

# A review on punctum plugs in the management of dry eye syndrome

## Abstract

Dry eye syndrome varies in severity, duration and etiology. In the majority of patients, the condition is not sight threatening and is characterized by intermittently blurred vision and troublesome symptoms of irritation that are usually worse at the end of the day. In some individuals, exacerbating factors such as systemic medication that decrease tear production or environmental condition that increase tear evaporation may lead to an acute increase in the severity of the symptoms. Elimination of such factor often leads to marked improvement and may even be curative. The disease may exhibit chronicity, characterized by fluctuating severity of symptoms and or a gradual increase in symptom severity with time. The aim of this review article is focus on the management of dry eye disease with the help of punctum plugs and benefits of punctal occlusion.

**Keywords:** dry eye disease, punctum plug, blurred vision, punctal occlusion

Volume 8 Issue 4 - 2018

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**Received:** August 06, 2018 | **Published:** August 27, 2018

## Introduction

With estimated prevalence ranging from 7.8% to 93.2% from different studies worldwide, dry eye disease is probably the most common ocular condition seen by eye care practitioners.<sup>1-4</sup> Apparently, Asian studies report higher prevalence than those from western countries and the 3 studies from India report the prevalence between 18.4% and 40.8%. Despite the common use of the term dry eye in ophthalmic literature, there was no formal definition of dry eye was proposed as 1995. The currently used definition of dry eye was proposed by the 2007 International dry eye Workshop, dry eye is a multi-factorial disease of the tears and ocular surface that results in symptoms of discomfort, visual disturbance, and tear film instability with potential damage to the ocular surface. It is accompanied by increased osmolarity of the tear film and inflammation of the ocular surface.<sup>5</sup>

With the widespread use of video display terminals (TVs, Computers, iPads, smart phones), increasing acceptance of contact lens use and laser refractive surgery, hormonal changes (reduced androgen levels, exogenous estrogen use) and imbalance in the dietary intake of essential fatty acids, there seems to be change in demographics of dry eye patients. While dry eye used to be considered predominantly and old age condition, these days an increasing number of younger people are getting diagnosed with dry eye, affecting their everyday social and physical functioning, work place productivity, and quality of life. The most commonly used first line therapy for the dry eye disease is largely palliative i.e., topically administered artificial tear substitutes, which provide basic lubrication to the eye surface.<sup>6</sup> Although mild cases of dry eye disease, in which there are no sign of damage to the conjunctiva or cornea, may be successfully managed with artificial tears applied up to four times per day, in moderate or severe cases, improvement is short lived because the tears drain through the lacrimal outflow channels and evaporate.<sup>7</sup> Since the retention of artificial tear supplements on the eye is poor, they need to be used frequently up to once in every 1-2 hours.<sup>7,8</sup> Additionally, compliance is known to significantly decrease if the dosing schedule is more than twice a day. Therefore poor compliance may substantially limit the benefits obtainable from artificial tears. While more viscous drops may increase the lubricants retention time and decrease the dosing frequency to a reasonable range, they tend to blur the vision and may

leave more residual foreign particles in the eye.<sup>9</sup>

## Punctal occlusion

Punctal occlusion is a simple procedure that blocks the lacrimal outflow system at the level of the punctum or canaliculus and aims to conserve the naturally produced tears in aqueous deficient dry eye and also to prolong the contact time of artificial tears. The use of punctum plug occlusion has been reported to improve the tear dynamics, ocular surface health, visual acuity, and decrease dry eye symptoms (Table 1). Although punctal occlusion is specifically indicated in the aqueous deficient dry eye, as such, any type of dry eye (Table 2) may improve with canalicular blocking, because the deficits are interrelated each affecting the other to some extent.

## Criteria for performing punctal/canalicular occlusion

Typically criteria used to decide implantation of punctum plugs includes aqueous insufficiency as indicated by Schirmer's test (with anaesthesia) of  $\leq 5$  mm at 5 min and presence of conjunctival/corneal staining. It is important to note that for a successful punctal occlusion at least some amount of aqueous secretion must be present. On the contrary, punctum plug implantation should be avoided in patients with mild dry eye. So as to reduce the risk of post occlusion epiphora. Further, the punctum plug should also be usually avoided in patients with immune-compromised status because of high risk of infection in these patients.

## Planning for punctal occlusion

Although rare, sub-clinical naso-lacrimal duct occlusion may be present and punctum implantation in such a case may completely isolate the lacrimal sac, thereby increasing risk of acute dacryocystitis. Therefore, before performing punctal occlusion, it is important to perform lacrimal irrigation to ensure the patency of the nasolacrimal duct.

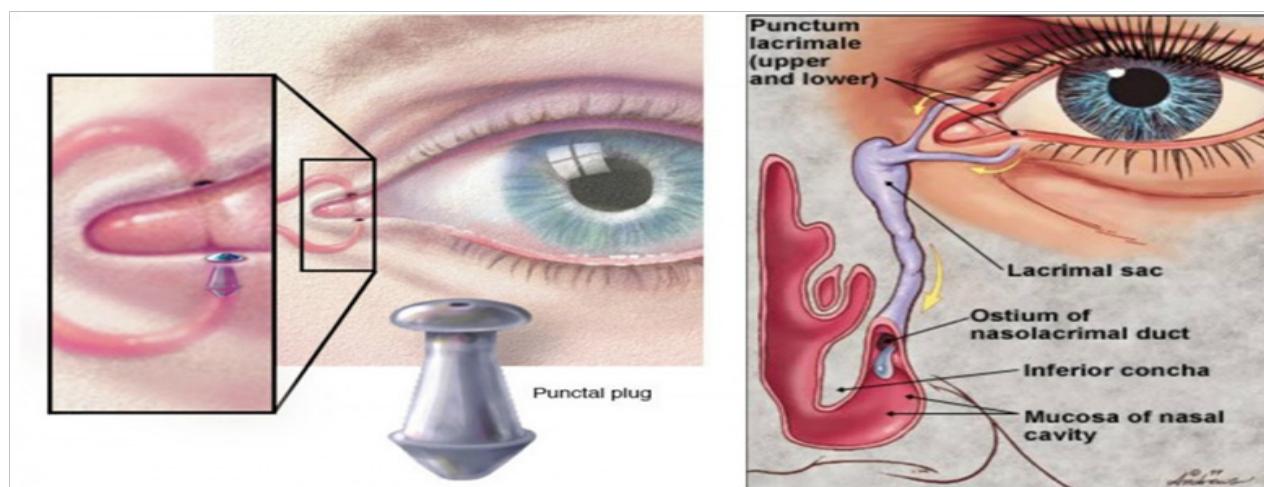
Ocular surface inflammation is commonly associated with dry eye. It is recommended that ocular surface inflammation be treated prior to performing punctal occlusion, because punctal occlusion in these patients may potentially worsen their concentration of pro-inflammatory cytokines. (Figure 1) revealed the insertion of punctum.

**Table 1** Revealed the benefits of punctal occlusion

Improvement in tear dynamics	Improvement in ocular surface health	Improvement in dry eye symptoms and visual acuity	Improvement in dosing tears and indirectly compliance
Increase in tear volume. <sup>10-13</sup>	Decrease in the ocular surface staining.	Relief in dry eye symptoms such as discomfort and itching	Reduction in the number of artificial tear instillation
Improvement in tear retention time. <sup>1</sup>	Increase in mucin goblet cell density	Improvement in contact lens tolerance	Patients who are unable to use eye drops because of occupational, physical or psychological limitation, may benefit from punctum plugs
Decreasing elevated tear osmolarity	Improve in corneal filaments, corneal erosion and ulcers	Reduction of higher order wavefront aberration of post-lasik eyes.	-
Improvement in tear stability	-	Improvement in visual acuity	-

**Table 2** Indication for punctal occlusion

1. Moderate to severe aqueous deficient dry eye (Not responding to artificial tears, poor compliance to the use of artificial tears, poor compliance to the use of artificial tears)
2. Keratoconjunctivitis sicca
3. Post-Lasik dry eye
4. Contact lens intolerance
5. Superior limbic keratoconjunctivitis.
6. Sjogren syndrome
7. Steven Johnson syndrome
8. Ocular cicatrical pemphigoid
9. Rheumatoid arthritis
10. Filamentary keratopathy
11. Superior limbic keratoconjunctivitis
12. Ocular surface epitheliopathy associated with
  - I. Penetrating keroplasty
  - II. Neurotrophic keroplasty
  - III. Recurrent corneal erosions
  - IV. Toxic epitheliopathy

**Figure 1** Insertion of punctum plug in puncta for dry eye management.

## Upper vs lower vs both punctum occlusion

The inferior punctum is larger and more accessible than superior one and it is generally believed that inferior punctum contributes more to tear drainage than does the superior one.<sup>14</sup> Therefore occlusion of only the inferior punctum is expected to produce sufficient relief. Correspondingly there is data to support that occluding both upper and lower puncta offers no practical beneficial gain compared with occluding just the lower punctum. In contrast, there is also evidence to suggest that anatomical difference between lower and upper punctal is not associated with any difference in tear drainage between the upper and lower canaliculi. Therefore, when occlusion of the lower punctum is not sufficient, the upper punctum can be occluded, usually achieving improved results.<sup>15</sup>

## Absorbable vs Non-absorbable punctum plugs

Various design and models of punctum plugs are available, made of absorbable [short-term (7-10days) implantation with collagen plug or extended duration (60-180days) implantation with plugs made from E-Caprolactone-L-Lactide copolymer] or permanent plugs made of non-absorbable material e.g., silicone. To determine the effect of treatment on dry eye symptoms and to evaluate epiphora tolerance in patient, short term temporary occlusion by a reversible means is often preferable initially, before considering a long term occlusion. While short term absorbable plugs have the advantage of easy insertion and relatively rapid spontaneous dissolution. Non-absorbable plugs provide long term occlusion until removed or extruded, however both absorbable and non absorbable punctum plugs have been demonstrated with similar efficacy for dry eye in the short term.

## Sizing of the plug

Appropriate sizing of the punctum plug plays an important role in achieving successful occlusion. To avoid over or under sizing, a punctal gauging instrument is preferable over subjective visual inspection to choose the correct plug size. An appropriate size is one that is snug fit and require gentle pressure for insertion and removal. It is important to ensure that the plug is not oversized which may cause the punctal annulus to be overly stretched, potentially increasing the risk of punctal migration or extrusion.

## Alternative uses of the punctum plugs (Glaucoma)

There is also evidence to suggest that increased contact time between the medication and the ocular surface following punctal occlusion might enhance the bioavailability of topical medication. For example, punctal occlusion has been found to enhance the intraocular pressure lowering effect of topical glaucoma medications.<sup>16</sup>

## Conclusion

A wide variety of punctum plugs are available in the pharmaceutical market. Their use is not only limited to non-pharmacological management of dry eyes but is gaining popularity in several other ophthalmic diseases. Newer designs are being made to decrease the risk of complications. Nevertheless there are limitations of these plugs and close monitoring is needed after placement. Future studies are needed comparing different types of plugs and following outcomes over longer timeframes. With new technology and ongoing research punctal plugs will continue to have an important role in the management of a myriad of eye conditions.

## Acknowledgments

The authors thank the following persons, which are the main body of my research institute. Dr. Vrish Dhawaj Ashwlayan, Dr. Vipin Kumar Garg, Dr. Satish Kumar Gupta and Mrs. Mansi Verma. These are those person who help me to update the review.

## Conflict of interest

Author declares that there is no conflict of interest.

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