Preliminary communication

Alleviation of myogenic ptosis by magnetic force

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Ptosis has usually been treated by surgery and the literature contains suggestions of over eighty different operations for its correction. Duke-Elder (1952) has pointed out that, in spite of the variety and ingenuity of remedial operations, the results are by no means invariably brilliant and in cases due to neuromuscular disease shortening of the lid is usually unsatisfactory.

Apart from the cosmetic defect, treatment is necessary for visual reasons when the ptosed lid covers the pupil and obstructs vision.

Walshe (1957) stated that the ptosis of myasthenia gravis should usually not be operated upon. For the ptosis of ocular myopathy, operation may be contraindicated because of the problem of exposure keratitis in the absence of Bell's phenomenon.

At the Endocrine Unit, New End Hospital, there is a register of 340 cases of myasthenia gravis. Some of these patients have been referred to the Eye Clinic because of ptosis, which is the commonest and often the presenting symptom.

These patients have in the past usually been treated by the provision of crutch glasses, which are useful when operation is contraindicated or not accepted by the patient, where the difficulty is temporary, or in the case of an elderly patient. Lid crutches to elevate the eyelid were introduced by Goldzieher (1890), who used a shell plate attached to the upper rim of a shell spectacle frame. Since then other appliances have been described, such as an adjustable watch spring (Kauffman, 1893); an independent wire crutch (Meyer, 1893); flexible single wire (Dodge, 1935); and a scleral contact lens with a superior ridge. Patients using crutch glasses often experience discomfort with the forced opening of the eye and watering owing to the pressure of the wire loop on the upper lid.

All electro-motive force used in commerce is magnetic in origin and it was thought that a magnetic force might be a useful method for elevation of the ptosed eyelid, especially in myasthenia gravis with its variable nature, remissions, and exacerbations.

Ptosis may be alleviated by inserting a metallic magnetic implant into the upper eyelid and elevating the eyelid by the action of a small magnet unobtrusively placed behind the upper rim of a spectacle frame. The attracting force pulls the eyelid upwards and forwards. Alternatively a metal strip may be fixed on to the upper lid using a skin adhesive. If it is placed in the upper palpebral furrow, the metal strip will be hidden in the skin crease of the furrow when the lid is elevated. There is no pressure on the eyelid as with a crutch spectacle, and the weight of the lid is taken off the eye. The power of the orbicularis muscle can overcome the magnetic force so enabling the patient to blink.

The magnetic force between two magnets is so much greater than that between a magnet and a piece of unmagnetized soft iron, or other ferro-magnetic material, that it is a great advantage to use an already permanently magnetized strip in the upper lid, rather than a simple soft iron or Mumetal (electrolytic iron melted *in vacuo* and annealed) strip. This is because the strip would be attracted to the magnet only by induction of magnetism in it by the external magnet, rather than there being interaction between two permanent magnets. Nevertheless, because of the high magnetic permeability of Mu-metal (Abrams, 1970), (25,000 to 50,000 compared with soft iron 3,000 to 6,000), quite efficient results are obtained with Mu-metal. Experiments using new magnetic materials, and especially Platinax, are proceeding, and appear to be showing even greater success.

It may be of interest to quote some of the cases of ptosis due to ocular myopathy and myasthenia that have been referred and treated.

Case reports

Case 1, a 63-year-old married woman, had a long-standing history of bilateral ptosis. Drooping of the eyelids began in the right eye during her teens, and the condition gradually deteriorated. For the past 20 years it had been static with no variation. There was no family history of myopathy.

Examination

There was severe bilateral ptosis (Fig. 1). The eyelids almost completely covered the cornea and there was marked interference with vision. The patient could see only by tilting her head backwards, but this caused her neck to ache. The forehead was wrinkled by contraction of the occipito-frontalis muscles. The levator palpebræ superioris muscles showed little or no function. With the eyelids raised, the visual acuity with spectacles was normal. Ocular movements were full and there had never been any diplopia. The pupils were equal and the reactions normal.

Examination of the central nervous system revealed no abnormal physical signs. A tensilon test was negative.

Neurological opinion confirmed a diagnosis of ocular myopathy. Operation for ptosis had been under consideration at another hospital for 10 years, but the patient was very apprehensive about having any surgery done. She had tried ptosis props but they caused discomfort and did not help her.

FIG. 1 Case 1, bilateral ptosis due to ocular myopathy

FIG. 2 Implant of Mu-metal

Treatment

An implant of Mu-metal (Fig. 2), an alloy of nickel and iron, size $13 \times 4 \times 0.5$ mm. was cut from a flat plate and shaped to the curve of the upper lid. This was coated with methyl-methacrylate in the dental laboratory.

As an outpatient procedure and under local anaesthesia, the implant was placed in the upper lid. Two small incisions 5 mm. long were made in the skin of the right upper lid and the implant inserted into a tunnel superficial to the tarsal plate. A suture through a hole at each end of the implant

served to fix it to the tarsal plate. A magnet held in the hand shows the magnetic elevation of the right upper lid which is then clear of the pupil (Fig. 3). This implant has been in the eyelid for 3 years and shows no sign of extrusion. Temporary spectacles with a small bar magnet on the upper rim of the frame alleviate the right ptosis and improve vision (Fig. 4). Permanent spectacles incorporating a hidden magnet are under construction.

FIG. 3 Case 1, elevation of upper lid by magnet

FIG. 4 Case 1, alleviation of right ptosis by magnet attached to upper rim of spectacle

Case 2, a 47-year-old man, was referred to the Endocrine Department with myasthenia gravis. At the age of 43 he noticed diplopia which was worse when he was tired. Several months later he developed drooping of the right eyelid and later of the left eyelid. This was followed by weakness of the hands and legs, accentuated by exercise. He worked as a postman delivering letters, and he would collapse in the street on his way home owing to muscular weakness.

Examination

The visual acuity was normal. There was bilateral ptosis, more marked on the right side where the pupil was covered. Diplopia was present in all directions of gaze. He had bilateral facial weakness and bulbar symptoms. A tensilon test produced marked improvement of the eye signs. Despite treatment with prostigmine and pyridostigmine, the myasthenia was not well controlled, and weakness and dysphagia increased. A thymectomy was performed by Mr. J. E. Piercy with marked improvement of myasthenic symptoms. About 18 months later he was referred to the Eye Department with severe right ptosis, the upper lid covering the cornea. There was limitation of horizontal and vertical ocular movements. Diplopia was helped by a vertical prism.

Treatment

A strip of soft iron wire was placed on the upper lid along the upper palpebral furrow and stuck to the skin using 'false eyelash' adhesive (Fig. 5). A small bar magnet glued to the upper rim of the spectacle frame raised the eyelid above the pupil (Fig. 6).

FIG. 5 Case 2, ptosis due to myasthenia gravis with strip of wire attached to right upper lid

FIG. 6 Case 2, alleviation of ptosis by magnet attached to upper rim of spectacle

Later a similar implant to that used in Case 1 was placed in the upper lid but this was extruded after a few months. Extrusion may have been due to the presence of unreacted monomer or catalyst in the methyl-methacrylate coating of the implant or to faulty technique in placing the incision over the ends of the implant and not as far from the site of implantation as possible.

Satisfactory results have been obtained with a metallic strip adherent to the upper lid for the past $3\frac{1}{2}$ years. The patient is adept at fixing the strip to the upper lid each morning and removing it in the evening. He has found 'Out-door Girl' eyelash adhesive to be a satisfactory preparation.

Case 3, a 31-year-old married woman, had complained for 2 years of double vision and drooping of the left upper eyelid. This was followed by the development of dysarthria, dysphagia, and peripheral muscle weakness, and the ptosis became bilateral. A tensilon test gave prompt relief from most of her symptoms.

She was treated with increasing doses of prostigmine and mestinon.

Owing to increasing myasthenia and side effects of the drugs, thymectomy was performed by Mr. M. J. Lange.

There was an improvement in her general condition in that she was able to look after her two children, do more housework, and manage reasonable walks.

3 years later she was referred to the Eye Department because of bilateral ptosis, which obscured her vision, and almost complete absence of ocular movements. With the eyelids raised, the visual acuity was 5/6 in the right eye, and 5/9 in the left with a small myopic correction.

As a temporary procedure a small strip of soft metal was stuck on to each upper lid using Blenderm adhesive tape (Fig. 7), and the eyelids were raised by magnets placed behind the upper rim of the spectacle frame (Fig. 8.)

FIG. 7 Case 3, ptosis due to myasthenia gravis with strip of metal stuck to each upper lid

FIG. 8 Case 3; temporary alleviation of ptosis by magnets placed behind upper rim of spectacle

An implant of Mu-metal covered with methyl-methacrylate was inserted into the right upper lid. Combined with a magnet on the spectacle frame this gave an immediate satisfactory result.

After about 2 months, however, the implant was extruded, and the patient returned to the previous method, using a magnetic strip adherent to the upper lid.

Discussion

The patients have mentioned that the magnetic attraction lifts the weight of the eyelid off the eye and it is more comfortable than the pressure of a ptosis prop.

Extrusion of some of the implants was probably due to faults in the surgical technique, in that the incision line was over the edge of the implant and not as far away as possible. There is also the difficulty that the implant cannot be buried deeply and has to be placed just under the skin and orbicularis muscle. Tension against the overlying skin should be avoided.

Methyl-methacrylate may be an unsuitable coating for the implant because of the possible presence of unreacted monomer or catalyst.

An implant of a cobalt-platinum magnet alloy coated with medical grade silicone is now in use. This alloy has outstanding magnetic properties combined with good workability. It can be machined, rolled, or drawn, and lends itself to the manufacture of very small magnets with a high energy product and coercive force.

The combination of two very small cobalt-platinum magnets, one in or on the eyelid and another in the upper rim of the spectacle frame, gives improved elevation of the eyelid when compared with the conventional magnetic material previously used.

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