

Forum:Seminar papers/Biophysics/2. LF/2018-2019/Group 2/HI

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Signature: Carmeljcaruana (talk)



Optometry

Introduction

There are many different roles within the field of eye-care. The comprehensive care of the eye is by an Ophthalmologist (which is a medical specialty) whilst an Optometrist is a healthcare profession who takes measurements on the eye; if the latter detects disease the patient should be referred to an Ophthalmologist. Vision is tested by Optometrists with devices such as Snellen Charts or refractometers. The Phoropter is a machine that tests refractive lens/cornea errors and whether or not the patient needs lenses. Surgery can also be performed in patients by an Ophthalmologist if required.

Importance in Clinical Medicine

The role this field plays in medicine is assessing your vision or how you see. They do this by administering basic eye exams to diagnose patients to help enhance their everyday lives. In the field of Optometry, the most common types of vision impairments found are far sightedness (Hyperopia) or near sightedness (Myopia). Hyperopia means that the eyeball is shortened and the focus of an image is behind the retina. Myopia is the fact that the eyeball is longer and the focus of the image is in front of the retina. In patients with farsightedness they can see images clearly far away but not close. Patients with nearsightedness can see images close clearly but far objects are not sharp. Myopia and Hyperopia can both be corrected with lenses that the Optometrist can prescribe. More severe conditions of the eye include Glaucoma or Cataracts. Routine eye examinations and tests can prevent the worsening of ocular conditions and diseases if detected early on.

Literature Review

Advantages and disadvantages

The automatic refractometer is easy to use, the procedure is fast, and the machine can calculate the patient's eyesight power. However, there's a possibility of calibration errors and the result may not be accurate. During the procedure communication between the examiner and patient is minimal, which allows to test someone who has some issues with communication or brain activity, and they are not able to respond.

Optotypes (also known as eye-charts) have disadvantages when compared to examination with a refractometer. The patient may try to memorize the symbols on the poster to fake their results, also it is problematic to test someone who has issues with communication due to age or a disease. It's essential that cooperation between the Optometrist and patient occurs so the test can be done successfully and with the least possibility of an error. The chart isn't standardized, there can be different combination of letters depending on which chart is used («The Snellen Eye Chart», «Tumbling E Charts», «Jaeger Eye Charts» etc.).

How it works

An optometric examination can be made in different ways.

First, a patient is tested with optotypes (also known as eye-charts). The point of that examination is that the patient tells the examiner what they see on the chart (that can be letters, symbols, etc.). The correction is made through trial and error of lenses with different optical powers and a retry of the examination.

To confirm a disorder, or a health condition, the examiner should use a refractometer. It's a more objective way of determining the visual acuity. The machine emits an infrared light beam and it's reflected from the retina. Depending on the refraction angle the refractometer assesses the extent of the eye defect (refractive error).

Types of refractive errors:

The most common types of refractive errors are myopia, hyperopia, presbyopia, and astigmatism.

Myopia (nearsightedness) is a condition where objects up close appear clearly, while objects far away appear blurry. With myopia, light comes to focus in front of the retina instead of on the retina.

Hyperopia (farsightedness) is a common type of refractive error where distant objects may be seen more clearly than objects that are near. However, people experience hyperopia differently. Some people may not notice any problems with their vision, especially when they are young. For people with significant hyperopia, vision can be blurry for objects at any distance, near or far.

Astigmatism is a condition in which the eye does not focus light evenly onto the retina. This can cause images to appear blurry and stretched out.

Presbyopia is an age-related condition in which the ability to focus up close becomes more difficult. As the eye ages, the lens can no longer change shape enough to allow the eye to focus close objects clearly.

Risks (for patient and clinical staff)

The biggest risk in optometric practice is infection - can be transmitted from a patient to a medical worker, from the latter to patients, from a patient to another patient and among medical workers by direct contact, aerosol formation or contamination of equipment or instruments in the practice. The aim is decreasing the risk of transmission of infection (in a droplet spread, airborne transmission). It's compulsory to disinfect and sterilize all the devices and things with which multiple patients can be in contact, to maintain a hygienic state and to act in accordance with infection control guidelines. A distinction is made between «standard precautions» and «additional precautions». Additional precautions are taken, when handling body fluids, for example blood, tears or mucous membranes of possibly infected patients and when there's a risk of droplet transmission. It is essential that the air in the room is fresh so the airborne transmitted infection cannot be spread. The optometrist should wash their hands regularly,

Ethical issues

In optometry, as in any other examination, it is important for an examiner to keep in mind all health ethical principles. Basic principles that help the optometrist in their decisions are beneficence, non-maleficence, justice and autonomy but also confidentiality and protection of the vulnerable have been included.

Sometimes an optometrist can get into situations where those principles conflict with each other. Choosing one will require disrespecting another, causing an ethical issue. Then the optometrist has to weigh the different perspectives against each other.

Examples:

1) The optometrist is bound to maintain confidentiality but in case of a patient having a heritable or infectious disease, he has also the obligation towards the patient's family or the society.

2) Autonomy of a patient is indispensable until he risks his or other people's health by behaving unreasonable. It's not justifiable to let a person with poor visibility drive a car.

Equipment and Protocol

Task 1: Examine the value of vision (visus) of the left and the right eye at normal and reduced level of illumination using Snellen charts.

Equipment

Eye charts are commonly used to measure visual acuity; they enable doctors to determine whether a patient without prescription lenses requires lenses or whether an existing prescription is to be modified. This method requires the patient's cooperation and also that they have basic reading skills. (Special charts such as the "tumbling E" see *figure 2* have been developed to diagnose patients who cannot read.)

The most commonly used chart used is the Snellen chart (*see figure 1*) it is made up of letters and numbers of specific sizes called Optotypes that are arranged according to size with the largest Optotype on top. Commonly used letters include C, D, E, F, L, N, O, P, T, Z

For distance vision the acuity 6/6 is perfect visual acuity and is used to compare patient's results (6/X) to perfect visual acuity (some countries that do not use the metric system use 20/20). **6/x** the 6 represents the distance from the chart that the patient is standing (6 meters), **X** is the number of the last row that the patient was able to read, which represents the distance that an individual with 6/6 vision would be able to stand at from the chart and still distinguish the same row.

The expression describes the value of vision for example 6/10 means that the patient can see a row from 6 meters that a person with 6/6 would be able to see even from 10 meters. This is known as the visus. Each eye can have a different visus, this is often the case. A patient with 6/12 has half the visual ability as someone with 6/6 vision.

Protocol

1. Make sure, that the chart is illuminated by natural or artificial light.
2. Position the patient at a distance of six meters from the chart.
3. If known, the “bad” eye should be measured first. Cover the non examined eye.
4. Measurement rules:
 - The smallest lines the patient can read are called “fraction”. For instance: 6/18 or 6/24 (written on the chart)
 - The upper number refers to the distance the chart is from the patient (6 meters).
 - The lower number is the distance in meters at which a person with no impairment should be able to see what you have seen.
5. Make sure that you put down in writing the results for each eye. Note if the eye is with or without correction (spectacles). If the patient is not able to identify the top letter at six metres, move him/her closer. One meter at a time until the top letters are identified. In such cases the result will be recorded as 5/60 or 4/60, etc.
6. Repeat the procedure with the other eye.

Task 2: Measurement of eye refraction using an eye refractometer in automatic mode.

Equipment

The objective examination of visual acuity can be carried out using a more objective method, for this task an automatic refractor Canon R-F10 instrument will be used. The experiment needs to be carried out without the use of any contact lenses and prescribed glasses.

After determining if a prescription is needed, doctors must determine how much the eyes need to be corrected. This is done automatically using an Automatic refractometer *see figure 3*. An automatic refractometer consists of four photo elements and infrared light.

The patient's eyes are detected and focused upon by the machine, a light ray is then directed at and reflected off the retina. The reflected ray is then captured by a digital camera. The index of refraction is measured by calibrating the character and direction of reflection of light as it passes through the eye. The shape and size of the ring on the retina are then determined by the automatic refractometer. Any abnormalities are expressed in Diopters (D). If the rays captured by the CCD camera are divergent, the patient has **hypermetropia**, if the rays are convergent, the patient has **myopia**.

Protocol

1. Turn on the refractometer.
2. For automatic mode examination, press the switch SET. - Set the following measurement parameters:

VD12.00

CYL+/-

COUNT ON

AUTO MEASURE3

R-L MEASUREON

AUTO PRINTOFF

After setting the parameters press the SET switch once again.

3. Position the patient on the chin rest correctly to obtain optimal results. Correct his/her position so that the eyes of the patient are level with the mark.

4. Press the START switch to start the automatic measurement. The results will be displayed on the monitor once the device has measured both eyes.

- the DISP switch will allow for the review of the results, press again to exit.

5. For manual mode examination, press the MANU switch.

6. Use the TRACKBALL to control the device head, use the ROLLER to change the slope of the three dots. Set the eye as displayed on the image below.

7. Press the START switch once you are ready to begin manual examination.

8. Repeat steps 5-7 to obtain 3 results.

9. Repeat procedure to obtain 3 results with the other eye.

FIGURES REFERENCED IN THIS SECTION:

Figure #1 (Rolling E Chart)

https://www.aci.health.nsw.gov.au/__data/assets/pdf_file/0007/154969/eem_education_session3.pdf

Figure #2 (Snellen Chart) <https://www.eyequ.com/wp-content/uploads/2018/09/Comparative-Study-EyeQue-Insight.pdf>

Figure #3 (Auto Refractometer) <https://5.imimg.com/data5/UV/VJ/MY-8154162/auto-refractometer-500x500.jpg>

Conclusion

The eye is the most essential sensory organ when it comes to daily life. According to CBS 61% of the population in America have prescription glasses. Weak eyesight has become a big issue in recent years.

The problem lies in the fact that that eyes will become progressively worse if not properly treated. Therefore, it is important to have regular checkups starting from an early age.

There have been significant improvements in treatment and diagnostic techniques over the past 100 years. Eye problems have become less of an issue due to corrective surgeries and a large variety of lenses and glasses to choose from. Optometry will continue to improve in the years to come.

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FIGURES REFERENCED:

- [14] Figure #1
- [15] Figure #2
- [16] Figure #3

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