

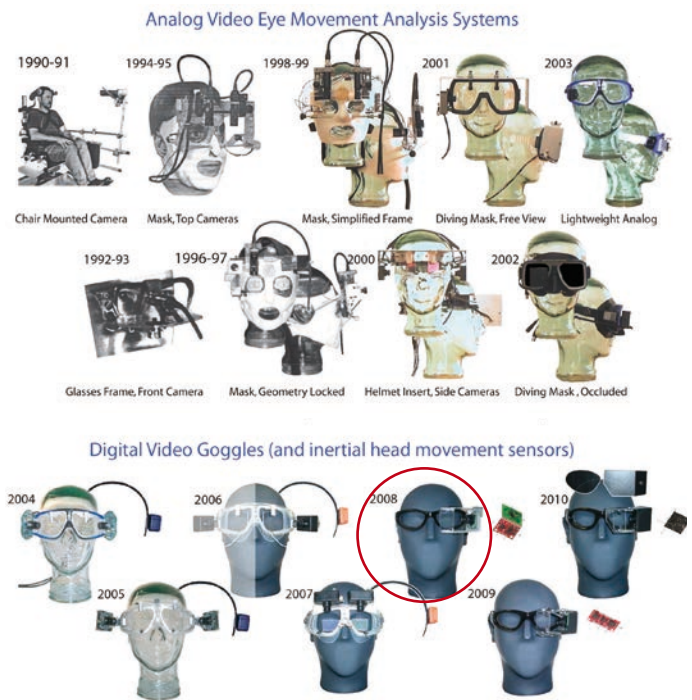
Why does ICS Impulse have a fixed right-eye camera?

For over 20 years, the vestibular researchers at the University of Sydney and Royal Prince Alfred Hospital have been working on developing vHIT goggles that could be used clinically and garner comparable results to the scleral search coil.

"It is not easy to explain the vHIT monocular strategy because people assume that binocular is always better. It was even more difficult to have the discipline to remove everything from the vHIT goggles that wasn't absolutely necessary. This was hard for us because we had invested more than a decade making our video goggles more and more sophisticated so it was painful for us to remove functions that we had worked so hard to implement. The big change in strategy with vHIT was to simplify the operation and equipment so that vHIT data could be accurately collected by a wide range of operators (i.e. physicians, physiotherapists, audiologist, etc) and ultimately benefit a much larger group of patients. It turned out that this simplification was also more technically challenging to implement than adding complexity. It is actually not that difficult to make binocular HIT goggles (as you see from the pictures we made several versions).

When it came to making the choice between clean Horizontal, LARP and RALP data from one eye OR completely inaccurate data from two eyes, we chose the clean Horizontal, LARP and RALP data from one eye. It is true that there are very rare occasions (less than one percent of the population) in which our monocular strategy will not work (internuclear ophthalmoplegia, glass right eye) but the alternative at the moment is far worse - i.e. inaccurate data and possibly diagnosis for the majority of the patients. We foresee in the future this will change as componentry becomes smaller but at the moment carrying the extra components (weight, inertia, mass, etc) and making the operation more difficult of overcoming these limitations was not worth the risk."

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In 2008, Otometrics began collaborating with the Sydney team to develop a commercial product. The decision to make the ICS Impulse one-eye only was a conscious one. The most important objective in developing ICS Impulse was designing a pair of vHIT goggles for maximum stability which is required for accurate data collection during high velocity/acceleration head impulses for all six semicircular canals. This meant:

- 1) **Reducing artifact** – any movement of the camera or mirror can cause artifact and any movement of these two parts would be seen as eye movement and the data would not be accurate. Having the camera that is both stable and movable was not doable while still being able to collect accurate Lateral/LARP/RALP head impulse data. A movable camera ultimately increased the risk of poor data collection.

Camera:

- The camera is fixed and screwed into place so that it does not move during horizontal or vertical head impulses.
- The camera is mounted sideways, not on top (as other cameras are), to be as close to the head as possible in order to minimize torque/inertia.

Mirror:

- The mirror is glued into place so that it does not move.
- The mirror also faces rightward instead of upward. Video head impulse testing can be performed in a well-lit room. Any reflection in the mirrors can distract the patient from staring at the fixation dot. If the mirrors face upward, you can have glare and reflections from the overhead lights. With a rightward facing mirror, you have a better opportunity to control your environment by placing the patient or equipment in a position that do not cause distracting reflections.

2) Algorithms – the two algorithms in the ICS Impulse ensure that quality data is collected.

3) Operator feedback – provides direct feedback during collection if the head impulse is performed properly.

Can you test a patient that has Strabismus (eye does not have full-range of motion)?

Yes, as long as it's not a paralytic strabismus. You need to cover one eye (the one that is not recorded) to make sure the patient is always fixating with the same eye.

What is the likelihood in your clinic that the patient will have a glass right eye?

Approximately 0.5 percent of the entire population has a prosthetic eye. Considering the size of the population that has a right prosthetic eye and vestibular symptoms, the chance of not being able to test a patient in your clinic is very slim. We built ICS Impulse to be accurate for the majority of the population – 99+ percent.

What is the likelihood in your clinic that the patient will have internuclear ophthalmoplegia?

Internuclear ophthalmoplegia (INO) is directly associated with multiple sclerosis (MS). Approximately 0.1 percent of the entire population has MS. Of the MS population, approximately 22 percent have INO. This means only 0.02 percent of the entire population will have INO. For testing INO, it is best to measure horizontal saccades binocularly and compare their velocities with the head stationary.

References

Please refer to this subset of publications utilizing ICS Impulse or the prototype for ICS Impulse:

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Zellhuber S, Mahringer A, Rambold HA Relation of video-head-impulse test and caloric irrigation: a study on the recovery in unilateral vestibular neuritis *Eur Arch Otorhinolaryngol* 2013 Sept; DOI 10.1007/s00405-013-2723-6.

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