate 6 mm – 8 mm into the horizontal canaliculus where, according to the manufacturers, it lodges where the canaliculus presumably narrows.

- Repeat for the other punctum if required

Advantage of the intracanalicular plug

- Once inserted it may be less irritating to the patient's lid than the Freeman type plug.
Disadvantages of the intracanicular plug

- It is difficult to confirm whether the plug has been extruded via the common canaliculus.

- If epiphora occurs or a plug needs to be removed for any other reason, lacrimal irrigation or probing will be necessary to remove the plug (see case study below). Therefore, the author recommends that practitioner must have received training to carry out lacrimal syringing before practising intracanicular occlusion.

Aftercare

The practitioner should ensure that the patient understands the need for ongoing follow-up examinations and seeks immediate attention in the event of the onset of any untoward symptoms.

Case study

The following case study describes a patient seen by the author in private practice.

The hypermetropic patient, Mrs DF, aged 55 years, was referred by a Consultant Ophthalmologist who specialises in anterior segment disease. She was uncomfortable with her soft contact lenses and had been diagnosed as having marginal dry eye. The consultant wished to explore refitting her with RGP lenses. After a number of refits with both RGP and various soft lenses, she found optimum comfort with a biometric soft material. However, after six months she returned still troubled by dry eye symptoms. The author fitted collagen plugs which produced a positive response from the patient. The consultant agreed to silicon plugs being fitted. The author fitted bilateral inferior intracanicular plugs and subsequently bilateral superior plugs. The patient reported a resolution of her symptoms and improved contact lens comfort.

The patient returned eleven months later complaining of bilateral epiphora which was causing her some annoyance. The author carried bilateral superior lacrimal syringing to remove the superior intracanalicular plugs. The patient was reviewed two weeks later and reported both a resolution of her symptoms and continued contact lens comfort. A further eight months later, the patient has not reported any further problems.

Exercises for the novice

Whilst the author strongly advises colleagues to attend a practical course to learn how to insert plugs, it may be helpful to carry out some exercises prior to carrying out collagen plug insertion for the first time. Using adhesive tape attach a cocktail stick, on the end of which a wine cork has been fixed, to the
foreground rest of your slit lamp microscope. Insert a sewing needle horizontally into the side of the cork with the eye of the needle positioned with the opening of the eye in the vertical. Pick up a 5 mm length of cotton with jeweller’s forceps. Practise inserting the cotton into the eye of the needle.

Conclusions

- The availability of punctum and intra-canalicual plugs provide the practitioner with various diagnostic, prognostic, therapeutic and prophylactic techniques to offer patients suffering from certain types of chronic tear deficiencies which have been inadequately controlled with other interventions.

- Collagen plugs provide an invaluable prognostic indicator of the likely efficacy of more permanent occlusion using surgery, punctum or intracanalicular plugs.

- Occlusion of one punctum will not reduce tear drainage by half. Indeed the other canaliculus may take over the entire drainage (Fayet et al., 1990).

- However, the author suggests that the novice practitioner adopt a conservative step-by-step approach as follows:
  1) occlude the inferior and superior puncta with collagen plugs;
  2) if an improvement in signs/symptoms is noted then occlude one punctum using a non-dissolvable plug;
  3) review patient after 1 – 2 weeks. If improvement in signs/symptoms is not adequate then occlude the homolateral punctum with a temporary collagen plug;
  4) if epiphora does not occur and there is a further improvement in signs/symptoms then occlude the homolateral punctum with a non-dissolvable plug.

- The patient may need to continue using artificial tears following occlusion.

- The primary eye care practitioner - the optometrist - has an important role to play in the management of patients with dry eye and as such may find the use of punctum and intra-canalicual plugs of benefit to some patients.

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