

Original Article

# Sleep position and the ocular surface in a high airflow environment



Vinod Gauba, FRCOphth\*; Zoe J. Curtis

## Abstract

**Purpose:** To study the relationship between sleep position and ocular surface symptoms and signs in an high air flow environment.

**Methods:** Prospective observational study of new patients attending the dry eye clinic was performed. Patients with pre-existing ocular history, relevant systemic history (e.g. Sjogren's syndrome) or who were using topical or systemic therapy for dry eye were not included. Data were collected from the patient to document their dry eye symptoms; preferred dependent sleeping side and their bedroom airflow. All patients were examined by a clinician blind to the patient's responses where Schirmer's test and slit lamp examination were performed looking for the presence of lagophthalmos and corneal epitheliopathy.

**Results:** 48 patients enrolled into the study of which 23 were males and 25 were females with a normal and comparable age distribution. The study found a strong association between patients' preferred sleeping side and the incidence of corneal epitheliopathy in the contralateral eye particularly in patients with evidence of lagophthalmos. Dry eye symptoms were found to be worse and tear production lower on the contralateral side to the preferred sleeping side particularly in patients who sleep in a high airflow environment.

**Conclusion:** In patients sleeping in a high airflow environment with nocturnal lagophthalmos, this study observed an association between preferred dependent sleep position and increased dry eye symptoms, lower Schirmer's scores and increased corneal epitheliopathy in the contralateral eye.

**Keywords:** Sleep, Dry eyes, Lagophthalmos, Epiphora

© 2014 Production and hosting by Elsevier B.V. on behalf of Saudi Ophthalmological Society, King Saud University.  
<http://dx.doi.org/10.1016/j.sjopt.2013.12.002>

## Introduction

We spend almost a third of our life sleeping. The act of sleeping involves closing our eyes. In some individuals, the eyes may remain partly open during some parts of the sleep cycle (physiological lagophthalmos). This can occasionally lead to symptoms and signs. There is considerable evidence that tear production is reduced during sleep and that the eye is in a relatively dry state.<sup>1,2</sup> It is also known that tear composition changes during sleep with a state akin to subclinical

inflammation.<sup>3</sup> High airflow in the room, such as in an air-conditioned room or in the presence of a ceiling or table fan, can increase the extent of moisture loss from our eyes and result in exacerbation of the already relatively dry ocular surface during sleep. Consequently the authors proposed that sleep position may result in an asymmetrical impact on the ocular surface potentially due to differential exposure to circulating room air currents.

Awareness of such potential ocular surface asymmetry based on sleep position and air flow may help explain asym-

Available online 12 December 2013

Imperial Healthcare Institute, Dubai Healthcare City, Dubai, United Arab Emirates

\* Corresponding author. Present address: 1st Floor, Suite 101, Block A, IbnSina Building 27, Dubai Healthcare City, P.O. Box 505133, Dubai, United Arab Emirates. Tel.: +971 4 439 3737; fax: +971 4 439 3736.  
e-mail address: [drgauba@imperialhealth.org](mailto:drgauba@imperialhealth.org) (V. Gauba).



Peer review under responsibility of Saudi Ophthalmological Society, King Saud University



Production and hosting by Elsevier

Access this article online:  
[www.saudiophthaljournal.com](http://www.saudiophthaljournal.com)  
[www.sciencedirect.com](http://www.sciencedirect.com)

metry in symptoms and may also help use targeted interventions to help improve the ocular surface. It is also of particular relevance in countries, such as the United Arab Emirates where the study is set, where the majority of individuals spend most of the year sleeping in a high air flow environment.

**Methods**

The study was conducted in accordance to the tenets of the Declaration of Helsinki. Institutional review board approval was obtained prior to commencing the study. Prospective data collection was performed on consecutive new patients visiting the dry eye clinic over a three-week period in May 2013. Patients with pre-existing ocular history, relevant systemic history (e.g. Sjogren’s syndrome) or who were using topical or systemic therapy for dry eye were not included. Patients who also had established lagophthalmos or had well known risk factors for this (any prior upper eyelid surgery, facial nerve palsy or myopathy and thyroid orbitopathy) were also excluded.

Patients were asked to complete specifically designed questionnaire. This asked about the patient’s dry eye symptoms and whether these were asymmetrical; which is the patient’s preferred dependent sleeping side if any (i.e. more than 50% of the time) and whether they sleep in a high airflow environment (bedroom air conditioning or ceiling/table fan). An ophthalmologist who was blinded to the questionnaire results examined the patients. The ophthalmologist performed a Schirmer’s test followed by slit lamp examination. During the latter, the ophthalmologist documented the presence or absence of corneal epitheliopathy, Bell’s phenomenon and lagophthalmos. The examination for nocturnal lagophthalmos involved asking the patient to close their eyes as if they were asleep and the lid position was evaluated after approximately 30 sec on the slit lamp using a very fine slit beam. Blink frequency and quality were also observed on the slit lamp and if the patient did not achieve full closure whilst blinking, this was considered as a positive indication of nocturnal lagophthalmos.

**Table 1.** Age and sex distribution of the study sample.

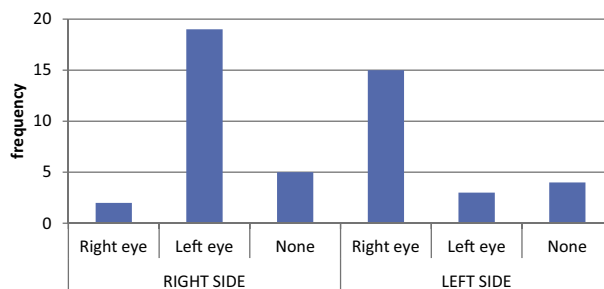
	Male	Female	Total
≤20	2	1	3
21–30	7	5	12
31–40	4	7	11
41–50	5	7	12
51–60	2	4	6
61–70	3	1	4
Total	23	25	48

**Results**

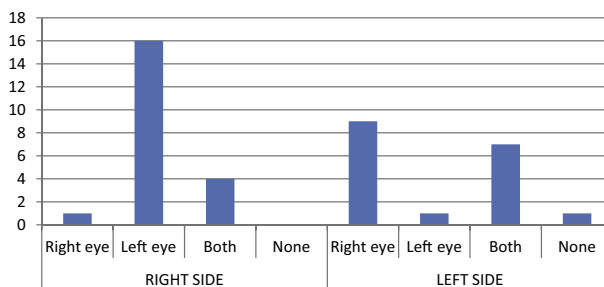
A total of 48 patients were included in the study. The age and sex distribution are shown in Table 1. Age was quite normally distributed with almost equal number of males and females. No patients were found to have persistent lagophthalmos whilst the majority of patients (81%) were found to have some degree of nocturnal lagophthalmos. All patients had Bell’s response although this was not formally graded. Corneal epitheliopathy, symptom asymmetry and Schirmer’s test results against sleep position and lagophthalmos are displayed in Table 2. All patients slept in a high airflow environment.

Fig. 1 displays the findings of corneal epitheliopathy related to preferred dependent sleep position. A significant association was noted between the patient’s preferred dependent sleeping position and an increased incidence of contralateral corneal epitheliopathy. This only seems to be present in patients who display evidence of nocturnal lagophthalmos. All patients without signs of nocturnal lagophthalmos did not have any corneal epitheliopathy in either eye.

An interesting finding was the presence of dry eye symptom asymmetry related to preferred dependent sleep position



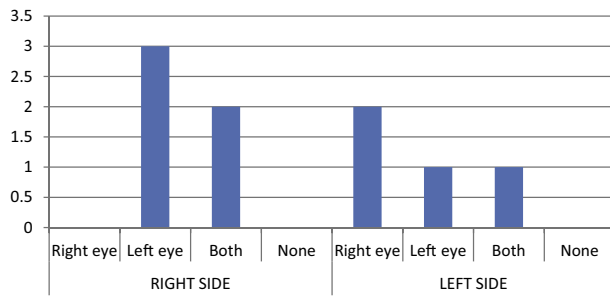
**Figure 1.** Corneal epitheliopathy related to preferred dependent sleep position.



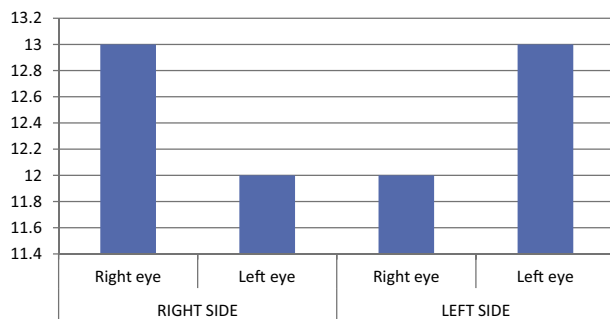
**Figure 2.** Symptoms related to preferred dependent sleep position in patients with lagophthalmos.

**Table 2.** Corneal epitheliopathy, symptom asymmetry and Schirmer’s test results against sleep position and lagophthalmos.

Sleeping position & lagophthalmos	Corneal epitheliopathy			Symptoms				Average Schirmer test score (mm)	
	Right eye	Left eye	Neither eye	Right eye	Left eye	Both eyes	Neither eye	Right eye	Left eye
Right side with lagophthalmos	2	19	0	1	16	4	0	13.2	12.1
Right side without lagophthalmos	0	0	5	0	3	2	0	13.3	12.8
Left side with lagophthalmos	15	3	0	9	1	7	1	12.2	13.4
Left side without lagophthalmos	0	0	4	2	1	1	0	12.7	13.2



**Figure 3.** Symptoms related to preferred dependent sleep position in patients without lagophthalmos.



**Figure 4.** Average Schirmer's score versus preferred dependent sleep position in patients with nocturnal lagophthalmos.

(Figs. 2 and 3). In patients with nocturnal lagophthalmos, there seems to be a considerable asymmetry in dry eye symptoms with an increase in the contralateral eye to the preferred dependent sleep position. In the absence of nocturnal lagophthalmos, these findings are not observed.

Fig. 4 displays the average Schirmer's test result versus the preferred dependent sleep position in patients with nocturnal lagophthalmos. It appears that a similar asymmetry is noted here with reduced Schirmer scores in the contralateral eye to the preferred dependent sleep position although this was not found to be statistically significant.

## Discussion

Nocturnal lagophthalmos with the eyes partly open during sleep is a fairly common phenomenon, frequently observed in normal individuals. Mueller et al. observed that nocturnal lagophthalmos was common in people of the Amharic race in Ethiopia, and some of these developed inferior corneal scarring possibly related to this.<sup>4</sup> Sturrock et al. observed a positive family history of nocturnal lagophthalmos in 5 of 102 patients presenting with corneal exposure symptoms after sleep, supporting the possibility of a genetic factor in at least some patients.<sup>5</sup>

Symptomatic nocturnal lagophthalmos episodes may occur in otherwise normal individuals. Lyons and McNab reported a series of 40 consecutive patients with corneal exposure symptoms secondary to nocturnal lagophthalmos.<sup>6</sup>

The commonest underlying causative factor was alcohol intoxication the night before presentation, occurring in 30%. Taking hypnotic medications was also a factor in 8%. Sturrock et al. had also observed the association of symptomatic nocturnal lagophthalmos with alcohol consumption.<sup>5</sup> McNab also reports that clinical testing of Bell's phenomenon did not predict eye position during sleep as manifested by the distribution of punctate corneal epithelial staining.<sup>7</sup>

The diagnosis of nocturnal lagophthalmos is particularly challenging as patients obviously would not usually know if their eyes do not close fully at night during parts of their sleep cycle. On some occasion, someone else may have observed this in the individual and such patients tend to be positive for the other tests of nocturnal lagophthalmos described in the methods section. Our incidence of diagnosing nocturnal lagophthalmos was highly possible due to the patient cohort who attends the dry eye clinic in a country like the UAE which has a particularly hot climate in the month of May. Our diagnosis of nocturnal lagophthalmos included people with incomplete blink as even a brief episode of poor eyelid closure during sleep in a high airflow environment may lead to considerable ocular surface and corneal desiccation. The extent of corneal epitheliopathy and dry eye symptoms in our sample may be due to the time of year the data were collected when air conditioning or fan usage is almost mandatory due to the high summer temperatures in the United Arab Emirates.

From the findings, it seems that there is an association between dependent sleep position and contralateral corneal epitheliopathy, increased dry eye symptoms and reduced tear production particularly in patients with signs of nocturnal lagophthalmos. The authors propose that this may be due to the increased exposure of the contralateral eye to the air currents in a high airflow room environment. The findings of the study may help explain the asymmetry of dry eye symptoms and signs amongst patients living in hot climates with high airflow at night. The findings may be particularly relevant when considering ocular surface surgery such as refractive surgery. It may also open the opportunity to introduce interventions such as altering the airflow direction; sleeping more on their back; placing a humidifier near the bed or using a lubricant eye ointment at night. Although the sample size in this study is fairly small, this topic requires further study.

## References

1. Baum JL. A relatively dry eye during sleep. *Cornea* 1990;9(1):1.
2. Gilbard JP, Cohen GR, Baum J. Decreased tear osmolarity and absence of the inferior marginal tear strip after sleep. *Cornea* 1992;11:231-3.
3. Tan KO, Sack RA, Holden BA, et al. Temporal sequence of changes in tear film composition during sleep. *Curr Eye Res* 1993;12:1001-7.
4. Mueller FO. Lagophthalmos during sleep. *Br J Ophthalmol* 1967;51:246-8.
5. Sturrock GD. Nocturnal lagophthalmos and recurrent erosion. *Br J Ophthalmol* 1976;60:97-103.
6. Lyons CJ, McNab AA. Symptomatic nocturnal lagophthalmos. *Aust NZ J Ophthalmol* 1990;18:393-6.
7. McNab AA. The eye and sleep. *Clin Exp Ophthalmol* 2005;33:117-25.