David Granet

3D headache may be 'avatar' of strabismus or other binocular vision condition

Howard Larkin

IF THE Western-warrior-rescues-noble-natives plot of James Cameron's *Avatar* isn't enough to give you a headache, focussing for 162 minutes on its lush, 3D images very well could. And if it does, it could indicate the presence of a treatable ocular condition.

"There are a number of somatic symptoms people might have watching 3D, and they could be based on a number of things," says Michael A Rosenberg MD, Northwestern University, Chicago, US, who specialises in neuro-ophthalmology as well as cataract and refractive surgery. "If someone told me they got a headache watching *Avatar* I would look for the reason why."

In the case of Dr Rosenberg's wife, he suspects her slight anisometropia may have been the cause. "I didn't have any problem and my son didn't have any problem, but about 90 minutes into the film, my wife became nauseous. She took her 3D glasses off for about 20 minutes and it went away, and then she was fine when she put them back on."

Dr Rosenberg believes the strain of trying to merge the slightly different images presented to each eye without relief fatigued her. "To see the image in 3D you need the images in each eye to be equally clear. If your eyes are not seeing the same image you can still get stereo vision, but it ups the ante for what your brain has to do to merge the two images. Ultimately it is what your brain is doing that gives you the headache but it is your eye situation that is creating the extra work for your brain. Under normal circumstances this may not be a problem. When you get eyestrain at your computer you get up for five minutes and rest your eyes. But when you are at a movie you have to concentrate longer."

Even patients with normal vision can have difficulty with 3D in part because it is not possible to focus on background objects as you can in the real world, notes David Granet MD, University of California-San Diego, California, US. "In the movie the focus stays where James Cameron wants it. If you look at a creature or animal off to the side, you can't focus on it. It's one way 3D falls apart. You can shift your focus, but it does not clear the image. To avoid a headache you have to go with the flow." Adapting to 3D glasses also can cause some discomfort, but for most people it is temporary, he adds.

But a big, long-lasting headache or an inability to perceive movie images in 3D may indicate a treatable problem, Dr Granet says. "It may be a red flag, especially in a child. It becomes almost a screening test for anisometropia, strabismus or amblyopia."

Ocular motility

Patients with abnormal retinal correspondence or imbalance in the muscles controlling the eyes are more likely to have 3D symptoms, Dr Granet notes. It's partially because 3D films tend to exaggerate the separation of the two images projected beyond what occurs in everyday situations. The greater convergence that this requires makes images pop off the screen because it is interpreted by the brain as a depth cue. But while a patient with a minor imbalance may never have a problem merging images with the relatively small amounts of convergence they experience every day, the greater convergence required to view a 3D image may strain their muscles and their neuroadaptive ability.

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Picture from the movie Avatar, courtesy of 20th Century Fox UK

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"I went with my 14-year-old and nine-year-old and we all walked out with fatigue. I have a mild convergence insufficiency and it was a workout," Dr Granet notes.

For patients who have problems with 3D, Dr Rosenberg suggests testing for an ocular motility disturbance. They may have a problem that they are not aware of. He recommends testing for phoria and tropia. Patients with a phoria have a muscle imbalance but no diplopia because they can overcome it. Patients with tropia will have diplopia in at least some circumstances, and if they have it at all times they will not be able to see the 3D image at all. Either condition may be congenital or may develop in life as a result of trauma, tumours or nerve palsies brought on by diabetes or other systemic disease, such as multiple sclerosis, myasthenia gravis or thyroid conditions.

They may also be treatable, even in adults. Dr Rosenberg recently operated on a woman to cosmetically correct strabismus. She had seen *Avatar*, but could not perceive the 3D effect at all.

"Before the surgery her one eye was pointed in so far she was only using one eye. I didn't think she would have much ability to regain 3D vision, but when she came in two days after surgery, her eyes were straight and when I put the 3D glasses on her she could see all the 3D images we use in the tests. Now she's going back to see *Avatar* in 3D."

Dr Granet, too, sent a patient who had no binocular vision to *Avatar* after prescribing spectacle prisms.

"She came back so excited because she could finally see the 3D."

3D TV

In some respects it's ironic that *Avatar* has drawn so much attention to the problems with 3D imaging. If anything, it was carefully made to reduce headache-inducing effects, Dr Rosenberg says. "Cameron designed this movie intelligently. He fixed it so that there is only one thing on the screen that he wants you to look at – when the tank is moving toward you, that is in focus and the background isn't." Also, nothing moves too fast. Both techniques make it easier for the brain to keep up with the 3D illusion.

However, as 3D moves to television, Dr Rosenberg suspects more viewers will have problems. He has a hard time imagining how a sporting event like football could be produced without quick movements. "People will be much more likely to be symptomatic watching on a small screen. I think that will cause the novelty to wear off," Dr Rosenberg predicts.

Research by the sports cable network ESPN seems to bear out that assessment. While viewers of test 3D sports broadcasts have been "wowed" by the experience, many also found quick camera shifts "hard on the eyes", according to published reports. Nonetheless, ESPN is set to debut its 3D network with a World Cup soccer match June 11 with as many as 85 more events televised by the end of the year. And 3D TVs are already on the market and selling well.

A wave of 3D headaches may follow. "There is definitely a subset of the population that will find 3D TV uncomfortable or unwatchable," Dr Granet says. "People need to be aware that if they respond to it differently than everyone else they need to get their eyes checked."

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