



(REVIEW ARTICLE)



EYE INFECTIONS IN DENTAL OPERATORS ARISING FROM INADEQUATE INFECTION CONTROL: A NARRATIVE REVIEW

Althaaf Khan *

BDS (SMU), Private Practice, South Africa.

* Corresponding Author

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ABSTRACT

Background: Dental operators work within the splash and aerosol field of the patient's mouth, and the conjunctiva is an unprotected mucosal surface that can act as a portal of entry for microorganisms. Inconsistent use of eye protection may therefore expose operators to eye infection.

Objective: To review the evidence on eye infections in dental operators that result from inadequate infection control, with attention to routes of exposure, causative agents, contributing failures and preventive strategies.

Methods: A narrative review was undertaken using targeted searches of PubMed/MEDLINE, PubMed Central and Google Scholar for English-language literature and infection-control guidelines. Sources reporting ocular infection, exposure or eye-protection behaviour among dental personnel were synthesised thematically.

Results: The evidence comprises mainly surveys, case reports, laboratory studies and guidelines. Two surveys report ocular events in 47.8% and 52.6% of dental respondents, with conjunctivitis reported by 27% in one. Documented infections include eyelid infection and herpetic keratitis; bloodborne and respiratory viruses are recognised potential exposures. Recurrent failures are non-use of eyewear, eyewear lacking lateral protection, uncontrolled aerosol and splatter, hand-to-eye contact, inadequate precautions with active herpetic lesions, and training gaps. South African studies show persistent shortcomings in eye protection.

Conclusion: Confirmed operator eye infections are mostly reported as isolated cases, but the exposure pathways are well described and largely preventable. Standard precautions for every patient, appropriate eyewear or face shields, aerosol control, hand hygiene and education should be core components of practice-level infection control. Prospective surveillance in South Africa is needed.

Keywords: Dental operator; Ocular infection; Conjunctivitis; Infection control; Personal protective equipment; Occupational health.

1 INTRODUCTION

Dental operators work in close proximity to the oral cavity, and many routine procedures, including the use of high-speed handpieces, ultrasonic scalers and air-water syringes, generate aerosols and spatter contaminated with bacteria and blood [1]. The operator's eyes lie within this contaminated field. A dental clinic can be a source of eye-related infection and injury through mechanical, chemical, microbiological and electromagnetic irritants, and the resulting effects range from mild irritation to blindness [2]. Concern about these hazards is not new: a survey and literature review published in 1991 already drew attention to the risk of ocular injury and infection for dental surgeons, dental assistants and patients [3].

Standard precautions require that the mucous membranes of the eyes, nose and mouth be protected during procedures likely to generate splashes or spatter, and current guidance from the United States Centers for Disease Control and Prevention (CDC) recommends eye protection with solid side shields or a face shield in addition to a surgical mask [4]. In practice, compliance is variable, and eye protection appears to be applied less consistently than gloves or masks. A systematic review of South African studies published between 1990 and 2007 concluded that, although the available studies were limited and relied largely on self-report, they still indicated serious shortcomings in infection control [5]. An observational study of public dental clinics in one South African province identified the absence of protective eyewear during procedures despite adequate provision of infection-control resources [6].

Existing reviews tend to consider ocular trauma and infection together [2]. A focused appraisal of infection-related ocular outcomes as a consequence of infection-control failure, with attention to South African practice, appears to be lacking. The objective of this review was therefore to synthesise the available evidence on eye infections in dental operators that arise from inadequate infection control, focusing on routes of exposure, causative agents and clinical presentations, contributing failures in infection-control practice, and preventive strategies.

2 MATERIALS AND METHODS

2.1 Study design

This study is a narrative review. It was designed to provide a structured qualitative synthesis rather than a systematic review or meta-analysis, because the available evidence is heterogeneous and consists mainly of cross-sectional surveys, case reports, laboratory studies and guidelines.

2.2 Literature search

Targeted searches were conducted in PubMed/MEDLINE, PubMed Central and Google Scholar in September 2026. Search terms were combined using Boolean operators and included: dental, dentist, "dental operator" and "dental personnel"; "eye infection", "ocular infection", conjunctivitis and keratitis; "eye protection", "protective eyewear" and "face shield"; "infection control"; aerosol, splatter and spatter; herpes; and COVID-19. No lower date limit was applied so that landmark publications could be captured. Reference lists of key articles were hand-searched, and national and international infection-control guidance, including the CDC guidelines for dental settings, was consulted.

2.3 Eligibility criteria

Peer-reviewed articles in English and authoritative guidelines were included if they reported (i) ocular infection or infection-related ocular symptoms in dental personnel, (ii) contamination or exposure of the operator's eyes or face during dental procedures, or (iii) eye-protection practices and other infection-control behaviours relevant to ocular exposure. Articles on ocular complications in patients resulting from dental treatment (for example, following local anaesthesia or implant surgery) and studies of ocular injury with no infectious or contamination component were excluded.

2.4 Data extraction and synthesis

For each source, the design, setting, population and main findings relevant to operator eye infection were extracted and grouped thematically: occurrence, routes of exposure, pathogens and clinical presentations, contributing infection-control failures, and prevention. No formal risk-of-bias appraisal or quantitative pooling was undertaken. Findings are therefore reported descriptively, and the strength of the evidence is discussed qualitatively.

2.5 Ethical considerations

This review used published literature only and involved no human participants, patient data or animal experiments. Ethical approval and informed consent were therefore not required.

3 RESULTS AND DISCUSSION

3.1 Nature of the evidence

The reviewed literature comprised cross-sectional surveys of dental personnel, case reports and case series, laboratory studies of splatter contamination, systematic and narrative reviews, and infection-control guidelines. Key studies are summarised in Table 1. Three features limit interpretation. First, most prevalence data are self-reported and drawn from convenience samples in single cities or institutions. Second, surveys generally report ocular "events" or "injuries" as a composite that combines foreign bodies, chemical splashes and infection, so the infectious component cannot always be separated. Third, documented operator eye infections are reported largely as individual cases or small series (Table 1).

Table 1: Summary of key sources included in this review

Source	Setting and design	Key findings relevant to operator eye infection
Roberts-Harry et al., 1991 [3]	Survey of dental practitioners with literature review	Highlighted the risk of ocular injury and infection to dental surgeons, assistants and patients; surveyed how often injuries occur and what preventive measures are used.
Al Wazzan et al., 2001 [7]	Riyadh, Saudi Arabia; survey of 204 dental personnel	One-month prevalence of foreign bodies in the eye 42.3% in dentists and dental technicians.
Revankar et al., 2019 [8]	Salem, India; questionnaire survey of 150 dentists	Ocular injury-related problems 52.6%; conjunctivitis 27%; corneal abrasion 5%.
Anzar et al., 2021 [9]	Karachi, Pakistan; online cross-sectional survey of 301 dental professionals	Ocular events 47.8%; facial injuries 5.3%; ocular events associated with experience, patient load, posture and armamentarium.
Mehtar et al., 2007 [6]	One South African province; observation of 24 public dental clinics, 75 staff interviewed, 23 procedures observed	Difference between knowledge and practice despite adequate provisions; lack of protective eyewear and hand washing between patients identified.
Oosthuysen et al., 2010 [5]	South Africa; systematic review of studies published 1990-2007	Serious shortcomings in infection control, including use of personal protective equipment; studies limited and largely self-reported.
Nejatidanesh et al., 2013 [10]	Iran; observation of 144 prosthetic and periodontal procedures	Visible splash accumulation on face shields mapped across facial areas, including the eye regions; dentist's face described as high-risk.
Browning and McCarthy, 2012 [11]	United States; case series of four cases	Ophthalmic herpes keratitis in a dental hygienist; herpetic whitlow in dentists and a hygienist after treating patients with active lesions.
Arvind and Roma, 2020 [12]	India; case report	Dental intern developed an eyelid infection after an operative procedure on an infected tooth; emphasised preventive barriers.

3.2 Occurrence of ocular events among dental operators

Cross-sectional surveys from several countries indicate that ocular events are common among dental personnel. In Riyadh, a survey of 204 dental personnel found that dentists and dental technicians had a similar one-month prevalence of foreign bodies in the eye of 42.3% [7]. Among 150 dentists in Salem, India, 52.6% reported ocular injury-related problems, 27% reported conjunctivitis, 5% corneal abrasion, 4.3% a retinal lesion attributed to chemical injury and 1.3% cataract [8]. In a Karachi survey of 301 dental students, interns, postgraduate trainees, general practitioners and specialists conducted during the COVID-19 pandemic, the overall prevalence of ocular events was 47.8% and that of facial injuries 5.3%; ocular events were associated with qualification, years of clinical experience, number of patients treated per day, posture and armamentarium [9].

Self-reported conjunctivitis, at 27% in one survey [8], is the closest available proxy for infectious ocular disease. However, definitions differ between studies, self-reported conjunctivitis may be allergic, irritant or infectious, and

causation by an infection-control failure cannot be established from these data. The findings nonetheless indicate that the eyes of dental operators are regularly exposed to material from the operative field.

3.3 Routes of ocular exposure

3.3.1 Aerosol and splatter

Many dental procedures generate aerosols and droplets contaminated with bacteria and blood, which represent a potential route of disease transmission [1]. Bentley and colleagues evaluated spatter and aerosol contamination during dental procedures [13], and Nejatidanesh and colleagues mapped visible splash accumulation on face shields across 144 prosthetic and periodontal procedures, treating the dentist's face, including the corners of the eyes, as a high-risk site for cross-contamination [10]. Contamination of the periocular region is therefore an expected consequence of operating within the splash field without adequate protection.

3.3.2 Hand-to-eye transfer

Contaminated gloves, fingers and instruments can carry pathogens to the eye. Browning and McCarthy note that herpes keratitis typically follows a person with an active labial lesion touching or rubbing the eyes, and identify a further route in which a member of the dental team touches the eyes after treating a patient with an active herpetic lesion [11]. Hand hygiene, glove changes and avoidance of touching the face are therefore as relevant to ocular protection as eyewear.

3.4 Pathogens and clinical presentations

3.4.1 Bacterial and soft-tissue infection

Infection-related ocular conditions that may follow dental exposure include bacterial and viral conjunctivitis and keratitis, together with contamination by hepatitis B virus, hepatitis C virus and human immunodeficiency virus (HIV) [2]. A case report illustrates the bacterial route: a dental intern developed an eyelid infection shortly after performing an operative procedure on a patient with an infected tooth, presenting three days later with diffuse swelling of the upper eyelid of one eye and mild congestion of the other [12]. The authors used the case to argue for the consistent use of preventive barriers and for additional protective gear when treating infected teeth [12].

3.4.2 Herpes simplex virus

Herpes simplex virus type 1 (HSV-1) is the best-documented viral occupational hazard affecting the eye. Approximately 70% of people in the western world are infected by the second decade of life, and dental workers are at risk of herpes labialis, herpetic whitlow and keratitis [14]. HSV-1 has been detected in the saliva of asymptomatic individuals, so the risk is not confined to patients with visible lesions [2]. Browning and McCarthy described four cases, including ophthalmic herpes keratitis in a dental hygienist alongside herpetic whitlow in dentists and a hygienist, and presented them as evidence that treating patients with active lesions is a potential occupational hazard for the dental team [11].

3.4.3 Bloodborne viruses

Bloodborne viruses may enter through the conjunctiva. The CDC estimates the risk of HIV transmission after mucous-membrane exposure of the eye, nose or mouth at approximately 0.1% [4]. Although low, this risk is not zero, and in a country where, as Oosthuysen and colleagues observe, the prevalence of infectious diseases ranks among the highest in the world [5], even small per-exposure risks warrant consistent protection.

3.4.4 Respiratory viruses.

The COVID-19 pandemic renewed attention to the eye as a portal of entry. Person-to-person transmission of SARS-CoV-2 was described as including contact of the virus with oral, nasal and eye mucous membranes, and dental personnel were considered at high risk because of face-to-face working and exposure to saliva and blood [15]. Lu and colleagues argued that transmission through the ocular surface must not be ignored [16]. In the Karachi survey, the authors emphasised eye protection alongside masks during dental treatment in this context [9].

3.5 Infection-control failures that contribute to operator eye infection

Across the literature, the failures that most plausibly convert routine exposure into infection can be grouped as described below and summarised in Table 2.

3.5.1 Non-use or selective use of eye protection

In the South African public-sector study, absence of protective eyewear during procedures was among the lapses observed, and the authors highlighted a marked difference between knowledge and practice despite adequate provisions [6]. The same paper summarises an earlier South African survey in which 87%, 63% and 80% of dentists

routinely used gloves, eye protection and masks respectively, rising to 98%, 92% and 94% when treating patients known to be HIV-infected [6]. Eye protection was thus the least consistently used barrier, and its use appeared to depend on the perceived infectivity of the patient rather than on universal application of standard precautions. Because HSV shedding and many bloodborne infections can be asymptomatic, risk-based selective use of eyewear is an unreliable safeguard [2,4]. More broadly, reviews of compliance in oral health-care facilities conclude that approaches differ widely between developed and developing countries although the principles of infection prevention and control are the same [17].

3.5.2 Inadequate eyewear design and maintenance

Open-sided spectacles do not shield the periocular region from spatter arriving laterally, which is why CDC guidance specifies solid side shields or a face shield [4]. The accumulation of splash on face shields in the study by Nejatidanesh and colleagues shows that such barriers intercept contamination that would otherwise reach the face [10], and the Manipal case report likewise presents side-shielded eyewear and face shields as protection against spatter and debris [12]. Reusable eyewear should be cleaned and, when visibly soiled, disinfected between patients [4]; failure to do so leaves contaminated equipment that the operator handles repeatedly.

3.5.3 Uncontrolled aerosol and splatter generation

The dental literature indicates that aerosol and spatter can be reduced by simple and inexpensive measures [1]. However, a Cochrane review of 16 studies assessing interventions to reduce contaminated aerosols measured bacterial contamination only, found no studies of viral or fungal contamination, and judged the evidence to be of very low certainty [18]. Aerosol-reduction measures should therefore supplement, rather than replace, personal protective equipment.

3.5.4 Hand hygiene lapses

Not washing hands between patients was among the lapses identified in South African public clinics [6]. Combined with the hand-to-eye route described above [11], lapses in hand hygiene and glove practice directly increase the risk of ocular inoculation.

3.5.5 Treating patients with active herpetic lesions without added precautions

Elective treatment of patients with active herpetic lesions should be deferred, and where urgent care is unavoidable Browning and McCarthy recommend additional protective equipment that fully covers the body, eyes and face, together with an N95-rated or higher respirator [11].

3.5.6 Knowledge and training gaps

An Indian national survey noted the absence of set guidelines for the prevention and management of ocular problems arising from dental infections, and that dental curricula do not address preventive approaches or preliminary management of eye manifestations arising from dental contamination [19]. The knowledge-practice gap reported in South Africa [6] suggests that knowledge alone is insufficient, and that training must be reinforced by practice-level protocols and audit.

3.5.7 South African context

No South African study specifically addressing operator eye infection was identified. The available South African evidence concerns infection control in general [5,6], and occupational health problems in dentistry have been reviewed by South African authors [20]. Practitioners in small private practices may lack institutional infection-control support, so responsibility for protocols, equipment and staff training rests directly with the principal dentist.

Table 2: Infection-control failures, potential consequences and preventive measures

Infection-control failure	Potential consequence	Preventive measure
Eye protection not worn, or worn selectively according to perceived patient risk	Direct splash or spatter contact with the conjunctiva; exposure to bacteria, HSV-1, bloodborne and respiratory viruses	Standard precautions for every patient; eye protection with solid side shields or a face shield, worn with a mask [2,4,6]
Eyewear without lateral protection, or unclean reusable eyewear	Periocular splash; contaminated equipment handled repeatedly	Side-shielded eyewear or face shield; clean, and disinfect if visibly soiled, between patients [4,10,12]
Uncontrolled aerosol and splatter generation	Increased contamination of the operator's face and eyes	Aerosol-reduction measures as an adjunct to, not a replacement for, protective equipment [1,18]
Hand hygiene lapses; touching the eyes during or after treatment	Hand-to-eye inoculation, including HSV-1 keratitis	Hand hygiene, glove changes and avoidance of touching the face [4,6,11]
Treating patients with active herpetic lesions without added precautions	Herpes keratitis and herpetic whitlow	Defer elective treatment; for urgent care use full eye and face coverage and an N95-rated or higher respirator [11,14]
Absent protocols, training gaps and no exposure plan	Normalised non-compliance; delayed management of ocular exposure	Written protocols, curriculum and CPD content on ocular hazards, immediate irrigation and follow-up after splash [4,19]

3.6 Prevention and management

Prevention rests on layered controls. First, standard precautions should be applied to every patient, with eye protection featuring solid side shields or a face shield worn together with a mask during any procedure likely to generate splash or spatter [4]. Second, aerosol and splatter generation should be minimised where practicable [1], recognising the limits of the current evidence [18]. Third, hand hygiene and glove changes should be strictly observed, and operators should avoid touching the face during treatment [4,11]. Fourth, dental team members should be vaccinated against hepatitis B in line with CDC recommendations [4], and patients with active herpetic lesions should be managed as described above [11]. Fifth, education on ocular hazards and their management should be included in undergraduate and continuing professional development programmes [19].

Finally, every practice should have a written exposure protocol. Any splash to the eye should prompt immediate irrigation, documentation and follow-up according to that protocol [4]. Periodic audit of eyewear availability, condition and use by all members of the team would convert these recommendations into verifiable practice.

3.7 Limitations and future directions

The limitations of this review include its narrative design, selection and extraction of studies by a single author, restriction to English-language publications and absence of formal quality appraisal, all of which introduce the possibility of selection bias. The evidence base itself is limited by self-reported data, heterogeneous definitions of ocular events, few microbiologically confirmed cases and the absence of South African ocular data. Future work should include prospective surveillance of ocular symptoms in dental teams using standardised case definitions and microbiological confirmation where possible, South African practice-based surveys of eyewear use, and comparative studies of eyewear design and aerosol-control strategies using clinically meaningful outcomes.

4 CONCLUSION

Eye infections in dental operators are documented mostly as individual cases, yet the routes of exposure (aerosol, splatter and hand-to-eye transfer) and the pathogens involved (bacteria, HSV-1, bloodborne viruses and respiratory viruses) are well described. The recurring failures are inconsistent or risk-selective use of eye protection, eyewear without lateral protection or adequate cleaning, hand hygiene lapses, inadequate precautions when treating patients with active herpetic lesions, and gaps in training. These are modifiable. Universal application of standard precautions with appropriate eyewear or face shields, supported by written protocols, education and audit, should be regarded as a core component of infection control in every dental practice. South African data specific to operator eye infection are needed to guide local practice.

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