Glaucoma UK

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# Aqueous Shunt Implantation

This free booklet is brought to you by Glaucoma UK (formerly the International Glaucoma Association). Contact the Glaucoma UK for further information or advice:

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Glaucoma UK

## Glaucoma UK is a registered charity that is here for everyone living with glaucoma throughout the UK.

- We raise awareness of glaucoma so that it is detected and treated early.
- We campaign for effective services for everyone affected by glaucoma.
- We provide advice and support to help people live well with glaucoma.
- We fund vital glaucoma research.

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# 01 What is glaucoma?

Glaucoma is the name of a group of eye diseases in which the optic nerve becomes damaged. This is usually due to increased pressure in the eye but there are other reasons glaucoma can occur, such as poor blood supply to the optic nerve. The optic nerve sends visual information from the eye to the brain and if it is damaged, it can result in sight loss and even blindness.

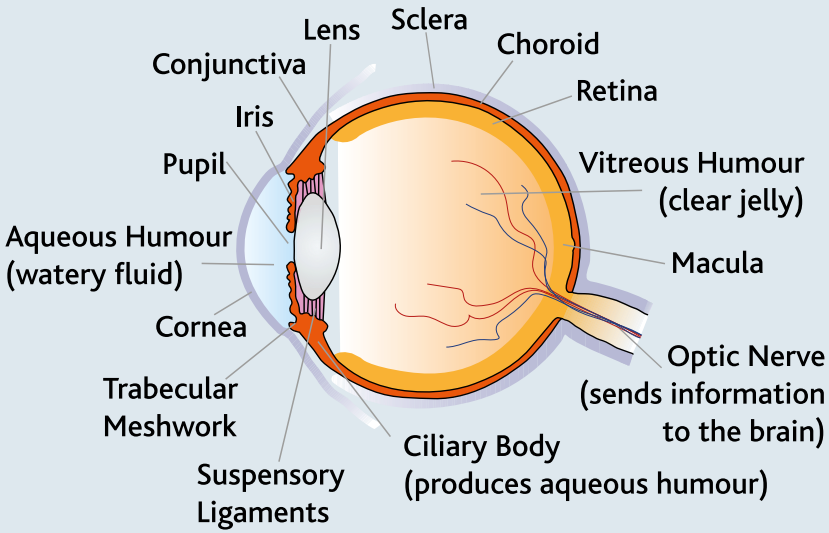
The most common type of glaucoma (primary open angle glaucoma) starts very slowly and has no symptoms to begin with, so it is usually discovered during an eye health check by an optometrist. If glaucoma is detected early and treatment is started and continued, significant sight loss is unlikely. However, you cannot get back any vision that has already been lost due to glaucoma.

There are three main types of glaucoma: primary, secondary, and developmental (glaucoma in babies and children).

Glaucoma is a complicated disease and diagnosis is not always easy. Several different tests will be needed to confirm how and why damage to the optic nerve has occurred.

To understand how glaucoma affects us, it is useful to understand the structure of the eye, and why keeping eye pressure within the normal range (10mmHg - 21mmHg) is so important.

# 02 Structure of the eye




The eye is shaped like a ball. The tough white outer coat is called the sclera and its surface is covered by a thin skin called the conjunctiva.

At the front of the eye, the outer coat is clear and is called the cornea.

Behind the cornea is the iris – the coloured part of the eye – with the pupil forming a hole in its centre. The lens of the eye, which helps to focus light, is behind the pupil.

The space between the cornea and the lens is filled with a clear, watery fluid, called aqueous humour (or just aqueous).

Aqueous is made inside the eye and delivers nutrients and oxygen to parts of the eye, before draining out of the eye through a sieve-like structure called the trabecular meshwork. It is different to tears, which are made outside of the eye and keep the outside of the eye moist.

Aqueous is responsible for creating the pressure in the eye (the intraocular pressure or IOP), which is important for the eye to keep its shape.

The eye pressure depends on how much fluid is made in the eye and how quickly it drains out of the eye. When this balance is disturbed it can cause the eye pressure to rise. This rise in pressure can damage the optic nerve, which leads to nerve cells dying and to glaucoma sight loss.

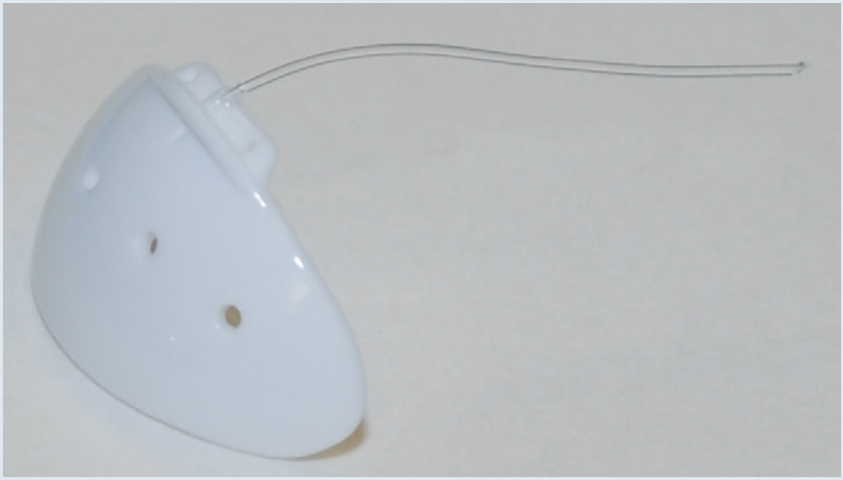
# 03 What are aqueous shunts and what do they do?

Aqueous shunts are devices that are used to reduce the intraocular eye pressure (IOP) in glaucoma by draining the fluid (aqueous humour) from inside the eye to a small blister or bleb behind the eyelid. Reducing the pressure on the optic nerve in this manner prevents further damage and further loss of vision in glaucoma.

Please be aware that control of the eye pressure with an aqueous shunt will not restore vision already lost from glaucoma.

Aqueous shunts have various other names such as tube implants, glaucoma tube shunts, glaucoma drainage devices, glaucoma drainage implants and setons. These names all refer to the same thing. Although there are many types of shunt available, two brands are in common use today and they function in a similar fashion. These are called the Ahmed Glaucoma Valve and the Baerveldt Glaucoma Implant. In certain circumstances a third type, known as the Molteno Implant, might also be used.

## Baerveldt 350 Implant



## Ahmed Glaucoma Valve

These shunts are made up of a small silicone tube (less than 1mm in diameter) attached to a plate. The tube takes the aqueous humour from inside the eye and drains it to the plate which sits on the white of the eye (sclera). The plate sits under the skin of the eye (conjunctiva), behind the eyelid.

Although all shunts perform approximately the same function, there are important differences that affect the eye pressure in the first few weeks after surgery and other differences that influence the healing of the eye around the shunt and the long-term eye pressure.

The Ahmed Glaucoma Valve contains a type of valve that helps to prevent very low eye pressure during the first few weeks after surgery. The Baerveldt and Molteno implants do not contain valves but do have other advantages.

Because the Baerveldt and Molteno implants have no valve, they must be blocked with a stitch that is either tied around the outside of the silicone tube (external ligature), or threaded through the inside of the tube (occluding suture) at the time of surgery. The purpose of the stitches is to prevent the shunt from draining excessively in the first few weeks after surgery and causing the eye pressure to be too low.

# 04 How will the shunt affect the external appearance of the eye?

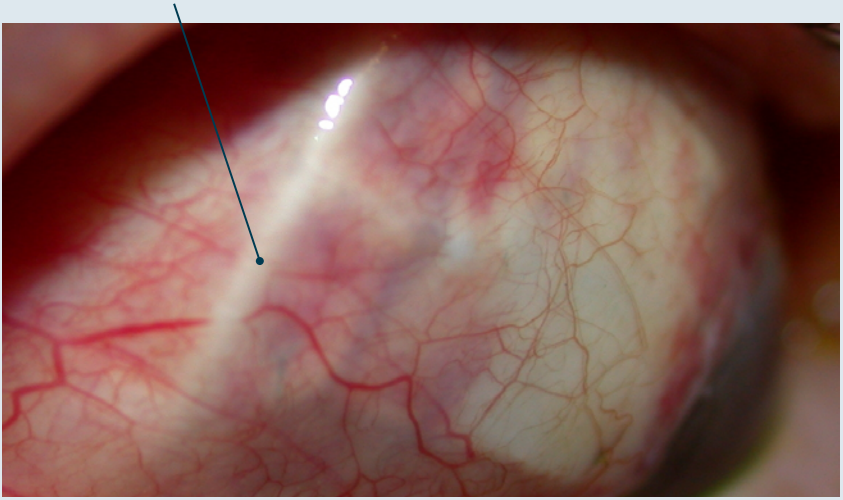
### On the outside of the eye

Initially after surgery the eye will be red and swollen to a variable degree. After major eye surgery the eyelid often droops. This normally resolves over a period of weeks to months. The aqueous shunt itself is not normally visible on the outside of the eye.

When the shunt is functioning normally, the drained fluid accumulates in a blister or bleb in the conjunctiva. The plate and its bleb are positioned far back behind the eyelid so they cannot usually be seen. This fluid is slowly absorbed by the blood vessels on the eye surface. The shunt and bleb in the pictures above are visible only because the eyelid has been lifted up manually. Occasionally, the shunt or bleb can be seen in extremes of gaze, when the eye is looking very far down and in.

The plate portion of a shunt can be seen just underneath the eye surface when the eyelid is lifted up manually.

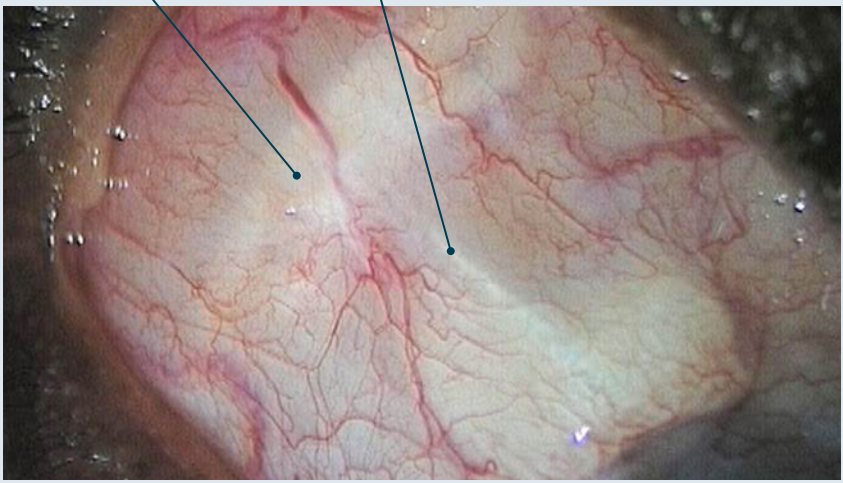
**Plate portion**



Most shunts are implanted behind the upper eyelid. Occasionally other areas are used, such as below the lower eyelid.

In the example above, the shunt can be seen under the eye surface. The drainage bleb is formed just above it.

**Plate portion and tube portion**



A patch made of donor eye tissue, either from the sclera (the wall of the eye) or cornea (transparent tissue that forms the front of the eye) is often used to keep the shunt in place. This is the only part of the operation that might be visible after surgery.

### On the inside of the eye

The tube part of the shunt is placed inside the eye at the time of surgery. This is very small and cannot be seen with the naked eye. The illustrations below show the appearance of the tube when viewed at high magnification. The outside diameter of the tube part of the implant is 0.6mm and the internal diameter, 0.3mm. The tube itself is made of transparent silicone. The length of the tube inside the eye is usually 1 – 2mm.

In the photograph below, the tube is seen entering the eye just in front of the brown iris.

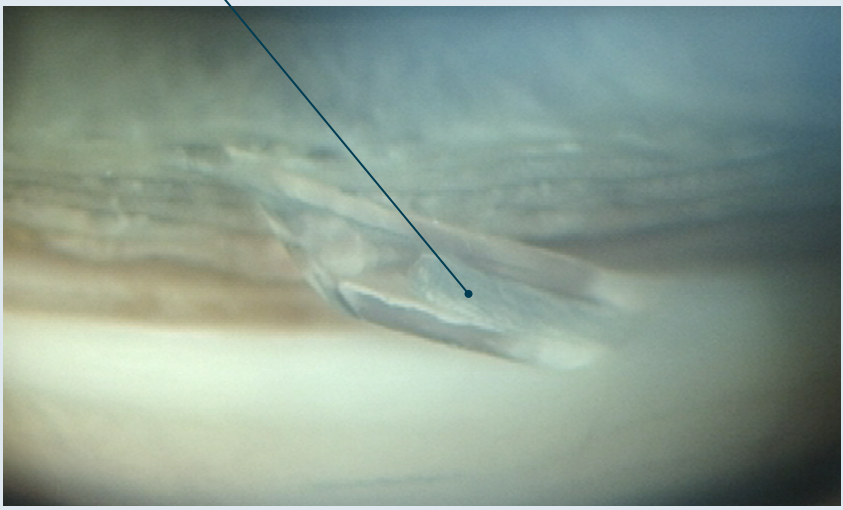
## Internal opening of the tube inside the eye

### Internal opening of the tube inside the eye

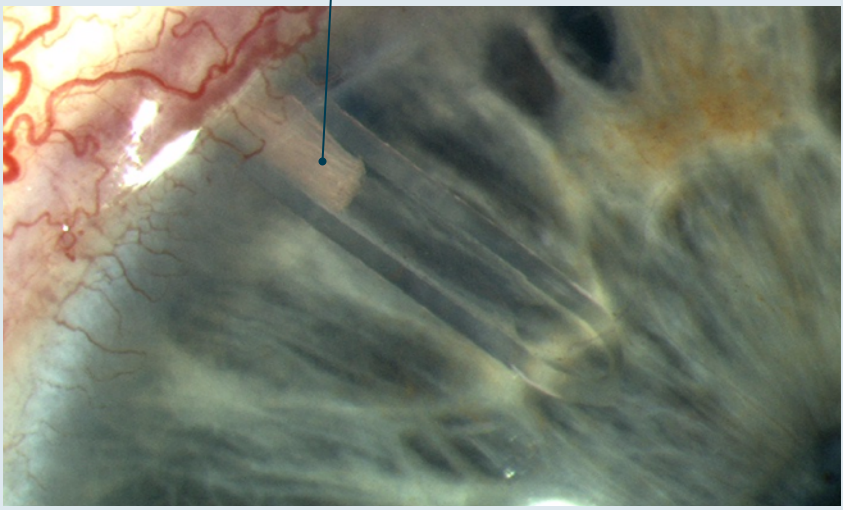
In the photographs below, the tube part of the shunt can be seen just in front of the blue iris. A white nylon occluding suture/stitch (Supramid), which is used to partially obstruct the tube in order to help regulate the eye pressure, can also be seen inside the tube.

Baerveldt tube partially obstructed by a white nylon suture/stitch (Supramid) inside the eye (just in front of the blue iris).

## Supramid



## Supramid & Tube



# 05 Medication prior to surgery

Prior to undergoing surgery, patients are asked to **continue all drops and tablets** in accordance with their normal treatment regimen up until the morning of the operation. Blood thinning medications such as Aspirin, Warfarin and Clopidogrel should also be continued. Your clinician may ask you to stop taking blood thinning medication prior to surgery to ensure it is within the correct therapeutic range.

If patients opt to have the surgery performed under general anaesthesia, a pre-operative assessment of their general health will be carried out prior to the surgery. Underlying medical conditions including cardiac disease, uncontrolled high blood pressure or diabetes will need to be addressed prior to scheduling of surgery.

# 06 The surgery itself

Aqueous shunt surgery may last one to two hours.

Anaesthesia Aqueous shunt implantation is often performed under general anaesthesia, although local anaesthesia is also possible under certain circumstances.

Patients who have their surgery under local anaesthesia will be awake during the operation but will have the option of requesting light sedation. The eye will be anaesthetised first with eye drops and then an injection of anaesthetic will

be administered around the eye. The anaesthetic injection itself may cause some mild discomfort; a slight sensation of pressure as the anaesthetic is delivered. The injection anaesthetises the eye, preventing not only pain but also excessive eye movement during surgery. During surgery patients are covered by a sterile sheet, or drape, which keeps the operation site sterile and also prevents patients from seeing any of the surgery. Patients will be aware of the surgeon working around the eyes, but it should not be painful. In the event of any pain or discomfort, calmly raise a hand and the surgeon will stop the surgery and top-up the anaesthetic if needed. Patients may also hear the surgeon speaking to the scrub nurse and other members of the surgical team.

### Mitomycin C

During the surgery, the drug Mitomycin C may be applied to the surface of the eye for a brief period of time (up to five minutes). Mitomycin C is a drug that was originally used to treat cancer, but it is also used in glaucoma surgery to reduce scarring. Scarring prevents the shunt from functioning in the long term, as it prevents the aqueous humour from being absorbed back into the circulation. The Mitomycin C is then washed away from the eye with sterile water so that no residual drug remains.

### Donor patch

A patch made from tissue either from an eye bank (cornea or sclera) or from a commercial source (pericardium)

is used to prevent break down of the conjunctival surface tissue over the shunt. If donor tissue is not used, breakdown of the conjunctival surface of the eye over the implant can occur in 10-14 per cent of cases. When donor tissue is used the risk of breakdown is less than three per cent.

The donor tissues used in aqueous shunt surgery are not live transplants. They are simply used to reinforce the eye surface over the outside of the shunt. These tissues do come from donors and are therefore tested to ensure that they cannot transmit certain infectious diseases such as Syphilis, Hepatitis B and C and HIV (the AIDS virus). They are not, as yet, tested for prion disease (Bovine Spongiform Encephalopathy or BSE, otherwise known as mad cow disease or v-CJD) as no suitable test exists. The risk of transmission of prion disease at present appears to be extremely low.

Please note that after receiving donor tissue patients are no longer eligible to donate blood in the United Kingdom.

# 07 After surgery: post-operative care

Patients are usually discharged home from hospital either the same day as the surgery or the following day. It is preferable to examine the eye again one day after surgery.

### Further visits to the hospital following surgery

Some hospitals may provide overnight accommodation for patients travelling from afar.

The eye is normally padded after surgery and the eye pad is removed the following day. If the unoperated eye does not see well, then the operated eye will not be padded. Instead, a clear shield will be placed on the operated eye so that it is still possible to see after surgery. The eye may be bloodshot for a few days following surgery.

Patients are advised to ask a friend or relative to accompany them home after surgery, especially patients who have poor sight in the unoperated eye or those who have had general anaesthesia.

It is usually best to avoid wearing make-up for approximately four weeks after surgery, depending of

course on individual reactions to surgery.

### Eye drops

Eye drops will be prescribed to use regularly after surgery. These are commenced on the day after surgery, after the post-operative examination. It is not usually necessary to use eye drops the first night after the surgery.

Acetazolamide (Diamox) tablets should also be stopped the night of surgery unless advised otherwise.

It is important that any eye drops for the unoperated eye are continued unless advised otherwise. The postoperative eye drops will usually consist of an antibiotic (e.g. chloramphenicol) and anti-inflammatory steroid (e.g. dexamethasone).

The steroid eye drop will initially be used intensively (every two hours or about eight times daily) and the antibiotic four times daily. During the period of intensive usage preservative-free drops may be used. When drops are prescribed to take intensively after surgery, it is usually intended that they are taken during the day only. If overnight intensive use is intended, then the patient will be advised of this separately.

Patients are given a supply of post-operative eye drops on leaving the hospital; these should last one month. The postoperative eye drops will normally need to be taken for two to three months. Patients are advised at each

postoperative visit whether a change in the dosage of drops is required. **The drops should not be stopped or the dosage changed without consulting the doctor.**

### Post-operative clinic visits

Patients are usually seen once a week for the first four weeks, and may be seen more frequently if the eye pressure is either too high or too low.

Patients who find it difficult to visit their surgeon will likely be able to alternate post-operative appointments between their surgeon and local ophthalmologist.

### High pressure after surgery

In some cases, the ligature or occluding suture may cause high pressure after surgery. A ligature can be cut using a laser, usually two to three weeks after surgery at which point the pressure drops. This procedure is very quick, painless and is performed in out-patients. The occluding suture inside the tube can usually be removed after three months and occasionally before. The occluding suture can sometimes be removed in clinic but more often requires a return to the operating theatre to have it removed as a short operation.

It is important to note that these sutures do have an important purpose; to protect the eye from the effects of low pressure in the first few weeks after surgery. If the pressure is high in the first weeks after surgery this does

not mean that the shunt will not work, but simply that the shunt is not working yet. In such cases, it is normal for the shunt to start working after the ligature or occluding suture has been removed.

### Low pressure after surgery

Sometimes the pressure may be too low after surgery and this can sometimes be dangerous. Although very low pressure is often painless, it may be associated with a dull aching feeling or a throbbing sensation within the operated eye.

Low pressure, when it occurs, is usually detected during clinic appointments and is often remedied by stopping any pressure-lowering eye drops and reducing steroid eye drops. Sometimes an injection of a jelly material (viscoelastic) is required to raise the pressure. Occasionally, a further operation is needed to reduce the drainage from the tube.

### Activity after surgery

It is important to avoid strenuous activity during the early post-operative period including swimming, tennis, jogging and contact sports.

It is perfectly OK to watch television and read, as these will not harm the eye. For patients who wish to pray, it is better to kneel but not to bow the head down to the floor in the first two to three weeks. Bending over can cause significant pain when the eye is still inflamed after surgery. Similarly,

activities such as yoga that require head-down posturing should be avoided.

As patients will be monitored closely following surgery it is recommended that they consult their doctor before commencing strenuous activity. If the eye pressure is very low after surgery the doctor may suggest refraining from all exertion and remaining sedentary until the pressure is restored.

### When can I go back to work/school?

The duration of time off work/school will depend on a number of factors such as the nature of the patient's employment, the state of the vision in the other eye and the pressure in the operated eye.

Typically someone working in an office environment would require two weeks off, if the post-operative course is smooth. Someone whose occupation involves heavy manual work or work in a dusty environment may require a month or more (e.g. builders, farmers). This can be discussed with your consultant.

### Contact lens use after aqueous shunt implantation

It is usually possible to restart contact lens wear around four weeks and sometimes sooner after aqueous shunt implantation.

### Flying after surgery

Although it is safe to fly after surgery, patients should

bear in mind that their surgeon will wish to see them for a number of post-operative visits to ensure that the tube is functioning properly and that the eye pressure is at the correct level.

### When is the eye back to normal?

In most cases, it takes two to three months for the eye to feel completely normal and sometimes longer in more complicated cases. At this point the patient will usually have a refraction (spectacle) test as the spectacle prescription may have changed slightly from the pre-surgery prescription.

# 08 Success rates and complications

## Success rates

Most glaucoma surgical studies examine success rates over a five year period. With aqueous shunts such as the Baerveldt, the expected success rate over five years is now between 70 and 80 per cent. Although a sizeable proportion of patients achieve good pressure control without the need for continued glaucoma medication, many patients still require some medication to assist the shunt in controlling the pressure.

In such circumstances, the medication required is usually less than that required before the surgery; in one recent study using the Baerveldt implant the success rate after five years was 70 per cent and the average patient achieved a pressure of 14.4mm Hg on an average of one glaucoma eye drop medication after five years.1

In a study at the author's eye hospital (2005) using the same implant, the average eye pressure was 11.6mm Hg with only one in four patients requiring a glaucoma eye drop medication to control the pressure by two years after surgery.2

Patients often ask about long term success over 10 years, 15 years or more. Because of the expense and other difficulties in performing very long-term studies, most research studies do not answer this question. Studies that have been carried out over longer periods show that most implants which are functioning successfully at five years continue to do so over longer periods of time.3-6

## Complications

Aqueous shunt surgery has become more popular as a treatment for uncontrolled glaucoma in recent years partly because of improved safety, but also because success rates have improved.

Severe complications are uncommon but are most likely to happen if the eye pressure drops very low or very quickly in the early post-operative period. A very low or an abrupt drop in eye pressure can result in a choroidal haemorrhage (severe bleeding at the back of the eye). This happens in less than one per cent of aqueous shunts, in the author's experience. If the pressure drops very low it may be elevated again either using an injection of a viscoelastic gel or a gas into the eye in the clinic, or by a return to the operating theatre to have the tube adjusted. These interventions are only performed when the pressure is very low in order to prevent complications such as a choroidal haemorrhage, rather than waiting until after they occur.

In the author's experience, about five per cent of aqueous

shunt patients required a return to the operating theatre in the first month after surgery for adjustment, either because of low pressure or high pressure (Moorfields Eye Hospital 2005-2006 aqueous shunt audit report, K Barton, June 2007).

The risk of serious infection inside the eye from aqueous shunt surgery, in the author's experience is rare (less than one per cent).

There is also a small long-term risk that the tube implant will; develop a blockage (requiring further surgery to unblock the tube); erode (the surface conjunctiva over the shunt breaks down, requiring a repair operation); or rub against the cornea requiring further surgery to either move the tube so it does not rub or, in extreme cases where significant corneal damage has occurred, a corneal transplant may be required.

# 09 Further help and information

## from Glaucoma UK

### Patient support group

We have many patient support groups around the country run by hospital staff for the benefit of people with glaucoma. A list of these, along with contact details, can be found in our newsletter or on our website at **www.glaucoma-association.com**

### Buddies

If you are due to have surgery for your glaucoma, you may feel that you would benefit from speaking to someone else who has already had that experience. We have a list of people who are willing to do this. You may find that after your own experience that you decide that you too would like to become a buddy.

For further information on the either of the above, please contact our helpline on **01233 64 81 70** or **helpline@glaucoma.uk**

# 10 Other free advice booklets

## that may be helpful

- Driving and glaucoma
- Dry eye disease: a guide
- Eye drops and dispensing aids
- Glaucoma: a guide
- Glaucoma and your relatives
- Glaucoma in babies and children
- Laser treatment for glaucoma
- Ocular hypertension
- Primary angle closure glaucoma
- Primary open angle glaucoma
- Secondary glaucomas
- Trabeculectomy

All our information booklets are free and can be downloaded or ordered at **www.glaucoma.uk**

# 11 Remember

If you have glaucoma in both eyes, you must inform the DVLA.

Prescribed drops should be used as recommended by your specialist, on a daily basis, unless and until you are told otherwise.

If you develop side effects or symptoms you are concerned about, you should let your eye doctor know as soon as possible.

# 12 Glossary

### Aqueous humour
Fluid inside the front portion of the eye. This fluid is pumped into the eye by tissue called the ciliary body, and normally escapes via drainage channels called the trabecular meshwork. This fluid is completely separate from the tears and excessive tearing does not mean that the aqueous humour is draining well.

### Conjunctiva
A thin transparent layer of skin covering the surface of the white of the eye.

### Cornea
Transparent tissue at the front of the eye in front of the iris and lens.

### Intraocular pressure
The pressure inside the eye. In glaucoma, high intraocular pressure is the main cause of damage to the optic nerve. This is usually measured in units known as mm Hg (millimeters of mercury). In patients with normal tension glaucoma, lowering the eye pressure still slows the condition.

### Mitomycin C

Mitomycin C is an anti-scarring drug that was originally used to treat cancer.

### Optic nerve

The large nerve connecting the eye to the brain. The optic nerve carries all of the visual impulses from the eye. These are then translated by the brain into the images that we see.

### Sclera

The wall of the eyeball itself. This is seen from the front as the white of the eye.

# 13 References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## About Glaucoma UK

- **We fund sight-saving research into the early detection and treatment of glaucoma**
- **We campaign to raise awareness of glaucoma so that no one loses their sight needlessly**
- **We provide support that helps people to live well with glaucoma**

Each year in the UK over 11,000 people are diagnosed with glaucoma. We are passionate about supporting them and are committed to providing our services free of charge to anyone who needs them. It is only through the generosity of our supporters that we can do this.

## Help us save sight and fund research

- make a donation by calling **01233 64 81 64**
- donate online at **www.glaucoma.uk**
- become a member for £17.50 a year. **Join online or call 01233 64 81 71**

Your support will make a difference to people with glaucoma today and will protect future generations from unnecessary glaucoma sight loss.

Glaucoma UK

The information in this leaflet was correct at the time of printing (printed 06/2020).

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Whilst every step has been taken to compile accurate information and to keep it up to date, we cannot guarantee its correctness and completeness.

Glaucoma UK and the author cannot take responsibility if you rely solely on the information in this booklet. The information provided is designed as an addition to, and not a substitute for, professional advice from a qualified doctor or other healthcare professional, which will be tailored to a patient's individual circumstances.

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