



**Mr Sacha Moore, MRCOphth**, is a Specialist Registrar in Ophthalmology undertaking an advanced subspecialty training opportunity in Oculoplastics with Miss Fiona Irvine.



**Miss Fiona Irvine, FRCOphth**, is a Consultant Oculoplastic Ophthalmologist at the West of England Eye Unit in Exeter.

#### Correspondence:

Mr Sacha Moore,  
West of England Eye Unit,  
Royal Devon & Exeter Hospital,  
Wonford, Barrack Road,  
EX2 5DW, Exeter, UK.  
Email:sash@doctors.org.uk

## To Enucleate or To Eviscerate? That is The Question

**T**his article aims to explain the main arguments for choosing either enucleation or evisceration when eye removal is contemplated. It considers the alternative treatments and discusses the past, present and future of these procedures. The currently available evidence, or lack thereof, supporting one or other procedure with attendant controversy is also discussed.

### History

In times predating modern drugs and therapeutics many eye problems were solved by the simplistic approach of removing the whole eye. In 2600 BC there was a Chinese god of ocularists.<sup>1</sup> The ancient Egyptians routinely removed eyes as part of mummification, replacing orbital volume with wax on which they placed a jewel for cosmesis. In 500 BC Egyptian and Roman priests, specialising in medicine, made painted clay prostheses to wear over unsightly eyes.<sup>2</sup> In 1555 Johannes Lange was said to have performed an enucleation. But it is not until 1583 that the first case of eye removal is properly documented by Bartisch. This uninspired method involved hooking the eye, to control it, and then hacking it out of its socket with medieval instruments, without anaesthesia.<sup>3</sup>

In 1841 O'Farrell adopted a more refined technique of dissecting with the benefit of knowledge of the anatomy. In 1846 general anaesthesia allowed Mules to develop ocular implants (originally glass spheres) for evisceration. Soon afterwards Frost was happy to adopt Mules' implants, but he disapproved of evisceration in favour of enucleation because of fears over Sympathetic Ophthalmia (SO). So the argument began.<sup>4</sup> The surgery has remained largely unchanged since. The most significant advances have been more to do with the science of implant material. Recently, acceptable alternative therapeutic options have also become available.<sup>1</sup>

### Demographics

Many enucleation or evisceration procedures are still being performed by ophthalmologists not specialising in orbital or oculoplastic surgery and their preference is most likely dictated by previous training or familiarity with a certain technique and the facilities available. These procedures are most commonly performed on young men following trauma.<sup>1</sup> There has been a general trend towards increasing popularity of evisceration over enucleation in both the United States of America and the United Kingdom.<sup>5,6,7</sup> Overall, there has been a decline in the requirement to perform either procedure as a result of health and safety measures, car seat belt laws and the increasing awareness, availability and affordability of protective eye wear. In addition, many traumatised eyes are now sight salvageable with modern vitreoretinal surgical techniques.<sup>8</sup> Most of the trauma requiring eventual eye removal is now due to blunt injury often with large retro-equatorial globe tears or tissue loss. Furthermore, small tumours that traditionally required enucleation are increasingly being treated without the loss of the eye. Glaucomatous eyes are also less likely to require removal with the advent of cyclodestruction and modern drainage procedures together with more effective medical treatments and prevention of neovascular glaucoma.<sup>9</sup>

### Indications

Both of these procedures have significant psychological effects and can be temporarily disfiguring and it may be difficult for a patient to come to terms with the loss of a body part. Evisceration may be perceived to be less devastating as the patient retains the shell of the eye.<sup>3</sup> Both have the potential for complications and should only be considered in circumstances where the eye is irreversibly blind and painful (most commonly from trauma, glaucoma or infection), where cosmesis is unacceptable, where there is a potentially life-threatening tumour or infection which cannot be adequately managed by alternative treatments.<sup>1</sup> It can be difficult initially to know whether an acutely traumatised eye is blind and therefore primary repair should always be attempted first unless this is not possible due to tissue loss or excessive damage.<sup>10</sup> Although histology is possible with evisceration, it should be done in all phthisical eyes due to increased risk of tumour: enucleation is indicated where life threatening tumour is suspected to allow assessment of tumour penetration through sclera or optic nerve involvement. In cases of severe trauma with excessive uveal prolapse enucleation within two weeks of injury, it has been suggested as an indication to prevent SO in the fellow 'normal' eye, but this is controversial (see later discussion).<sup>4</sup>

Paediatric cases with congenital or acquired pathology present a particular challenge. When removal of the eye is necessary it may be difficult to maintain good cosmesis and expansion of the socket as the child grows.<sup>2</sup> Enucleation is the procedure of choice in children as it allows larger

implants to be placed which may encourage normal growth of the socket, and it is often a necessity due to retinoblastoma.<sup>11</sup>

### Alternative therapies

For eyes that are unsightly but not painful, a cosmetic shell can sometimes provide a good solution to improve appearance and avoid surgery with its attendant risks, inconveniences and cost.<sup>12,13</sup> It is prudent to consider non-surgical options including conservative management in some patients particularly the elderly who would sooner avoid surgery. However phthisical eyes carry a small risk of becoming cancerous and may require follow-up.<sup>14,15</sup>

Long-term pain relief with analgesics carries a risk of dependency and addiction and should therefore be avoided. Some success with retrobulbar injections of Ethyl Alcohol, Phenol, Chlorpromazine and intravitreal corticosteroids has been reported. However this is only a temporary solution lasting from six months to two years. There are also associated risks of chemosis, proptosis, lid oedema, ptosis, squint and neurotrophic keratitis.<sup>15</sup> They may be particularly useful when a patient cannot tolerate surgery or general anaesthesia, or when the patient remains undecided about a permanent surgical solution particularly where the eye is not unsightly but is painful and blind, as in refractory glaucoma.<sup>16</sup>

Cyclodestruction is a further useful therapy now available and has been successful in treating pain associated with raised intraocular pressure. The main risk is hypotony and phthisis. This risk has been considerably reduced with the replacement of cyclocryotherapy and Nd-YAG with transscleral diode laser therapy.

Many non-painful seeing eyes with small tumours such as retinoblastoma and choroidal melanoma no longer require enucleating due to developments in external beam radiotherapy, transpupillary thermotherapy, plaque radiation therapy, cryotherapy or a combination of different therapies with or without adjunctive chemotherapy.<sup>17</sup>

### Consent

To obtain consent, a patient's age, social background including his / her ability to comply with postoperative care and to attend follow-up should be considered. There may be individual concerns such as occupation and relationships or religious or cultural beliefs that need to be explored. Recent trauma victims may not be psychologically fit to consent. Patients with a history of depression may be unsuitable for surgery if there are concerns that it may increase their risk of suicide.<sup>14</sup> The patient should be advised of

the alternative treatments available and given adequate time to come to a decision with a chance for discussion with relatives if possible.<sup>12</sup> In trauma cases where discussion may not be possible immediately, the procedure should be delayed if there is an option to allow recovery and informed patient choice later. Primary or delayed secondary implant is an option to be discussed.<sup>10</sup> Patients need to be made aware of the postoperative recovery process leading up to the eventual fitting of a prosthesis. The risk of SO is negligible in enucleation, whilst for evisceration it is advisable to inform the patient of a small risk of one in many thousands for SO in the fellow eye and that this would be treatable if it did occur.

*The risk of meningitis from enucleation of an eye with endophthalmitis has now been found to be negligible, particularly with the advent of antibiotics*

### Anaesthesia

General anaesthesia (GA) is preferable so that the patient does not experience any discomfort or stress. However, not all patients are suitable for GA. In these patients local anaesthesia (LA) in the form of a peribulbar or retrobulbar block with sedation may be considered. Antiemetics and strong pain relief may be required.<sup>18,19</sup> Evisceration is quicker, requiring less dissection and is therefore better tolerated than enucleation under LA. Enucleation under LA may also result in the 'Augenblick' phenomenon; a sudden brief intense sensation of light perception on severing the optic nerve. This can be particularly distressing for the patient as they may mistakenly believe they still had useful sight in the eye.<sup>15</sup>

### Enucleation techniques

In both enucleation and evisceration patients with any bleeding tendencies or clotting abnormalities need to be identified and managed to reduce the risk of haemorrhage or haematoma.

There are many different approaches possible in enucleation. In principle the conjunctiva and tenons are dissected circumferentially. Sutures are pre placed in the recti muscles before they are

detached. A wrapped implant or porous implant to which the muscles can be sutured is placed within the cone and the recti muscles reattached. The most appropriate implant for maximal volume replacement should be used. The oblique muscles are divided at their attachments and may also be sutured to the implant to provide added support, particularly the inferior oblique. The optic nerve can be cut using slightly curved scissors from the lateral approach whilst the globe is rotated medially by traction on the medial rectus stump allowing a sufficient length of optic nerve to be taken. A wire snare may also be used.

The selection of implants and wrapping materials is varied and controversial. It is too great a subject for discussion in this article. Porous implants such as polyethylene (Medpor) or hydroxyapatite implants have been popular more recently due to their ability to allow fibrovascular in growth which is associated with good integration and the potential for dynamic artificial eye fitting.<sup>7</sup> However, they can be complicated by infection and exposure. Subsequent remedial surgery to remove the implant can be very difficult. A cause of complications may be the so called 'cactus syndrome', where the conjunctiva is drawn into deeper tissues as the implant is inserted. Some surgeons, therefore, now wrap these implants with donor sclera to prevent this complication. The risk of transmissible diseases such as variant CJD is thought to be minimal with modern methods of selection and processing of donor tissue. A reasonable alternative is implantation of a simple acrylic ball with scleral wrapping to allow muscle insertion. This can offer good postoperative motility and is very cost effective.

It is important to close the tenons and then the conjunctiva as separate layers. Some surgeons advocate vertical closure of the conjunctiva to maximise fornix depth. The principle of providing a conjunctival recess to allow movement of the artificial eye should be considered. An appropriately sized plastic perforated conformer is placed to prevent the fornices from shortening and allow future placement of prosthesis. Retrobulbar bupivacaine and epinephrine may be injected at the end of the procedure to minimise immediate postoperative pain and haematoma.<sup>16</sup>

### Evisceration techniques

Again evisceration techniques are varied. Current techniques include large posterior sclerectomies and anterior relaxing scleral incisions to allow insertion of an unwrapped implant to maximise orbital

volume replacement with anterior sclera closure in an overlapping fashion in front of the implant. It is preferable to excise the corneal disc to limit postoperative pain. The exact technique used will vary according to the amount of viable tissue and the possibility of extrusion. Tenons and conjunctiva must be closed in separate layers.<sup>4</sup>

Another recently developed technique is a combined enucleation and evisceration procedure, whereby the eye is enucleated, the enucleated eye is eviscerated and then placed around an implant so that the posterior aspect of the sclera covers the anterior aspect of the implant in order to reduce extrusion rate.<sup>20</sup>

### Postoperative care

Intraoperative intravenous antibiotics are effective in preventing infection. The patient may also be treated with topical and oral antibiotics postoperatively for ten days. A short-term pressure bandage is useful postoperatively to limit swelling and minimise risk of orbital haematoma. Adequate analgesia should be prescribed; pain is thought by some to be greater in the initial postoperative period for evisceration, presumably because the long ciliary nerves are still intact.<sup>21</sup> However, some studies disagree and suggest that pain is greater post-enucleation.<sup>22</sup> Within one to two weeks most patients are comfortable after either technique.<sup>23</sup> Following review at one month they are referred for artificial eye fitting at six weeks' post-operation. This can be done earlier with evisceration as recovery is quicker.

### Complications

Enucleation is associated with a higher rate of perioperative complications than evisceration. This is due to the greater amount of dissection required, especially with respect to cutting the optic nerve which leads to haematoma.<sup>12,24</sup> Von Graefe was the first proponent of evisceration for the management of a blind painful eye in the presence of endophthalmitis. He felt it should avoid the dissemination of intracranial infection that could arise with enucleation because of the exposure of the meninges from cutting the optic nerve.<sup>25</sup> The risk of meningitis from enucleation of an eye with endophthalmitis has now been found to be negligible, particularly with the advent of antibiotics.<sup>26</sup> There does not appear to be a great difference in extrusion rates between evisceration or enucleation as this is more dependent on the implant and wrapping technique or material selected.<sup>5,6,22</sup> However, there are some who claim that extrusion rate is higher for enucleation.<sup>15,27</sup>

### Sympathetic ophthalmia

SO is a sight threatening bilateral granulomatous panuveitis which typically follows trauma (iatrogenic or accidental) to one eye, but has been described in the absence of trauma. The most famous, presumed, case was that of Louis Braille who went blind after injuring one eye as a child. The avoidance of SO was the main proposed advantage of enucleation over evisceration. But SO is no longer believed to be a significant risk with either technique, and also trauma, following the publication of several studies showing that it is extremely rare.<sup>10,24,28,29</sup> It is more of a concern following multiple vitreoretinal procedures. It can occur from five days to 56 years following an 'inciting' event.<sup>30</sup> It is now widely believed to be caused by exposure of uveal antigens to the immune system. This theory is based on its association with severe trauma and on experimental studies using mice to reproduce SO by injecting uveal antigens into the bloodstream. This has yet to be definitively proven. The problem of identifying its exact cause is made difficult due to its rarity.<sup>28</sup> SO is also now treatable with modern immunosuppressive drugs and its occurrence therefore does not mean inevitable blindness.

### Consensus

Studies vary in proposing either enucleation or evisceration as the procedure with the best cosmesis and motility. However, the overall consensus of published literature is currently favouring evisceration for easier technique with less disruption of orbital anatomy, good motility and fewer complications such as ptosis, implant migration, implant exposure and deep superior sulcus.<sup>6,9,12,14,25,27,31-33</sup> One survey of ophthalmologists in particular supports evisceration.<sup>34</sup> These advantages are further magnified when considering patients in poor general health who cannot tolerate a GA or a lengthy procedure under LA. Whilst proponents of enucleation argue that this technique allows greater volume replacement, which is especially important in the paediatric population, those favouring evisceration claim that enucleation leads to more long-term fat atrophy, implant migration and a tendency towards post-enucleation socket syndrome (enophthalmos, ptosis and backwards tilting of prosthesis).<sup>2</sup>

However the evidence base comparing enucleation and evisceration is limited. There are many confounding variables that prevent definitive conclusions from being

reached. These include: bias of case selection, bias of surgeon preference and skill in one procedure, type of implant or wrapping material used, coexisting pathology, variation in skill of ophthalmologist, variation in postoperative care, variation in method of assessing outcomes and observer bias.<sup>27,31-33</sup> Surveys are also limited in their conclusions but do seem to suggest that there is an increasing preference of evisceration.

### Conclusion

The choice of procedure may depend on the specific pathology presented, the patient's preferences, social circumstances and general health, surgeon's training and the ophthalmologist facilities available. Enucleation may be necessary in cases of life threatening tumours or phthisis.<sup>12</sup> Either technique has its own merits.<sup>14,35</sup> Although definitive evidence remains elusive, traditional strongly held preferences based on risk of SO and meningitis are no longer of concern. They have been shown to be rare problems and can both be effectively treated with modern immunosuppressive and antibiotic therapy. Evisceration is a quicker, easier to perform procedure with less associated pain and quicker postoperative recovery period. It is therefore more cost effective. Evisceration may also have a better motility outcome and cosmetic result with less potential for the post enucleation socket syndrome. However, enucleation can have just as good outcomes as evisceration in the hands of experienced specialist surgeons.<sup>15</sup>

In the current climate of increasing patient expectations and surgeon accountability there is a move towards both enucleation and evisceration being carried out exclusively by oculoplastic or orbital specialists to ensure the best possible outcomes. **EN**

#### Further recommended reading

- Plastic and Orbital Surgery. Richard Collin and Geoffrey Rose. Fundamentals of Clinical Ophthalmology. BMJ Books.
- Colour Atlas of Ophthalmic Plastic Surgery. A.G.Tyers, J.R.O.Collin. Butterworth Heineman Elsevier.
- Oculoplastic, Orbital and Reconstructive Surgery Volume 2. Orbit and Lacrimal System. Williams and Wilkins.

#### Recommended websites

- [www.bopss.org](http://www.bopss.org)
- [www.esoprs.com](http://www.esoprs.com)
- [www.aapos.org](http://www.aapos.org)
- [www.asoprs.org](http://www.asoprs.org)
- [www.cuttingedge2007.org](http://www.cuttingedge2007.org)

### Take Home Message

- Evisceration is quicker, simpler and less traumatic; recovery is therefore quicker and associated with fewer complications.
- Enucleation is more appropriate for life-threatening tumours.
- There are several alternatives to consider first before removing an eye.
- Patients need adequate time to come to terms with the decision to remove an eye and psychological support in the follow-up period.
- There is no definitive study comparing the outcomes of enucleation and evisceration. There are many variables and confounding factors which make this difficult
- Endophthalmitis does not rule out the use of evisceration.
- The role of the ocularist should not be underestimated.

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