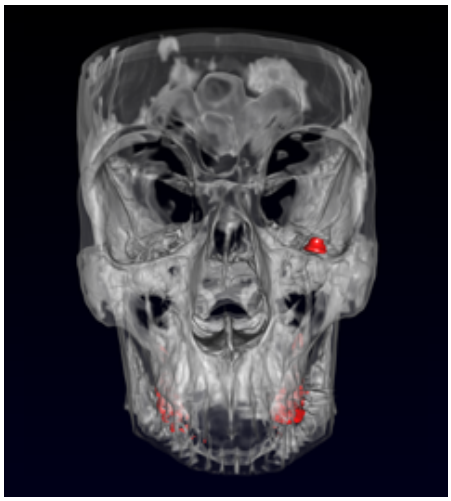

MAGNETIC EYE IMPLANTS FOR NYSTAGMUS

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A man with debilitating nystagmus, or constant eye flicker, has been able to return to work, read and watch television, after successful treatment with magnetic implants. Here, Dr Parashkev Nachev, Institute Of Neurology, UCL, UK explains how his team developed the device to calm nystagmus, which is notoriously difficult to treat with drugs.

Many causes, one effect

"Seeing the world through wobbly eyes" is how one young girl describes nystagmus[1], a constant rhythmic

from birth, or acquired in later life.

Researchers agree that nystagmus is due to a neural problem in the part of the brain responsible for eye movement[2], leading to malfunctioning of the muscles that move the eye. Tracing back the neural malfunction should have given researchers a root cause for nystagmus, that could be targeted with drugs. But many different neural malfunctions were found, frustrating efforts to find a drug that can treat all cases.

Hard to treat

Since the root cause of nystagmus is hard to treat, the other option is to target the effect – the eye flicker itself. Some people with nystagmus have a point of gaze with minimal flicker, known as the "null point", which patients often find by turning or tilting the head. Surgery can help pull the null point into straight ahead gaze, but "complete immobilisation of the eyes results in worse, if different, symptoms," according to Nachev. Partially immobilising the eye with a stitch risks fibrosis, "that would eventually freeze the eyeball completely," he warns.

Nachev and his team started looking for new solutions for nystagmus at the request of an adult patient with debilitating nystagmus who hadn't responded to several drug therapies. The patient had been forced to give up his work as a heavy goods lorry driver, and his eye flicker was having a serious impact on his daily quality of life. Searching for solutions, the team came across an idea by a Brazilian ophthalmologist published in an informal report (who later described his idea in a peer-reviewed journal[3], after this project was well advanced). His idea was to implant magnets in the eye socket and in the ocular muscle to calm the eye flickering. Recognising the promise of the theory, Nachev's team gained ethics approval to trial the therapy in the patient.

Magnetic therapy

"Our solution is to damp the oscillation of the eye without immobilising it completely," says Nachev, "through a means that will not cause fibrosis." This compromise would preserve normal eye movement, allowing the patient to shift gaze when needed. "We created a two-part magnetic implant," says Nachev. The rare-earth magnets were encased in titanium cylinders for implantation. The larger 3.73x2mm magnet was glued to the orbit, and the smaller 3x1mm ocular magnet was sutured just behind the insertion of the eye muscle. "The force between the two components reduces the amplitude of the oscillation," explains Nachev.

The patient had two surgeries to implant the magnets and results after 4 years of follow-up were recently published[3]. Over this period, nystagmus substantially decreased with improvements in symptoms and visual acuity. "The patient was able to return to work, though not in his original occupation as a heavy goods vehicle driver," says Nachev, "Crucially, the range of movement of his eyes has remained unchanged over follow-up." Thanks to the improvements in eye flicker and vision, the patient also regained the ability to read and watch television.

"The force between the two components reduces the amplitude

of the oscillation"

Next steps

"This is the first description of an oculomotor prosthesis, magnetic or otherwise, in a human being," says Nachev, "and opens the way to a new class of interventions in oculomotor disorders." A limitation is that magnetic implants prevent use of MRI, therefore the implant isn't suitable for everyone.

A team approach

Turning an idea for a medical device into reality takes collaboration. "This project lies at the intersection between neurology, orbital ophthalmology, strabismus ophthalmology, materials science, and biomedical engineering," says Nachev, "and could only be delivered by a highly multi-disciplinary team."

According to Nachev, clinical academic research groups plug an important gap in developing devices for rare diseases such as nystagmus. "It falls on clinical research groups to deliver not just the science, but the entire developmental pathway," says Nachev, with the drawback that "academic frameworks that are generally not tuned for this kind of activity." Support from the UK's National Institute for Health Research (NIHR) was invaluable for bringing this work into clinical testing.

The team have moved on to the next step of a pilot study, "to replicate the approach across a larger cohort of patients," says Nachev, "It is gratifying to be able to help a set of patients for whom medicine has currently little to offer."

With additional reporting by Nayanah Siva

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