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LITERATURE REVIEW

RELATIONSHIP BETWEEN CONTACT LENS WEAR AND THE RISK OF ACQUIRED BLEPHAROPTOSIS

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ABSTRACT

Objectives: *Contact lenses (CL) wear has been reported to be associated with acquired blepharoptosis. This literature review aims to summarize and evaluate the risk of acquired blepharoptosis in contact lens wearers.*

Methods: *Literature searching was conducted using three online databases including PubMed, Cochrane Library, and Embase. Search terms such as "contact lens", "ptosis", and "blepharoptosis" were included. Reference lists of each study were also assessed for potentially relevant sources.*

Results: *Using relevant search terms in various databases, a total of three articles were included in this review. All studies reviewed were single-center retrospective studies. The three studies suggested that wearing contact lens was significantly associated with blepharoptosis. Long-term contact lens wear, ranging from 15 to 34 years, seemed to have a significant effect on the incidence of blepharoptosis. Hard contact lens (HCL) wear has a greater risk for ptosis to occur than soft contact lens (SCL) wear.*

Conclusion: *There is evidence of a clear association between hard or soft contact lens wear and an increased risk of blepharoptosis. Patients wearing contact lenses should be informed of the risk of blepharoptosis, and a history of contact lens wear should be sought in all patients who have acquired blepharoptosis.*

Keywords: *contact lens, acquired blepharoptosis, ptosis*

INTRODUCTION

Contact lenses (CL) are one of the best-known innovations in ophthalmology, with functions ranging from vision correction, cosmetic purposes, to therapeutic modalities for corneal pathologies. The use of CL has significantly increased. Based on the population-based survey, 16.7% of adults (aged ≥18 years) in the United States wear contact lenses.[1]

Despite various advantages from CL, it can also lead to some eye complication without adequate lenses' care.[2] Several previous studies has been reported that CL wear associated with acquired blepharoptosis.[3–5] Blepharoptosis or ptosis is an abnormal dropping of the upper eyelid with the eye in primary gaze.[6] Ptosis is the most common eyelid disorders encountered in the practice, however data from large population-based study are limited. Estimates of ptosis prevalence from region-specific studies in United Kingdom, Iran, and South Korea, was 11.5%, 4.7%, and 13.5%, respectively.[7–9]

Blepharoptosis can be categorized by the etiology as myogenic, aponeurotic, neurogenic, mechanical, or traumatic.[10] The mechanism of contact lens-induced ptosis has been proposed to be aponeurotic, which is stretching or dehiscence of the levator aponeurosis or disinsertion from its normal position.[5,11] Some theories suggested that the common method of removing rigid contact lenses by blinking forcefully while pulling the eyelids taut laterally may play a role in the levator disinsertion.[12] Another study indicated that chronic irritation from wearing CL may also lead to acquired blepharoptosis.[5]

A thorough clinical examination should be performed to evaluate blepharoptosis. The physical examination begins with five clinical measurements including margin–reflex distances 1 and 2, vertical palpebral fissure height (PFH)1, upper eyelid crease position, levator function (LF) or upper eyelid excursion, and presence of lagophthalmos. The margin–reflex distance 1 (MRD1), which is the distance from the upper eyelid margin to the corneal light reflex in primary position, is the single most important measurement in describing the degree of ptosis.[13]

Ptosis causes reversible peripheral vision loss and the superior visual field is most commonly involved. Nevertheless, central vision may also be affected. It can decrease the overall amount of light reaching the macula and, therefore, can reduce visual acuity of patients.[10] Drooping of the upper eyelid can lead to ‘sleepy’ appearance and asymmetry, in both unilateral and bilateral cases.[14] This can have major consequences on patient well- being, including diminished independence and increased anxiety and depression.[15]

This literature review aims to summarize and evaluate the risk of acquired blepharoptosis in CL wearers, as well as the duration of CL wear and type of CL that may induce ptosis. This will also discuss other factors thought to contribute to the development of ptosis in CL wear.

METHODS

Literature searching was performed using three online databases including PubMed®, Cochrane Library®, and Embase®. Database searching was done on March 28th, 2023. Reference lists of each study were also assessed for potentially relevant sources.

Literature searching was done using these keywords: “contact lens”, “ptosis”, and “blepharoptosis”. The literature searching diagram is summarized in Figure 1 and searching terms in each database are shown in Table 1. Inclusion criteria for searching results consist of accessible full text and available in English. Filtering for double articles was also done.

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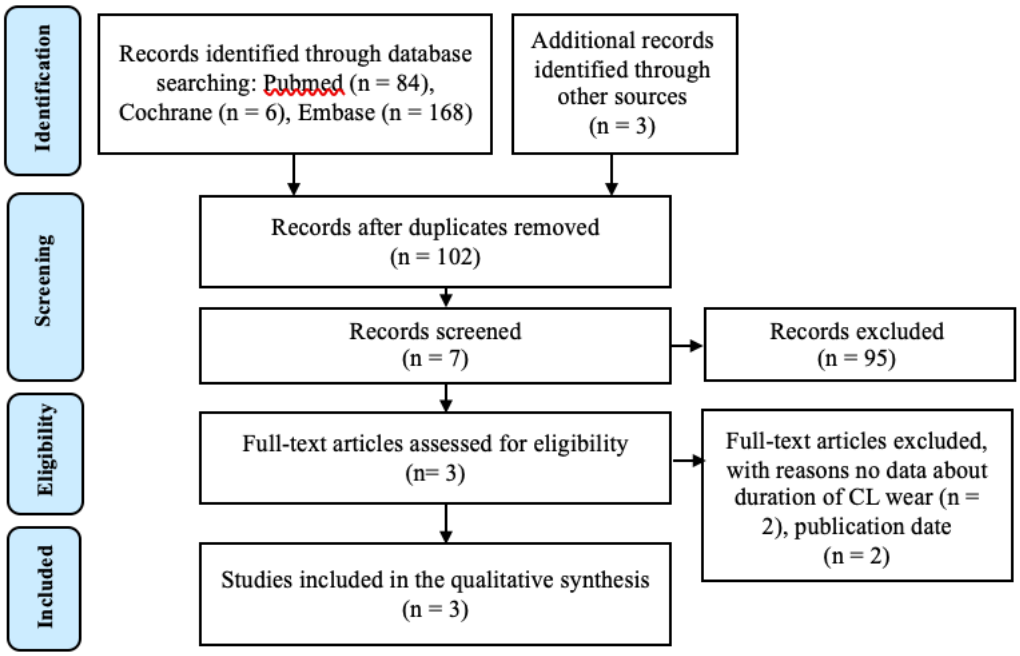

Figure 1. A literature search using PRISMA flow chart

Table 1. Search terms in each database

Database	Search terms
PubMed	Search: ((contact lens*[MeSH Terms]) OR (contact lens*[Title/Abstract])) AND (((ptosis[MeSH Terms]) OR (ptosis[Title/Abstract])) OR ((blepharoptosis[MeSH Terms]) OR (blepharoptosis[Title/Abstract]))) Filters: Full text, English
Cochrane	#1 (MeSH descriptor: [Contact Lenses] explode all trees #2 (contact lens):ti,ab,kw #3 #1 OR #2 #4 MeSH descriptor: [Blepharoptosis] explode all trees #5 (blepharoptosis):ti,ab,kw #6 #4 OR #5 #7 #3 AND #6
Embase	('contact lens'/exp OR 'contact lens' OR 'contact lenses') AND ('ptosis (eyelid)'/exp OR 'blepharoptosis') AND [english]/lim AND [embase]/lim

Based on search results as described previously, articles were considered eligible to be reviewed if the articles met the following inclusion criteria: (1) studies must include the data about durations of CL wear and type of CL used by subjects, (2) studies included must be in the last 15 years to practice the novelty of this literature review, (3) studies must not include subjects with history of congenital ptosis, ophthalmic surgery, ophthalmic disease, trauma, muscular or neurologic disorders. Articles that observed primarily etiologic other than contact lens wear were excluded. Furthermore, we also excluded cross-sectional studies and case reports. All studies included in this review were rated based on the Oxford Center of Evidence-

Based Medicine 2011 Level of Evidence. All articles that fulfilled the inclusion and exclusion criteria were thoroughly examined for data collection.

RESULTS

There were three selected articles from the literature searching in this report: Kitazawa[16], Watanabe et al.[17], and Bleyen et al..[18]All studies reviewed were single-center retrospective studies. Table 2 summarizes the design and characteristics of each study. These three articles were then critically appraised based on validity, importance, and applicability aspects for etiology study. The result of the critical appraisal can be seen in Table 3.

DISCUSSION

The three studies conducted by Kitazawa, Watanabe et al., and Bleyen et al. stated that CL wear was a risk factor for developing acquired ptosis.[16–18] Watanabe et al. and Bleyen et al. found that CL wearers were more prevalent in females than males population.[17,18] However, there seems to be no difference in the likelihood of ptosis occurring in the two genders. No studies have analyzed statistical comparisons of ptosis between females and males. Thus, the two studies could not explain whether aponeurotic ptosis affects females predominantly or whether females more typically ask that it be corrected.

The age range of the subjects included in the study also varied in all studies, where the subjects had an age range of 30-60 years in Kitazawa's study, while in the Watanabe et al.'s and Bleyen et al.'s study the age ranges were 26-68 years and 18-50 years, respectively. Nonetheless, including elderly subjects in the studies may lead to bias, whether the ptosis occurring was solely due to the use of contact lenses or involutional. In aging patients, changes in the upper eyelid manifest through various findings as the skin undergoes elastosis and thinning, resulting in dermatochalasis, or laxity. Involutional ptosis can occur as part of the aging process.[19]

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Table 2. Characteristic of included studies

Author, years, location	Level of Evidence (Design)	Age (yrs)	Subject Number	Contact Lens Type	Duration	Results
Kitazawa, 2013, Japan	IV (Age-matched case-control study)	30-60	51 ptosis patiens and 38 controls	RGP	Ptosis group: 29.6±8 yrs Control group: 23.2±8.3 yrs	Mean±SD of MRD, PFH, and LF for ptosis eyes was 0.5±0.8 mm, 6.3±1.2 mm, and 11.3±3.2 mm, respectively.
Watanabe et al., 2013, Japan	III (Retrospective cohort study)	26-68	98 patients (194 eyelids)	HCL	32±9 yrs	11 eyes: no ptosis; 37 eyes: 1.5 mm ≤ MRD1< 2.8 mm; 47 eyes: 0 mm < MRD1 < 1.5 mm; 99 eyes: MRD1 ≤ 0 mm.
Bleyen et al., 2011, The Netherlands	IV (Retrospective consecutive series)	18-50	35 patients	HCL or SCL	HCL: 17.6 yrs (6-27 yrs) SCL: 9 yrs (1.5-20 yrs)	Mean±SD of PFH of ptosis subjects was 7.06±1.52 mm

RGP = rigid contact lens, HCL= hard contact lens, SCL= soft contact lens, MRD= Margin Reflex Distance, PFH = palpebral fissure height

Watanabe et al. distributed the grade of ptosis in CL wearer by age group, with a 10-year span in each group, and found that the most severe ptosis was seen in the age group of 60-69 years. The path analysis showed that the severity of ptosis was also significantly influenced by patient's age.[17] However, the study did not explain any further whether the ptosis found in these elderly patients was involutional or contact lens–induced.

The methods for defining ptosis were also different in each study. Kitazawa photographed the subjects with a scale beside their eyes and used the pictures to measure MRD and PFH. The criteria defining ptosis adopted in Kitazawa's study were based on the definition by Small et al[20], who defined ptosis as an MRD of 1.5 mm or less. This cut-off was considered to be suitable for Japanese subjects as most of them presenting a typical Mongoloid eye characterized by a puffy eyelid and narrow palpebral fissure. Whereas, in Watanabe et al.'s

study, which also conducted in Japan, MRD1 of less than 2.8 mm was diagnosed as ptosis according to the criteria proposed by van den Bosch and Lemij.[5] Ptosis was then classified as either no ptosis (MRD1 greater than 2.8 mm), mild (MRD1 greater than or equal to 1.5 mm to less than 2.8 mm; grade 2), moderate (MRD1 greater than 0 mm to less than 1.5 mm; grade 3), or severe (MRD1 equal to or less than 0 mm; grade 4).[17] These two studies also differed from Bleyen et al.'s study in Dutch population, which defined ptosis as a vertical lid fissure smaller than 7 mm and/or asymmetry in the upper eyelid position greater than 2 mm and with no scleral show superiorly.

Kitazawa suggested that 90% of the ptosis patients had a history of wearing HCL, which is much greater than that of previous studies that have reported a range from 7% and 47%.[11,21] These differences may be due to distinct in the prevalence or preference of HCL or regional differences in the myopic population. Statistical analysis by Kitazawa showed HCL wearers had 20 times increased risk of ptosis (OR: 19.9; 95% CI= 6.32-62.9; $P < 0.001$).

Bleyen et al. indicated that not only HCL wear but also SCL wear may be associated with ptosis, with the prolonged wear of HCL most likely carriying a higher risk for developing ptosis than SCL. Bleyen et al. reported the OR for SCL wear was 14.7 (4.2 to 50.7; 95% CI) and the OR for HCL wear was 97.8 (22.5 to 424; 95% CI). The significantly higher OR value in the Bleyen et al.'s study may be due to the study group compared to a Dutch population, which was thought not representative of the source population, namely a group of patients visiting an ophthalmologist because of ptosis.

In 2015, Hwang and Kim reported a systematic review of five studies (Kitazawa and Bleyen et al. study were also included), and a meta-analysis of these data suggested there was an increased risk of blepharoptosis in HCL wearers over nonwearers (n=7426; OR: 17.38; 95% CI 3.71-81.29, $P < 0.00001$), and also increased risk of blepharoptosis in SCL wearers over nonwearers (n = 90; OR: 8.12; 95% CI = 2.68-24.87; $P < 0.0002$).[22] Differences between HCL and SCL in terms of material, size and shape, and thickness of the lens margin can lead to differences in mechanical trauma and contact with the levator aponeurosis.[18]

Table 3. Critical Appraisal of The Chosen Articles

Critical Appraisal	Kitazawa, 2013	Watanabe et al., 2013	Bleyen et al., 2011
Validity Aspect			
Is there a clearly focussed question? (Consider patients, exposure, outcome)	Yes. To estimate the risk of developing ptosis from wearing HCL.	Yes. To investigate the impact of myopia and duration of HCL wear on the progression of ptosis.	Yes. To establish an association between prolonged HCL or SCL wear and ptosis.
Were there clearly defined group of patients, similar	Yes. All subjects were female divided into 2	Yes. All patients were long-term HCL wearer	Yes. Subjects were divided into 3 group:

in all important ways other than exposure to the treatment or other causes?	groups: ptosis and control.	with ptosis. Patients with ptosis due to other etiologies were excluded.	HCL wearer, SCL wearer, and nonwearer.
Were treatments/ exposures and clinical outcomes measured in the same way of both groups?	Yes. All patients and controls were questioned about past HCL wear and measured the MRD and PFH.	Yes. Information of past HCL wear were obtained and MRD1 measurement were done in all patients.	Yes. Histories of past CL wear and ophthalmologic examination were done in all patients.
Was the assessment of outcomes either objective or blinded to exposure?	Blinding was not described in this study.	Blinding was not described in this study.	Blinding was not described in this study.
Was the follow-up of study patients sufficiently long for the outcome to occur?	There was no follow-up of study patients.	There was no follow-up of study patients.	There was no follow-up of study patients.
Do the results of the harm study fulfil some of the diagnostic tests for causation?	Yes. The longer the duration of wearing HCL, the greater the risk of ptosis (dose-response gradient).	Yes. The longer the duration of wearing HCL, the greater the risk of ptosis (dose-response gradient).	Yes. There was no analysis on the duration of CL wear and the risk of ptosis.
Importance Aspect			
How strong is the association between exposure and outcome, i.e. the estimate of risk?	There was a significant association between the history of HCL wear and acquired ptosis (OR: 19.9; 95% CI: 6.32-62.9; P< 0.001).	The severe ptosis was correlated positively with patient's age (OR 2.18 for 10-year increase, P = 0.001) and the duration of HCL wear (OR 2.05 for 10-year increase.	The odds ratio for SCL wear is 14.7 (4.2 to 50.7; CI = 95%). The odds ratio for HCL wear is 97.8 (22.5 to 424; CI = 95%).
How precise is the estimate of risk? Were the results presented with confidence intervals?	The study used 95% CI to determine statistically significant.	The study used 95% CI to determine statistically significant.	The study used 95% CI to determine statistically significant.
Applicability Aspect			
How can I apply the results to patient care?	Patients with prolong HCL wear should be informed of the risk of blepharoptosis.	Patients must be informed that high myopia, age, and the duration of HCL wear are risk factors of ptosis progression.	Patients should be informed that not only HCL but also SCL can lead to ptosis.

CL= contact lens, HCL= hard contact lens, SCL= soft contact lens, MRD= margin reflex distance, PFH= palpebral fissure height, OR= odd ratio, CI= confidence interval, SERE= spherical equivalent refractive error

Acquired ptosis is classified according to its pathogenesis as either neurogenic, myogenic, or aponeurogenic, with the latter being the most common.[23] Ptosis associated to HCL wear is thought to be aponeurogenic, resulting from excessive physical manipulation of the eyelid during the removal of the HCL. [3,5,11,21] There were three most widely used techniques for HCL removal which were by pulling the lids laterally at the lateral canthus followed by a harsh blink, by manipulation of the eyelids with the fingers, or by using a suction holder.[21,24] At first, some researchers thought that the use of suction holder to remove the lens would not cause

ptosis. However, van den Bosch and Lemij found two cases of HCL wearers who still developed ptosis in spite of using suction holder.[5] In addition, a recent study by Yang et al. also reported that there was no significant difference in MRD, PFH, and LF measurements between suction holder and finger-lid manipulation technique to remove HCL. They suggested that the removal method with finger-lid manipulation did not cause contact lens–induced ptosis.[24]

Previous studies have tried to elucidate some of the possible mechanisms of contact lens-induced ptosis. Theory that was accepted by many studies was disinsertion or dehiscence of the levator aponeurosis from its distal insertions in the eyelid due to simultaneous contraction of the orbicularis and the levator muscles in the lid manipulation over years.[12] Other than that, Watanabe et al. reported microscopic fibrosis with plentiful collagen fibers but little fatty degeneration in the Müller muscle of fifteen long-term conventional rigid gas permeable (RGP) wearers. This histopathological finding revealed remarkable histologic differences concerning Müller muscle between samples from younger patients with long-term HCL wear and elderly patients with involutional ptosis. [25] Some studies also argued that every blink made during the regular wearing of HCL rubs the lens against eyelid structure, which may eventually cause levator disinsertion. Also, chronic irritation of the eyelid by the lens edge or deposits on the lens surface may induce eyelid edema and ptosis.[5,24]

The duration of CL wear that is considered to potentially induce ptosis varied in each study. Kitazawa found that the mean duration of CL wear in ptosis patients was greater than control, which was 29.6 years and 23.2 years, respectively. However, the statistical analysis showed these differences were not significant ($P < 0.016$).[16] In Watanabe et al.'s study, the average duration was 31 ± 11 years (mean ± SD, range 14–50 years) in no ptosis, 29 ± 10 years (12–46 years) in mild ptosis, 30 ± 9 years (12–46 years) in moderate ptosis, and 34 ± 8 years (8–50 years) in severe ptosis. The analysis showed that the average duration of HCL wear was significantly higher in severe ptosis than in moderate ptosis ($P < 0.05$) or mild ptosis ($P < 0.01$), but there was no difference in the mean duration of HCL wear between severe ptosis and no ptosis. Meanwhile, the study from Bleyen et al. was slightly different in which the average duration for HCL wear in ptosis patients was 17.6 years (range 6 to 27 years) and for SCL wear was 9 years (range 1.5 to 20 years). Yet there was no statistical analysis of the relationship between the duration of CL wear and the development of ptosis in this study. Previous studies suggested that prolonged CL wear, with an average duration of 15 years of wear was associated with ptosis.[21] Van den Bosch and Lemij found that 25 percent of long-term HCL wearers developed ptosis.[5]

Watanabe et al. also found that patient with severe ptosis has a higher spherical equivalent refractive error (SERE) significantly compared to moderate, mild, and no ptosis patients. Thus, they stated that high myopia together with patient age and long-term HCL wear were risk factors associated with the progression of ptosis. The thickness of the HCL edge increases with the degree of myopia, the severity of the ptosis was then affected by wearing HCL with a thicker edge. In addition, a structural change in the eyeball and eyelid due to myopia is also postulated as a possible mechanism.[17]

Van den Bosch and Lemij postulated that ptosis due to CL wear is reversible only in the early stage of CL wear because discontinued wear of the lenses would remove the irritation, allowing the eyelids to recover their original morphology. However, blepharoptosis may not resolve after long-term irritation from the HCL.[5] Bleyen et al. recommended advising patients with blepharoptosis and CL wear to discontinue CL wear for 3 months, and if the ptosis does not resolve, ptosis surgery can be planned.[18]

Limitation of this literature review includes lack of multi-center study and randomized control trial (RCT) available for CL wear. Even though longitudinal study that monitor subjects before and after contact lens wear would be ideal, it would not be easy to follow such subjects over many years, especially as their vision correction needs may change over time. Furthermore, data on the association between CL wear and ptosis in Indonesia was lacking. As the number of CL wearers in Indonesia has increased significantly, either for medical or cosmetic purposes, further studies that evaluate cases of contact lens-induced ptosis in Indonesia will be essential

CONCLUSION

Based on the literature searching and critical appraisal that has been carried out by this report, it can be concluded that all three studies gave consistent results that CL wear was a risk factor for developing acquired ptosis. The mean duration of CL wear that is considered to potentially induce ptosis varied between 15 to 34 years. All studies agreed that HCL has a greater risk for ptosis to occur than SCL. Therefore, medical doctors should inform the risk of blepharoptosis in patients wearing CL, and a history of CL wear should be sought in all patients who develop acquired ptosis.

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