COMMUNICATIONS

MAGNETIC INTRA-OCULAR IMPLANT*

NEW SURGERY OF THE IMPLANT—THE MAGNETIC ARTIFICIAL EYE

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And all their desire is in the work of their craft.—Ecclesiasticus, xxxviii.

THE advent of this new intra-ocular implant ushers in a novel method of motivating artificial eyes. The magnetic implant is of the "all-buried" type. Owing to the safety factor incorporated in the design of the implant some limitation has been placed upon the types of globes in which it can be employed (*vide infra*, Mode of Use), and this in turn has made the surgical approach a sterner task. The essence of all this, however, is that this, the first intra-ocular magnetic implant,† would provide a satisfactory cosmetic correction of a permanent nature. The prosthesis is also magnetically activated.

Description

(A) Magnetic Implant.—The implant body consists of a solid mass of "non-free monomer" acrylic resin with a squared opening at either end; the anterior aspect is flat while the posterior end is rounded, the main body itself not being quite cylindrical in form. The anterior cup is that in which the peg of the magnetic prosthesis will ultimately rest so that the complementary magnet within the body of the peg of the artificial eye will be in close apposition with the magnet of the implant, seated immediately beneath the floor of the anterior cup of the implant. The posterior squared recess holds the curved manipulative key for use during surgical operative procedure (Fig. 1*a* and *b*).

Fig. 1(*a*).—Magnetic implant from superior aspect, showing anterior ostea, "magnetic cup", and posterior squared recess.

Fig. 1(*b*).—Anterior view of magnetic implant, showing oblong "magnetic cup" with gold-plated magnets beneath floor of cup.

Within the body of the implant are placed two powerful aluminium nickel cobalt bar magnets, the two north and the two south poles having been coupled together in a counter-attractive manner to increase the magnetic attraction. These magnets

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† The implant is manufactured by Messrs. C. and L. E. Attenborough, Ltd., George Street, Nottingham.

lie beneath the floor of the anterior cup; they are gold plated and covered by an acrylic substance, being thus insulated against erosion from tissue structures and fluids.

The length of the implant body is 12 mm., the height 12 mm., and the width 14 mm. The *floor* of the anterior cup has an area of 11×8 sq. mm., and the overall *depth* of the cup is 4 mm. The width of the superior and inferior walls is 11 mm.; that of the lateral and medial walls being 8 mm. The medial side of the implant is that to which the *south pole* on the magnet points, the implant being inserted within the globe with its long axis in the horizontal meridian. The thickness of the lip of the cup is approx. 1.5–2 mm. throughout. Around the body of the cup is an equatorial groove indicating the point of exit of the four canaliculi which perforate the substance of the implant. The canal entrances are at the four "corners" of the floor of the anterior cup (Fig. 1a); their position has been specially chosen so that when the operation commences no difficulty will be found in inserting the sutures. These canals are capable of taking a Jameson needle, doubly threaded with tantalum wire and a nylon suture.

The manipulative key previously mentioned is S-shaped. It is so designed that, while fitting into the base of the implant, it still bends forward anteriorly to curve round the bony upper margin of the orbit (Fig. 2).

Fig. 2.—Magnetic implant, lateral view, showing correct position on manipulative key.

(B) Magnetic Prosthesis.—This will be found to be a prosthesis of the semi-shell type with a peg back, in which are inset the complementary aluminium nickel cobalt magnets. The shell principle has been found desirable because the new fornices created by the inclusion of the implant within the globe are wider than usual and extend back posteriorly around the circumference of the implant in the form of a para-implant sulcus (Figs 3a, 3b, 4a, 4b).

Fig. 3(a).—Posterior view of magnetic artificial eye showing semi-shell nature of prosthesis with central peg enclosing magnet.

Fig. 3(b).—Depth of peg in relation to cornea and curvature of prosthesis.

Fig. 4(a).—Magnetic artificial eye with foreign body protractor on cornea. Note acentral position of peg.

Fig. 4(b).—Peg with enclosed magnet extending posteriorly beyond posterior limits of ciliary body in normal globe.

Mode of Use of Magnetic Implant

The present magnetic implant is an attempt to design an implant which is completely reliable in every sense of the word. This is a formidable task since the stages of development of implants, in general, have not yet reached a perfection which will enable them to be used universally.

With the tremendous advances in ocular therapeutics, contact lens technique, and surgical applications, many more eyes are being saved annually than ever before. Consequently implant surgery is becoming less necessary but *more specialized*, as improvements in design and surgery point the way to a more exact method of solving these problems.

In step with these ideas has been the development of the magnetic implant, which has been designed for a limited and specialized application. This new implant is to be used only in those globes in which the section anterior to the anterior attachments of the extrinsic recti muscles is reasonably intact. Such cases would include :

- (1) Unresolved primary glaucoma.
- (2) Unresolved secondary glaucoma.
- (3) Degeneration consequent on birth injury.
- (4) Recent traumatic perforation, provided this has destroyed the globe, either by perforation by way of the lid substance, or by perforation through the palpebral aperture into the posterior section of the globe.
- (5) Phthisis bulbi.
- (6) Old traumatic perforation, provided it conforms to the pathological pattern mentioned above. An exception would be a blind eye, with uncontrolled tension from spontaneous haemorrhage or other complication, provided that any foreign body had been removed at the time of the original injury.
- (7) *Absolute* blindness from any cause after injury from acids, alkalis, or other industrial reagents, exceptions being globes which would take a suitable cosmetic contact lens.
- (8) Gross congenital malformation of the globe necessitating cosmetic correction.

Preparation

Table

- (1) All instruments for evisceration.
- (2) All instruments for enucleation.
- (3) Magnetic implant.
- (4) Implant manipulative key.
- (5) Four Jameson needles, two doubly threaded with tantalum wire and nylon and two unthreaded.
- (6) Other nylon sutures.
- (7) Absolute alcohol.
- (8) Methylene blue plus marker and sterile blotting paper.
- (9) Roll of tantalum wire, fine.
- (10) 2-mm. trephine.
- (11) Surgical operating gloves.
- (12) Special "fish-hook" needles (emergency measure).
- (13) Small bar magnet appropriately stamped "N" and "S".

Anaesthesia

(1) General anaesthesia and local retrobulbar injection of novocaine 4 per cent. and adrenaline 1/40,000,

or

(2) Retrobulbar anaesthesia using same solution combined with cocainization of conjunctival sac.

For the retrobulbar injection, 4 ml. "Novutox" should be injected well posteriorly, to produce physiological proptosis of the globe and render the posterior segment more accessible for sclerotomy and the introduction of the magnetic implant.

Pre-Operative Precautions

- (1) Unsuitable subjects:
 - (a) Patients of a highly nervous or neurotic nature.
 - (b) Patients who suffer from angioneurotic oedema, marked allergic diathesis, dermatographia, or giant urticaria.
 - (c) Patients with exophthalmos are unsuitable owing to the increasing deposition of orbital fat and its continuing encroachment upon and infiltration of all tissues.
 - (d) Patients who normally have a lowered resistance to infection from any general cause, such as diabetes or pulmonary phthisis.
- (2) Adequate pre-medication if the operation is to be performed under local anaesthetic.
- (3) Prophylactic, antibiotic, and chemotherapy instituted 2 days before the operation; the antibiotic therapy is carried on for a further 6 days, and the chemotherapy for 14 days.
- (4) The globe in which the implant is to be inserted must have a complete scleral casing as far back as the insertion of the recti muscles.
- (5) Allergy to acrylic resin, penicillin, and the chemotherapeutic agent used in pre-operative medication must be excluded.
- (6) Where older children are concerned it is most important to exclude chronic infection in the ear, nose, or throat, and impetiginous lesions on the skin. Swabbing for diphtheritic infection should be routine in all child patients. The implant is not suitable for younger children.
- (7) Short-wave diathermy should be available for deep heat therapy post-operatively.

Surgical Technique

Preliminary Remarks.—As this operation involves procedure first on a firm globe, and later on on a collapsed globe, some stages of the operation are best performed before trephining, posterior sclerotomy, and evisceration soften the globe.

Firstly, with a firm globe, the corneal marking with methylene blue to indicate the ultimate sites for the insertion of the implant-holding sutures is facilitated.

Secondly, the conjunctival and episcleral implant-covering sutures may be inserted before the trephine is done. It should be noted, however, that these sutures can also be inserted later on, since the use of the implant manipulative key enables the implant to be held firmly against the cornea while the sutures are being inserted. To delay putting these sutures in until the stage when the implant is in position and held by its own holding sutures may invite disaster, since it may be impossible to cover the cup adequately in the correct manner,

even with small corneal needles or the use of "fish-hook" needles, through the walls of the cup interfering with the insertion of needles and embarrassing the full action of the needle holder. This would then result in faulty implant covering, exposure of the wires and sutures, and the conversion of the completely buried magnetic implant into a partially buried one.

Thirdly, the paracorneal implant suture must be inserted early so that it is accurately placed in relation to the corneal limbus and the anterior attachments of the extrinsic recti muscles. *At the same time the DEPTH to which the suture is inserted is easily controlled*, the globe not being perforated at the various points of attachment of the suture. This suture is so important that it is discussed more fully below.

Trephining the globe before sclerotomy and evisceration facilitates more difficult operative procedure later.

Paracorneal Implant Suture.—To understand clearly the nature of the suture and its significance in the operative technique, an analysis of the anterior section of the globe to be invaginated into the implant cup must be undertaken.

It will be seen that the cornea alone will not cover the total area of the implant cup, and that sclera will be needed in addition if the cup is to be adequately covered. For this reason the accurate measurement of the internal diameters of the cup in at least two principal meridians is necessary if the corresponding corneo-scleral area to fill the cup is to be mapped out by the suture which, when contracted and tied, invaginates the contained area of sclera and cornea into the implant cup, so covering it.

The principal meridians are very simply calculated, remembering from the description of the implant that the floor is 11×8 mm. in area, upper and lower walls 11×4 mm., side walls 8×4 mm., and thickness of walls 1.5 mm. all round.

Principal horizontal meridian	$1.5 + 4.0 + 11.0 + 4.0 + 1.5$ mm.	22 mm.
Vertical meridian	$1.5 + 4.0 + 8.0 + 4.0 + 1.5$ mm.	19 mm.
Total area	...	22×19 sq. mm.

Knowing that the corneal diameter is 11.5 mm., the actual distance of the stitch from the limbus above, below, and from the side-to-side areas can be calculated.

The paracorneal suture is therefore roughly oblong in outline when inserted in the sclera.

As some corneae are larger than others, the method of working out the distance of the suture in relation to the circular cornea is given below:

The difference in the width of the cornea and limits of the paracorneal suture, horizontally, is $22 - 11.5$ mm. = 10.5 or 11 mm. The distance on each side of the cornea to which the suture should extend is 5.5 mm. Similarly, in the vertical meridian, the distance is 4 mm. above and below.

If the calculation is based on the positions of the anterior attachments of the extrinsic ocular muscles, the appropriate distances from each muscle, starting from the medial rectus, are as follows:

Internal rectus muscle to limbus	5.5 mm.	Suture at attachment.
Inferior rectus muscle to limbus	6.5 mm.	2.5 mm. from attachment.
Lateral rectus muscle to limbus	7 mm.	2 mm. from attachment.
Superior rectus muscle to limbus	7.75 mm.	3.5 mm. from attachment.

Surgical Anatomy.—It is well to consider the surgical anatomy of the part in question before undertaking the new surgery of the magnetic implant

operation. For this reason detailed references to the anatomical structure of the orbit and the globe are mentioned hereunder. Careful reference to the pictures will show the position of the principal intra-orbital structures in relation to the area of operation. All the pages and figures quoted in the following paragraphs are from Duke-Elder (1932).

Figs 232 and 233 (p. 166) illustrating frontal sections through the right orbit near the eyeball, and through the posterior part of the orbit respectively, show that the only clear entrance to the posterior globe is between the superior and lateral recti muscles. It will also be noted, in that section near the eyeball, that the supra-orbital artery lies under cover of the superior rectus and of the levator palpebrae superioris, while the frontal nerve lies above it. As the posterior orbit is not invaded further than the posterior aspect of the globe at operation, these structures are quite safe if the operative technique is strictly adhered to.

Figs 234 and 235 (pp. 167 and 168) show how the oblique muscles are avoided in the incision. Examination will also demonstrate clearly how the forward movement of the globe, by means of physiological proptosis, renders the posterior aspect of the globe more accessible for surgical intervention.

Fig. 237 (p. 170) illustrates the relation of the blood vessels and nerves as they leave or enter the orbit to the apex of the bony pyramid and the optic nerve. These structures take an oblique course and lie well away from the area of operation in their course through the orbit.

Fig. 254 (p. 178) illustrates the bend in the optic nerve which allows the globe to move forward (being straightened out) after retrobulbar injection; the same diagram also shows the relation of the equator of the globe to the bony orbital margin.

The important nerves and vessels are very beautifully illustrated in Fig. 257 (p. 183), and Figs 262 and 263, (pp. 190 and 191).

It has been shown that the supero-lateral area of the globe offers the only really safe approach to the posterior of the globe, for, as the ophthalmic artery goes forward into the orbit, the principal branches will be seen to diverge in various directions away from the site of election of operation. The ophthalmic artery wends its way anteriorly to the medial side of the orbit to lie below the superior oblique muscle (actually between it and the medial rectus), while the supra-orbital artery goes forward beneath the roof of the orbit, lying between it and the levator palpebrae superioris, to emerge at the supra-orbital notch anteriorly.

The lacrimal artery runs along the lateral orbital wall along the upper margin of the lateral rectus to the lacrimal gland. The posterior ciliary arteries will be seen to pierce the globe around the optic nerve. *It is important, therefore, with the posterior sclerotomy incision, not to penetrate as far posteriorly as the ciliary arteries.* It may be thought that this is virtually impossible, seeing how far they are placed posteriorly in the orbit, taking into account all the essential structures which lie between them and the anterior aspect of the orbit, but, with the surgical technique advised, it is quite an easy matter to reach to the posterior ciliary arteries. Dissection, therefore, in the more posterior aspect of the globe should be very carefully done. The veins, of course, appear to be more numerous and are not so strategically placed, but it is remarkable how free the whole operation is from haemorrhage of any kind. The retrobulbar injection of novocaine and adrenaline is of great assistance in this respect.

The principal orbital nerves (the frontal and lacrimal nerves) follow roughly the course of the arteries (Fig. 262, p. 190).

Surgery of the Intra-Ocular Magnetic Implant Mark I

(A) The Intact Globe

Stage 1.—4 to 5 ml. "Novutox" 4 per cent. is injected slowly into

the most posterior part of the orbit. The conjunctiva is anaesthetized by the instillation of a few drops of 4 per cent. cocaine hydrochloride. After a few minutes the full effect (proptosis) of the retrobulbar injection becomes manifest.

Stage 2.—The conjunctiva is dissected up around the limbus of the cornea, and, with blunt scissors, it is dissected up widely posterior to the anterior attachments of the extrinsic muscles.

Stage 3.—The globe is exposed by incising the conjunctiva at the free limbal edge in its upper outer segment, so that with the episclera and Tenon's capsule they are incised almost to the posterior limits of the globe above and to the outer side. *The intactness of all muscles is checked by means of a muscle hook.* A conjunctival suture is placed on either side of the incision so that this section of the conjunctiva can be accurately re-sutured later, when the conjunctiva is being reconstituted for the purpose of covering the implant cup (Fig. 5a).

Stage 4.—The above manoeuvre is repeated in the lower outer quadrant but not exposing the sclera so far back. The trephining of the globe which will be done in this segment later needs to be performed slightly anterior to the equator of the globe (Fig. 5a).

Stage 5.—The corneal epithelium is removed mechanically or with absolute alcohol (Fig. 5b).

Stage 6.—The insoluble paracorneal implant suture is inserted as recommended above under "preliminary remarks" (Fig. 5b).

Fig. 5(a).—Limbal conjunctiva and episclera dissected up from anterior globe. Epithelium of cornea removed. Tenon's capsule still intact.

Fig. 5(b).—Paracorneal circular implant suture in position. Methylene blue corneal marker points seen. Posterior sclera exposed for trephining and posterior sclerotomy. Note potential site of sclerotomy. Globe trephined.

Remember that this suture, after insertion, has a single tie placed in it, and is tightened slightly. In no circumstances is the sclera to be perforated when suturing, as this may cause a serious reduction in tension of the globe.

Stage 7.—Using the magnetic implant as a marker guide, four points are marked with methylene blue on the anterior surface of the cornea, corresponding to the position of the anterior ostea of the implant suture canals. The two superior marks should be 11 mm. apart, and the two inferior marks should be 11 mm. apart. These upper and lower marks on the medial and lateral sides of the cornea should be at a corneal distance of 8 mm. (Fig. 5b).

These marks are renewed from time to time if they show signs of becoming obliterated during the course of the operation.

Stage 8.—The globe is trephined at the site of election with a 2-mm. trephine.

(B) The Collapsed Globe

Stage 9.—A long oblique posterior sclerotomy is now made, commencing with a Graefe incision slightly posterior to the anterior attachments of the external rectus muscles at about 2 o'clock, running slightly obliquely posteriorly to the back of the globe. The wound can be enlarged with blunt-tipped scissors as required (Fig. 5c).

Stage 10.—The globe is now eviscerated in a systematic order through the posterior sclerotomy wound, starting with the separation of the ciliary body and working backwards to the posterior fundus. This can be neatly achieved by using an iris repositor and bending it to the required shape for the purpose. Careful dissection will result in the whole of the uveal tract of the retina being eviscerated *in toto*. The interior of the globe is then carefully scrutinized under a powerful light and any uveal elements completely removed (Fig. 5c).

Fig. 5(c).—Posterior sclerotomy done. Globe eviscerated and rotated medially for introduction of magnetic implant.

Fig. 5(d).—Implant in position with manipulative key temporarily removed.

Stage 11.—With a small bar magnet, the *north pole* pointing towards the implant, the polarity of the magnets of the implant are checked, so that when it is inserted in the globe, the south pole of the implant magnets will be pointing to the medial side. The manipulative key is placed in the posterior recess of the implant in the correct manner, *i.e.* so that the south pole is medial when key is held vertically.

Stage 12.—The implant is now ready for insertion into the scleral cavity through the posterior sclerotomy wound. This ensures that the wound is of the correct size and that there will be no hindrance to the further operative procedure (Fig. 5d).

Stage 13.—The key is manipulated so that the implant is pressed up against the cornea (Fig. 5e). This gives sufficient backing to the cornea for inserting these sutures which will ultimately bind the covering conjunctiva and the cornea together, so causing the implant to become completely buried. Four of these conjunctival implant-cup-covering sutures, black silk and doubly armed, are inserted into the cornea just below and above the superior and the inferior methylene blue marker points respectively. When the conjunctiva is then brought over the “magnetic cup”, the conjunctiva can be duplicated over the whole of the cup area by bringing the upper conjunctiva to the lower limits of the cup and the lower conjunctiva to the upper limits of the cup, both layers of the conjunctiva being pierced by the doubly-armed needles, the sutures being tied to hold them in place. *This latter operative manoeuvre, however, is delayed until Stage 27, as the surgical procedure now involves the difficult problem of inserting the implant-holding sutures and wires and the nylon posterior sclerotomy-limiting sutures.*

Stage 14.—It is perhaps best to insert the nylon sclerotomy-limiting sutures first, one at each end of the incision. These can be cut long and used as retractors if necessary. They are particularly useful when the wound is finally sutured.

Stage 15.—The globe is now almost ready for the insertion of the implant-holding sutures, but so that there is not too much strain on these the paracorneal implant suture is now tightened in order to cause the cornea and the anterior sclera to invaginate *partly* into the implant cup. *The paracorneal suture is not yet ready for final tying.*

Fig. 5(e).—Cornea pushed forwards by use of manipulative key on posterior aspect of implant, showing complete operative control of implant for all suturing purposed. Key in penultimate position.

Stages 16, 17, and 18.—It will be seen that two of the Jameson needles (or their equivalent) are doubly threaded with an insoluble nylon suture and a tantalum wire. There is only one needle on these sutures at first. The corneal site of penetration for the first needle and suture is the upper and inner quadrant. With the implant held by the manipulative key in the correct position, the needle is passed through the upper inner methylene blue marker on the cornea into the implant cup. The point of the needle is then moved gently across the floor of the cup until it strikes the corresponding osteum of the implant suture canal, when it is passed through the implant body and finally out through the posterior sclera, where the needle is removed and the free ends are *clamped separately*.

The *free end* of this nylon suture is now threaded on to another Jameson needle and to a fresh piece of tantalum wire, which wire is itself already threaded to a Jameson needle in combination with a further nylon suture.

The original nylon suture and the new piece of tantalum wire are then passed through the lower inner marker on the cornea, through the corresponding osteum and suture canal of the implant body, and so through the posterior sclera below. This piece of nylon is then lying in the vertical meridian to the medial side and the two ends are clamped together but not yet tied.

There are now two tantalum wires both penetrating the cornea on the medial side above and below (Fig. 5f). The free end of the tantalum wire below, after passing through the posterior sclera, should be clamped with an artery forceps. The other end of this wire (which is already threaded through a Jameson needle, together with a fresh piece of nylon) is then passed through the lower outer corneal marker into the implant cup through the corresponding osteum and suture canal of the implant, and so through the posterior sclera as before. The ends of the nylon suture and the tantalum wire, after emerging from the posterior sclera, are clamped to prevent their slipping through the cornea again.

We now have one free end of a tantalum wire and one free end of nylon suture left. These are threaded on to a fresh Jameson needle, and this doubly-threaded needle is passed in a similar manner through the remaining upper outer corneal marker point into the implant cup and so through the body of the implant and the posterior sclera. The two ends of the tantalum wire above are then clamped together, and the two below are similarly dealt with. The outer nylon ends are also clamped.

Stage 19.—The nylon sutures are now tied permanently on either side (Fig. 5f and g).

Stage 20.—A permanent tie is now placed in the paracorneal implant suture, seeing that the sclera has been brought well forward and that the cornea and sclera have been thoroughly invaginated into the implant cup. This suture takes the strain off the implant-holding wires and sutures. The stage is now set for the final step of tying the corneal limbus tantalum wires above and below (Fig. 5f).

Fig. 5(f).—Manipulative key in ultimate (correct) position for inserting dual implant-holding nylon sutures and tantalum wires. Corneo-conjunctival sutures omitted for pictorial purposes.

Fig. 5(g).—Cornea and sclera sutured into "magnetic cup". Paracorneal implant suture tied and cut short. Nylon implant-holding sutures tied and cut short. Tantalum wires twisted, cut short, and bent back posteriorly on sclera.

Stage 21.—The tantalum wires are twined together firmly, cut short, and the free ends turned back to lie on the posterior globe, avoiding the superior and inferior recti. It may be found expedient to pass the wire under the anterior attachment of the recti if the sutures have been inserted sufficiently posteriorly on the globe. Keep twined ends away from muscle in tying (Fig. 5g).

Stage 22.—Now that the difficult section of the operation has been finished it only remains to remove the manipulative key by easing it gently from the posterior section of the globe by means of an artery forceps.

Stage 23.—The whole of the interior of the globe and the retained implant must now be atomized with sulphathiazole and penicillin powder.

Stage 24.—The sclerotomy wound is now closed, using the nylon limiting-sutures as retractors. The wound should be sewn up with interrupted nylon sutures closely placed, *commencing posteriorly and working forwards*, seeing that a sufficiently wide section of the sclera on either side of the wound is taken up in the sutures. This helps to limit the space available within the globe, and at the same time, by taking plenty of sclera, there is less chance of the sutures cutting out (Fig. 5g).

Stage 25.—All the raw areas in relation to the posterior sclerotomy wound are atomized with sulphathiazole and penicillin powder, before suturing them with an absorbable suture.

Stage 26.—Tenon's capsule, the episcleral tissues, and the conjunctiva are reconstituted so that the free edge of the conjunctival limbal ring has been re-made.

Fig. 5(h).—Conjunctivo-episcleral flaps reconstituted and brought over whole globe and "magnetic cup" as dual overlapping flaps. Suturing appears wide, flaps being somewhat oedematous.

Stage 27.—The reconstituted conjunctiva is then gently drawn down over the implant cup, while the doubly-armed atraumatic silk sutures are passed through the conjunctiva. The lower section of the conjunctiva is dealt with in a similar manner and the sutures are then tied. In this way infection is less likely to creep in between the layers of conjunctiva in the healing stage, since the lower conjunctiva overrides the upper conjunctiva and thus brings the raw edge towards the upper section of the cornea and away from the lower conjunctival fornix (Fig. 5h).

Stage 28.—The whole of the contents of the socket is re-atomized with penicillin and sulphathiazole powder.

Stage 29.—A simple penicillin "tulle gras" dressing is applied*

Stage 30.—A firm pad and binder are now applied and left in position for at least 5 days without renewal.

Post-Operative Treatment

The patient should rest in bed for at least 10 days after operation, although on the seventh day he may go to the toilet. Sedatives should be employed.

The orbital reaction may be severe if the patient is allowed too much liberty (Fig. 6a).

The pressure bandage should be renewed quickly on the fifth day so as

Fig. 6(a).—Seventh day. Dependent oedematous conjunctiva extruding from lids. This safety measure relieves tension in external tissues.

Fig. 6(b).—Sixteenth day. Receding dependent conjunctiva rotated under upper lid. Lids held together with a simple suture.

* Under no circumstances do a tarsorrhaphy or suture the lids together. There must be room for swelling of the conjunctiva as a kind of release mechanism so as to prevent any of the implant-holding sutures from cutting out.

to limit conjunctival dependent oedema. Repeat the tulle gras penicillin dressing. DO NOT use a dry dressing.

On the eighth day the patient may be taken to the short-wave diathermy in a chair.

As conjunctival oedema begins to recede, the skin over the lids begins to wrinkle, indicating that there will soon be a "socket space" forming underneath the lids of sufficient capacity to "swallow" any dependent conjunctiva. This is achieved by rolling the swollen conjunctiva under the upper lid and suturing the lids together. DO NOT do a tarsorrhaphy with lid union (Fig. 6b).

Continue short-wave diathermy. After some days the suture may be removed from the lids. The conjunctival swelling having subsided, the magnetic implant cup lined with conjunctiva will be seen. Remove sutures.

From the 14th day x rays may be taken to see the movement of the globe, with the contained magnetic implant, by observing the positions of the radiographic opacities caused by the magnets and tantalum-holding wires.

From the appearance of the cup, and the movements a decision to insert a shell may be taken, but it is quite unnecessary.

When the conjunctiva shows no sign of prolapsing through the palpebral fissure (Fig. 6c), a dry dressing may be employed to prevent undue softening of the skin of the lids.

During this healing phase keep the lids closed and the conjunctival fornices filled with penicillin G ointment.

When clinical evidence shows that active swelling has subsided, short-wave diathermy may be stopped. Sometimes it may be necessary to continue once a week to help in absorbing deep orbital swelling.

After about 2 months a magnetic prosthesis may be made.

After insertion the prosthesis should be removed about every 4 weeks, with all due regard to cleanliness.

Fig. 6(c).—Conjunctival swelling receding. Small adventitious adhesion of conjunctiva above and below cut, exposing excavation of "magnetic cup".

Fig. 6(d).—"Magnetic cup" fully formed. Note that it has taken the form of the prosthesis peg and is almost round. Prosthesis peg rests on reactive subconjunctival fibrotic cushion.

Special Note.—If the paracorneal implant suture has been inserted sufficiently wide, the implant cup will be fully seen (Fig. 6 *c* and *d*), otherwise some of the cup space will be encroached by that suture, with the necessity of modifying and scaling down the magnetic prosthetic peg accordingly.

End Results

The end results of this major surgical procedure are most satisfying cosmetically. The patient also derives great benefit in other ways, since he is enabled to join in sports and games without the prosthesis tumbling from its socket. Moreover he is also enabled to work in difficult postural positions without prosthetic anxiety. Owing to the splendid fitting, the palpebrae have a more natural look. The prosthesis need only be removed about once every month, and in this way the lysozyme of the tears is enabled to cope more readily with any infection which may enter or be introduced into the socket.

Summary

Details of a new intra-ocular magnetic implant and prosthesis are given. The mode of use of the implant is outlined. The surgical operative procedure is described in full detail. Post-operative management is discussed. A series of photographs of the magnetic implant and prosthesis and detailed sketches of the actual implant operation are included.

I should like to thank the Area Management Committees of both the General Hospital and the Nottingham and Midland Eye Infirmary, under the aegis of the Sheffield Regional Hospital Board, for permission to reproduce the various *x* rays and photographs.

I am indebted to the President and the Committee of the Midland Ophthalmological Society for their kindness in permitting me to show this new magnetic artificial eye at the combined Presidential and Coronation Meeting of the Society at the Nottingham and Midland Eye Infirmary in June, 1953.

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The making of the magnetic prosthesis was in the hands of Mr. Steer Wardman, to whom I am greatly obliged for its perfection.

REFERENCES

- DUKE-ELDER, S. (1932). "Text-book of Ophthalmology", vol. 1, Figs 232 and 233, p. 166; Fig. 234, p. 167; Fig. 235, p. 168; Fig. 237, p. 170; Fig. 254, p. 178; Fig. 257, p. 183; Fig. 262, p. 190; and Fig. 263, p. 191. Kimpton, London.
- YOUNG, J. HORTON (1951). *British Journal of Ophthalmology*, **35**, 623.
- (1952). *Trans. ophthal. Soc. U.K.*, **72**, 589.