

# OPTOMED

HAND-HELD FUNDUS CAMERA IN NEUROLOGICAL USE

Background Information

# Fundus Examination in Neurological Patients – Why?

- Examining the fundus is a standard procedure (included in neurology patients current care guidelines) in all acute neurological patients <sup>(2-5)</sup>
- The main reason for this is to check whether there is elevation in intracranial pressure <sup>(2-5)</sup>
- **What is increased intracranial pressure, ICP?** <sup>(2)</sup>
- Increased intracranial pressure (ICP) is a rise in pressure around your brain. It may be due to an increase in the amount of fluid surrounding your brain. For example, there may be an increased amount of the cerebrospinal fluid that naturally cushions your brain or an increase in blood in the brain due to an injury or a ruptured tumor.
- Increased ICP can also mean that your brain tissue itself is swelling, either from injury or from an illness such as epilepsy. Increased ICP can be the result of a brain injury, and it can also cause a brain injury.
- Increased ICP is a life-threatening condition. A person showing symptoms of increased ICP must get emergency medical help right away.



(2) <https://www.healthline.com/health/increased-intracranial-pressure>

(3) Fuller G. Neurological examination made easy. 5th edition. Edinburgh; London: Churchill Livingstone/Elsevier 2013.

(4) Neurologinen statustutkimus päivystyspoliklinikassa. Duodecim 2014;130:413–22.

(5) <https://www.ean.org/Reference-Center.2699.0.html>

## How - Current standard practice is direct ophthalmoscopy



### The fundus is examined without dilating the pupils

Basic procedure is to check:

- whether the optic disc is swollen (papilledema)
- Venous pulsation, can the vein movement be seen
- is there any bleeding in the retina
- Is there is increased cerebrospinal fluid on papilla
- Other abnormalities

### How to perform the examination:

1. Darken room, ask patient to look at the same point as far as possible in the room (this will help to dilate the pupil).
2. Use your right hand & your right eye to look at the patient's right eye. (Less important if using the PanOptic.)
3. Look through the ophthalmoscope, if you are nearsighted and have taken off your glasses, you may need to adjust the focusing wheel towards the negative/red until what you see at a distance is in focus.
4. Direct the ophthalmoscope 15 degrees from center and look for the [red reflex](#). Simply follow the red reflex in until you see the retina. If you lose the red reflex, come back until you find it again and repeat.
5. To look around the retina using a traditional direct ophthalmoscope, you should "pivot" the ophthalmoscope, angling up, down, left and right.

## Standard practice is direct ophthalmoscopy

- Papilla must be examined in patients with the following symptoms:
  - Head-ache, especially patients who describe that the pain is most severe in the morning or migraine patients, whose head-ache symptoms have changed
  - nausea
  - vomiting
  - increased blood pressure
  - decreased mental abilities
  - confusion about time, and then location and people as the pressure worsens
  - double vision, especially patients with forehead pain and temporary vision blurriness or double vision
  - pupils that don't respond to changes in light
  - shallow breathing
  - seizures
  - loss or low-level of consciousness
  - coma



(2) <https://www.healthline.com/health/increased-intracranial-pressure>

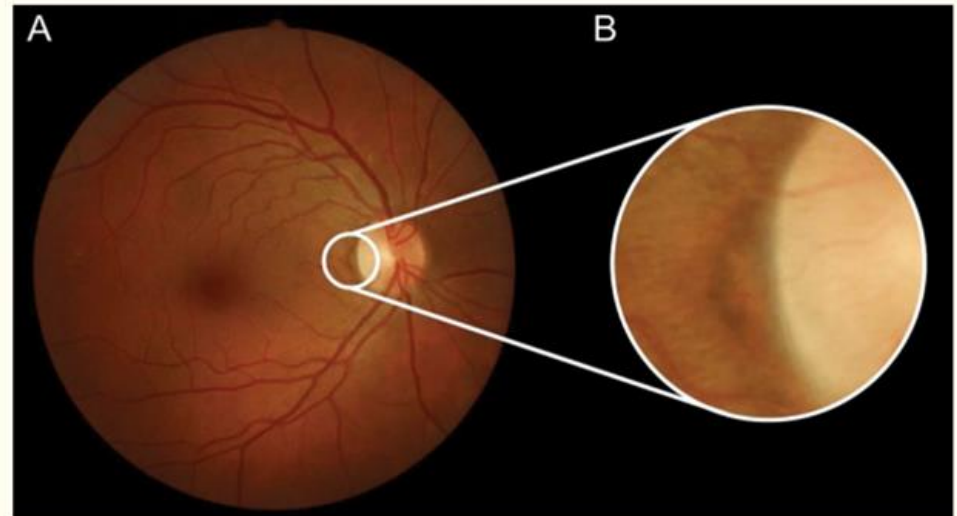
(3) Fuller G. Neurological examination made easy. 5th edition. Edinburgh; London: Churchill Livingstone/Elsevier 2013.

(4) Neurologinen statustutkimus päivystyspoliklinikassa. Duodecim 2014;130:413–22.

(5) <https://www.ean.org/Reference-Center.2699.0.html>

# Difficulty of Direct Ophthalmoscopy

- Despite funduscopy is an essential part of any full neurologic examination, funduscopy with a direct ophthalmoscope is rarely, if ever performed
  1. Main reason for this is the difficulty of performing direct ophthalmoscopy, which is listed as second in the Stanford Medicine 25 list of difficult examination skills.
    - <https://stanfordmedicine25.stanford.edu/the25/fundoscopy.html>
  2. Other reasons are the need for dilatation of the pupils to be able to visualize the retina and the optic nerve and dilatation is not preferred in neurological patients due to the loss of the ability to follow pupillary reactivity
  3. And the limited view of the direct ophthalmoscope (5-10 degrees)



**Figure 2**

## Nonmydriatic ocular fundus photography vs classic direct ophthalmoscopy

(A) Nonmydriatic ocular fundus photography. (B) Classic direct ophthalmology. The 45° field of view from the nonmydriatic fundus photograph allows simultaneous examination of the optic disc, macula, and major vascular arcades. The 5° view (15× magnification) from the classic direct ophthalmoscope is useful for detailed, but isolated, examination of the optic disc margins, the macula, and dynamic phenomena such as venous pulsations when centered on the optic disc, but adds difficulty to the integrated examination of the retina and other details of the ocular fundus.

## References:

<https://www.uptodate.com/contents/evaluation-of-the-adult-with-nontraumatic-headache-in-the-emergency-department>

The use of retinal photography in non-ophthalmic settings and its potential for neurology. Neurologists 2013. Petzer et al.

Ophthalmoscopy in the 21st century: The 2017 H. Houston Merritt Lecture. Neurology. 2018 Jan. Biousse V1, Bruce BB1, Newman NJ2.

## Superiority of Handheld Cameras in Emergency Care Patients – Clinical Evidence

- There are around 50 publications of the application of fundus photography in emergency care patients from 2010-2018
- In the US, the use of fundus photography has become more common in the examination of emergency care patients such as: headache patients with suspected papilledema, recognition of hypertensive retinopathy, risk stratification of patients with suspected TIA or stroke and in critically ill patients in whom identification of ocular fundus abnormalities may affect acute management or prognosis
- In the US neurology clinics, primary care centers, urgent care centers and emergency departments use nonmydriatic fundus cameras that connect directly to electronic medical records and integrate the photographs into a patient's systematic evaluation.
- One of the first and most cited research supporting the use of fundus cameras in emergency departments are the FOTO-ED studies (US), "The Fundus Photography vs Ophthalmoscopy Trial Outcomes in the Emergency Department", which has three phases
  - The studies clearly showed that most emergency department providers constantly failed to identify relevant funduscopic findings using the direct ophthalmoscope and proved that nonmydriatic fundus photography is superior both in number of patient's fundus examined and identification of the findings.
  - Included total of **1291 patients**, of which **153 (12%)** had relevant findings, which altered the ED management of these patients
  - ED providers were not able to identify any of the relevant findings with direct ophthalmoscopy (0%)
  - They recognized 36,7% of the relevant findings when given access to the fundus photographs (in phase I the photographs were analyzed by an ophthalmologist consultant) and they identified 87% of normal images
  - The study triggered a great deal of interest to the use of fundus camera's in emergency care patients
  - And led to the change in current practice of these patients in different health care clinics

# FOTO-ED I

- The topic of ocular funduscopy has been widely studied in the last years
- One of the main publications carried in the US are the FOTO-ED studies, “The Fundus Photography vs Ophthalmoscopy Trial Outcomes in the Emergency Department”, which has three phases
- The first phase evaluated the routine clinical use of direct ophthalmoscopy by emergency department (ED) providers
  - It also compared direct ophthalmoscopy to nonmydriatic fundus photography (using Kowa nonmydriatic fundus camera)
  - This phase demonstrated that direct ophthalmoscopy was infrequently and poorly performed by ED providers, only 14% of 350 patients were examined
  - The study also showed the superiority of nonmydriatic fundus camera in examining ED patients, the photographs were of good quality and identification of relevant findings was possible in 97% of enrolled patients.
  - Out of 350 patients, 13% had an ocular fundus finding relevant to their emergency department care
  - All of these findings were missed by ED physicians with direct ophthalmoscopy

## FOTO-ED II and III

- The second phase of the FOTO-ED study evaluated the sensitivity of non-mydriatic ocular fundus photography as an alternative to direct ophthalmoscopy in emergency department use
  - The most relevant findings were, that non-mydriatic fundus photography was more frequently performed than direct ophthalmoscopy (68% vs. 14%)
  - ED physicians sensitivity of identifying relevant abnormalities was 46% vs. 0% with direct ophthalmoscopy
- The third and final phase of the FOTO-ED study was a quality improvement project performed to determine whether a 30-min web-based educational module would improve ED physicians ability to identify abnormalities in the fundus images.
  - Pre- vs. post-training, the emergency providers reviewed 45% vs. 43% of photographs; correctly identified abnormal in 67% vs. 57% of cases; and correctly identified normals in 80% vs. 84%.
  - The Fundus photography vs. Ophthalmoscopy Trial Outcomes in the Emergency Department studies have demonstrated that emergency providers perform substantially better with fundus photography than direct ophthalmoscopy, but our web-based, in-service training did not result in further improvements.



## Superiority of Handheld Cameras in Emergency Care Patients – Clinical Evidence

- In a review article published in JAMA Neurology the following conclusions were drawn:
- Nonmydriatic ocular fundus photography has notable advantages over direct ophthalmoscopy that outweigh the associated increased costs.
- These advantages are:
  1. The superiority in examining the abnormalities in the fundus related to the medical care of emergency neurological patients (especially headache and cerebrovascular disease patients)
  2. The ease with which images can be added to electronic medical record systems for improved documentation and shared with experts via telemedicine solutions for more detailed consultation
  3. The improvement in the level of fundus examination needed for clinical care
- According to the authors the most exciting development in this area are the commercially available handheld nonmydriatic cameras that produce adequate quality images and allow the examination of sicker and variable age-group patients (children, elderly, disabled) that are not able to sit in front of a tabletop camera.

**JAMA Neurology** is a monthly peer-reviewed medical journal published by the American Medical Association. According to the Journal Citation Reports, the journal's 2017 **impact factor** is 11.560, ranking it **5th** out of 197 journals in the category "Clinical **Neurology**"

## Optomed camera studies in patients with neurological symptoms

- In a 2018 published study in Telemedicine and Health, the sensitivity and specificity for detection of optic disc edema in patients with neurological symptoms using the Pictor Plus camera were:
  - Sensitivity 71,8-92,2%
  - Specificity 81,6-95,2%
  - 109 patients
  - *Conclusion: Portable photography holds a promise for use in remote screening of optic disc edema*
- In a study made in Oulu, which will be submitted for Neurology (Impact Factor is 8.055) Smartscope Pro was compared to a direct ophthalmoscope and the results were:
  - Fundus photography in the fundus examination succeeded in 56 (93.3%), partially succeeded in 2 (3.3%) and failed in 2 (3.3%) cases.
  - Ophthalmoscopy in the fundus examination succeeded in 35 (58.3%), partially succeeded in 14 (23.3%) and failed in 11 (18.3%) cases.
  - The fundus camera is better suited for a neurological fundus examination than an ophthalmoscope.
  - 60 patients
  - *Conclusion: The fundus camera is better suited for a neurological fundus examination than an ophthalmoscope. The difference is statistically and clinically significant*



## Related studies:

- Nonmydriatic ocular fundus photography in neurologic emergencies. JAMA Neurol. 2015 Apr. Bruce BB1, Biousse V2, Newman NJ3.
  - <https://jamanetwork.com/journals/jamaneurology/fullarticle/10.1001/jamaneurol.2014.4053>
- The use of retinal photography in nonophthalmic settings and its potential for neurology. Neurologist. 2012 Nov. Pérez MA1, Bruce BB, Newman NJ, Biousse V.
  - <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3521530/>
- Ophthalmoscopy in the 21st century: The 2017 H. Houston Merritt Lecture. Neurology. 2018 Jan. Biousse V1, Bruce BB1, Newman NJ2.
  - <https://www.ncbi.nlm.nih.gov/pubmed/29273687>
- Diagnostic accuracy and use of nonmydriatic ocular fundus photography by emergency physicians: phase II of the FOTO-ED study. Ann Emerg Med. 2013. Bruce BB1, Thulasi P, Fraser CL, Keadey MT, Ward A, Heilpern KL, Wright DW, Newman NJ, Biousse V.
  - <https://www.ncbi.nlm.nih.gov/pubmed/23433654>
- Quality of nonmydriatic digital fundus photography obtained by nurse practitioners in the emergency department: the FOTO-ED study. Ophthalmology, 2012. Lamirel C1, Bruce BB, Wright DW, Delaney KP, Newman NJ, Biousse V.
  - <https://www.ncbi.nlm.nih.gov/pubmed/22218140>
- Fundus Photography vs. Ophthalmoscopy Outcomes in the Emergency Department (FOTO-ED) Phase III: Web-based, In-service Training of Emergency Providers. Neuroophthalmology 2018 Jan. Bruce BB1,2,3, Bidot S1, Hage R1, Clough LC1, Fajoles-Vasseneix C1, Melomed M1, Keadey MT4, Wright DW4, Newman NJ1,2,5, Biousse V1,2.
  - <https://www.ncbi.nlm.nih.gov/pubmed/30258471>

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