

## Microbial keratitis: a community eye health approach



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Microbial keratitis is an infection of the cornea. Corneal opacities, which are frequently due to microbial keratitis, remain among the top five causes of blindness worldwide. Microbial keratitis disproportionately affects low- and middle-income countries. Studies indicate that the incidence of microbial keratitis may be up to 10 times higher in countries like Nepal and India compared to the United States.

Rural agricultural communities in low- and middle-income countries face a particularly high burden from corneal blindness. The most common cause of microbial keratitis is infection following a corneal abrasion. People are at greater risk of corneal injuries from agricultural activities, manual labour, and domestic work, which can result in infections of the cornea through contact with contaminated objects. Microbial keratitis tends to affect people at younger ages, in their prime working years, compared to other causes of blindness (such as cataract), which generally affect older people

Rural communities in low- and middle-income countries face numerous obstacles in accessing appropriate treatment for microbial keratitis. Long delays in presen-

tation and use of traditional medicines are common, increasing the risk of perforation and other complications that may result in vision loss. Patients with corneal ulcers may also face worse outcomes due to a lack of effective treatment options as well as an inability to afford medications when treatment is available. Opportunities for rehabilitation through surgical procedures are also limited by a lack of donor corneas for transplants.

Even when appropriate medical care is available, the corneal scarring that accompanies healing often results in visual impairment, despite successful antimicrobial treatment. Trials comparing antimicrobials for microbial keratitis generally have been unable to discern differences in visual acuity after treatment. An exception is that natamycin has been shown to be more effective than voriconazole for fungal corneal ulcers. Studies trialling adjunctive therapies with agents, such as topical corticosteroids, to reduce



Jessica Kim

**A community health volunteer practises applying fluorescein to detect corneal abrasions. NEPAL**

scarring, also have been largely unable to demonstrate major differences in visual outcomes in bacterial keratitis.

Given the limitations associated with available treatment options, secondary prevention (i.e. the prevention of visual impairment in someone with a corneal injury and/or infection) may be the best option for reducing vision loss associated with microbial keratitis.

A series of studies in Southeast Asia suggested that antimicrobial ointment applied soon after a corneal abrasion could dramatically reduce the incidence of microbial keratitis. The Bhaktapur Eye Study in Nepal was the first of these to show promising results for microbial keratitis prevention programmes at village level. In this study, primary eye care workers from the community were trained to diagnose corneal abrasions with fluorescein strips and a blue torch. They then provided topical chloramphenicol to all patients with a corneal epithelial defect. This study found that only 4% of patients treated for a corneal abrasion developed a corneal ulcer, and that an ulcer only developed if the antibiotic was applied more than 18 hours after the eye trauma.

### ABOUT THIS ISSUE

This issue of the *Community Eye Health Journal* focuses on microbial keratitis – corneal ulceration caused by microorganisms – which is a major cause of unilateral (and some cases of bilateral) corneal blindness, particularly in rural low-resource settings. The aim of the issue is to promote good practice in preventing, diagnosing and treating microbial keratitis. There are also practical articles on how to take a corneal scrape in microbial keratitis and the indications and procedure for tarshorrhaphy. We hope you find the articles of help in your work and we look forward to receiving any comments you may have.

*Continues overleaf* ➤

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A similar study conducted in Bhutan corroborated the Nepal study's findings, and suggested that a microbial keratitis prevention programme may be effective even in isolated rural areas. In Myanmar, low rates – much lower than previous estimates – of bacterial and fungal ulcers were observed after the institution of the village eye worker programme. In a trial conducted in South India in individuals with corneal abrasions, those randomised to antibiotic prophylaxis had low rates of corneal ulcers, similar to rates observed in patients randomised to antibiotic plus antifungal prophylaxis, suggesting that antibacterial prophylaxis alone might prevent both bacterial and fungal infections.

These studies demonstrated that village health workers can be trained to diagnose corneal abrasions and provide prophylactic treatment, and suggested that this simple intervention might be effective.

These studies also indicate that the following simple tools may be used to identify and prevent microbial keratitis.

- 1 **Fluorescein dye.** Applied to the eye using sterile strips or solution, fluorescein will stain corneal epithelial defects/abrasions.
- 2 **Blue torch.** A blue light shone onto the cornea with fluorescein dye will highlight a corneal abrasion, which is visible as a bright green area.
- 3 **Loupes.** Magnifying loupes are helpful in determining the existence of a corneal abrasion.
- 4 **Prophylaxis.** Once a corneal abrasion is identified, antibiotic and antifungal

ointments should be applied three times a day for 3 days to prevent infection.

- 5 **Education.** Health education campaigns inform local community members about corneal infections and encourage them to seek care in the event of ocular injury.

As infectious ocular diseases decline, microbial keratitis continues to be a major cause of vision loss globally. While the continued exploration of treatment options for corneal ulcers is essential, we must also focus efforts on opportunities for prevention. In low- and middle-income countries, the prevention of microbial keratitis is a promising intervention for reducing corneal blindness. A large community randomised trial (Village Integrated Eye Worker trial, NIH-NEI U10EY022880) examining corneal ulcer prevention by trained village-level health workers is currently underway in Nepal. Similarly, another study in south India will further examine corneal ulcer education programmes.

Looking forward, with increased awareness and implementation of preventive strategies, it should be possible to reduce the burden of corneal blindness worldwide.

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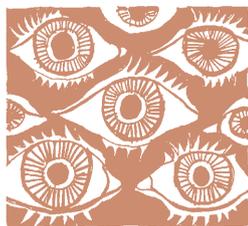
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# Diagnosing and managing microbial keratitis



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Infections of the cornea can lead to corneal opacity and blindness if not identified quickly and managed appropriately. The terms ‘microbial keratitis’, ‘infective keratitis’ and ‘suppurative keratitis’ are all used to describe suppurative infections of the cornea. In this issue we use the term **microbial keratitis**. These infections are characterised by the presence of white or yellowish infiltrates in the corneal stroma, with or without an overlying corneal epithelial defect, and associated with signs of inflammation (Figure 1).

**Figure 1. Severe microbial keratitis due to a filamentary fungal infection. Extensive infiltrate, satellite lesions and a hypopyon are present**



Matthew Burton

The common symptomatic complaints of patients with microbial keratitis are as follows (all with varying degrees of severity):

- redness of the eye
- pain
- blurring of vision
- photophobia
- watering or discharge from the eye.

The aim of this article is to review both bacterial and fungal keratitis, with an emphasis on identification and management at the primary, secondary, and tertiary levels. Guidelines for referral will be suggested.

## Diagnosis

### History taking

History taking is an important step in the management of corneal infection. If there

has been an injury, ask when and where the injury was sustained, what the patient was doing at the time of injury, whether or not he or she sought help following the injury, and what treatment – including traditional eye medications – had been used. A past history of conjunctivitis may suggest that the infection is secondary to a conjunctival pathogen.

**Figure 2. A bacterial ulcer. The eye is very red and inflamed; note the ring infiltrate in the cornea and a large hypopyon in the anterior chamber**



Dr M Srinivasan/Aravind Eye Hospital

## Examination

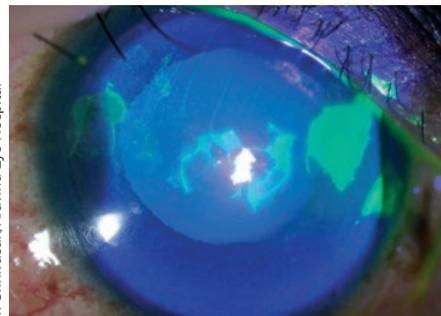
### 1 Visual acuity

Visual acuity should always be recorded in co-operative patients. If it is not possible to record the visual acuity of a child, for example, a note of this should be made. Vision should be recorded first in the unaffected eye, then in the affected eye; with or without glasses. This provides a useful guide to the prognosis and response to treatment. It is also important documentation in the event of medico-legal issues.

### 2 Examination of the cornea

A torch with a good source of focused light and a loupe for magnification are essential. A slit lamp microscope, if available, is always helpful, but not absolutely essential. Another essential tool is fluorescein dye, either in a sterile strip or a sterile solution.

**Figure 3. Fluorescein staining of the cornea. Epithelial defects appear bright green under blue light**



M Srinivasan/Aravind Eye Hospital

Fluorescein stains any part of the cornea that has lost the epithelium, even due to a trivial injury, and appears brilliant green when viewed under blue light (Figure 3).

## 3 Clinical signs

When you examine the eye, look for the presence of the following signs and document them carefully in the clinical notes. This will be helpful when considering whether the eye is responding to treatment.

- Eyelid abnormalities – such as trichiasis and lagophthalmos
- Reduced corneal sensation
- Conjunctival inflammation and discharge
- Corneal epithelial defects (confirmed with fluorescein) – size and shape
- Corneal inflammatory infiltrate – size and shape
- Thinning or perforation of the cornea
- Hypopyon.

Please refer to the article on clinical signs for clues about the likely cause of the infection (page 6).

## 4 Microbiology

For lesions >2mm in diameter, a corneal scrape sample should be collected for microbiological analysis whenever possible. Please refer to the article on page 8.

## Management at primary level

Microbial keratitis is an ophthalmic emergency, which should be referred to the nearest secondary/district eye centre for proper management. The following are useful guidelines when referring the patient.

- **Do** apply antibiotic drops or ointment.
- **Do** instruct patients and/or their accompanying persons to apply drops frequently until patients arrive at the centre.
- **Do** instruct patients and/or their accompanying persons to avoid traditional medicines.
- **Don't** give systemic antibiotics; they are not helpful.
- **Don't** use steroid drops and/or ointment; they can be dangerous.
- **Don't** routinely patch the eye; it is not necessary.

## Management at secondary level

More complete management of corneal infections begins at the secondary level of

*Continues overleaf* ➤

eye care where there is an ophthalmologist and/or an ophthalmic nurse/assistant, or a physician trained in managing common eye diseases. At the secondary level:

- A corneal scraping should be taken, if diagnostic microbiology services are available (see page 8).
- In some units, microbiology support may not be available. In these circumstances the choice of treatment is empirical, based on the clinical presentation (see page 6) and the known patterns of disease in the local area.
- It should be remembered that, in tropical regions, bacterial and fungal infections occur with similar frequency.
- The patient should be admitted to the hospital to ensure adequate treatment and frequent follow-up.
- Ensure clear documentation of the clinical state, its progression and the specific treatments provided.

### Specific initial treatment

#### 1 No fungal elements seen on microscopy, or fungal keratitis is not suspected on clinical grounds (see page 6): treat with **either**

- Cefazolin 5% and gentamicin 1.4% eye drops, hourly, **or**
- Ciprofloxacin or ofloxacin eye drops, hourly.

If it is not possible to administer hourly drops, a subconjunctival injection can be given.

#### 2 Fungal elements seen on microscopy, or fungal keratitis is suspected on clinical grounds: treat with natamycin 5% eye drops hourly, particularly if filamentary fungi are seen on microscopy. If yeasts (*Candida*) are suspected, use freshly reconstituted amphotericin-B 0.15% eye drops hourly.

Antibiotics may have a limited role to play in such cases and may occasionally be harmful. Clinical judgment correlated with laboratory tests are the best guide in such cases.

### Adjunctive treatment

- Atropine 1% or homatropine 2% could be used twice a day to dilate the pupil; this helps to prevent synechiae and relieve pain
- Oral analgesics will help to minimise pain
- Anti-glaucoma medication may be advisable if the intraocular pressure is high
- Vitamin A supplements may be helpful, particularly in countries where vitamin A deficiency is prevalent.

Remember the five As: **Antibiotic/antifungal, Atropine, Analgesics, Anti-glaucoma medications, and Vitamin A.**

### Subsequent management

Microbial keratitis patients should be admitted and examined daily (if possible with a slit lamp) so that their response to treatment can be evaluated and the frequency of antibiotics adjusted accordingly.

Reduce the frequency of antibiotic administration when the patient experiences symptomatic improvement (less tearing and photophobia, relief from pain and improvement in vision), and when the ulcer shows signs of improvement, including:

- decrease in lid oedema
- decrease in conjunctival chemosis and bulbar conjunctival injection
- reduction in density of the infiltrate and area of epithelial ulceration
- reduction of haziness of the perimeter of the ulcer and of the stromal infiltrate
- decrease in inflammation, cells, fibrin, and level of hypopyon
- dilatation of pupil.

If the patient is judged to be improving, the dose of antibiotics and/or antifungal drops should be reduced from hourly to 2-hourly, then 4-hourly over the next 2 weeks for bacterial ulcers. For fungal ulcers, treatment should be continued with three-hourly drops for at least three weeks, as late reactivation of infection can occur. Longer courses may be needed in more severe cases.

**Note:** In the case of bacterial infection, the inflammatory reaction may be enhanced by endotoxin release during the first 48 hours of treatment; however, definite progression at this stage is unusual and implies that either the organisms are resistant to therapy, or the patient is not instilling the drops as prescribed.<sup>1</sup>

### Guidelines for referral to a tertiary centre

Immediate referral on **presentation** if:

- the ulcer is in an only eye
- the patient is a child
- there is impending or actual perforation.

**Following initial treatment**, if cases of bacterial ulcer fail to show any improvement within 3 days, and fungal ulcers within a week, patients should be referred to a tertiary care centre.

### Management of corneal ulcer at tertiary level

Many tertiary eye care centres have their own protocol for the management of corneal ulcer. The management

suggested is based on a WHO recommendation with suitable modification according to local circumstances.<sup>2</sup>

### Background, examination, and recording of findings

By the time patients have reached a tertiary centre, they will have travelled from one place to another (with attendant hassles) received several treatments, may have lost faith in eye care personnel, and may already have run out of money, (particularly in low-income countries). Considering this broader personal situation is important in the overall care of corneal ulcer patients.

A careful history of the development of the disease may point to the existence of an underlying predisposing condition such as diabetes mellitus, immunosuppression due to local or systemic steroids (or other immunosuppressants), dacryocystitis, or other ocular conditions. A full list of drugs used by the patient should be obtained to ensure that drugs which have not helped in the past are not repeated; this may also help to discover possible drug allergies. Findings should be carefully noted on a standard form.

A meticulous corneal scraping subjected to laboratory processing often provides a sound guideline to treatment (see page 8).

### Hospitalisation

This provides patients with rest and adequate medication; they can also receive frequent follow-up, management of systemic problems, such as diabetes, and further surgical intervention, if warranted.

### Treatment

The initial treatment (see Tables 1 and 2) depends on the results of the corneal scrape and the local pattern of pathogens and antibiotic resistance.

- If microscopy is negative, if it is not possible to perform a corneal scrape, if Gram-positive or Gram-negative bacteria are visualised, treat the patient with antibiotic eyedrops. Use either a combination of cefazolin 5% and gentamicin 1.4%, or fluoroquinolone monotherapy (e.g. ciprofloxacin 0.3% or ofloxacin 0.3%). To begin with, drops should be given hourly for 2 days and then tapered, based on response.
- If microscopy reveals fungal hyphae, topical natamycin 5% or amphotericin-B 0.15% should be used hourly for a week and then tapered.
- If the ulcer seems to respond well to treatment, continue therapy as before for 2 weeks for a bacterial ulcer and at least 3 weeks for a fungal ulcer.

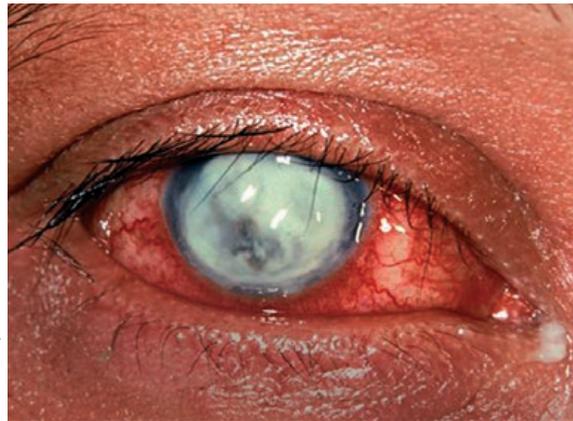
- If the response is poor and the culture shows growth of a bacterial organism, the choice of antibiotic is guided by the sensitivity reports.

Natamycin 5% suspension is recommended for treatment of most cases of filamentous fungal keratitis, particularly those caused by *Fusarium sp.* Natamycin 5% was found to be more effective than voriconazole in a recent clinical trial.

Most clinical and experimental evidence suggests that topical amphotericin-B (0.15 – 0.5%) is the most efficacious agent available to treat yeast keratitis. Amphotericin-B is also effective for fungal keratitis caused by *Aspergillus sp.*

Oral anti-fungal agents may be considered as an adjunctive therapy in more severe fungal keratitis with deep corneal or intraocular involvement. Oral fluconazole (200–400 mg/day) has been used successfully for severe keratitis caused by yeasts. Oral itraconazole (200 mg/day) has broad-spectrum activity against all *Aspergillus sp.* and *Candida sp.* More recently oral voriconazole has

**Figure 4. Subtotal fungal ulcer**



Dr. Whitcher/UCSF

been used in cases of keratitis due to filamentary fungus.

Other agents such as polyhexamethylene biguanide (PHMB) 0.02%, chlorhexidine 0.02%, povidone iodine 1.5–5% and silver sulfadiazine 1% have been reported to possess variable antifungal activity and may be used if other drugs are not available.

Fungal infection of the deep corneal stroma may not respond to topical antifungal therapy because of poor penetration of these agents in the presence of an intact epithelium. It has

been reported that a 5 mm epithelial debridement (as a diagnostic scraping or therapeutic procedure) greatly enhances the penetration of antifungal drugs.

Animal experiments indicate that frequent topical application (every five minutes) for an hour can readily achieve therapeutic level.

### Surgical management

The range of surgical interventions available for management of corneal ulcers can include debridement, corneal biopsy, tissue adhesives, conjunctival flap, tarsorrhaphy, or therapeutic corneal graft.

Evisceration of the eye is performed for severe pain, panophthalmitis, or life-threatening complications.

### Tarsorrhaphy

This is an old surgical technique that is still very useful today. Tarsorrhaphy often leads to rapid resolution of persistent epithelial defects, whatever the underlying cause. Tarsorrhaphy is effective in promoting healing in microbial keratitis caused by fungal and bacterial infections, provided the ulcer has been sterilised by effective antibacterial and/or antifungal treatment. It can be difficult to instil drops and to see the cornea following central tarsorrhaphy, so it is vital to ensure that the infection is under control before closing the eyelids. See page 10 for a description of two useful tarsorrhaphy techniques.

### Conjunctival flap

The principle of this technique is to promote healing of a corneal lesion by providing adequate nutrition via the conjunctival blood vessels. The flap could be of three types:

- 1 A total flap covering the entire cornea, called Gunderson's flap.
- 2 A pedicle (racquet) flap. This carries its own blood supply from the limbus and is useful for ulcers near the limbus.
- 3 A bucket handle flap. This carries its blood supply from both ends of the flap and may be less likely to retract. It is more useful for central corneal ulcers.

This procedure can be performed under local anaesthesia. Harvesting adequate bulbar conjunctiva in eyes which have had previous surgery may be difficult. The flap should be as thin as possible, with minimal adherent subconjunctival tissue. Following removal of any remaining corneal epithelium, the flap should be sutured to the cornea with 10-0 nylon sutures.

The conjunctival flap promotes healing

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**Table 1. Preparation of fortified antibiotic eye drops**

Antibiotic	Method	Final concentration
Cefazolin/cefuroxime	Add 10 ml sterile water to 500 mg cefazolin powder; mix and use as topical drops. Shelf life: 5 days	50 mg/ml (5%)
Gentamicin (tobramycin)	Add 2 ml parenteral gentamicin (40 mg/ml) to a 5 ml bottle of commercial ophthalmic gentamicin (3 mg/ml)	14 mg/ml (1.4%)
Penicillin G	Add 10 ml of artificial tears to a 1 million unit vial of Penicillin G powder; mix and decant into empty artificial tear bottle or xylocaine vials (30 ml)	100,000 units/ml
Vancomycin	Add 10 ml sterile water to a 500 mg vial of vancomycin powder; mix, add sterile cap and use immediately	50 mg/ml (5%)
Amikacin	Add 2 ml of parenteral amikacin containing 200 mg of the antibiotic to 8 ml artificial tears or sterile water in a sterile empty vial.	20 mg/ml (2%)

Although a large number of antifungal drugs are available for systemic mycoses, only a few are effective for treatment of corneal ulcers. The commonly recommended drugs are listed in Table 2.

**Table 2. Commonly recommended antifungal drugs**

Drug	Topical	Systemic
Amphotericin-B	0.15–0.5% drops	IV infusion
Natamycin	5% drops	Not available
Econazole	2% drops	Not available
Voriconazole	1% drops	Oral tablets 100–200 mg/day

by vascularisation. It is particularly useful in patients with impending perforation, when it may preserve the globe and allow subsequent corneal grafting. However, a flap may limit the penetration of topical antibiotics, so it should only be performed once the ulcer has been sterilised and the infection brought under control.

### Conclusion

Management of microbial keratitis remains a major challenge worldwide, more so in low- and middle-income countries with inadequate health care resources. Although the outcome of treatment has improved significantly, many patients continue to deteriorate in spite of the best treatment that can be offered. The continued emergence of strains of microorganisms that are resistant to an ever-expanding range of antimicrobials poses an additional challenge. Further research related to prevention of microbial keratitis and enhancing host resistance are two worthwhile goals to pursue. Large-scale public education programmes to alert those at risk of microbial keratitis, and to encourage earlier presentation, should be undertaken. Coupled with this, education of practitioners, general physicians, and other health workers, as well as general ophthalmologists, will go a long way towards ensuring correct diagnosis, appropriate treatment and timely referral before extensive damage to the cornea occurs. Several studies have indicated that the best way to prevent corneal ulcers in low- and middle-income countries is to treat corneal abrasions in the primary care setting within 48 hours of the injury.<sup>3-6</sup> This could be adopted in any population and is cost-effective for both health providers and the patient.

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# Distinguishing fungal and



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In many settings, laboratory support for the diagnosis of the type of microbial keratitis is not available.

Experienced ophthalmologists have long maintained that it is sometimes possible to distinguish fungal from bacterial microbial keratitis on the basis of clinical signs. Formal data to support this view are limited, and it is important to establish the validity of such claims to understand whether signs can reliably

guide clinical decisions. In addition, antifungal treatment is often in limited supply and prohibitively expensive. Therefore, it is not feasible or desirable to prescribe empirical antifungal therapy to every patient who presents with microbial keratitis in tropical regions, where fungal infections are more frequent. Here we review research to determine whether it is possible to reliably distinguish bacterial and fungal infection clinical features alone.

**‘It is not feasible or desirable to prescribe empirical antifungal therapy to every patient who presents with microbial keratitis in tropical regions, where fungal infections are more frequent.’**

In a large series from India and Ghana, cases of microbial keratitis were systematically examined for specific features.<sup>1</sup> These included: serrated infiltrate margins, raised slough, dry texture, satellite lesions, hypopyon, anterior chamber fibrin, and colour. Serrated infiltrate margins and raised slough (surface

Figure 1. Examples key clinical features

(a) Serrated margin



(b) Defined margin



(c) Raised profile



(d) Flat profile



# bacterial keratitis on clinical signs

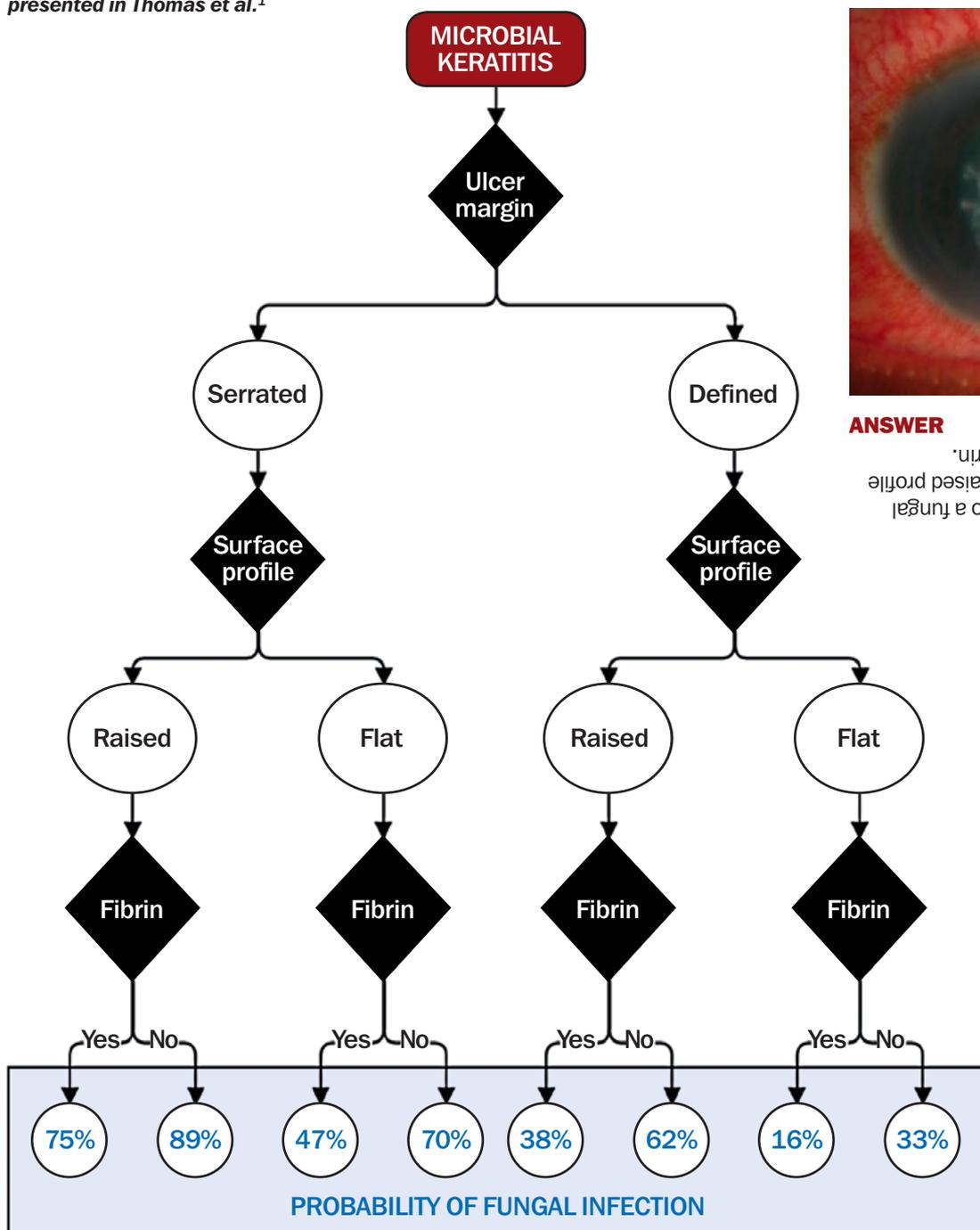
profile) were independently associated with fungal keratitis, and the anterior chamber fibrin was independently associated with bacterial keratitis.<sup>1</sup> Some of these features are illustrated in Figure 1. By combining information about all three features in an algorithm (Figure 2), it is possible to obtain a probability score for the likelihood that

the microbial keratitis case is due to a fungus.

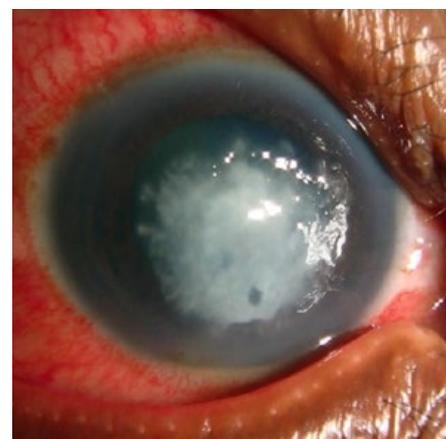
**Challenge:** Use the algorithm (Figure 2) to estimate the probability that the microbial keratitis case in Figure 3 is due to a fungal infection. The algorithm is primarily for use as a guide in settings where clinicians do not have any laboratory facilities and treatment decisions have to be

made based on clinical judgement alone. Where diagnostic microbiology is available it is strongly recommended that it is used. As discussed in the article on laboratory diagnosis in this issue, microscopy alone can provide a diagnosis if an infection is fungal; the presence of fungal hyphae in corneal tissue is a definitive diagnosis.

**Figure 2. Algorithm for determining the probability of fungal keratitis. The black diamonds are decision points about three clinical features: ulcer / infiltrate margin, surface profile, and anterior chamber fibrin. These probabilities are based on data presented in Thomas et al.<sup>1</sup>**



**Figure 3. Use the algorithm (Figure 2) to estimate the probability that the keratitis is due to a fungal infection**



**ANSWER**

89% probability this is due to a fungal infection: serrated margin, raised profile and no anterior chamber fibrin.

**Reference**

1. Thomas PA, Leck AK, Myatt M. Characteristic clinical features as an aid to the diagnosis of suppurative keratitis caused by filamentous fungi. *Br J Ophthalmol* 2005 89(12): 1554-1558.



## DIAGNOSIS

# Taking a corneal scrape and making a diagnosis



### Astrid Leck

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This article aims to provide a comprehensive guide to taking a corneal scrape and making a diagnosis (Figures 1–4). However, there are settings in which there are either limited or no laboratory facilities available to the ophthalmologist; for example, at primary level eye care centres in rural locations. In these circumstances, microscopy may still provide valuable information to guide clinicians in their choice of treatment (Figures 5–11 are images of infected corneal tissue as seen by microscopy).

## Taking a corneal scrape

What you will need:

- **21-gauge needles or Kimura scalpel**
- **Two clean microscope slides**
- **One fish blood agar plate (FBA)**
- **One Sabouraud glucose agar plate (SGA)**
- **One batch brain heart infusion broth (BHI) (for fastidious organisms)**
- One batch cooked meat broth (CMB) (excludes facultative anaerobes)
- One batch thioglycollate broth (TB)
- One batch non-nutrient agar (NNA) (if *Acanthamoeba sp.* is suspected)

In order to have the best possible chance of providing the clinician with an accurate diagnosis, all the media listed are required. In some remote settings, some media may not be available or there may be limitations in the variety of media it is possible to process. For these situations, the minimum requirements are denoted by **bold type**, in order of importance. Liquid phase media (broths) must be used when available. If only one liquid phase media is to be used, this should be

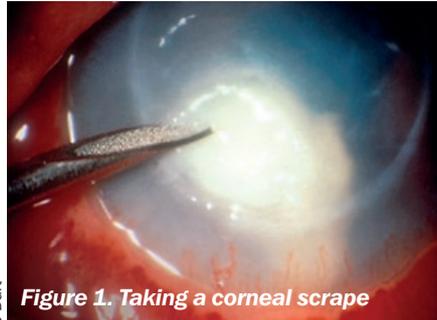


Figure 1. Taking a corneal scrape

BHI; it is essential to inoculate more than one bottle. NNA is indicated only if amoebic infection is suspected.

### General principles

- If possible, withdraw the use of antimicrobial agents for 24 hours prior to sampling. Where this is not possible, the use of liquid phase media, for example BHI, serves as a diluent that reduces the concentration of the drug below the minimum inhibitory concentration (MIC).
- Apply anaesthetic drops that do not contain preservative.
- Use a different needle to take each specimen or, if using a Kimura scalpel, flame the scalpel between samples.
- If fungal or amoebic infection is suspected, it is preferable to sample material from the deeper stromal layer of the cornea.

Order of specimen preparation:

- 1 Slide for Gram stain and slide for alternative staining processes
- 2 Solid phase media (FBA/HBA, SGA, NNA)
- 3 Liquid phase media (BHI, CMB, TB)

If the ulcer is very discrete, or only a small amount of corneal material is available, inoculate one solid and one liquid phase medium.

### Specimen collection for microscopy

- Label slide with patient's name, date of

birth, and hospital number.

- Draw/etch a circle on the slide and place specimen within the circle (Figure 2).
- Air-dry and cover with a protective slide (tape the ends) or place in a slide transport box.

### Inoculating culture media

- Gently smear material on the surface of agar in C-streaks (Figure 3); taking care not to puncture the surface of the agar.
- Sellotape the lid of the plate to the base around the perimeter.
- Incubate inoculated culture media as soon as possible. Refrigeration of specimens is to be discouraged and, if not being transported directly to the laboratory, it is preferable to keep samples at room temperature.

## Making a diagnosis

### Microscopy: the Gram stain

- 1 Air-dry and heat-fix specimen using a Bunsen burner or spirit lamp
- 2 Allow slide to cool on staining rack
- 3 Flood slide with crystal violet; leave for 1 minute (Figure 4)
- 4 Rinse slide in clean running water
- 5 Flood slide with Gram's iodine; leave for 1 minute
- 6 Rinse slide in clean running water
- 7 Apply acetone and rinse immediately under running water (exposure to acetone <2 seconds)
- 8 Counter-stain with carbol fuchsin for 30 seconds
- 9 Rinse in clean running water then dry with blotting paper
- 10 View specimen with 10x objective
- 11 Place a drop of immersion oil on the slide and view with 100x oil-immersion objective.

- Gram positive (+ve) cocci most commonly associated with suppurative keratitis are the *Staphylococci* (Figure 5) and *Streptococci* (Figure 6, *Streptococcus pneumoniae*).

Figure 2. Slide with label and circle for placing the specimen

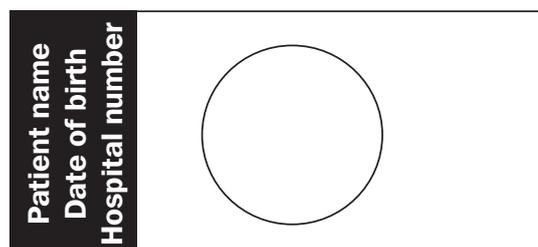
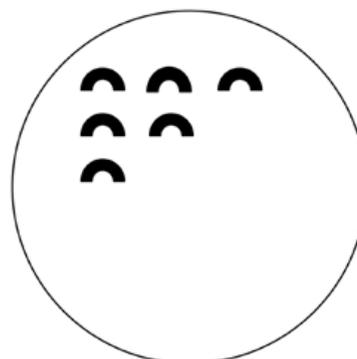
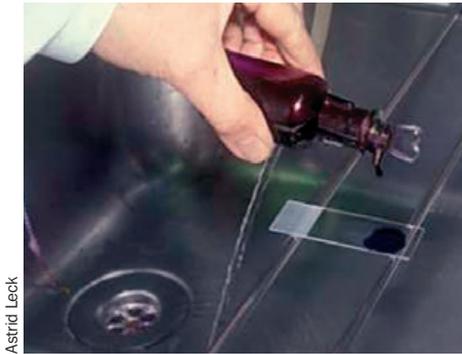


Figure 3. Smear the material on the surface of agar in C-streaks



Astrid Leck

**Figure 4. Flood the slide with crystal violet**



Astrid Leck

- Gram negative (–ve) bacilli, such as *Pseudomonas* sp. (Figure 7), may be associated with corneal infection.
- A definitive diagnosis of *Nocardia* sp (Gram variable) may be possible

Although the Gram stain is not the first choice of stain for specimens containing fungi, yeast cells, pseudohyphae and fungal hyphae may be observed in Gram-stained corneal material. Apart from yeast cells, which will stain Gram-positive, hyphae and pseudohyphae will stain either negatively or Gram-variable. In order to provide a more definitive diagnosis, prepare a second corneal scrape preparation using a more appropriate stain, e.g. lactophenol blue.

**Microscopy: additional methods**

Lactophenol cotton blue (LPCB) or potassium hydroxide (KOH) wet mount preparations are used to visualise fungi (Figure 10).

- 1 Add a drop of lactophenol cotton blue mountant to the slide.
- 2 Holding the coverslip between your forefinger and thumb, touch one edge of the drop of mountant with the coverslip edge, then lower it gently, avoiding air bubbles. The preparation is now ready.
- 3 Initial observation should be made using the low power objective (10x), switching to the higher power (40x) objective for a more detailed examination.
- 4 Calcofluor white and Periodic Acid Schiff reaction (PAS) staining may also be used.

**Diagnostic criteria**

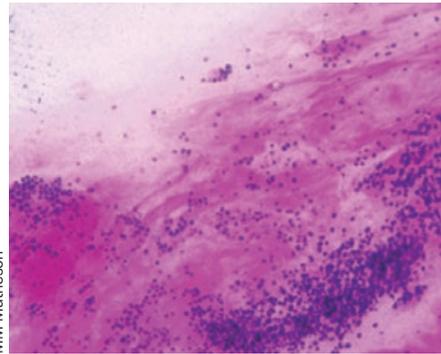
**As applied to bacterial culture:**

- the same organism growing at the site of inoculation on two or more solid phase cultures, or
- growth at site of inoculation on one solid phase media of an organism consistent with microscopy, or
- confluent growth on one media.

**As applied to fungal specimens:**

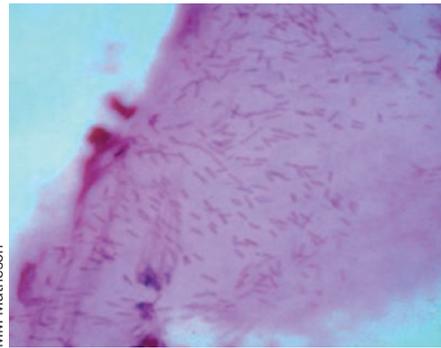
- fungal hyphae observed in corneal specimen stained on microscopic examination, or
- growth at site of inoculation on solid culture media

**Figure 5. Staphylococci sp.**



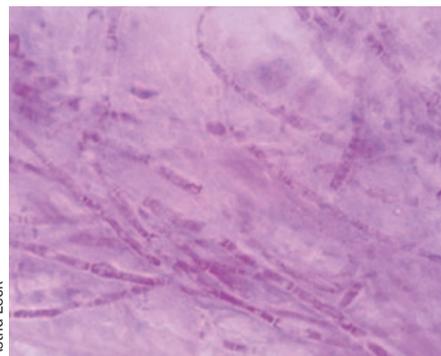
MM Matheson

**Figure 7. Pseudomonas sp.**



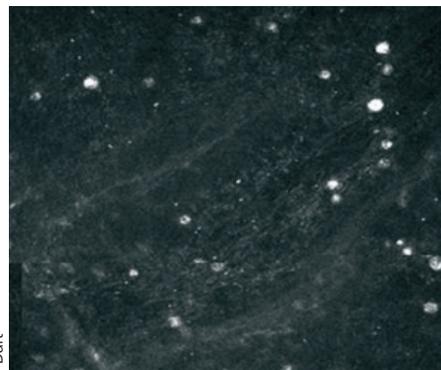
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**Figure 9. Fungal hyphae visible after Gram stain**



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**Figure 11. Calcofluor white preparation**

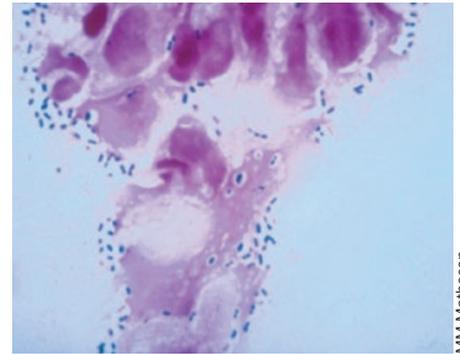


J Dart

**Amoebic infections**

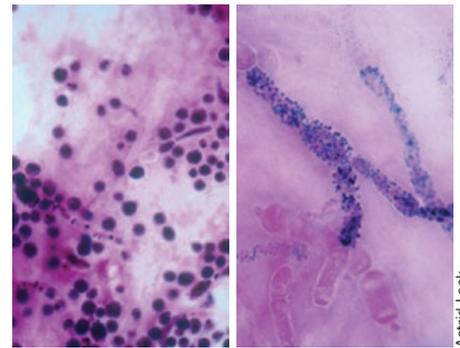
The cyst form of *Acanthamoeba* sp. can be visualised in corneal material using a direct fluorescent technique such as calcofluor white (Figure 11), haematoxylin and eosin, LPCB or PAS. If corneal infection with *Acanthamoeba* sp. is suspected, inoculate corneal material onto non-nutrient agar in a demarcated

**Figure 6. Streptococcus pneumoniae**



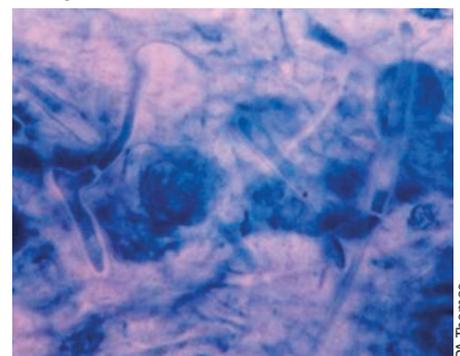
MM Matheson

**Figure 8. Gram appearance of yeast cells (left) and pseudohyphae (right)**



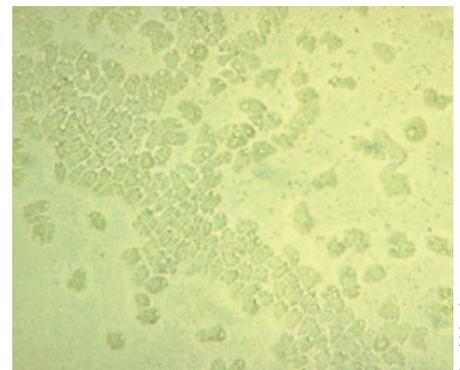
Astrid Leck

**Figure 10. Fungal hyphae stained with lactophenol cotton blue**



PA Thomas

**Figure 12. The trophozoite form of Acanthamoeba**



Astrid Leck

area of the plate. In the laboratory, the square of agar where the specimen was inoculated will be excised and inverted onto an NNA plate seeded with a lawn of *E.coli*. Growth of the trophozoite form is imperative to confirm viability of the organism and thus prove it to be the organism responsible for infection (Figure 12).



# Performing a tarsorrhaphy



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## What is tarsorrhaphy?

Tarsorrhaphy is the joining of part or all of the upper and lower eyelids so as to partially or completely close the eye. Temporary tarsorrhaphies are used to help the cornea heal or to protect the cornea during a short period of exposure or disease. Permanent tarsorrhaphies are used to permanently protect the cornea from a long-term risk of damage. A permanent tarsorrhaphy usually only closes the lateral (outer) eyelids, so that the patient can still see through the central opening and the eye can still be examined.

## What are the indications for tarsorrhaphy?

To protect the cornea in the case of:

- inadequate eyelid closure, for example due to facial nerve palsy or cicatricial (scarring) damage to the eyelids caused by a chemical or burns injury
- an anaesthetic (neuropathic) cornea that is at risk of damage and infection
- marked protrusion of the eye (proptosis) causing a risk of corneal exposure
- poor or infrequent blinking, for example in patients in intensive care or with severe brain injuries.

To promote healing of the cornea in patients with:

- an infected corneal ulcer, which is taking a long time to heal
- non-healing epithelial abrasions.

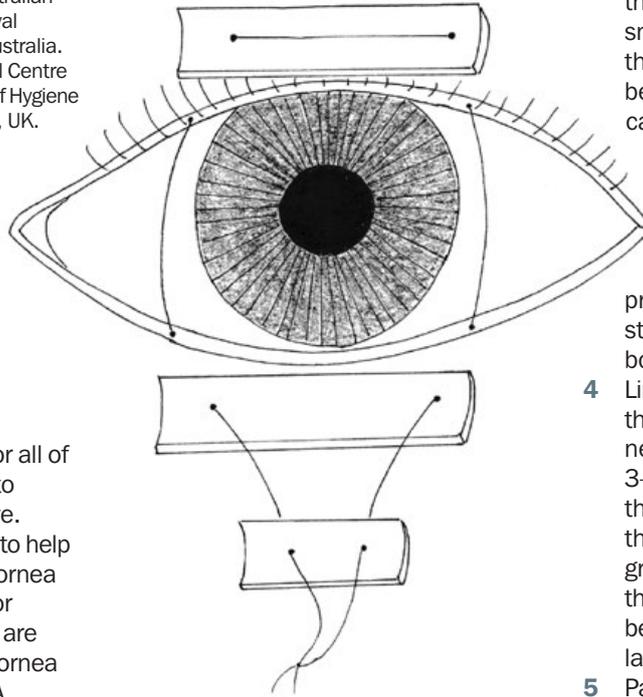
Other indications include:

- To prevent conjunctival swelling (chemosis) and exposure after ocular surgery
- To retain a conformer or other device, for example in children with anophthalmia or adults after evisceration or enucleation.

## What are the different types of tarsorrhaphy?

The techniques for joining part or all of the upper and lower lids can be divided

**Figure 1a. Alignment and threading of bolster**



into short-term (temporary) and long-term (permanent) tarsorrhaphies. In both cases the procedure almost always involves using a suture to join the lids. Other techniques that are occasionally used are botulinum toxin tarsorrhaphy (the upper lid levator muscle is paralysed with the toxin), or the use of cyanoacrylate glue to join the lids and placing a weight (usually gold) in the upper lid.

We will describe two simple procedures:

- A temporary central tarsorrhaphy with a drawstring that allows it to be repeatedly opened and closed for examining the eye.
- A permanent lateral tarsorrhaphy that leaves the central lids open, allowing the patient to see and the eye to be examined.

### The drawstring temporary central tarsorrhaphy (Figures 1a and 1b)

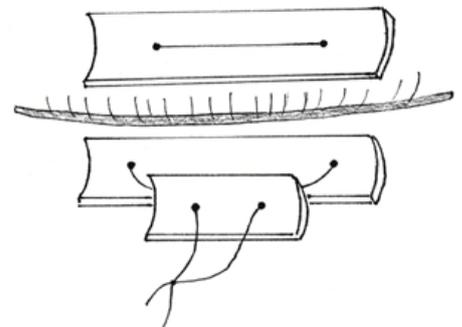
This simple suture tarsorrhaphy will be effective for 2–8 weeks.

- 1 Anaesthetise the central area of both the upper and lower eyelids with an injection of a few millilitres of local anaesthetic (e.g. lidocaine 1–2% or bupivacaine 0.5%). If anaesthetic with adrenaline is available it will reduce operative bleeding.
- 2 Clean the area with 5% povidone iodine. Leave the iodine for a few minutes. During this time prepare two x 2cm bolsters and one x 1cm

bolster. The sutures are tied over the bolster (e.g. plastic tubing or small cotton wool balls) to prevent them cutting into the skin. They can be made from paediatric butterfly cannulas or other similar sterile plastic tubing. Cut each bit of tubing lengthwise to prepare a bolster 'gutter'.

- 3 Pass a double-armed non-absorbable suture (e.g. silk, prolene or nylon 4-0, 5-0 or 6-0) straight through one of the 2cm bolsters, 2 mm from the end.
- 4 Line up the bolster in the middle of the upper lid and pass the same needle into the upper eyelid skin 3–4 mm above the lid margin, through the tarsal plate and out of the grey line of the lid margin. The grey line is the slightly darker line in the middle of the lid margin that is between the anterior and posterior lamellae of the lid.
- 5 Pass the same needle into the grey line of the lower lid, into the tarsal plate and out of the skin 2–3 mm below the lower eyelid margin.
- 6 Align the lower lid bolster centrally, and pass the needle through it a few millimetres from one end.
- 7 Pass the other needle of the suture through the upper bolster – upper lid – lower lid – lower bolster in the same way as the first needle, 2mm from the other end of each of the bolsters.
- 8 Pass both needles through the shorter length of bolster, 2mm from each end of the bolster (Figure 1a).

**Figure 1b. Using sutures and bolsters to close the eye**



- 9 Slide the two lower lid bolsters upwards to close the eye. The smaller bolster 'locks' the lid closed (Figure 1b).
- 10 To separate the lids, pull the smaller bolster down and the lids will easily open.

If a single armed suture is being used, the needle can be passed from the lower bolster back up to the upper bolster.

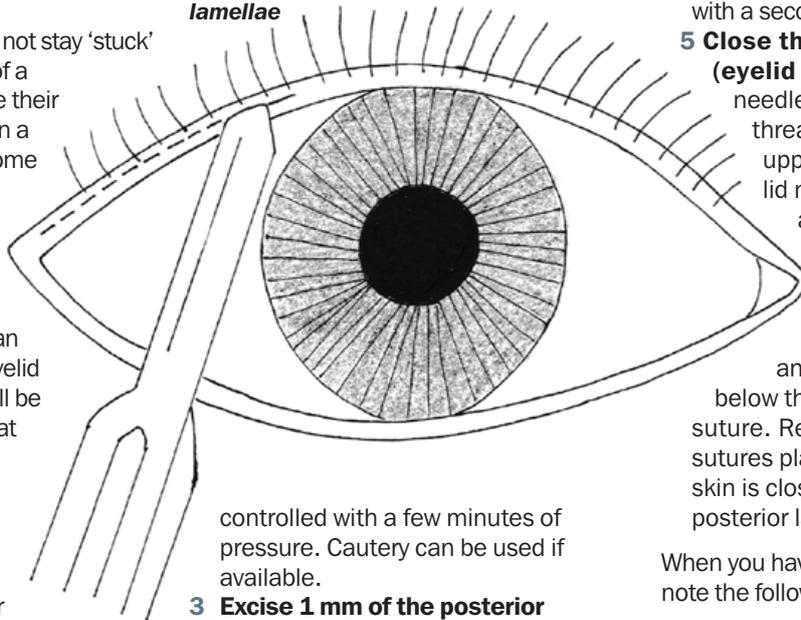
**The permanent tarsorrhaphy (Figure 2a-f)**

The upper and lower lids will not stay 'stuck' together when the sutures of a temporary tarsorrhaphy lose their tension after a few weeks. In a permanent tarsorrhaphy, some of the lid margin is debrided which allows the lids to stick together as they heal. Permanent tarsorrhaphies are almost always only lateral so that the patient can still see out of the central eyelid opening and the eye can still be examined. They should last at least 3 months (and sometimes forever).

The steps of a permanent lateral tarsorrhaphy are:

- 1 **Anaesthetise** the upper and lower lids as above.
- 2 **Split the anterior and posterior lamellae** (Figure 2a). Use a number 11 blade if available (or otherwise a number 15 blade) to cut along the grey line of the lateral third of the upper and lower lids to a depth of 2 mm. This will separate the anterior and posterior lamella. Continue the split inferiorly (lower lid) or superiorly (upper lid) for about 5 mm using either a blade or spring scissors. Make sure you keep the split parallel to the tarsal plate so that the eyelid neatly separates into anterior and posterior lamellae. The eyelid is likely to bleed and this can be

**Figure 2a. Splitting the anterior and posterior lamellae**



controlled with a few minutes of pressure. Cautery can be used if available.

- 3 **Excise 1 mm of the posterior lamella** (Figure 2b). This removes the epithelium of the lid margin and will enable the lids to stick together when they heal.
- 4 **Close the posterior lamella** (Figures 2c and 2d). Pass the needle of an absorbable 5-0 or 6-0 suture into the posterior lamella of the upper lid and then bring it out a little bit further along the upper lid posterior lamella. Pass the needle into the posterior lamella of the lower lid in line with the point of emergence on the upper lid. Pass the needle so that it emerges from the posterior lamella of the lower lid in line with where the needle was first

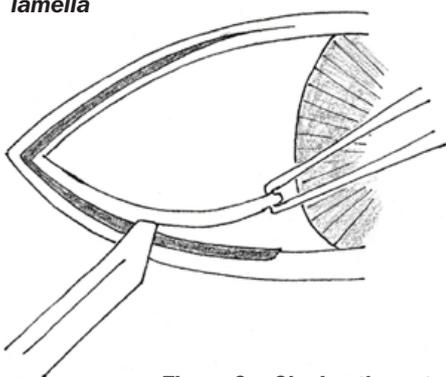
inserted into the upper lid. Repeat this with a second suture.

- 5 **Close the anterior lamella (eyelid skin)** (Figure 2e). Insert a needle drawing a 4-0 to 6-0 sized thread into the skin of the upper lid, 2-3 mm above the lid margin and bring it out of the anterior lamella of the upper lid margin. Pass the needle directly across into the anterior lamella of the lower lid margin and out of the skin 2-3 mm below the lid margin. Tie the suture. Repeat this with several sutures placed 3 mm apart until the skin is closed over the closed posterior lamella.

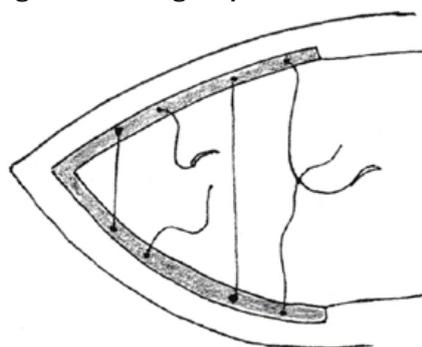
When you have finished the procedure note the following two things (Figure 2f):

- If you have neatly joined the lateral third of the upper and lower eyelids, there will still be an opening that the patient can see through. The opening will obviously be narrower horizontally, but it will also be narrower vertically, which will give more protection to the cornea in the open area.
- In this procedure, the anterior lamella and eyelashes are undamaged – therefore if the tarsorrhaphy is opened at a later date, the lid will look almost normal. These tarsorrhaphies often last forever, but if they need to be divided this can be done by injecting some local anaesthetic and cutting the sutures.

**Figure 2b. Excising 1 mm of the posterior lamella**



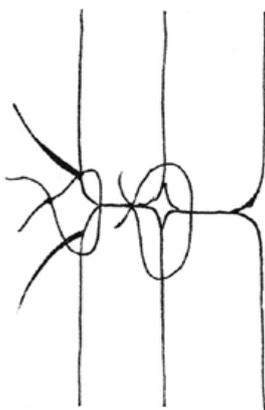
**Figure 2c. Closing the posterior lamella**



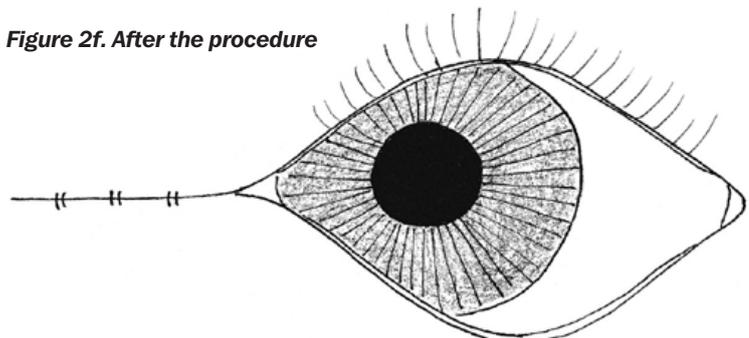
**Figure 2d. Closing the posterior lamella (side view)**



**Figure 2e. Closing the anterior lamella**



**Figure 2f. After the procedure**



# Measuring the outcome of cataract surgery: the importance of the patient perspective



**Robert Lindfield**

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Most eye care staff have had the pleasure of removing the pad from a patient's eye after cataract surgery and seeing their joy at having their sight restored. However, when the outcome of cataract surgery is discussed prior to surgery, the first thing most people think about is visual acuity or complications. Whilst these are critically important, they are only part of the story.

Imagine the following scenario. An 85-year-old woman presents with a visual acuity of 'hand movements' and dense white cataract in both eyes. She is advised to have cataract surgery. Cataract surgery in the first eye goes well with excellent technical success (a perfect capsulorrhexis, good centration of the intra-ocular lens, etc.) and her visual acuity improves to 1/60 in her operated eye.

Is this a good outcome? From a technical point of view it is – the surgery went well. However, from a visual acuity perspective, it is not ideal as the woman continues to have poor vision in the operated eye. What we don't know, is what the woman thought about the outcome. Was she happy? If not, why not?

## What do patients think?

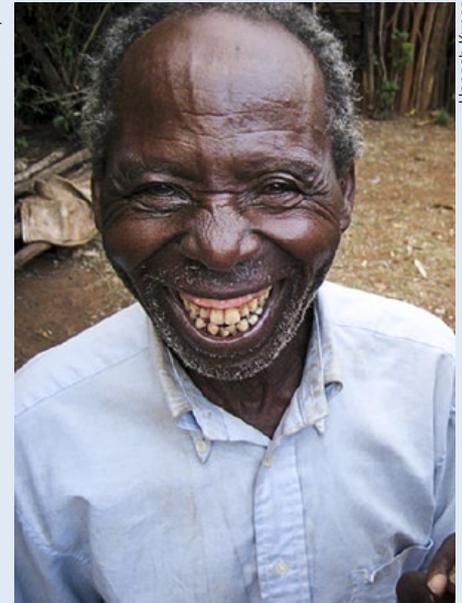
We can, of course, ask patients about whether they are happy with the outcome of surgery, but we have to remember that – as humans – we are influenced by a variety of different things when considering whether we're happy with any outcome. For example, if the surgeon had told the patient that she would have perfect vision restored by surgery, would she be happy? If she had spent her life savings on surgery, would she be happy?

Understanding the patient's perspective on the visual outcome of cataract surgery can improve our cataract surgical service. It allows the hospital team to identify where improvement is required. For example, if the patient reported that the surgeon told her to expect perfect vision, then the information routinely provided by the surgeon could be reviewed and expectations better managed.

**NOTE: Remember to manage the patient's expectations. What you say will depend upon any risk factors and the presence of any co-pathology that might affect the outcome.**



Hannah Kuper



Hannah Kuper

**A patient before (left) and after cataract surgery. KENYA**

So, how can we collect the patient's perspective on outcome? There are several ways:

- 1 Comments boxes.** Many hospitals have comments boxes: patients are encouraged to write down their comments and put them in a box. The advantage of this system is that it is anonymous, so patients can be honest about their care; however, they are of limited use in countries where literacy levels are low. They also rely on ready access to paper and pen, and are less likely to be used by older patients.
- 2 A questionnaire.** Questionnaires are available that capture patients' perspective on the outcome of their care. They either can be given to patients to complete (if they are able), or administered by a member of staff or volunteer. Questionnaires must be culturally appropriate and in the correct language. They rely on either the patient or carer being able to read, or one of the staff helping the patient to complete the questionnaire (which can be problematic as patients might be reluctant to raise concerns or offer criticism in the presence of a staff member).
- 3 Patient interviews/exit interviews.** This involves talking with patients about their experiences at the hospital and recording their responses. Ideally, volunteers (or anyone who is **not** associated with the clinical care patients receive) should ask the questions, in order to ensure that patients feel it is safe to be honest.

## What questions to ask

The purpose of getting the patients' perspective is to find out whether he or she is satisfied with our cataract service (and will recommend it to others), and to find out how we can do better.

A simple yes/no answer (e.g.: 'Yes, I am satisfied', or 'No, I am not satisfied') is not enough. For example, patients might not have been satisfied because the bed was uncomfortable or because they were expecting their visual acuity to be perfect; these are two very different things requiring different remedial actions. In addition, satisfaction levels may be artificially high as patients might not want to be critical about aspects of their care.

It is usually more helpful to understand patients' **experience** of the cataract service. Patient experience questionnaires use quantifiable, objective measures of outcome and patient care in order to explore patients' views. A patient experience questionnaire asks a series of questions designed to try and understand the whole picture. For example, questions about:

- Information and education provided
- physical comfort
- emotional support
- respect for the patient (e.g. 'Did the doctors/nurses sometimes talk as if you weren't there?')
- involvement of family and friends
- continuity and transition (e.g. 'Were you shown how to instil eyedrops before you left the hospital?').

It is possible to find free examples of patient experience questionnaires online.<sup>1</sup> These may provide a useful starting point.

## Demonstrating impact

If we want to show that surgery has changed someone's life, then just showing that their vision has improved is not enough. We need to show that they can do things that they could not do before surgery, or that they feel better.

To do this, we can do a 'quality of life' audit. This involves using a specially designed questionnaire and asking a randomly selected group of patients (e.g. every fifth patient) to complete it (with or without help) both before and after surgery. This makes it possible to identify any changes that have occurred and to determine the impact that surgery is having on the lives of patients.

Quality of life questionnaires have been validated (proven) to measure change in a number of areas, including people's ability to function. They ask questions such as: 'Can you read a newspaper?' or: 'Can you recognise faces?'

Quality of life questionnaires are an objective and independent method of measuring the patient's perspective on outcome. The advantage of using quality of life questionnaires is that, because we are asking for descriptions of what people can and cannot do – rather than how they

feel about the outcome – there is less chance that the patient's response will be affected if the interviewer is a staff member.

Many different studies have shown that cataract surgery can improve function, and there are several questionnaires that can be used to assess this. Care has to be taken when using the questionnaires as they are context-specific. This means that each questionnaire has been developed based on the culture of the people that are being questioned. A good example is activities of daily living. In the UK, most people have a television and questionnaires often include a question on the patient's ability to watch programmes before and after surgery. Obviously this is a pointless question in places where there are few televisions. There are also difficulties in translating the questions as many languages use different types of words to describe the same thing. Therefore, care must be taken in choosing a questionnaire that is right for your country, culture and language.

At the hospital we can use quality of life questionnaires to show our patients, our staff and our supporters (including donors) that, not only do most patients see better after surgery, but most have an improved quality of life too.

## In summary

- The outcome of cataract surgery is not just about visual acuity or complications. One of the most important areas, which is rarely investigated, is the patient's perspective.
- It is important to remember that the patient's perspective is influenced by lots of different things; not just whether or not they can see.
- Quality of life questionnaires that have been designed to measure how people's functioning changes following cataract surgery are available – contact the author for details.
- Getting feedback from patients about outcome is important; however, it is only useful if it is acted on and the changes monitored to see if they have brought about the desired results. The critical outcomes of seeking patients' perspectives on their treatment, therefore, are the changes you make to your service in response to their comments.

### Reference

- 1 The Picker Patient Experience Questionnaire: development and validation using data from in-patient surveys in five countries. *International Journal for Quality in Health Care* 2002; 14(5): 353–358. <http://intqhc.oxfordjournals.org/content/14/5/353.full>

## ICEH update

The International Centre for Eye Health (ICEH) was started by Prof Barrie Jones 35 years ago, in 1980. In 1988, ICEH (then led by Prof Gordon Johnson) started to publish the *Community Eye Health Journal* under the editorship of Dr Murray McGavin. Since then, over 80 issues of the *Journal* have been produced, and versions are now translated into French, Spanish and Chinese, with a total readership of over 30,000 people in more than 150 countries. In 2002, ICEH became part of the London School of Hygiene and Tropical Medicine (LSHTM), which strengthened its ability to engage in international health matters.



Pak Sang Lee

The objectives of ICEH are summarised as follows:

- 1 To **provide evidence** of the magnitude, causes and impact of visual loss and eye diseases for policy makers and health planners.
- 2 To **undertake research and systematic reviews** to identify cost-effective interventions for the prevention and treatment of blinding eye diseases.
- 3 To promote **international and national level leadership** in community eye health through training at LSHTM.
- 4 To facilitate implementation of national and **district VISION 2020 programmes through the provision of local training** in community eye health, planning and management.



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- 5 To work with **partners** to increase the capacity of institutions to develop research programmes and to provide high quality training in eye care delivery.
- 6 To support local health providers with relevant **eye care educational materials** and information on good practice.
- 7 To contribute towards the Global VISION 2020 initiative and the Global Action
- 8 Plan 2014–2019 **in collaboration with WHO, the International Agency on the Prevention of Blindness (IAPB), International non-governmental organisations (NGOs)** and other institutions and organisations.

Clare Gilbert (Co-director, ICEH) and Matthew Burton lead the eye research work, Cova Bascaran and Daksha Patel the teaching courses, Marcia Zondervan and Claire Walker the V2020 LINKS programme, Robin Percy the V2020 workshops, Sally Parsley the E-open digital resources, and Elmien Wolvaardt Ellison and Nick Astbury the *Journal*.

As from this issue, we plan to keep one page in the *Journal* to update you on key reports and activities of ICEH and its core supporters.

A report on ICEH activities from 2010–2014, including the references for all published papers, is available at <http://iceh.lshtm.ac.uk/report-2010-2014/>

If you have suggestions on how we can do things better, please let us know.

Allen Foster, ICEH Co-director

# School eye health – going beyond refractive errors



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Health, including visual health, is inextricably linked to school achievement, quality of life, and economic productivity.<sup>1</sup> Introducing health education in schools is essential as knowledge and good habits acquired at an early age are likely to persist.

Globally, 19 million children are living with vision impairment<sup>2</sup> and approximately 12 million children have a significant, uncorrected refractive error. Of particular concern is the rapid increase in myopia, particularly in East Asia, where 78% of children in China are affected.<sup>3</sup>

School eye health programmes, when integrated into broader school health education and backed up by eye and child health services, can reach a large number of children and their families.

School eye health can encompass the following:

- **Health promotion and prevention** to increase awareness among children and teachers and to promote a healthy school environment. This can reduce the impact of local endemic eye diseases such as trachoma.
- **Primary eye care** to detect and treat common eye conditions (e.g. infections), refer people with conditions such as cataract, and to manage refractive errors with high quality, appealing and affordable spectacles.

Activities may include:

- Training children to spread eye health messages and conduct simple vision screening among peers and family members (the child-to-child approach).
- Showing children and adults how to help and interact with those who are blind or have irreversible low vision.

Children should be offered general vision screening when they enter and leave primary school, and when they leave secondary school/high school. Any child with visible eye conditions (squint, white pupil, red eyes) and associated symptoms



Visual health is linked  
to school achievement.  
PAKISTAN

Jamshad Masood

(abnormal head/face turn, inability to copy from the blackboard, complaints of chronic headaches), should also be screened and provided with, or referred to, the appropriate services.

The ideal is to conduct eye health screening for children and teachers in school, and refer those who need further management to the eye unit for examination, refraction and dispensing of spectacles. Another option is to screen and refract the children in the school and allow them to choose a frame they like. The local eye unit can cut lenses, fit them and deliver the spectacles to the school.

Factors that contribute to a successful school eye health programme include:

- The support and engagement of the local education authorities.
- The involvement of parents/carers.
- The enforcement of policies and guidelines to prevent unnecessary prescribing (see below).
- Financial support for optical correction from the government (child health services/insurance schemes).
- Qualified personnel to fit affordable and good quality spectacles.

Spectacles should **not** be prescribed to children with minimal refractive error. Children will not notice a significant improvement in their vision and will therefore simply not wear them! This is a waste of resources.

The guidelines for correction are:

- myopia  $\geq -0.50D$
- hypermetropia  $\geq +2.00D$
- astigmatism  $\geq 0.75D$

To increase follow-up and referral, the

following must be systematically recorded.

- Uptake of referrals (to ensure services are accessed, including low vision care).
- Spectacle wearing after 3–4 months and any reasons for non-wear.
- Any educational adjustments made for children identified with irreversible vision impairment (by consulting with teachers).
- New and/or progressed myopia cases and replacement of broken/missing spectacles (by repeating screening of 11–15 year-old children).

In order to increase coverage, members of school health programmes can work with school nurses and teachers after consultation with educational authorities.

In order to make informed decisions, research (which can be multi-disciplinary) plays a pivotal role in providing evidence, which might be needed for:

- Planning – needs assessment based on prevalence data, reviews of existing resources and analysis of policy.
- Improving implementation – operational research to identify gaps and challenges could improve the efficiency, effectiveness and quality of programmes.
- Assessing impact – in terms of satisfaction, academic achievement, quality of life, etc.

Eye health is an essential part of a school health programme and should be comprehensive and respond to the locally relevant eye conditions and diseases. Correction of refractive errors is critical but should not be the only focus of a school eye health programme.

Figure 1 describes a systematic approach to school eye health.

Figure 1. A systematic approach to school eye health

**In the school**

**As part of the curriculum [using the Healthy Eyes Activity Book]**

- Education on how to keep eyes healthy
- Personal hygiene education, which includes face washing
- Children encouraged to take these health messages home
- Primary eye care provided by a trained school nurse or teacher

**Visit by the eye care team**

- Screen teachers and alert them to eye conditions/low vision
- Train teachers to screen visual acuity at 6/12 level

**After visit by the team**

- Teachers screen children and list those who fail

**Second visit by the eye care team**

- Refract and dispense spectacles to children with significant RE

Refer children with complex refractive error and other eye conditions

**In the eye unit**

- Refract and dispense spectacles to children with complex prescriptions
- Diagnose and manage other eye conditions
- Low vision assessment. Prescribe low vision devices if required, and provide training in their use

**In the school**

**Post-service**

- Encourage children to wear their spectacles in class
- Support children with low vision

**Compliance monitoring by eye care team**

- Ensure children wear their spectacles

**References**

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- 2 World Health Organization. Visual impairment and blindness – Fact Sheet No. 282. 2012; Available from: <http://www.who.int/mediacentre/factsheets/fs282/en/>. Accessed: February 2015.
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# Electrosurgical units – how they work and how to use them safely



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Electrosurgery is used routinely in eye surgery to cut, coagulate, dissect, fulgurate, ablate and shrink tissue. High frequency (100 kilohertz to 5 megahertz), alternating electric current at various voltages (200–10,000 Volts) is passed through tissue to generate heat. An electrosurgical unit (ESU) consists of a generator and a handpiece with one or more electrodes. The device is controlled using a switch on the handpiece or a foot switch.

Electrosurgical generators can produce a variety of electrical waveforms. As these waveforms change, so do the corresponding tissue effects.

In **bipolar electrosurgery** (Figure 1),

both the active electrode and return electrode functions are performed at the site of surgery. The two tips of the forceps perform the active and return electrode functions. Only the tissue grasped in the forceps is included in the electrical circuit. Because the return function is performed by one tip of the forceps, no patient return electrode is needed. Bipolar electrosurgery operates regardless of the medium in which it is used, permitting coagulation in a fluid environment – a great advantage when attempting to coagulate in a wet field. As a result, bipolar electrosurgery is often referred to as ‘wet field’ cautery.

In **monopolar electrosurgery** (Figure 2), the active electrode is placed at the surgical site. The patient return electrode (also known as a ‘dispersive

*Continues overleaf* ➤

Figure 1. Bipolar electrosurgery

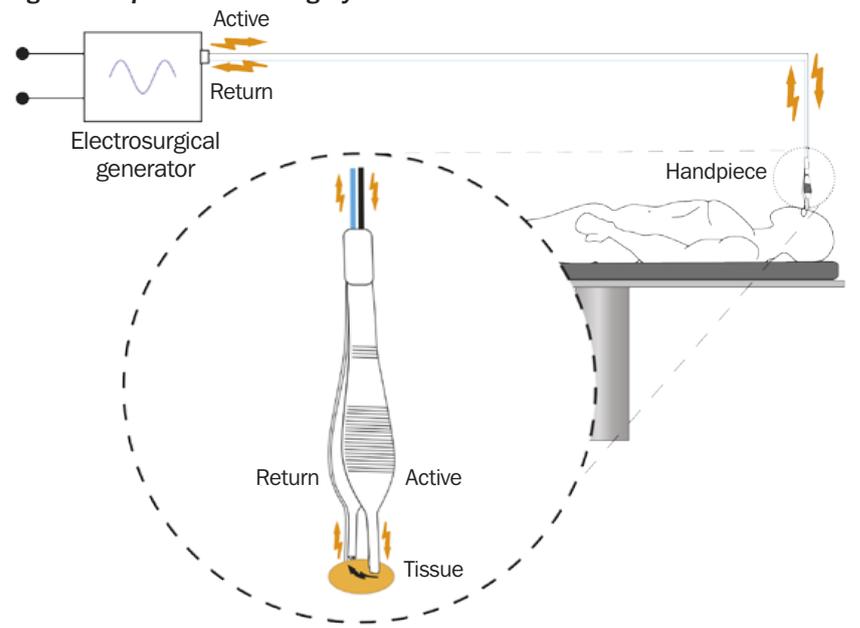
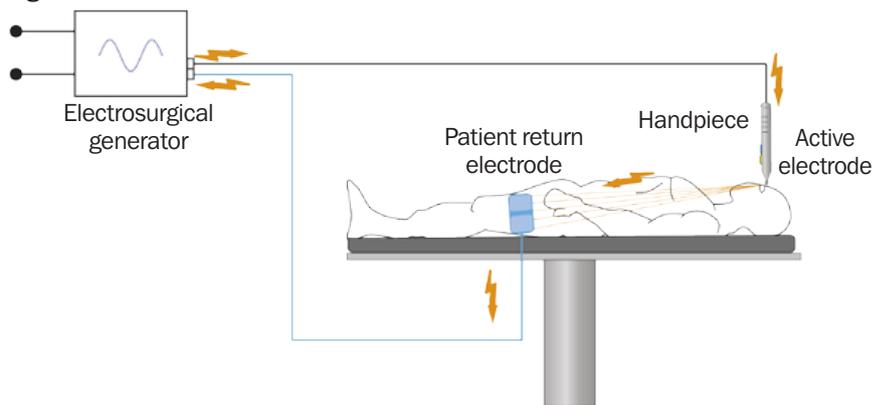


Figure 2



pad' is placed somewhere else on the patient's body. The current passes through the patient as it completes the circuit from the active electrode to the patient return electrode. The function of the patient return electrode is to remove current from the patient safely. A return electrode burn will occur if the heat produced, over time, is not safely dissipated by the size or conductivity of the patient return electrode.

Modern electrosurgical machines have built-in safety features to prevent burns from occurring due to poor contact between the patient and the return electrode when using the monopolar mode.

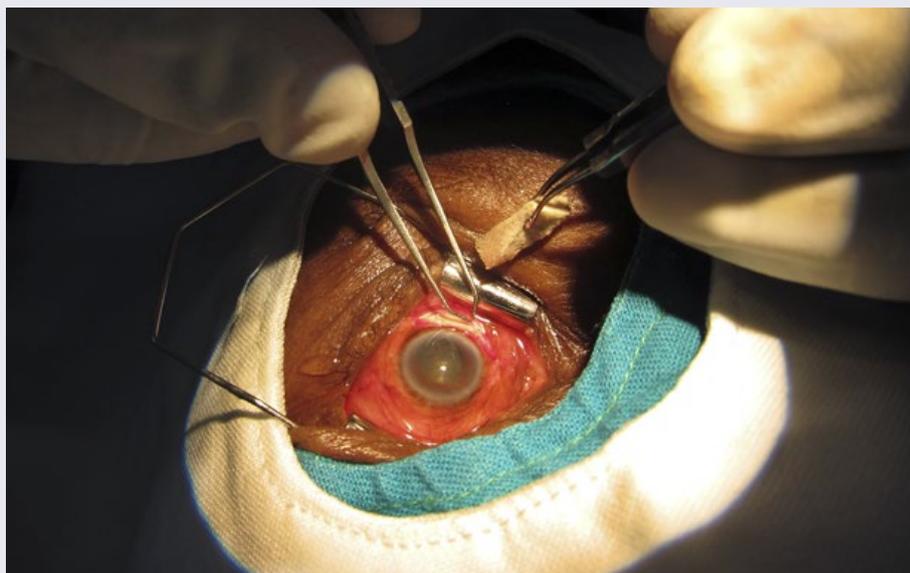
Often, the term 'electrocautery' is incorrectly used to describe electro-surgery. Electrocautery refers to direct current (electrons flowing in one direction) whereas electrosurgery uses alternating current. In electrosurgery, the patient is included in the circuit and current enters the patient's body. During electrocautery, current does not enter the patient's body. Instead, current flows through a heating element, which burns the tissue by direct transfer of heat. Electrocautery or, more precisely, thermocautery units (Figure 3) are usually portable battery powered devices that can be either disposable or reusable.

### Using the ESU safely

ESUs produce very high current that can injure both patient and operator if not properly used and maintained. Many problems have been associated with the use of ESUs, such as burns at the return electrode site and surgical fires. Some of these safety problems can be avoided by taking simple precautions.

#### Dos

- The hand piece should always be placed in the nonconductive holster when not in use.
- Always use the lowest possible generator setting that will achieve the desired surgical effect. When higher than necessary voltages are used, the chances of arcing are increased. If the surgeon continues to ask for a higher setting, this could be a signal that the integrity of the skin/dispersive pad interface is compromised.
- Clean the electrode tip frequently. As



Heiko Philippin

### Electrosurgery. TANZANIA

eschar (dead tissue from burning) builds up on the tip, electrical impedance increases and this can cause arcing, sparking or ignition and flaming of the eschar. When cleaning the electrode, the eschar should be wiped away using a sponge rather than the common scratch pad, because these pads will scratch grooves into the electrode tip, increasing eschar build-up.

#### Don'ts

- ESUs should not be used in the presence of flammable agents or in oxygen-enriched environments.
- Avoid using flammable substances that can be ignited by sparks, such as alcohol and skin degreasers. If you must use alcohol-based skin preps, do not allow them to pool near the dispersive pad; be sure prep solutions are thoroughly dry and fumes have dissipated before ESU activation.
- Rubber catheters or other materials should not be used as a sheath on active electrode tips.
- Cables should never be wrapped around metal instruments, as the current running through them can pass into the metal instrument, causing burns.
- Do not use sharp towel clips or metal instruments to attach cables to drapes. Sharp metal clips can damage electrical cables or provide an unwanted point of contact with the patient's skin. Overlapping electrical wire around

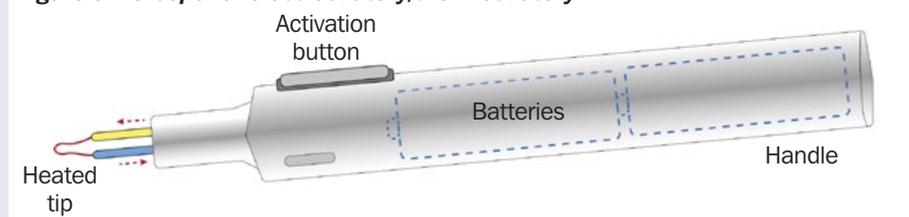
a metal clip creates an electrical transformer that can cause a hazard and may ignite drapes.

- Never operate electrosurgical equipment with wet hands or wet gloves. If sterile gloves have holes in them, electrical current can pass through. Be sure that all team members at the surgical field have intact gloves.
- Never operate electrosurgical equipment while standing on a wet surface. Keep the foot pedal dry. Protect it from fluid spillage by covering it with a clear, waterproof cover.

### Monopolar electrosurgery

- Determine whether the patient has any metal implants, including cardiac pacemakers. There is potential for injury if a patient return electrode is placed on the skin over a metal orthopaedic implant.
- For optimum safety, have the patient remove any jewellery to avoid complications from possible current leakage.
- Position and insulate the patient so that she or he is not touching any grounded metal objects.
- Choose a location for the return electrode/dispersive pad that is as close to the operative site as possible, clean and dry, well vascularised, and over a large muscle mass. Avoid bony prominences, adipose tissue, scar tissue, skin over implanted metal prostheses, hairy surfaces, and pressure points. If necessary, shave very hairy skin at the dispersive pad site. Make sure that conductive gel is moist and uniformly spread all over the contact area and that the dispersive pad achieves uniform contact with the patient's skin.
- Position ECG electrodes away from the electrosurgery site and the current pathway through the body.

**Figure 3. Forceps for electrocautery/thermocautery**



# Techniques for aseptic dressing and procedures



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When applying or changing dressings, an aseptic technique is used in order to avoid introducing infections into a wound. Even if a wound is already infected, an aseptic technique should be used as it is important that no further infection is introduced. This technique should be used when the patient has a surgical or non-surgical wound in or around the eye.

### What you will need

- A clear available work space, such as a stainless steel trolley. The space must be big enough for the dressing pack to be opened on
- A sterile dressing/procedure pack
- Access to hand washing sink or alcohol hand wash
- Non-sterile gloves to remove old dressing
- Apron
- Appropriate dressings
- Appropriate solution for cleaning the wound, if needed.

### Preparation

- Introduce yourself to the patient and explain what you are doing and why. If possible, provide privacy.
- Position the patient comfortably and make sure the surrounding area is clean and tidy before you start.
- Check the patient's care notes to update yourself on any changes in the patient's condition and to make sure the dressing is due to be changed.
- Wash your hands and put on an apron.
- Clean the trolley using soap and water, or disinfectant, and a cloth. Start at the top of the trolley and work down to the bottom legs of the trolley using single strokes with your damp cloth.
- Place the sterile dressing/procedure pack on the top of the trolley.
- Open the sterile dressing pack on top of the trolley. Open the sterile field using the corners of the paper.
- Open any other sterile items needed onto the sterile field without touching them.

### Removing an old dressing

- Wash your hands and put on non-sterile gloves (to protect yourself) before



### Start at the top and clean the trolley using single downward strokes

- removing an old dressing. Dispose of this dressing in a separate dirty clinical waste bag.
- Complete a wound assessment. This includes a visual check and comparing and evaluating the smell, amount of blood or ooze (excretions) and their colour, and the size of the wound.
- If the site has not improved as expected, then the treating physician or senior charge nurse must be informed so they too can evaluate it and consider changing the care plan.

### Cleaning and dressing the wound

- Make sure that you have selected the correct dressing type and materials to provide full and appropriate coverage of the type, size and location of the wound as per the care plan or the physician or senior charge nurse's recommendations.
  - Wash your hands and put on sterile gloves. If the gloves become deesterilised, remove them, re-wash your hands and put on new sterile gloves. This is best practice, but where resources are not available, safe modifications to this process can be made, for example by using non-sterile gloves to protect the nurse while removing the dressing and then washing the hands with gloves on and using alcohol gel on the gloves to make them clean enough to clean the wound and redo the dressing. This then protects both the nurse and the patient.
- Start from the dirty area and then move out to the clean area. Be very careful when doing this as the tissue or skin may be tender and there may also be sutures in place. Clean the area without

**'If the site has not improved as expected, inform the treating physician or senior nurse.'**



### If your gloves become deesterilised, wash your hands and put on fresh gloves

- causing further damage or distress to the patient.
- Make sure you do not re-introduce dirt or ooze by ensuring that cleaning materials (i.e. gauze, cotton balls) are not over-used. Change them regularly (use once only if possible) and never re-introduce them to a clean area once they have been contaminated.
- Make sure that you have selected the correct dressing type and materials needed to provide full and appropriate coverage for the type, size and location of the wound, according to the care plan or the physician's or senior charge nurse's recommendations.
- Dress the wound as per instructions.
- **Note:** Ensure that the materials and dressing pack are only used for one eye at a time to prevent cross-contamination. If, for some reason, another part of the face or the other eye also needs a dressing change, then open another pack and start on the other side with clean hands and gloves.

### After the procedure

- Fold up the dressing/procedure pack and place all contaminated material in a bag designated for clinical waste, making sure all sharps are removed and disposed of in a sharps container.
- Remove gloves and place in waste bag.
- Wash your hands.
- Clean the trolley with soap and water or disinfectant solution as before.
- Record (document) on the patient's chart your wound assessment, the dressing change and the care you have given.
- Provide the patient with some dressing management education and answer any questions before you go.
- Report any changes to a senior nurse or doctor.

Eimien Wolvaardt Ellison

Eimien Wolvaardt Ellison

# Treatment coverage surveys as part of a trachoma control programme



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One of the pillars of the SAFE strategy for trachoma control is the use of mass drug administration (MDA) using azithromycin (Zithromax®) donated by Pfizer Inc. Azithromycin is very effective for curing infections with ocular *Chlamydia trachomatis* with a single oral dose. Unusually for the administration of antibiotics, MDA is offered to all members of a defined population without first making an individual diagnosis for each recipient. This is done, in part, because the clinical signs of trachoma do not always mean that *C. trachomatis* is present and an accurate test for infection is costly and time-consuming to conduct. As a result, members of a defined population (the ‘target population’) are offered treatment whether they have a confirmed current infection or not.

In order for MDA to be effective in stopping transmission of ocular *Chlamydia*, as many as possible of those with current infections should receive the correct dose of Zithromax® during the distribution. The term ‘treatment coverage’ is used to describe the

proportion of people who received Zithromax® among all those targeted by the MDA. Untreated persons left harbouring an infection are a potential source of contagion and could be responsible for a fresh outbreak of infection and on-going transmission. Almost all infections are in children and therefore children are the most important targets for Zithromax® treatment.

In a simplified example, if 20% of children (1 in 5) are infected, and all of them receive treatment, none will remain infected and transmission will only be possible by reintroduction from a neighbouring untreated area. But what if not all the infected children are treated? Transmission will likely start again in that district a few months after the distribution.



Mark Tuschman/ITI

**A patient is given Zithromax®. ETHIOPIA**

In our hypothetical district where one in five children are affected, a distribution reaching half of the children (50% coverage) will leave one in 10 children able to transmit ocular *Chlamydia*. Reaching almost all children (95% coverage) will leave just one in 100 as a potential source of infection. In MDA for trachoma control, coverage matters, and the higher the prevalence of infection, the more important it is to achieve high coverage.

Country programmes routinely report treatment coverage by subtracting the number of doses of Zithromax® left in stock after a distribution from the target population, or by summing the reports from the drug distributors. While both of these methods are better than doing nothing, it is important to check the accuracy of such routinely

reported coverage figures, as they are subject to manipulation and error. An effective approach is to conduct a coverage survey. Coverage surveys are investigations in random sample of members of the target population designed to establish the proportion of people who received treatment.

Experience has shown that during MDA, a whole family, village or even group of villages is often missed, meaning that those people do not have the opportunity of treatment with Zithromax®. Because coverage can be patchy, it is best to survey a large number of villages, but (unlike a prevalence survey) only a few households in each village need to be interviewed. One inexpensive approach to estimate coverage is based on a survey of seven households

in each of 30 villages, called the ‘7x30 method’. The survey team should select 30 villages from the district (or other target population) of interest at random and follow up with at least seven randomly selected households in each, asking the family members if they took Zithromax®. To help people remember, and to avoid confusion with MDAs for other diseases, it is best to do the survey within a few weeks of the distribution and to show them what the tablets and suspension look like – Zithromax® is the only MDA that uses pink tablets or a liquid suspension for younger children. Experience suggests it is easy to remember.

Coverage surveys can be used for more than just estimating the proportion of people who received treatment; they can be used to determine *why* treatment was not taken, allowing for immediate or longer-term remedial action if needed. For example, if a group of villages did not get MDA because no distributor collected Zithromax® from the health centre, the programme can conduct an immediate ‘catch-up’ distribution. If coverage was low because people did not wish to participate at the time a long-term process of sensitisation and health education can be planned to improve compliance the following year. Coverage surveys also offer a valuable platform for research, and other important questions regarding the health knowledge, attitudes and practices of the population can be included.

**‘Untreated persons left harbouring an infection are a potential source of contagion’**

## Take-home messages on coverage surveys for trachoma MDA

- In MDA for trachoma control, coverage with Zithromax® matters.
- The 7x30 method (interviewing at least seven households in each of 30 communities) is a good and inexpensive method for conducting a Zithromax® MDA coverage survey, as interviewing a few households in a community generally gives the same result as interviewing all of them.
- Coverage surveys can be used to identify areas in need of immediate action (e.g., ‘catch-up’ distributions), as well as long-term action (e.g., sensitisation to improve compliance).



# Test your knowledge and understanding

This page is designed to help you test your own understanding of the concepts covered in this issue, and to reflect on what you have learnt. We hope that you will also discuss the questions with your colleagues and other members of the eye care team, perhaps in a journal club. To complete the activities online – and get instant feedback – please visit [www.cehjournal.org](http://www.cehjournal.org)

<b>1. What measures would help prevent or reduce sight loss from microbial keratitis?</b>		<b>Select all that apply</b>
a	Prophylactic treatment of simple corneal abrasions with chloramphenicol eye ointment	<input type="checkbox"/>
b	Rapid referral from primary health care facilities to regional eye units	<input type="checkbox"/>
c	Use of protective goggles in work situations where eyes might be injured	<input type="checkbox"/>
d	Improved awareness of microbial keratitis among primary health workers	<input type="checkbox"/>
e	Reliable availability of appropriate antibacterial and antifungal eye drops	<input type="checkbox"/>
<b>2. To make a diagnosis of microbial keratitis it is necessary to have a slit lamp. True or False?</b>		<b>Select one</b>
a	True	<input type="checkbox"/>
b	False	<input type="checkbox"/>
<b>3. Which of the following are helpful in identifying the type of organism causing microbial keratitis infection?</b>		<b>Select all that apply</b>
a	Gram stain of scrape slide	<input type="checkbox"/>
b	Presence or absence of a hypopyon	<input type="checkbox"/>
c	Presence or absence of serrated/feathery edges to the corneal infiltrate	<input type="checkbox"/>
d	Potassium hydroxide stain of corneal scrape slide	<input type="checkbox"/>
e	Presence or absence of raised slough on the cornea surface	<input type="checkbox"/>
<b>4. Antimicrobial treatments work equally well in different settings . True or False?</b>		<b>Select one</b>
a	True	<input type="checkbox"/>
b	False	<input type="checkbox"/>

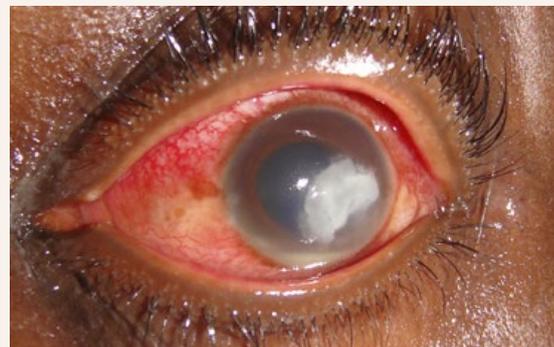
## ANSWERS

**1.** All of these measures are likely to be helpful. The prevention of sight loss from microbial keratitis requires action at different stages: to prevent microbial keratitis, recognise it, refer patients rapidly and treat them effectively. **2. FALSE.** A slit lamp certainly helps in the assessment of microbial keratitis; however, many of the signs can be detected using a torch (with or without a blue filter), a pair of magnifying loupes and some fluorescence for corneal staining. It is therefore realistic to train and equip health workers to identify cases of microbial keratitis in a primary care setting. **3. a, c, d and e** are helpful indicators of the cause. Both feathery infiltrate edges and raised corneal slough are more common in fungal microbial keratitis (see pages 6–7). Microscopy of slides or corneal scrapes can be very helpful in providing a rapid diagnosis (see pages 8–9). **4. FALSE.** The pattern of organisms that cause infections and their sensitivity to antibacterial or antifungal agents can vary significantly between regions. Therefore, it is very important to have an understanding of the typical causative organisms in different regions and their usual antibiotic sensitivity profile to guide treatment, particularly if microbiology services are generally limited.

## Reflective learning

Visit [www.cehjournal.org](http://www.cehjournal.org) to complete the online 'Time to reflect' section.

## Picture quiz



Matthew Burton

A 35-year-old man in an equatorial African country presents with a two-week history of gradually progressive pain, redness and reduced vision (6/60) in the left eye. The problem began after the left eye was scratched by a maize leaf while he was harvesting. The right eye is not affected.

**1.** What is the most likely diagnosis?

- a. Chronic uveitis
- b. Herpes simplex viral keratitis
- c. Microbial keratitis (possibly fungal)
- d. Traumatic abrasion
- e. Corneal scar

**2.** What clinical signs are present?

- a. Conjunctival injection
- b. Hypopyon
- c. Corneal perforation
- d. Corneal slough
- e. Trichiasis

**3.** What treatments might be useful in managing this condition?

- a. Atropine eye drops
- b. Acyclovir eye ointment
- c. Oral anti-fungal medication
- d. Natamycin 5% eye drops
- e. Topical or sub-conjunctival antibiotics

## ANSWERS

**1. c.** On microscopy this was diagnosed as a case of filamentary fungal microbial keratitis. There was a history consistent with traumatic corneal abrasion with vegetable matter (maize leaf), which is a likely source of fungal infection. The history of a sub-acute course is also consistent with a fungal infection. By contrast, significant bacterial microbial keratitis tends to have a more rapid or acute course. The signs are most consistent with a fungal infection (see next answer). **2. a, b and d.** This eye has signs of active inflammation. The eye is red (conjunctival injection). There is a large white area of inflammatory infiltrate in the cornea that on examination has a slightly raised profile, with an irregular or feathery superior and nasal edge and there are signs of intraocular inflammation, with a small hypopyon (pus collection in the anterior chamber). **3. a, c, d and e.** Management of fungal microbial keratitis involves intensive treatment with topical antifungal drops, of which natamycin 5% appears to be the most effective for filamentary fungi. If there is deep corneal or intraocular involvement, oral antifungal medication may be a useful addition to topical treatment. If one does not have a confirmed laboratory diagnosis of a fungal aetiology, then it is also advisable to treat with broad-spectrum topical or sub-conjunctival antibiotics. Pupil dilation with atropine will help reduce pain and the risk of adhesions between the iris and lens.

## Book review

**Eye Surgery in Hot Climates**

Fourth edition  
by William Dean and John Sandford-Smith

It is a sad fact that, despite the technological revolution in eye surgery, there are still 39 million people in the world who are blind, with over half afflicted by cataract. There is a need for more trained eye staff to carry out high-quality and cost-effective surgery in the hardest-to-reach places. The fourth edition of this classic text is an invaluable aid to anyone wanting to know how to tackle cataract, glaucoma and lid surgery. Just as important, however, is the chain of successful surgery – sterilisation, pre-op preparation, local anaesthesia, magnification and illumination, good instruments, surgical knowledge and technique – all of which are described in detail in the book.

The fourth edition has an expanded section on the principles of learning surgical skills from the novice stage to the competent eye surgeon. The instructions are comprehensive and the line drawings clear. Together with the DVD on suturing, local anaesthesia and operative procedures, and two quizzes, the student will have everything bar the patient!

Readers may be surprised to read in detail about intra-capsular cataract extraction with forceps or cryo and retrobulbar anaesthesia, but the long list of potential complications associated with the latter should convince the wise surgeon to use the safer sub-Tenon's instead. Phacoemulsification is quite rightly put on the back burner whilst small incision cataract surgery is given the attention it deserves.

It is a pity that there are a number of typographical errors. Hopefully these will not appear in the fifth edition that will inevitably follow in years to come.

– Nick Astbury

## Online courses

**New free online course: International Centre for Eye Health (ICEH)**

An online short course on **Global Blindness: Planning and Managing Eye Care Services** introduces the magnitude and causes of visual impairment at a global level, highlights key global initiatives to manage avoidable blindness, and provides practical approaches to strengthen and plan local eye health services, with an emphasis on low- and middle-income country settings. Starts April 2015 for 6 weeks. Time commitment: 4 hours per week. Register your interest: [www.lshtm.ac.uk/eyecourse](http://www.lshtm.ac.uk/eyecourse)

## Other courses

**German Jordanian University, Amman, Jordan**

Professional diploma and MSc in Vision Rehabilitation. For more information, visit <http://tinyurl.com/rehabcourse>  
Email: [vtc@gu.edu.jo](mailto:vtc@gu.edu.jo)

**Community Eye Health Institute, University of Cape Town, South Africa**

Short courses, postgraduate diploma, and MPH Community Eye Health. Scholarships are available for the MPH. For more information, visit [www.health.uct.ac.za](http://www.health.uct.ac.za) or email [chervon.vanderross@uct.ac.za](mailto:chervon.vanderross@uct.ac.za)

**Lions Medical Training Centre, Nairobi, Kenya**

Small incision cataract surgery (SICS). Write to: The Training Coordinator, Lions Medical Training Centre, Lions SightFirst Eye Hospital, PO Box 66576-00800, Nairobi, Kenya. Tel: +254 20 418 32 39

**Kilimanjaro Centre for Community Ophthalmology International**

Visit [www.kcco.net](http://www.kcco.net) or contact Genes Mng'anga at [genes@kcco.net](mailto:genes@kcco.net) and/or [genestz@yahoo.com](mailto:genestz@yahoo.com)

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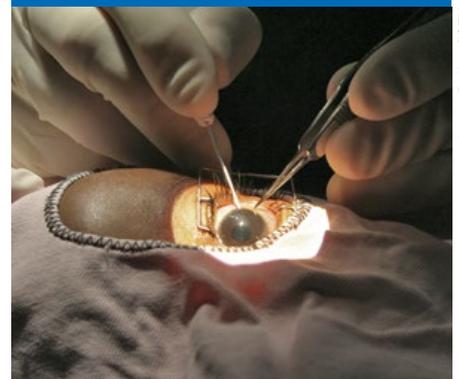
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## Next issue



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The theme of the next issue of the *Community Eye Health Journal* is **Safety**