IN BRIEF

- Risks encountered within the dental environment cause harm to the unprotected eyes of both staff and patients.
- Ocular injuries and infections may have serious long term effects.
- Professional bodies and the Health and Safety Executive support and advise on the need for eye protection; several choices are available.
- Eye protection by all staff and patients is currently suboptimal, especially during surface and instrument cleaning and disinfecting.

Eye safety in operative dentistry – A study in general dental practice

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Aim In this safety conscious age all general dental practitioners should be promoting the use of eye protection. The aim of this study was to highlight the uptake of eye protection by all clinical staff and patients within the general dental practice setting, with regard to adequate protection and its use at appropriate times.

Method Questionnaires were sent to 200 GDPs, chosen at random, to accumulate information on the use of protection, the preferred methods of eye protection and any experience of ocular injury.

Findings Eighty-seven per cent of GDPs wore eye protection routinely, but their choice of protection was not always adequate and not worn for all procedures. Forty-eight per cent of GDPs had experience of ocular trauma or infection which occurred during a variety of procedures; 75% of these injuries resulted from not wearing eye protection. In contrast less than half of the DNs and Hygienists use protection routinely, particularly when cleaning contaminated instruments. However, hygienists did wear eye protection for the majority of their patient work (96%).

Conclusion Eye protection use by all staff and patients is currently suboptimal to conform to published guidelines. Risks encountered within the dental environment do cause harm to the unprotected eye, which can be reduced or even eliminated by improving the uptake of suitable eye protection; several choices for eye protection are available. Each individual dentist is responsible for the uptake of eye protection for all persons in their surgery environment.

INTRODUCTION

Prior to the 1980s many dentists and their staff performed dental procedures with little knowledge of personal protection. Despite knowledge of infectious diseases, the perceived risk was thought to be low and few wore operating gloves, masks or eye

protection. Ever increasing awareness of personal protection and cross infection control, from both dental professionals and indeed patients has changed this perception. While the use of protective gloves and masks by all the participants in operative dentistry appears now to be the norm, this may not be true of eye protection.

Ocular injuries may have serious and long term effects. Symptoms of direct mechanical trauma often relate to the degree and type of trauma, and include pain, lacrimation, and blurring of vision. However, mild symptoms may disguise a potentially blinding intra-ocular foreign body. The potential ocular adverse effects that may affect both staff and patients, along with their symptoms and treatment are identified in Table 1.¹ These injuries, often acutely painful, have grave implications for sight, and especially if there is a detached retina or the cornea and sclera are involved. Penetrating ocular trauma often causes visual damage and may require extensive surgery. Chemical injuries can result in long term visual impairment and discomfort, which may limit a practitioner's future clinical practice. However, following minor trauma, generally the eye heals well and rarely are there any long term sequelae, with the exception of recurrent erosion syndrome.

Contamination of the eye with bodily fluid such as blood and saliva carries with it several potential risks, both bacterial and viral¹ (Table 1). Previous studies highlighted that eye infections were common among dentists and although many were concerned, few were using proper eye protection.^{2,3} Since the surface of the eye is a vital structure, simple contact with an infected substance, for example from a contaminated aerosol, has the potential to cause infection, without the need to be breached.^{4,5} More recently, concern has been raised about infections caused by methicillin resistant staphylococcus aureus (MRSA). This can be spread by direct contact and although not normally found within the oral cavity, it is found in nares. In addition it has been occasionally isolated from oral infections.⁴ Wilcox *et al.* found contact lenses to be a predisposing factor to keratitis caused by herpes simplex, once again demonstrating the possibility of contamination of the eye during dental procedures if adequate protection is not taken.⁶ It must be emphasised that most carriers of latent infection are unaware of their condition and it is important that the same infection control routine is adopted for all patients; surgeons are more likely to use adequate protection if a patient is known to be infected.^{4,7}

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Table 1 Possible adverse effects affecting eyes

Infective / Trauma	Adverse effect	Cause	Symptoms	Treatment	Outcome
Trauma	Corneal abrasion	Foreign Body	Acutely Painful	Self limiting	Heals rapidly, Recurrent corneal erosion, Secondary infection
	Haemorrhage into anterior chamber	Penetrating foreign body	Acute Pain Altered vision Altered appearance	Remove foreign body, Suturing	Cataracts Pupil distortion Detached retina Uveitis
	Torn iris				
	Lacerations	Blunt / Sharp object	Laceration, may involve lid margin	Anatomical repair	Scarring
	Chemical Injury	Acid / Alkali	Mild conjunctivitis Epithelial erosions Superficial punctuate keratopathy	Copious irrigation Remove any particles pH with litmus paper Topical antibiotics Lubricants Topical steroids Vitamin C	Usually recovers Corneal defects (opacities and perforation)
Infective	Bacterial Conjunctivitis	Staphylococcus, Streptococcus, Pneumococcus, Haemophilus	Redness, Discharge, Ocular irritation	Usually self limiting	Heals
	Bacterial keratitis	Staphylococcus epidermidis, Staphylococcus aureus, Streptococcus pneumoniae, Coliforms, Pseudomonas, Haemophilus	Pain, Purulent discharge, Ciliary injection, Visual impairment, White corneal opacity	Topical antibiotics	Heals
	Viral conjunctivitis	Adenovirus, Coxsackie, Picornavirus	Watery, Purulent discharge, Chemosis, Excess lacrimation	Self limiting but highly contagious	Heals
	Viral keratitis	Herpes simplex	Dendritic ulcers on the cornea, May involve the stoma		Ulcers heal without scarring, Risk of permanent scarring and blindness
	Hepatitis B & C	Hepatitis virus	Systemic infection	Interferon treatment.	Possible chronic hepatitis, cirrhosis, Risk of hepatocellular carcinoma
	HIV	HIV	Systemic infection	Supportive drug therapy	Poor long term prognosis

Ultraviolet light is that portion of the EMR spectrum of invisible light below 286 nm to 400 nm. UV is further categorised into groups A, B, and C by its wavelength. UV light in group C (320–400 nm) is the most damaging, and is transmitted to the lens of the eye causing ocular damage. The human eye has an inherent potential for photochemical lesions, which increases with light exposure. As dental technology advances, the use of various light sources is increasing. A standard dental light curing unit emits blue light between 350–500 nm, which includes UV group C, indicating the necessity for filtration to protect the eye. Protection against UV and blue light should be incorporated in safety glasses to prevent acute and chronic changes in ocular structures, such as UV cataracts, solar retinitis, corneal and conjunctiva dystrophies, arc eye and macular degeneration, which may lead to irreversible damage.⁸ Since tinted lenses used by the clinical team would hinder clinical practice if worn at all times, additional methods must be adopted, such as the use of wide orange filtration paddles when a dental light curing unit is in operation.^{4,9–11} As the restriction in colour vision does not have the same impact on patients they must be provided with shaded or colour tinted glasses for optimal protection. It is possible to have glasses treated with clear UV absorbing dyes but these are only effective up to 400 nm.

Continuous developments within dentistry have seen an increased use of light cured materials and it may be some time before any correlation is made between exposure to UV radiation, ocular symptoms and dentistry. Suitable eye protection against

electromagnetic radiation must be considered to avoid irreversible damage. More recent dental light sources, such as the light emitting diode, plasma arc curing, quartz tungsten halogen and laser curing lights, not only require eye protection against the intense light but also the associated increased temperature.^{12–15}

In February 2003 the British Dental Association (BDA), published an advice sheet, 'Infection Control in Dentistry',⁴ distributed it to their members and made it freely available.⁴ The BDA advice sheet stated that:

'Operators and close support clinical staff must protect their eyes against foreign bodies, splatter and aerosols that may arise during operative dentistry:

During scaling, (manual and ultrasonic)

Using rotary instruments

Cutting and use of wires

Cleaning instruments.

Ideally protective glasses should have side protection. Patients' eyes must always be protected against possible injury; tinted glasses may also protect against glare from the operating light.'

In addition the American Dental Association (ADA) has published 'Guidelines for Infection Control in Dental Health – Care Settings 2003'¹⁶ which state:

'Protective eyewear with solid side shields or a face shield should be worn by dental health care personnel during procedures and patient-care activities likely to generate splashes or sprays of

blood or body fluids. Protective eyewear for patients shields their eyes from spatter or debris generated during dental procedures.'

The use of protective clothing, including eye wear, is also advised by the Health and Safety Executive, Control of Substances Hazardous to Health (COSHH), 2002¹⁷ and Personal Protective Equipment, (PPE), at work Regulations, 1992.¹⁸ The routine use of goggles or spectacles with side pieces and plastic lenses conforming to British Standard BS2092 are recommended.

Every practice must have a written infection control policy, stating the necessity to wear eye protection.^{4,17} Failure to employ adequate methods of cross infection control may render a dentist liable of serious professional misconduct or susceptible to litigation.¹⁹ Each individual dentist is responsible for the uptake and use of such protection by themselves, their immediate staff and importantly the patient under their care in the surgery environment; it is suggested that compliance with health and safety form part of an employee's contract of employment.⁴

STUDY AIM

This study aimed to find out the extent to which normative advice about eye safety in operative dentistry was being adopted. It had three objectives:

- Define operative dental procedures in which, by dentist, DCP staff and patients' protection was a) used; b) was not used.
- Ascertain the method of protection used by/for each participant in the operative field for a given procedure.
- Whether or not the practice or practitioner had a written policy regarding eye protection.

MATERIALS AND METHOD

Following a local pilot study, questionnaires were sent to 200 general dental practitioners (GDP), in the South Wales area in 2002. They were chosen at random from the Bro Taf Health Authority dental register. The questionnaire was sent with an explanatory letter; GDPs were asked to respond on behalf of themselves and their patients, and compile the information from their auxiliary staff once collected in person. It was made clear within the covering letter that all responses were anonymous. A stamped addressed envelope was enclosed for their return.

RESULTS

The results are described according to each group in which eye protection is required and the complications which occurred resulting from inadequate protection.

General dental practitioners

One hundred and thirty-eight of the 200 questionnaires were returned, which equated to a response rate of 69%. Of those that returned their questionnaire 64% were male and 36% were female. The GDPs had been chosen at random, and there was a good cross section of respondents related to year of qualification (Table 2).

Of the 138 questionnaires returned, 94% of GDPs said that they were aware of the need for eye protection, although compliance with their own surgery policies concerning eye protection were less than optimal (Table 3). Eighty-seven per cent of responding GDPs used some form of eye protection routinely; 58% of these were male and 33% female. Personal glasses were most popular with GDPs (58%), but of those dentists using personal glasses as protective eye wear, only 21% had additional side shields attached. Twenty-nine per cent stated they had 100% UV protection with their glasses and 79% had a scratch resistant coating in place. Twenty-five per cent of GDPs who replied used loupes, and 82% of these said they used eye protection concurrently. Table 4 shows the preferences in protection for GDPs.

Of the GDPs using eye protection, it was most often used during restorative procedures (99%), scaling and polishing (97%) and extractions (80%), with only 67% wearing them for examinations alone (Table 5).

Dental Care Professionals

Less than half of DNs (48%), were reported to use eye protection regularly and 31% wore it sometimes. Those hygienists who wore eye protection did so routinely. Visors were favoured by DNs (41%), whereas hygienists used all types of protection, with safety glasses being the least popular (25%) (Table 4).

DNs tended to wear eye protection for those procedures assumed to be high risk, eg restorations and scale and polish, which also reflects GDPs' practice. Hygienists wore eye protection for the majority of their work (96%), but only 17% used any protection when carrying out examinations (Table 5).

This study highlights that a less than optimal number of all staff wore any eye protection when cleaning instruments and disposing of contaminated equipment; 51% of GDPs, 39% of DNs and 42% of hygienists wore eye protection (Table 5).

Patients

Sixty-seven per cent of adult patients and 52% of child patients were reported to use eye protection by the GDPs who responded.

Fig. 1 Agents of adverse events

Table 2 GDP year of qualification and use of eye protection

	GDP year of qualifying				
	- 1969 n = 14	1970 -1979 n = 33	1980 -1989 n = 34	1990 -1999 n = 38	2000 - n = 19
Percentage of year group using eye protection	79%	88%	88%	89%	84%

Table 3 Compliance with surgery policy

Staff	67%
Patients	83%

Table 4 Preferred eye protection – if worn

Wearing eye protection	Percentage of type of Personal glasses	Visors	Safety glasses
GDP 87% (120)	58%	17%	25%
DN 48% (66)	30%	41%	29%
Hyg 79% (109)	39%	36%	25%

Table 5 Procedures when eye protection is worn

	Examination	Filling	Scale & polish	Extraction	Root canal treatment	Denture work	Instrument cleaning
GDP	67%	99%	97%	80%	80%	62%	51%
DN	22%	88%	85%	69%	62%	11%	39%
Hyg	17%	~	96%	~	~	~	42%
Px	42%	88%	83%	64%	81%	38%	~

Table 6 Patient eye protection

Patients	Percentage using eye protection	Percentage of type of eye protection used	
		Personal glasses	Safety glasses
Adult	67%	8%	92%
Child	52%	4%	96%

Table 7 Variables in adverse events

Variable	Percentage of adverse events		
	GDP 70% (46)	DN 9% (6)	Px 21% (14)
With protection	33%	17%	0%
Without protection	67%	83%	100%
Female	20%	/	/
Male	80%	/	/
Hospital treatment	59%	33.3%	7%
Optician treatment	20%	33.3%	36%
Self treatment	21%	33.3%	57%
No staff policy	65%	/	/
No patient policy	17%	/	/

The majority of patients wore safety glasses compared to personal glasses, as shown in Table 6.

In general, patients used eye protection in all treatment circumstances, with the percentage of use weighted towards those procedures believed to be of increased risk to the unprotected eye. However, for no treatment modality was the compliance 100% (Table 5).

Sixty per cent of the respondent GDPs would continue to treat a patient if they declined to wear any eye protection; 5% gave no response, and only 35% stated they would refuse to continue with the scheduled treatment.

Adverse events

Almost half of the 138 GDPs who replied (48%) had experience of incidents regarding injury to the eye, with 70% of these episodes involving the GDPs themselves (Table 7). More than half of these GDPs (65%) had no staff policy and 59% required hospital treatment. Overall, 75% of such injuries resulted from no eye protection being worn, while 25% occurred with inadequate eye protection. Twenty-one per cent of incidents involved patients, 9% involved DNs, but no hygienists were reported to have experienced any harm to the eye in this study. The majority of adverse events were caused by amalgam entering or scratching the eye (52%); other causative agents responsible for injury are represented in Figure 1. Of the reported episodes 46% required hospital treatment, 24% were dealt with by an optician, and the remainder (30%) were managed by the injured party themselves.

DISCUSSION

The 69% response rate is good although there may be some response bias towards the figures analysed. In hindsight it may have been beneficial to assure confidentiality rather than anonymity so the non-responders (31%), could have been identified and contacted. However, anonymity was thought to encourage honest rather than biased responses. The non-responders may have differed by a lack of interest in safety or research, no

Table 8 Types of eye protection

Type	Advantages	Disadvantages
Safety glasses	Good dimensions with side shields Tinted lenses offer adequate filtration Cost effective Child sizes available Can be used with loupes Protect against vapour	Optically imperfect Tinted lenses Clear lenses – inadequate filtration of UV light, additional protection required
Visors	Less claustrophobic to wear Protect face from splatter Clear Face more visible to patient Shields easily replaced Cost effective	Optically imperfect Need for additional UV protection Not suitable for patients Must be adjusted to use with loupes
Personal glasses	Needed for vision correction Optically perfect Side shields can be added A degree of UV filtration can be added Convenient for patients Can be used with loupes	Unsuitable dimensions for adequate protection Need for additional UV protection

available time to complete the questionnaire, no current use of eye protection or just perceived insignificance of the study. The distributing and returning of questionnaires was carried out by post. GDPs responding on behalf of their patients and with the responsibility for obtaining the information from their auxiliary staff does introduce a factor of reliability to the results, which must be considered when discussing the findings. It is also important to recognise that from those GDPs who did not reply, it was not only information about themselves that was not submitted but also data concerning their patients, DN and hygienist.

The ADA and the BDA recommend wearing visors, manufactured safety glasses or personal glasses with additional side shields. Visors and safety glasses are made of polycarbonate which is optically imperfect, and although causing no permanent damage it may be an inconvenience when carrying out work with defined precision. Table 8 shows the advantages and disadvantages of the various types of eye protection.^{2,20,21}

The use of personal glasses may be a suitable means of protection for clinical staff and patients.⁴ Personal glasses should have an adequate frame diameter to shield the ocular area, and preferably have additional side shields; suitable UV protection is required in conjunction. However, modern prescription glasses are becoming increasingly small and narrow making them unsuitable for the use of eye protection.⁴ It is therefore up to the GDP to judge whether the patient's, or indeed their own, glasses will offer adequate protection, and if not, provide adequate protection.

Most, but not all, GDPs were aware of the need for eye protection but in spite of this, the present study confirmed earlier studies that found total compliance with eye protection guidelines to be less than 100%.²²⁻²⁴ The routine use of eye protection by GDPs in this study was dependent on the procedure; those tasks associated with most risk to an unprotected eye such as carrying out a filling, had the best compliance. Females are generally more health conscious than males which is reflected in these results concluding that 92% of female GDPs who responded were using eye protection routinely, compared with 84% of males; this too is reflected in

the incidents reported with 80% of GDPs involved being male. Of the injuries involving GDPs, twice as many occurred without eye protection than with what can be assumed inadequate eye protection. It can be concluded that incidents occurred during a variety of treatment episodes due to the nature of the reported agents. The severity of the eye injuries could be reflected in the fact that more than half of GDPs required hospital treatment.

It is also recommended that patients should wear eye protection for all treatment modalities, particularly when supine as the risk of injury is increased.^{4,16,25,26} However, this study demonstrated that eye protection is not used routinely with either adult or child patients, and it is at these times eye injuries occur. Almost all the adult and child patients who did wear eye protection were provided with safety glasses, with only a small percentage, 8% and 4% respectively, using their own glasses.

Eye protection does prevent injury, but needs to be worn 100% of the time during exposure prone procedures to ultimately reduce the risks, since injuries were recorded during all of the procedures questioned. The only time eye protection is not imperative for staff is during a basic oral examination.⁴ In view of this, the necessity for a practice policy with reference to eye protection adhered to by staff and patients alike is evident, as well as compulsory.^{4,19} Patient and staff cooperation requires implementation of the practice policy through good communication and clear explanations as to why eye protection is required.^{4,27} The public generally welcomes and accepts the use of barrier protection by dentists, if educated in its advantages and necessity.^{28,29}

Alarmingly, less than half of the DNs (48%) in this study were reported to be using suitable eye protection routinely; the majority choosing to wear visors. Previous studies have shown that DNs choose eye protection relative to its protective ability, explaining this result.³ It appeared from the results that DNs wore eye protection during operative procedures which mimicked the use by GDPs, although general compliance was not as good. Although 96% of hygienists wore eye protection when scaling and polishing, only 79% of them used eye protection for all procedures. Visors and personal glasses were more popular than safety glasses.

The study raised concern that the general lack of eye protection being worn when cleaning contaminated instruments with only 39% of DNs and 42% of hygienists doing so. Surface and instrument cleaning and disinfecting are associated with a high risk of potential injury, and all personal protection is strongly advocated by the BDA and ADA.^{4,16} The instruments are contaminated with saliva and often blood which increases the risks of a blood borne infection while handling these instruments during the cleaning process. A chemical injury to the eye resulting from the detergents used in surface disinfecting is also a concern. This highlights the need for further education and reinforcement for all staff by GDPs who are ultimately responsible for the implementation of practice policy.

Lonnroth *et al.*³ documented that visual clarity is the most important factor influencing a GDPs choice of eye protection. This is demonstrated in this study by 58% of GDPs choosing their personal glasses for eye protection; however, only 21% of these had additional side shields, which provide the recommended level of protection. As people age, their need to wear prescription glasses will increase because of presbiopia; this may be a contributory factor in the number of GDPs using personal glasses as eye protection. Scratch resistant coating only provides protection by increasing the longevity of the lens. GDPs are at risk due to a lack of suitable eye protection, with almost half having had some experience of ocular injury. If those GDPs without side shields on their personal glasses are excluded, then only 47% of GDPs were wearing adequate eye protection in accordance with published guidelines, rather than the first thought 87%.^{4,16} Twenty-five per cent of the GDPs in this study use loupes and the majority used their chosen

form of eye protection simultaneously. Loupes are generally provided with adequate protective glasses, but it is also possible to wear visors over loupes, and if prescription lenses are required, these can be incorporated into the loupes. Integral eye protection and the improved posture common when using loupes, which increases the distance between the operative field and the eye, will also reduce the risk of ocular injury. It may be suggested that those using loupes are innovative, up to date and more conscientious than those GDPs who do not. In hindsight it would have been interesting to ask the GDPs to specify if any injury had occurred while wearing loupes. Staff qualifying more recently will tend to be more familiar with the use of eye protection for all those involved in patient care, including the patients themselves.

Although a low level of work related incidents involve the eye, this study and that of other authors have highlighted the eye as a vulnerable target, especially with prolonged exposure.^{21,22,30} Publications about the occurrence of eye injuries within a dental environment, due to inadequate or no eye protection have been predominantly based on orthodontic practices, the hospital environment and dental laboratories.^{23,31} This study emphasises the need for appropriate eye protection in the general dental practice setting during at risk procedures and is something which should be expected from the whole dental team; with effective communication and education towards patients, this should result in 100% compliance by all.

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