

Hanna Miettinen

**CLINICAL GUIDELINE FOR FINNISH OPTOMETRISTS – GERIATRIC PATIENT  
ASSESSMENT AND MANAGEMENT**

An Innovation Project

# **CLINICAL GUIDELINE FOR FINNISH OPTOMETRISTS – GERIATRIC PATIENT ASSESSMENT AND MANAGEMENT**

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Hanna Miettinen  
Master Thesis  
Fall term 2023  
Master of Health Care,  
Clinical Optometry  
Oulu University of Applied Sciences

## ABSTRACT

Oulu University of Applied Sciences  
Master's degree in health care, Clinical Optometry

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Author: Hanna Miettinen

Title of the Thesis: Clinical Guideline for Finnish Optometrists – Geriatric Patient Assessment and Management

Supervisors: Dr. Robert Andersson and Tuomas Juustila

Term and year of thesis completion: Fall term 2023

Pages: 53 + 2 appendices

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**Introduction:** Life expectancy continues to grow worldwide, and an aging population in health care will be a growing group. Age-related changes in the eyes predispose to some eye diseases. These eye diseases may cause massive social and economic burdens if left untreated. Optometrists have the crucial role of prevention of these age-related eye diseases. In this study, age-related eye diseases are considered to include macular degeneration, glaucoma, cataracts, and dry eye related to normal aging. These diseases cause symptoms that strongly affect vision and quality of life.

**Purpose:** The Ethical Board of Optometry (OEN) in Finland made a project decision to order topic-based clinical guidelines. This study aimed to create evidence-based guideline recommendations for Finnish optometrists' geriatric patient assessment and management.

**Methods:** This innovation project is a literature review analysis-based research project for Finnish optometrists' geriatric patient assessment and management. It consists of a literature review and recommendations for a clinical guideline. The first phase was a literature search on existing guidelines and evidence-based literature on geriatric patient assessment and management. The second phase was to analyze and decide the main elements from the literature and existing guidelines. The third phase was to define the content and create a clinical guideline for Finnish optometrists for geriatric patients' eye examinations. Literature searching was performed in the fall of 2021 and spring of 2023. PubMed and Google Scholar were used as primary databases. The search was limited to English or Finnish literature and mainly between 2013-2023.

**Results:** Based on the literature search, there were two results of this innovation project. The first is a literature review on primary age-related eye diseases. The second result is a clinical guideline for Finnish optometrists about geriatric patient assessment and management. After gathering and analyzing, the main elements could be divided into patient history, ocular assessment, ocular management, eye examination pathways, and age-related eye diseases. These elements were also divided into sub-elements. These elements formed the clinical guideline.

**Conclusions:** The result of this innovation project was to create a recommendation for a current clinical guideline for geriatric patient ocular examination and pathways. Aging is a massive societal burden, and timely preventive care is crucial. This clinical guideline aims at facilitating the work of optometrists and opticians.

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Keywords: age-related eye diseases, aging, vision impairment, quality of life, clinical guideline

# CONTENTS

1	INTRODUCTION .....	6
2	THEORETICAL BACKGROUND .....	8
2.1	Geriatrics and Ageing of the Eye .....	10
2.2	Age-Related Eye Diseases.....	13
2.2.1	Low Vision.....	13
2.2.2	Age-Related Macular Degeneration .....	15
2.2.3	Glaucoma in the Elderly .....	17
2.2.4	Age-Related Cataract .....	19
2.2.5	Dry Eye in the Elderly .....	21
2.3	Geriatric Patients in Optometric Practice .....	23
2.4	Care Procedures, Assessment, and Management .....	25
2.4.1	Patient History .....	25
2.4.2	Ocular Examination and Assessment .....	26
2.4.3	Management and Counselling .....	27
3	THE PURPOSE, OBJECTIVES, AND TASKS OF THE RESEARCH DEVELOPMENT WORK AND OF THE DIFFERENT STAGES .....	29
3.1	Purpose of the Study .....	29
3.2	Statements of the Research Question.....	29
3.3	Summary Description of Experimental Design .....	29
3.4	Aims of the Study .....	30
3.5	Methodology .....	30
3.5.1	Literature Search and Selection .....	30
3.5.2	Analysis of the Literature.....	31
3.5.3	Development the Guideline.....	32
4	IMPLEMENTATION OF THE RESEARCH AND DEVELOPMENT WORK .....	33
4.1	Specific Aim 1, Literature Search and Selection on Geriatric Patients and Clinical Guidelines .....	33
4.1.1	Methods .....	33
4.1.2	Results.....	33
4.2	Specific Aim 2, Analysing and Determining Main Elements of Literature and Existing Guidelines.....	34

4.2.1	Methods .....	34
4.2.2	Results .....	34
4.3	Specific Aim 3, Defining the Content of Geriatric Patient Guideline.....	36
4.3.1	Methods .....	36
4.3.2	Results .....	36
4.4	Evaluation of the Research and Development Work .....	36
5	DISCUSSION .....	38
6	CONCLUSIONS .....	41
7	TIMETABLE AND BUDGET .....	42
8	ACKNOWLEDGEMENTS .....	43
	REFERENCES .....	44
	APPENDICES .....	54

#### APPENDIX 1: ABBREVIATIONS

#### APPENDIX 2: COMPREHENSIVE EYE EXAMINATION FOR GERIATRIC PATIENT

# 1 INTRODUCTION

Life expectancy continues to grow worldwide. Longer life and aging make changes in the body and the eye. Some of these eye changes are related to eye diseases. Therefore, it is essential to differentiate these conditions. Optometrists in Finland know of age-related eye diseases like age-related macular degeneration, glaucoma, cataracts, or dry eye. However, according to the *healthcare professional's decree*, diagnosing and monitoring belong to an ophthalmologist (Finland's Ministry of Justice 564/1994, n.d.) Age-related eye diseases increase the risks of falling and impact the quality of life. Therefore, prevention of eye diseases plays a significant role in these situations. Furthermore, that all begins with optometrists or optician eye examinations.

Aging, eye examination, and vision-related concerns in older people have been researched worldwide. The European Council of Optometry and Optics (ECOO) and the American Optometric Association (AOA) have published clinical guidelines. (American Optometric Association, 2015a; Elliott et al., 2020.) Norway and Sweden have published guidelines for age-related eye diseases in Nordic countries separately (Norges Optikerforbund, n.d.; Optikerförbundet, n.d.) In Finland, optometrists have a guideline about comprehensive eye examinations (Hyvä Optometristin Tutkimuskäytäntö, 2019). It is aimed at all patients regardless of age. The Finnish Ethical Board of Optometry (OEN) has highlighted the need for clinical guidelines in Finland that correspond to the same level as international guidelines. Geriatric patient assessment and management is one of those. The aging population will be a growing group in health care. According to Bayer's (2018) report, the consequences of age-related vision should be addressed in time. They believe in improving independent living and reducing premature retirement through this. The economic burden must also be taken into account. In Finland, the Finnish Association of Vision and Eyecare (NÄE ry) has created the statement that ocular examination should be included in the comprehensive health care service for older people (Mikhailova et al., 2023). However, no law in Finland obliges an aging person to have a regular eye examination. (Bayer, 2018; Mikhailova et al., 2023.) Optometrists are in a critical role in the care of eyes and can handle these examinations.

This project aims to create clear clinical guidelines for a geriatric patient's comprehensive eye examination for optometrists in Finland. It consists of things to consider when assessing and managing elderly patients. In this thesis, age-related eye diseases are reviewed in the theoretical

part. In addition, other markable age-related issues have been highlighted because eyes and vision are essential parts of these things.

Today's clinics are modern, and clinical knowledge of optometrists is high. However, geriatric patients have to be considered as a whole. Spectacles are just one part of that. Evidence-based literature is a base for this innovation project and recommendations for clinical guidelines. This guideline is aimed at Finnish optometrists and opticians to help understand things related to elders' vision and lives.

## 2 THEORETICAL BACKGROUND

The theoretical background consists of geriatric and aging, age-related eye diseases, and assessment and management of geriatric patients. This thesis will focus on optometrists' eye examinations only in a clinical environment. Systemic diseases such as diabetes are strongly related to vision impairments and low vision, and these effects are commonly secondary consequences. Therefore, these are excluded from this thesis. Furthermore, this thesis deals only with normal aging processes. According to the law, 65 years old is considered elderly in Finland (Ikääntynyt, läkäs Vai Vanha? | Ikätaalo | Terveyskylä.Fi, n.d. [healthvillage.fi](https://www.terveyskyla.fi/)). So, the definition of elderly in this thesis is considered 65 years or older.

**General:** Life expectancy will rise in many countries and increase the average population age. According to the forecast, the age distribution of the population in Finland will change. People's life expectancy is getting longer (Figure 1), which will be reflected in the increase in the number of older adults in society (Statistics Finland, 2022.) With this, age-related eye diseases will grow. It can lead to vision impairment without proper treatment, causing a substantial economic burden. (WHO 2019, p. 16.) Worldwide, at least 2.2 billion people live with some visual impairment. The definition of visual impairment covers conditions of the eye that affect the visual systems or some visual functions. Visual acuity measurement is a typically used method when categorizing visual impairments. Visual functions are assessed with vision field and contrast sensitivity. This problem is estimated to need 14.3 billion dollars in additional funding annually to solve the situation (WHO 201, p. 28).

# Age structure of population on 31 December

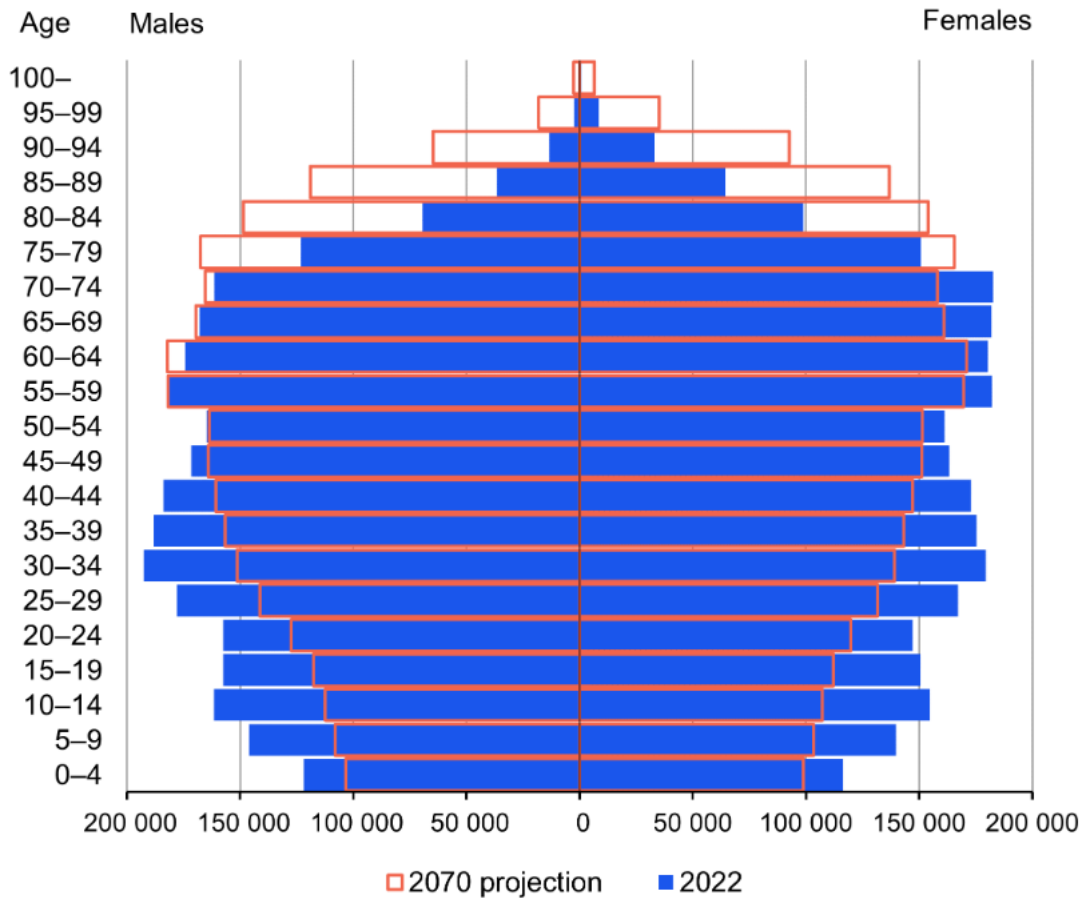


FIGURE 1. Age structure of the population on 31.12.2022. Statistics Finland

According to WHO (2019, p.11), the classification for visual impairment distance is mild, moderate, severe, or blindness. Mild visual impairment occurs when visual acuity is 0.5-0.3, with the best correction. Moderate visual impairment is categorized when visual acuity is under 0.3, and visual impairment can be severe if visual acuity is between 0.1-0.05 with the best correction. Blindness is less than 0.05 with the best correction.

There are 55,000 visually impaired people in Finland for the 2021 estimation. Forty-five thousand of them are over the age of 65. (Tolkkinen, 2022, p. 9.) The Finnish Federation of the Visually Impaired (Näkövammarekisteri) uses the same classification and recommendation of vision as the World Health Organisation (WHO). It defines a person with low vision as having the best correct visual acuity of less than 0.3. A person is considered blind if the visual acuity in the better eye is less than 0.05 after the best correction or the visual field is less than 20 degrees. Determining the differences in visual impairments is difficult because the visually impaired may have considerable

differences in functional vision. Furthermore, only diagnoses made by a doctor are recorded in the statistics. (Tolkkinen, 2022, p. 9-12.)

In Finland, the most significant cause of visual impairment in people over 65 is age-related macular degeneration, 57.9 % of all diagnoses. Glaucoma causes 10.8 % of cases. The trend in Finland is very similar to other high standards of living countries. (Tolkkinen, 2022, p. 40.) This growing group of visual impairments will be a massive economic and healthcare burden in the future. Public healthcare will not be able to meet demand with the current operating model. In Finland, diagnosing, treatment, and monitoring still belong to an ophthalmologist (Finland's Ministry of Justice 564/1994, n.d.)

## 2.1 Geriatrics and Ageing of the Eye

**Geriatrics:** People of ancient times thought of aging as an illness. Since diseases and treatment are linked to later life, we believe an individual's genetic makeup determines age. Also, external factors affect life expectancy. Modern geriatrics was born in 1909 by Ignatz L. Nascher in the United States. Marjory Warren was a pioneer in the United Kingdom in Europe in the early 1900s. These times, geriatrics care noticed some illnesses that would have benefited early management instead of sending the person to a retirement home. Geriatrics care differs between the nations but is focused on the highest standard to give excellent care. (Evans, 1997.) Baeyens (2019) described geriatrics as keeping people steady and independent as long as possible. According to him, gerontology concerns begin earlier. It focuses, for example, on preventing accidents and incapacity. Cooperation with geriatrics and gerontology will be beneficial when people are aging.

**Aging:** Humans are full of complex processes, and these form physiological integrity. These processes degenerate over the years. Researchers have found things that can decelerate age-related changes. However, aging is in our biological genes, and these pathways are impossible to change completely. (Cai et al., 2022.)

Cells are programmed to die while aging. These two pathways are regulated necrosis and apoptosis. External factors such as trauma or infection cause cell necrosis. Apoptosis is normal programmed cell death. Cell's average turnover may lead to misregulation while aging. (Tower, 2015.) Aging affects many levels; cellular, tissue, organ, organ system, and organismal, and at

these levels, many hallmarks of aging are present. Cells are time-dependent, and reduced functions decrease functional ability and quality of life, causing diseases. Cells and organs can self-renew and repair tissue damage. This capability reduces over the years and may lead to tissue dysfunction. Stem cell tissue function regulates organs' physical functions. Stem cell exhaustion and dysfunction play a significant role in aging. Cell nuclear and mitochondrial DNA damage are age-related, and cells' function decreases. Tissue regeneration ability is reducing. Stem cells are the target when developing new strategies and medicines to delay aging. This cell aging is not fully understood and needs more investigation. (Cai et al., 2022.)

**Economic burden of aging:** The World Health Organization (WHO) describes healthy aging as an excellent functioning ability. Good quality of life should be enabled for all ages, older too. In the population, aging is the most prominent medical and demographic problem globally. Aging will rise dramatically, and WHO has addressed aging as the highest priority worldwide. Understanding the economic impact of aging is crucial. Our current understanding has limitations and gaps, and an appropriate approach needs more substantial investment in older populations. Communication and teamwork with health professionals should develop. Issues such as an adequate number of caregivers and their work status should be addressed. The lack of this service is a severe problem, especially in low-income countries. Taking good care of the aging population lowers our economic burden. (Rudnicka et al., 2020.) Previous studies have shown that many older people want to continue contemporary work after retiring. It is beneficial for financial obligations and keeps the elderly mobility longer. (Bishop, 2022.)

**Aging of the eye:** Aging causes significant changes in the eye. Changes can occur in all the specialized sensory organs, causing multiple effects. However, all changes are not disease processes and automatically lead to visual impairment or blindness. Therefore, it is important to distinguish normal aging and actual disease processes. (Kovács, 2022; Salvi et al., 2006.)

Changes in the eyelids and lacrimal system are age-related changes in the eye. Tissues around the eye will form gradually atrophic, and shrinking skin may cause eyelid malposition and blepharochalasis. Eyelid ectropion or entropion affects the eye's surface and may cause watery eyes. Watery can also be a result of nasolacrimal duct obstruction. Lacrimal gland production may be disrupted by aging and cause tearing problems. Syndrome of dry eye occurs, such as decreased tears quality and quantity. (Kovács, 2022; Salvi et al., 2006.)

Refractive power alterations, such as presbyopia and astigmatism, are common in the elderly and are caused by corneal curvature changes. Corneal luster and sensitivity will reduce and are considered age-related changes. Arcus senilis is peripheral band opacity in the corneal stroma, and white-yellow deposit cholesterol esters form it. This asymptomatic and harmless change is pervasive in the elderly. (Kovács, 2022; Salvi et al., 2006.)

Increased intraocular pressure develops a risk of glaucoma. Aging increases pigmentation formation, blocking trabecular meshwork and uvea and decreasing aqueous outflow. Pigment loss of the iris may also do the same. (Kovács, 2022.)

The crystalline lens is one of the essential parts of the eye affected by aging. Biochemical changes cause the hardening of the lens. Lens hardening and opacity affect the capsular elasticity. As a result, presbyopia starts to develop at the age of 40. These regular age-related changes continue progressing, and later, they will form a cataract. (Kovács, 2022.)

In vitreous, collagen fibers and hyaluronic acid components change and cause floaters. Vitreous gel motility also changes. These changes will compact the gel and cause fibrillar structure enlargement changes. These are effects of normal aging. Liquefaction increases and finally causes posterior vitreous detachment (PVD). Floaters in front of the eye are typical signs. PVD is mostly harmless. More severe cases like a retinal tear or retinal detachment can occur due to posterior vitreous detachment. (Kovács, 2022.)

Decreased visual acuity, visual field, contrast sensitivity, and dark adaptation are age-related changes in the retina; these retinal neural elements changes will affect visual function. In addition, photoreceptor cells and retinal pigment epithelium (RPE) metabolism may be disturbed, causing decreased choroidal blood flow. RPE function plays a significant role in this visual function. Bruch's membrane permeability may also alter the metabolic by-product deposits. These are age-related changes, but lifestyle may increase the risk of age-related macular degeneration. (Kovács, 2022.)

**Measurement of vision:** Visual function and functional vision do not mean the same, and it is essential to recognize the difference between these. Visual functions are visual acuity, contrast sensitivity, and color vision. These functions are strongly related to a patient way of life. Motor, cognitive, or sensory functions form functional vision. (Bennett et al., 2019.)

Changes in contrast vision and color vision also significantly affect vision function. (Daiber & Gnugnoli, 2023.) Visual acuity is still considered a critical measurement when evaluating visual function. It is the level of the finest detail that can be identified. The average or “normal” visual acuity level is 0.0 logMAR at a distance. There are different ways to report this value in the world. Snellen chart reports this “normal” visual acuity as 20/20. (Daiber & Gnugnoli, 2023.) The best visual acuity increases from birth to 10 years old and then decreases individually (Bennett et al., 2019). In Finland, optometrists and opticians cannot prescribe glasses independently to someone whose visual acuity will not become standard with eyeglasses (Finland’s Ministry of Justice 564/1994, n.d.). Optometrists and ophthalmologists have created recommendations and cooperation guidance for some eye diseases in Finland. Glaucoma and suspicion of cataracts are one of them. They have considered an early stage of cataracts as an age-related condition. (Hoitopolkusuositukset, silmäterveyspalvelut.fi, n.d.) When making comprehensive optometrists’ eye examinations and excluding other eye diseases, monitoring can be done in the optometrist’s practice. (Kaihipotilaan tai -epäilyn tutkiminen. Optometristi-Silmälääkäriyöryhmän Suositus, 2022.) According to this, slightly reduced visual acuity is not always the reason to send the patient to the ophthalmologist.

## **2.2 Age-Related Eye Diseases**

Eye diseases related to normal aging can be considered low vision, age-related macular degeneration, glaucoma in the elderly, age-related cataracts, and dry eye in the elderly. In terms of disease progression and severity, their identification, monitoring, and treatment are crucial.

### **2.2.1 Low Vision**

**Introduction:** Vision plays a significant role in everyday life and is our dominant sense. Visual impairment is a loss of sight. It can be related to the eye or visual system and affects one or more visual functions. Standard glasses, contact lenses, optical devices, and surgical or medical treatment cannot correct it. Blindness can be a partial or complete loss of vision. In 2019, at least 2.2 billion people had a visual impairment or blindness globally. (WHO 2019, p. 23.) In Finland, the prevalence of mild vision impairment (0.5-0.32) is, (age over 30) at 173 000, 6% of the population (Tolkkinen, 2022, p. 9).

Age-related changes in the eye's tissues can alter diseases and the ability to manage daily tasks. Visual acuity, contrast sensitivity, dark adaptation, and color vision changes will typically be reduced. Pupil size and retinal illumination are physical changes. In addition, external factors such as environment, diet, and physical and mental activities are also related to visual changes. (Erdinest et al., 2021.)

**Consequences:** Ageing promotes visual loss throughout life and causes various health problems in the eye. Vision impairment is common and consequential. It interferes significantly with daily life. These pathological changes take months and years, and symptoms may be minimal initially. However, the effect on an older person's lifestyle can be significant. Vision is closely related to visual-motor coordination. Chronic visual impairment can increase psychological problems and depression. (Loh & Ogle, 2004.) Previous studies have shown connections between physical activity and visual impairment. It is known that visual impairment reduces physical activity, but recently, it is also found to be the opposite way. Physical activity protects from visual loss. People with advantaged eye disease are more likely to have an inactive lifestyle. (Ong et al., 2018.)

Vision loss can affect many daily living activities. Reading, driving, and walking require seeing fine details. Loss of contrast sensitivity complicates, for example, face recognition or color distinction in everyday life. Macular disorders cause distortions; patients may feel obstacles to disappear and metamorphose. Peripheral vision loss causes collisions and moving difficulties, and obstacle detection decreases. Dark adaptation also changes and creates problems with different obstacles in dim light or when driving bright light into a dark tunnel. (Dagnelie, 2013.)

**Management:** Modern and developing mature populations feel digitalization is beneficial. For example, computer and smartphone maintain their everyday activities. When the vision starts to change, it is vital to identify these age-related vision changes at the beginning. Patients with visual impairment need to get management. Professionals and caregivers can help and address patients appropriately with assistive instruction and devices. Optoelectronics and digital technology have improved enormously. Vision rehabilitation plays a significant role in low vision. (Dagnelie, 2013; Erdinest et al., 2021.) Audio reading has become a handy and widely used option. The text is converted to speech and is usable with computers, tablets, or smartphones. (Jackson et al., 2022.)

The patient's vision measurement includes visual acuity, contrast sensitivity, and visual field. Currently, this measurement can be considered as detail vision and surround vision. The more

descriptive designation makes it easier to understand the situation and can be helpful to the patient. Attention needs to be paid to explaining the situation. The term “legal blindness” sounds heavy. Patients may imagine that visual impairment always leads to total blindness. Knowledge of one’s position and future is crucial. Expanding focus on the patient and assessing limitations and consequences in a societal context is essential. (Colenbrander, 2018.)

## 2.2.2 Age-Related Macular Degeneration

**Pathophysiology:** Fovea is the central part of the macular area and is responsible for central visual function in everyday life. Age-related macular degeneration (AMD) is a progressive eye disease that pathologically changes retinal layers in the macular and surrounding area. AMD includes two main types: non-neovascular or dry form and neovascular or wet form. The dry form affects retinal pigment epithelium, leading to RPE dysfunction, photoreceptor loss, and retina degeneration. In the wet form, neovascularisation is formed in the choroid, which can be seen as hemorrhages and RPE detachment. The dry form occurs more, about 80%-90% of cases. Changes in the foveal area lead to central vision loss. Age-related macular degeneration is divided into existing signs. (Table. 1) Classification is early or intermediate AMD; advanced AMD is divided into non-neovascular and neovascular, also called the late stage. (Bowling, 2016; Schultz et al., 2021; Thomas et al., 2021.)

*TABLE 1. Clinical classification of age-related macular degeneration (AMD) (Adapted from Bowling, 2016, 600)*

Category	Definition, based on presence of lesions within two disc diameters of the fovea in either eye
No apparent ageing changes	No drusen No AMD pigmentary abnormalities
Normal ageing changes	Only drupelets No AMD pigmentary abnormalities
Early AMD	Medium drusen ( >63 µm but < 125 µm) No AMD pigmentary abnormalities
Intermediate AMD	Large drusen ( > 125 µm) Any AMD pigmentary abnormalities
Late AMD	Neovascular AMD and/or any geographic atrophy

Drusen are yellow extracellular deposits that are hallmark clinical findings in AMD. They are typical, and usually, first findings in dry form. These early findings may progress later to the neovascular form of AMD. Drusens in the retinal layers are classified as a hard or a soft form. Hard drusen are small and well-defined. Soft drusen borders are less distinct, forming a higher risk of disease progression. Drusen can be classified in size as small ( $<63\text{ }\mu\text{m}$ ), medium ( $63\text{-}124\mu\text{m}$ ), and large ( $\geq 125\mu\text{m}$ ). Bigger sizes can contribute to a higher risk of disease progression. There are small and medium-sized drusen in the early and intermediate stages in the macular area. Pigmentary changes in the macula area can progress to early-stage AMD. Choroidal neovascularisation can lead to fluid leakage and hemorrhage bleeding. That causes wet AMD by forming an advanced form of AMD. Vision symptoms may vary depending on the stage of the disease. In early-stage AMD, vision impairment may be blurring while reading and having decreased contrast sensitivity. Scotomas or blind spots are common symptoms, particularly wet form. That makes, for example, difficulties in recognizing faces. Metamorphopsia is also common. (Thomas, Mirza & Gill, 2021.)

**Prevalence:** The World Health Organization (2019) estimated in 2020 that there are 195.6 million people aged 30-97 worldwide with AMD. Moreover, by 2030, it might be 243,4 million. In Finland in 2021, age-related macular degeneration caused vision impairment in 67.3% of the entire population. Over 65 years old, it was 57.9%. (Tolkkinen, 2022.) Age-related macular degeneration prevalence is higher in high-income countries (WHO, 2019). It also varies with ethnicity and is more common in whites and Europe (Schultz et al., 2021).

**Risk factors:** Risk factors for age-related macular degeneration are several. Aging is the primary risk factor; other factors are race, lifestyle, and blue iris. Elevated blood pressure and atherosclerosis are the systemic factors that can predispose to AMD. Smoking, hyperlipidemia, and increased body mass index are markable risk factors, too. (Deng et al., 2022; Thomas et al., 2021.) Several studies show the genetic risk behind AMD. For example, Colijn et al. (2021) provided genetic risk and lifestyle connections in age-related macular degeneration. So, an unhealthy lifestyle significantly increases individuals' possibility of getting AMD with genetic risk.

**Management:** AMD is a progressive disease, and no cure is available. However, prevention and slowing of the disease progression are possible. Dry AMD treatment options are limited. Patients with early AMD in one or both eyes are advised to modify their dietary and exercise lifestyles. Dietary should incorporate antioxidant-rich food and omega-3 and six fatty acids and green vegetables. Smoking cessation and weight loss are highly beneficial. AREDS2 is supplementation

with vitamins (Vitamin C, Vitamin E, Copper, Lutein, Zeaxanthin, and Zinc). This treatment is recommended in early AMD if the fellow eye is advanced AMD. AREDS2 is beneficial if AMD is in the intermediate stage. These treatments aim to slow dry AMD progressing atrophy stage. (Schultz et al., 2021; Thomas et al., 2021.) In wet AMD treatment, the formation of neovascularisation is the critical point. Anti-VEGF treatments have proven beneficial in inhibiting choroidal neovascularisation (CNV). It is an intravitreal injection targeting CNV lesions. There are various forms of anti-VEGF therapies and extended treatments that could preserve vision in part. (Deng et al., 2022; Thomas et al., 2021.)

### 2.2.3 Glaucoma in the Elderly

**Pathophysiology:** Glaucoma is a definition of group progressive optic neuropathies. Optic nerve head structural changes are irreversible and characteristic hallmark findings in glaucoma. Changes may lead to visual field loss or even blindness if left untreated. Glaucoma can be divided into different forms depending on the underlying cause. However, primary open-angle glaucoma (POAG) and primary angle-closure glaucoma (PACG) are the most common age-related glaucomas. These diseases can affect peripheral vision and progress to tunnel vision. Visual loss can progress because the disease is mainly asymptomatic unless it ends the stage. First, visual field defects are peripheral; the fellow eye can compensate for this. Then, increased intraocular pressure may lead to a glaucoma diagnosis. (Gupta & Chen, 2016.) Researchers have shown glaucoma affects cognitive function and activity levels (Varin et al., 2020). Patients have also noticed that vision test results are better in clinical examination than later at home (Hamedani et al., 2021).

Aqueous humor is produced in ciliary processes. Aqueous outflows circulate mainly via trabecular meshwork at the anterior chamber and partly via the uveoscleral route. Aqueous production and outflow rates must be balanced. This circulation forms intraocular pressure (IOP). The average IOP range is about 11-21 mmHg. (Bowling, 2016, p.307.) Glaucoma types can be distinguished based on the angle. In open-angle glaucoma, the trabecular meshwork is unblocked by iris tissue, and the angle is still open. The pressure inside the eye leads to stress in the optic nerve head, and the axons of the retinal ganglion cell will be damaged. These patients' IOL may be expected as standard, ranging from about 50% of diseases. Angle-closure glaucoma IOL increases because of blocked aqueous outflow. The anterior chamber is shallow, and while the pupil dilates, the

peripheral iris prevents aqueous outflow. IOL may arise rapidly. Fluctuating IOP forms an acute or subacute situation in the eye and is usually a painful experience for the patient. It also leads to corneal edema and causes halos around the lights. Typical clinical findings are hazy cornea, conjunctival injection, and mid-dilated pupil. This patient needs to get an ophthalmologist examination immediately. (Gupta & Chen, 2016.)

Intraocular pressure measurement with tonometry is part of a comprehensive glaucoma assessment. It requires a full optic nerve head and the retinal nerve fiber layer examination. A gonioscopy is mandatory for chamber angle evaluation. Visual field tests should preclude scotomas. These tests need to be repeated when making the diagnosis of glaucoma. (Gupta & Chen, 2016; Schuster et al., 2020.)

**Prevalence:** Glaucoma prevalence increases worldwide. WHO (2019) estimated that in 2020, 76 million glaucoma patients are between 40 and 80 years old worldwide. The numbers will grow in the future. Their estimation is 2030, about 95.4 million. In Finland, in 2021, a visual impairment of 12.3% was caused by glaucoma. For those over 65 years old, it was 10.8%. (Tolkinen, 2022).

**Risk factors:** Ageing increases glaucoma risk significantly. POAG prevalence over 80 years old, black or Hispanic, is about 11,3% to 23,2%. White population prevalence over 75 years white is 9%. Ethnic background as black or Hispanic has a higher glaucoma risk than the white population. PACG prevalence is higher in the Asian population compared to the white. Family history is also a significant risk factor. First-degree relatives increase the risk about 9-fold. In some previous research, aging, and family history are considered high-risk factors for glaucoma. Other high or moderate factors are high myopia and increased axial length, higher than -3.0 D. PACG is associated with a hyperopic patient. Also, previous blunt trauma may predispose to glaucoma. Systemic disease history can be markable, too. Diabetes, hypotension, or thyroid disease increases the risks of glaucoma. Sleep apnea and glaucoma have recently found a connection. Changes in the eye are also risk factors. Pigmentary dispersion and pseudoexfoliation syndrome can predispose to secondary open-angle glaucoma. Increased intraocular pressure can be medication-related. Corticosteroid is known to affect increasing IOP. Fluctuation and elevation are typical. (Gupta & Chen, 2016; Haines et al., 2020; McMonnies, 2017; Schuster et al., 2020.)

**Management:** Glaucoma is irreversible, so treatment is to prevent the disease's progression. Medical eye drops are commonly used. The drops' main target is to reduce intraocular pressure and delay vision loss. Drugs differ in the mechanisms of action of lowering the pressure. Prostaglandin analogues, Beta-blockers, Alpha-adrenergic agonists, and Carbonic anhydrase inhibitors are the most used glaucoma drops. The effect of these drugs varies by individual. Sometimes, multiple drugs are needed to achieve the required pressure. Glaucoma drugs may cause some side effects or complications. Then, laser therapy or surgery may be considered. Laser therapy increases the aqueous outflow. In surgery, a stent is placed in the canal of Schlemm. Aqueous outflow increases and IOP reduces. (Gupta & Chen, 2016; Schuster et al., 2020.)

#### 2.2.4 Age-Related Cataract

**Pathophysiology:** The crystalline lens is an avascular, transparent part of the eye. It lies behind the iris and in front of the vitreous body. The lens is an integral part of the refractive index. The light enters the eye through the lens. (Forrester et al., 2016, p. 33.) The lens grows and changes surface curvature throughout life. These physiological changes decrease nutrients, ions, and antioxidants transport, leading to cataract formation. (Remington, 2012, p. 102.) During the aging process, the function of the lens may be damaged. Oxidative damage is also known to involve lens opacity. (Lim et al., 2020; Petrash, 2013.) The changes in the lens are caused by water flow disrupted aquaporin. Lens thickness decreases anterior chamber depth and the transport of nutrients and ions. These age-related changes may lead to cataract formation. Lens loses its ultraviolet radiation (UVR) filter approximately 12% every decade, allowing UVR damage in the eye. (Remington, 2012, p. 102.)

A cataract is also called a clouding of the lens. If the cataract is untreated, it causes visual impairment and even blindness. It also reduces the quality of life. (Lim et al., 2020; Petrash, 2013.) Cataracts divide into cortical, nuclear, and subcapsular types. These types of cataracts can be associated with age-related cataracts. (Remington, 2012, p.105.) Cortical cataracts typically show opacities in the lens's peripheral part and vacuoles. Radial spoke-like opacities are, in general, located in the inferonasal quadrant. Patients may suffer glare and scatter of light. A nuclear cataract occurs in the nucleus or central part of the lens and is typical in aging. A nuclear cataract may result from previous ocular surgery. Blurred vision and changes in color vision are shared, and patients may also see various yellow or brown hues. Myopia often increases with nuclear cataracts. Diabetic

medications or corticosteroids are often associated with posterior subcapsular cataracts. Cataracts are usually more than one area of the lens. (Bowling, 2016, p. 270; Lim et al., 2020; Petrash, 2013.)

**Prevalence:** WHO (2019) estimated that the prevalence of cataracts in 2019 was 65.2 million. It includes all types of cataracts. In Finland, 30% over 65 years old have some visual impairment caused by cataracts. Over 85 years old, the number is around 70%. About 50 000 – 60 000 cataract surgeries are made in Finland annually. (Kaihi (Harmaakaihi, Katarakta) - Terveyskirjasto, n.d..)The amount of cataract surgery is nearly the same in Sweden. There are about 10 million inhabitants and 110 000 cataract surgeries yearly. Therefore, society must be aware of the prevalence of cataracts among the aging population. The burden of cataracts will increase the costs of health care. (Hugosson & Ekström, 2020; Lim et al., 2020.)

**Risk factors:** Aging is a significant risk factor for cataracts. Regular cellular changing is part of that. Researchers have found other cataract risk factors, too. Smoking, sunlight exposure, female gender, high body mass index, and pseudoexfoliation are linked to cataracts. Diabetes and steroid use are also predisposing factors. Ultraviolet radiation (UVR) increases the risk of lens opacity and cataracts. The aging population with longer life expectancies and the prevalence of obesity are rising worldwide. Previous studies have indicated the connection between being overweight and cataracts. Therefore, it is worth understanding the cataract from a public health perspective. (Hugosson & Ekström, 2020; Pan & Lin, 2014; Remington, 2012, p.102-106.)

**Management:** The nonsurgical relief for vision impairment due to the cataract can be glasses or contact lenses. Visual acuity must be suitable when reading, driving, and working. If that is not possible, then surgery is justified. (Petrash, 2013.) In Finland, public health care allows cataract surgery if visual acuity is in the better eye with a corrected lens of 0.5 or worse. Alternatively, a better eye with a corrected lens is over 0.5, and the fellow eye is 0.3 or worse. Refraction changes can also cause changes in the size of an image. Each surgery will constantly be evaluated on a case-by-case basis, and necessary if daily life is disturbed. (Cataract (Adults): Current Care Guidelines Abstract 2019, n.d..)

### 2.2.5 Dry Eye in the Elderly

**Pathophysiology:** Dry eye syndrome (keratoconjunctivitis sicca) is a multifactorial tear film and ocular surface disorder. A dry eye causes ocular discomfort. Studies have also combined dry eye with visual acuity and contrast sensitivity. Typical symptoms are foreign body sensation, blurred vision, redness, dryness, light sensitivity, discharge, epiphora, itching, and eye fatigue. It is a multifactorial disease. The lacrimal gland, tear film, ocular surface, eyelids, and nervous system play a significant role in dry eye. (Sharma & Hindman, 2014; Szczotka-Flynn et al., 2019; Tsubota et al., 2020.)

The tear film in the ocular surface traditionally consists of three specialized layers. The innermost layer over the cornea is the mucin layer. It is made by conjunctival goblet cells. Then, in the middle, the lacrimal gland forms the nutritive aqueous layer. Meibomian glands secrete the outermost lipid layer. It provides tear film stability. (Nebbioso et al., 2017; Sharma & Hindman, 2014.) However, Tear Film & Ocular Surface Society, Eye Workshop II, TFOS DEW II, have described tear film as a 2-lipid layer. According to them, mucin and aqueous form together mucoaqueous layers. This layer forms ocular surface hydration. (James et al., 2017.)

Dry eye disease (DED) is divided into two categories. Aqueous deficiency is lacrimal gland dysfunction. The meibomian gland's reduced function is called evaporative dry eye. Currently, many patients can have signs and symptoms from both types simultaneously. (Buckley, 2018.) Many factors predispose to dry eye. Age, environment, digitalization, decreased blinking, diseases, and medication are some reasons for DED. It is not easy to distinguish one specific reason. Infection and allergies may present very similar signs and symptoms. Determining the primary cause is essential, but all causes and forms will produce the same results. The stability of homeostasis is significant in DED. The ocular surface will react if a loss of homeostasis occurs. Therefore, comprehensive and effective care is crucial. (James et al., 2017.)

Aging and changes in the eyes have remarkable impacts on dry eye syndrome. Aqueous tear deficiency increases in older people. Meibomian gland atrophy and dysfunction and lacrimal gland dysfunction cause decreased tear volume. Hormonal changes are known to affect ocular surface homeostasis, and the female gender is more likely affected. Eyelid abnormal position can be seen in older adults. Lid malposition predisposes corneal surface disorder and tear film evaporation. Diseases, for example, Parkinson's disease, have lower blink reflexes, and it affects corneal

sensation. (Sharma et al., 2014.) Lipid production may become disturbed. Conjunctivochalasis is an age-related disorder, and its prevalence increases significantly with age. Conjunctiva folds between the globe and the eyelid become redundant. That may obstruct the inferior tear meniscus and puncta, causing epiphora and discomfort. The corneal nerve controls lacrimal gland secretion. Corneal central sensitivity decreases sharply with aging and can lead to corneal scarring and even severe ulceration. TFOS DEWS II investigated corneal sensitivity and noticed neurosensory abnormalities be part of dry eye. Oxidative stress also combines with dry eye and aging. Oxidative stress increases dry eye patient tears osmolarity and inflammatory cytokine levels. (Buckley, 2018; De Paiva, 2017; James et al., 2017; Nebbioso et al., 2017; Sharma & Hindman, 2014; Tsubota et al., 2020.)

Demodex mites are ectoparasites and infest humans' normal flora. It is better known for skin disorders but not often recognized in eye examinations. Demodex excessive reproduction may lead to a pathogenic situation in the eye and surrounding area. Mites increase with age, and two-thirds of older adults have demodicosis. Reduced immunity affects a number of mites. Demodex is highly prevalent in the elderly and is closely related to dry eye. (Paichitrojjana, 2022; Tashbayev et al., 2020.)

**Prevalence:** Dry eye syndrome is a highly prevalent disease affecting millions worldwide. The prevalence varies; the estimation is 5%-50%, depending on the diagnostic criteria. Over the decades' patients with DED have increased. DED is a complex disease and classification based on clinical signs. Undiagnostic people may occur much more, and dry eye forms a massive burden on patients and society. (Messmer, 2015; Szczotka-Flynn et al., 2019; Tashbayev et al., 2020.)

**Risk factors:** Several reasons can cause dry eye symptoms. Aging is known to be significant. The lid's malposition and conjunctivochalasis may be age-related changes by the cells aging and the structures changing. Meibomian and lacrimal gland dysfunction cause tear film decreased quality and quantity. Older people may suffer from diseases that have side effects on the eyes. Dryness and eye irritation can be caused by systemic or topical medication. Systemic diseases such as diabetes, rheumatoid arthritis, thyroid disease, or rosacea are associated with dry eye. Reduced immune defense is common in these patients. Previous eye operation or surgery increases dry eye symptoms. Demodex mites are also risk factors. (De Paiva, 2017; James et al., 2017; Messmer, 2015; Paichitrojjana, 2022; Sharma & Hindman, 2014; Szczotka-Flynn et al., 2019; Tashbayev et al., 2020; Tsubota et al., 2020.)

**Management:** Dry eye management is advanced over the decades while increasing knowledge. Patient awareness of underlying conditions makes long-term treatment more effective, and commitment is essential. Subjective and objective measurements need to be done when planning the treatment. For mild dry eye symptoms, artificial tears and gels may be adequate. Artificial tears relieve pain and are temporary eye lubricants. In more severe cases, lid cleaning and hygiene are essential. A warm compress is also beneficial. Dietary supplements, environmental, air conditions, and humidity should be considered. Some patients may get help with punctual occlusion. In difficult situations, topical non-steroidal anti-inflammatory (NSAID) drugs are effective. To improve the corneal surface and decrease ocular irritation, low doses of corticosteroid drugs may help. Intense pulsed light therapy (IPL) treatment is also much studied, and it has shown beneficial in meibomian gland dysfunction and Demodex mites. Tea tree oil treatment is effective for Demodex mites. (James et al., 2017; Messmer, 2015; Nebbioso et al., 2017; Paichitrojjana, 2022; Sharma & Hindman, 2014; Szczotka-Flynn et al., 2019; Tashbayev et al., 2020.)

### 2.3 Geriatric Patients in Optometric Practice

**Reasons for concern:** After traffic accidents, falls are the predominant cause of accidental death in older people (Saftari & Kwon, 2018). In the elderly, falls are general and multifactorial causes of injuries. Stairs and steps are usual causes of falling. (Elliott et al., 2019.) Falling may lead to activity restriction, social isolation, or even depression. Fear of falling can have similar causes. Visually impaired elderly have a higher risk of falling than those customarily sighted. Risk factors of falling can be many: Weakness of balance control, impaired muscle strength, cognitive impairment, hypotension, stroke, arthritis, Parkinson's disease, polypharmacy, and history of falls. Furthermore, as said, these unavoidably deteriorate with age. (Elliott, 2014; Saftari & Kwon, 2018; White et al., 2015.)

**Cognitive and sensory impairments:** Sensory impairments like vision and hearing are common in the elderly. These are closely related to independence, social participation, and mental health. The prevalence of these cognitive impairments increases a concern. People become more dependent on others with age, and assisting older may cause challenges. (Mitoku et al., 2016.)

Previous studies have reported age-related macular degeneration and cataracts associated with cognitive impairment (Mitoku et al., 2016). Researchers have found the same risk factors with vision

and cognition. Hearing problems are also strongly related to cognitive impairments, which are more common than vision impairments. Hearing loss is gradual and may be recognized later. Hearing impairments have shown a strong relationship with dementia, which can be associated with age-related impairment. Demented patients' behavior will change, and the impact on life is markable. A demented person is expensive for society. Hearing and vision-correcting devices are cost-effective and quite easily achievable. Elders with sensory and cognitive impairment have increased risks of accidents and mortality. Communication with these patients is essential and needs to improve. The patient must feel to be understood and that the treatment would be effective. Lack of communication may negatively affect patient care. (Littlejohn et al., 2022; Mitoku et al., 2016; Nagarajan et al., 2022.)

Population aging and life expectancy continue rising. In developed countries, age-related vision-threatening diseases will increase. Various studies have reported that visual impairment diminishes quality of life. (Saftari et al., 2018.) Finnish researchers found the same results as previous studies: Vision impairment affects health-related quality of life more than the awareness of underlying eye disease (Puroila et al., 2021). It is estimated that over 60 years old population, 20 % worldwide, live with some psychiatric or neurological disease. Major depressive disorder, such as dementia, is highly prevalent. Mental vulnerability alters the fear of falling. In December 2019, the COVID-19 virus started to spread globally. The virus can be fatal for older people. Patient isolation and minimized face-to-face contact have enormous consequences. The COVID-19 virus had a massive global impact on older people. Age-related disorders increased, and access to treatment was poor. Repairing these consequences takes a long time. (Grolli et al., 2021.)

**Customized eye examinations:** Eye examination requires good cooperation with the patient. Monitoring is crucial with age-related eye diseases. Digitalization gives good opportunities for these. Slit lamp tests, visual field tests, or Optical Coherence Tomography (OCT) are widespread in many clinics. Patients need to be stable and concentrate while doing tests. Monitoring importance is also essential. Dementia patients can be hard to understand and need to remember instructions. (Eye Exam - Mayo Clinic, n.d.)

Many older people spend their lives in a nursing home or may live independently with domiciliary care. Immobility may limit access to clinical examination. In the UK, a domiciliary eye examination benefits people with physical or mental disabilities and the inability to access community practices. Educated optometrists examine with the required equipment. Patients may struggle with body

position, and regular sitting causes difficulties. Examination at home can offer flexibility for the patient and the examiner. (Rashid et al., 2013.) Researchers have studied the prevalence of vision loss and its effect among nursing home residents in the United States. Many nursing home residents had vision impairment that significantly affected their quality of life. The examination was conducted in an assisted exam room with relevant devices. These ways of acting are considered adequate. (Andersson et al., 2020.)

**Vision correction:** The need for correctable vision may be one leading cause of falling. Older people may suffer financial problems and cannot afford new glasses, or they do not want to use them. The elderly may benefit from updated glasses. Lens type and changes in magnification are essential when thinking of new spectacles. Previous glasses are good indicators. Progressive addition lenses (PAL) and bifocals are very dissimilar. Distortions in the peripheral part of progressive lenses may increase the risk of falling. The higher the additional correction is in the prescription, the higher the risk of falling. The older presbyopic should warn of this risk factor. Significant refraction changes are known to predispose to falling. Greater than  $\pm 0.75$  DS is not recommended to change to new glasses. The cylinder 0.75 or under-axis changes should be 10 degrees. Over 0.75, the cylinder should change only 5 degrees if needed. Hyperopia and myopia changes are possible, too. A previous hyperopic patient may feel that new and myopic spectacles have a smaller magnification. These kinds of changes are linked to the vestibulo-ocular reflex. Magnification changes disturb the reflex and thus require a longer adaptation time. Many studies have found it beneficial to wear single-vision glasses outdoors to reduce the risk of falling. ("Ageing Eyes and Falls - Look After Your Eyes Look After Your Eyes," n.d.; Elliott, 2014; Elliott et al., 2020.)

## **2.4 Care Procedures, Assessment, and Management**

### **2.4.1 Patient History**

The eye examination initial part is the patient history. Finding patients' health status, medications, and other vital backgrounds is beneficial. Eye and vision status is essential for a comprehensive picture of patients' situations, and it helps solve and identify patient problems. (American Optometric Association, 2015a.) Connection and trust with the patient are critical. Patients can be more liberated and talk openly about their problems and situations. These can give early clues

about possible diseases to the optometrist. (Schiedermayer, 2010.) There is a recently completed Master's Thesis in Patient history in Finland. In this work, a patient history questionnaire was created to facilitate the work of optometrists. (Andersson, 2022.)

Every patient must be encounter as an individual, but certain things are essential to learning about patient history. These are; demographic data, the problem, that chief complaint and its duration, general health and social history, patient and family visual and ocular history, current use of medications and vitamin supplements, and patient's other health care providers. (American Optometric Association, 2015a; Chuck et al., 2021; ECOO, 2013.)

#### **2.4.2 Ocular Examination and Assessment**

Visual acuity should also be measured uncorrected and with habitual correction for near and distance. Moreover, it should be done monocularly and binocularly. Pinhole test when indicated. (American Optometric Association, 2015; ECOO, 2013.)

Refraction is needed when determining an optical prescription. Patient visual needs can be obtained when having accurate refraction and are also necessary when thinking about comfort vision correction. As mentioned, finally, lens prescription sometimes differs from optimal refraction. Sometimes, refraction measurement can be challenging for the elderly, and then autorefraction is a valuable tool for objective measuring. (American Optometric Association, 2015a.)

Ocular motility and binocular vision are essential when thinking near and distance vision. The cover test is a rapid and easy test for the patient ocular deviation measurement. Binocularity is closely related to comfortable vision. Suppression tests are also valuable. (American Optometric Association, 2015a; AOA Evidence-Based Optometry Committee, 2015; ECOO, 2013.)

Anterior eye examination is vital when thinking about ocular health situations. Structural changes are commonly age-related but can be an ocular manifestation of systemic diseases. Anterior eye examination with slit lamp biomicroscopy includes evaluating eyelid margin and position, lashes, tear film, conjunctiva, sclera, and cornea. Pupillary size and response evaluation are essential and can indicate, e.g., neurological disorders. Anterior ocular assessment includes anterior chamber angle evaluation with gonioscopy. Iris, lens, and anterior vitreous structural assessment are

necessary to evaluate. Intraocular pressure should be measured with tonometry. (American Optometric Association, 2015a; AOA Evidence-Based Optometry Committee, 2015; ECOO, 2013.)

Posterior segment evaluation requires pupil dilation. Mid and posterior vitreous can be evaluated with the slit lamp. Ocular posterior segment examination can be performed with direct or indirect (+ 90 D lens) ophthalmoscopy. Fundus structures, vasculature, macula area, and optic nerve need to be evaluated. (American Optometric Association, 2015a; Chuck et al., 2021; ECOO, 2013; Saumya & Radhika, 2019.)

The visual field can be tested rapidly by using the confrontation test. All four (temporal, nasal, upper, and lower) peripheral and central quadrants can be tested using a finger as a target. Amsler grid is helpful when evaluating central field defects. (American Optometric Association, 2015a; AOA Evidence-Based Optometry Committee, 2015; Saumya & Radhika, 2019.)

### **2.4.3 Management and Counselling**

**Counselling and monitoring:** Patients usually visit the clinic with a visual problem. Listening patiently to the chief complaint and reviewing the status of their visual symptoms is crucial. The optometrist should discuss the findings and the results of assessments with the patient. Moreover, this should be described in understandable language and added to the patient's general health and social status. (American Optometric Association, 2015b; AOA Evidence-Based Optometry Committee, 2015; Chuck et al., 2021.)

Discussion about management and monitoring includes close patient counselling. Optometrists should explain different available options. Refractive correction can improve vision and benefit a patient's everyday life. Patients are also entitled to know the situation that cannot be improved with optical devices. The patient may need further investigations and an ophthalmologist's opinion. The importance of discussion is vital. Patients need to understand the significance of re-examination and the importance of follow-up. (American Optometric Association, 2015b; AOA Evidence-Based Optometry Committee, 2015.)

The situation in clinics may be a frightening experience, and counselling may fail. Therefore, optometrists should also give instructions and information to the patient in writing. The timetable for every patient should be long enough when examining the elderly patient. The time burden in clinics may be heavy, but it is necessary when the patient is in focus. (American Optometric Association, 2015a.)

**Protection and prevention:** A healthy lifestyle is essential when talking about good eye health. Regular exercise with healthy diet are crucial and may help to prevent age-related eye diseases. Smoking has a significant role in ocular health. Patients commonly know that smoking impacts other systemic disorders but do not know the relationship with the eyes. Therefore, tobacco products discussion should increase in optometrists' examinations. Smoking cessation and an active lifestyle can reduce the risk of age-related eye diseases. (American Optometric Association, 2015a.)

Ultraviolet radiation protection is needed because long-term exposure may alter the development of cataracts or pterygium. Patients should use sunglasses to protect their eyes. These can also be used to eliminate glare. (American Optometric Association, 2015a.)

Falling can be a life-changing thing for an elderly patient. New spectacles may help or make things even worse. So, glasses with current vision correction are essential and cheap devices. Optometrists should advise the patient to get various glasses in a different environment. Patients should have counselling if the visual field narrows or binocularity has changed dramatically. (American Optometric Association, 2015a; Elliott et al., 2019.)

Patients aged over 65 years should have regular optometric eye examinations annually. Furthermore, patients with a higher risk of falling should have comprehensive eye examinations more often if necessary. For asymptomatic patients, a routine exam is crucial. It can protect from significant eye conditions and changes. In addition, regular eye examinations preserve the independence of daily living and the quality of life. (American Optometric Association, 2015a.)

### **3 THE PURPOSE, OBJECTIVES, AND TASKS OF THE RESEARCH DEVELOPMENT WORK AND OF THE DIFFERENT STAGES**

#### **3.1 Purpose of the Study**

This project aimed to create evidence-based recommendations for clinical guideline for optometrists when assessing and managing geriatric patients in Finland.

#### **3.2 Statements of the Research Question**

Research questions were formed by using the ECLIPSE framework. Six concepts are identified: Expectation, Client group, Location, Impact, Professionals, and Service. In this study, the framework was ECLIPSE. (Eclipse,2023.)

E (expectation) = Clinical guideline

C (client group) = Eye examination for a geriatric patient (assessment and management)

L (location) = Finland

P (professionals) = Optometrists

S (service) = Geriatric patient

#### **Research question:**

- What are the main elements and guidance that should be included in geriatric patients' eye examinations in Finland by optometrists?

#### **3.3 Summary Description of Experimental Design**

This thesis is an innovation project, literature review analysis-based research project guideline for Finnish optometrists for geriatric patient assessment and management. There were three phases of this project. The first was to gather comprehensive, evidence-based literature and clinical guidelines about aging and age-related eye diseases, macular degeneration, glaucoma, cataracts, and dry eye. The second phase was to conduct and analyze literature and selected guidelines. The

main elements were decided based on the analysis. The third phase was forming the guideline that is suitable for Finnish optometrists.

### **3.4 Aims of the Study**

The first aim was to search and gather evidence-based literature and clinical guidelines for theoretical background about aging, age-related eye disease, and other things strongly related to geriatric patient life.

This thesis's second aim was to analyze and decide the main elements from the literature and existing guidelines.

The third and final aim the define the content and create a clinical guideline for Finnish optometrists for geriatric patients` eye examinations.

### **3.5 Methodology**

#### **3.5.1 Literature Search and Selection**

Literature search and selection were performed in the fall of 2022. Clinical guidelines were searched at first. The search terms were "clinical guidelines," "guidelines and optometry," "geriatric guidelines," and "optometristin ohjeistukset". It gave information about the structure of published clinical guidelines and the current state of optometry guidelines. The criteria for inclusion were publications and guidelines about geriatric patients, age-related eye diseases, and free full text published in English. Exclusion criteria were publications over ten years and other language than English.

The literature search was performed in the fall of 2022 and spring 2023. The evidence-based literature was searched and gathered using books, medical articles, PubMed, and Google Scholar databases. The material selection for this evidence-based research used the PICO (Population/Problem, Intervention, Comparator, and Outcome) table.

P (population): Adults over 65 years old

I (intervention): Eyes and health of eyes

C (comparator): Eye and vision examination

O (outcome): Clinical outcome, what should be known and included in the eye examination for the elder

Keywords were age-related macular degeneration, glaucoma, cataract, dry eye, aging, and geriatric patient. Search terms were “age-related macular degeneration” OR “cataract” OR “glaucoma” OR “dry eye” OR “aging” OR “age-related eye disease” OR “falling” OR “quality of life” OR “visual impairment” OR “low vision” OR “clinical guideline” OR “optometrist” AND “optometry” OR geriatric AND gerontology.” The search was limited to English or Finnish and between 2013-2023. However, some older studies were accepted because of their relevancy. Some grey literature sources were also chosen for this study because these were closely related to the topic.

Searching and conducting the theoretical background helped to understand the basics of aging and age-related eye diseases. The approach method was a narrative because it provides a descriptive overview of the search and selected literature. (Atkinson & Cipriani, 2018). Searching and conducting also added insight into aging and what kind of challenges there might come when getting older. That is important when making the guidelines. It is crucial to get the whole picture of the patient to fill all needs.

### **3.5.2 Analysis of the Literature**

Literature analysis was started by gathering similarities of chosen materials using content analysis. In this thesis, qualitative content analysis is used inductively. The analyzed material is approached openly, without preconceptions. Content analysis involves three phases: preparation, organization, and reporting. (Im et al., 2023, Elo et al., 2014.) First, the similarities between doing an eye exam and examining the eye's health were gathered together. Then, the most critical issues related to age-related eye diseases were coded and gathered. Next, similarities were collected from matters related to the everyday life and activities of older people. Finally, specific components began to repeat and were linked together, forming the justified aims. Some unexpected elements emerged from the literature. These were related to aging and have also been conducted and discussed in this thesis. Inductive analysis enables this (Im et al., 2023; Elo et al., 2014).

While doing material analysis, understanding increases what one should know and do when facing an elderly patient. Throughout the research, the focus was on Finnish optometrists.

### **3.5.3 Development the Guideline**

Comprehensive Adult Eye and Vision Examination, Clinical Practice Guideline (American Optometric Association, 2015a) is used as a vanguard. It is extensive and very informative. However, it consists of many parts; some are not allowed for optometrists in Finland.

This master's thesis and clinical guidelines are written and done by one author. Nevertheless, it is informative and advisory and preserves Finnish optometric practice. It is designed as the basis of a comprehensive vision examination for an aging patient's encounter with an optometrist. It contains all the steps to consider when examining an aged person. The main target was to keep it simple and easy to re-check.

## **4 IMPLEMENTATION OF THE RESEARCH AND DEVELOPMENT WORK**

### **4.1 Specific Aim 1, Literature Search and Selection on Geriatric Patients and Clinical Guidelines**

#### **4.1.1 Methods**

The first phase was to search existing clinical guidelines related to eye and eye examination of older people. That deepened my understanding of the structure and contents of guidelines. Then, an extensive literature search was conducted and thoroughly evaluated. Evidence-based literature searching for the theoretical background was consuming but eye-opening to understand the significance of aging and its effect. After that, guidelines for further analysis were selected.

#### **4.1.2 Results**

Literature searching emerged several topics closely related to aging and are affected by vision. Five clinical guidelines were determined.

Based on the search and selection process, for further analysis, identified the following guidelines:

1. The Finnish Ethical Board of Optometry (OEN) Guidelines for Finnish optometrists on the good eye and vision examination methodology (Hyvä optometristin tutkimuskäytäntöohjeistus 2019)
2. American Optometric Association (AOA) evidence-based clinical guidelines on adult eye and vision examination (American Optometric association 2015)
3. AOA Evidence-Based Optometry Committee (AOA) Evidence-Based Clinical Practice Guideline – Comprehensive Adult Eye and Vision Examination (AOA 2015)
4. The European Council of Optometry and Optics (ECOO) Guidelines for Optometric and Optical Services in Europe (ECOO 2013)
5. Guidelines: How opticians and optometrists can help prevent falls in older patients (European Council of Optometry and Optics 2020)

## **4.2 Specific Aim 2, Analysing and Determining Main Elements of Literature and Existing Guidelines**

### **4.2.1 Methods**

Evidence-based literature and guidelines were gathered, and then analysis and coding were carefully made. Finally, repeated and relevant elements were collected. After this, the main issues were reached and defined.

### **4.2.2 Results**

The following elements were gathered in the first part.

- patient history
- ocular assessment
- ocular management
- eye examination pathways
- age-related eye diseases

In the second part, these elements were divided into sub-elements:

- patient history includes:
  - demographic data
  - the chief problem complaint and its duration
  - general health and social history
  - patient visual and ocular history
  - family visual and ocular history
  - current use of medications and vitamin supplements
  - other health care providers

-ocular assessment includes:

- external and functional assessments of the eye are divided into visual acuity, monocular, binocular, pinhole, refraction, autorefraction, ocular motility, binocularity, the visual field with confrontation, and Amsler grid.

- anterior assessment is divided into eyelid margin, position, lashes, tear film, conjunctiva, sclera, the cornea, pupil size and response, anterior chamber, iris, lens vitreous, and intraocular pressure.

- posterior assessments are divided into mid and posterior vitreous, fundus structures, vasculature, macula, and optic nerve.

-ocular management includes:

- after ocular assessment, management is divided into results, devices, vision impairment, the hygiene of the eye, protection, general health, and general appearance.

-eye examination pathways include:

- after ocular assessment and management, the optometrist needs to decide on monitoring the patient based on findings: no eye health problems, suspected eye disease, and diagnosed eye disease

-age-related eye disease includes:

- short brief about age-related eye disease signs, effects on vision, symptoms, and management (age-related macular degeneration, glaucoma for the elderly, age-related cataracts, and dry eye for the elderly)

The third phase was writing the theoretical background about gathered references.

### **4.3 Specific Aim 3, Defining the Content of Geriatric Patient Guideline**

#### **4.3.1 Methods**

Planning the guidelines was the final part of this project. The guideline has been made to keep it simple and easy to use for supporting optometrists' daily work.

#### **4.3.2 Results**

This guideline is formed into four parts, and the first is a short review of age-related eye diseases. There have been collected signs, changes of vision, risk factors, and management of these age-related eye diseases. It also has observational pictures of age-related eye disease and shows the image from the patient's view. The second part includes patient history and eye examination assessment. Management and counselling are the third part. Finally, the treatment pathways of a geriatric patient are briefly explained.

The Comprehensive Eye Examination for the Geriatric Patient guideline was created and designed during this thesis project. The guideline is presented in Appendix 2.

### **4.4 Evaluation of the Research and Development Work**

The Ethical Board of Optometry (OEN) made a project decision to order topic-based clinical guidelines for Finnish optometrists from the Master's Degree in Health Care, Clinical Optometry degree program. Therefore, they will have permission for this clinical guideline.

Evidence-based literature forms the basis of the main elements, and the reliability of the sources has been assessed carefully. Literature searching and the relevance of key search terms were ensured with the help of an information specialist in the Oulu University of Applied Sciences library. Larger entities were created by combining knowledge from the literature, which was formed in stages. A coherent set of recommendations was achieved when the knowledge base acquired from the literature at different development stages was linked to a larger whole. OUAS content adviser's guidance was used to add reliability to the content analysis process. In this project, writing has been tried to be reflective. With it, the author's thought is more visible and critical.

As a result of this study, recommendations for the clinical guideline have been created. Only one author has done this project, so elements or choices have not been discussed in a larger collegial group. A larger panellist group would bring more reliability to this study. Doing evidence-based research has taught me to read a scientific text critically, and my understanding of different research methods has increased. And this has been an intensive and rewarding journey.

During this project, many things have arisen for me to use for the broader usability of the study. Many people in the nursing field are working with aging people. Although the study concentrates on the eye and vision from an optometrist's perspective, the guideline is clear and easy, even for the care and nursing field. This study could provide better insight into the vision of an elderly patient.

This study has been done according to the accepted guidelines of the Oulu University of Applied Sciences (Oulu UAS). Oulu UAS is committed to following the guidelines of the Finnish National Board on Research Integrity, TENK (Finnish National Board on Research Integrity TENK 2021). This study did not involve any people being interviewed or processing personal data. This thesis is evidence-based literature research; an IRB or statistical approach was not required.

## 5 DISCUSSION

At the beginning of this project, the plan for the research development was made. It comprises age-related eye diseases, ocular assessment, management, and clinical guidelines. During the literature search, age-related eye diseases were largely familiar. Aging, low vision, and all elements related to vision impairment were massive. However, some surprising and vital elements closely linked to vision emerged during the literature search. Moreover, it became clear that these markable elements had to be included in this study. As optometrists, we usually strive to get the best possible visual acuity for the patient. However, it is not always the best decision based on the searched literature. Alternatively, the chosen lens type differs from earlier and predisposes to falling. These are our everyday choices and can be considered minor and immeasurable, but they strongly impact the patient's situation. These elements emerged strongly in many studies and should be better considered.

It is known that aging will become a big problem by causing a social and economic burden. Literature searching was an eye-opening process in many ways. Comprehensive and coded analysis showed that aging is a significant issue, and it was occasionally hard to keep things tightly together because of the extent of the matter. Aging affects many things, and the patient must be seen as a whole. Eyes and vision are the most crucial sensory. Optometrists in Finland have good knowledge of eye diseases. Education and research equipment have improved, which allows possible eye diseases to be identified quickly and the patient to receive appropriate treatment. Optometrists should guide the patient more on the benefits of new glasses. Even a tiny change of refractive error could help the patient prevent, for example, falling. It is quite a small price if considering falling elderly rehabilitation. Optometrists are crucial in this and can participate in handling this matter even more in the future.

Society should understand the potential of optometrists in this situation, and there have already been some changes. Optometrists and ophthalmologists have more cooperation in the private sector. This kind of cooperation is very cost-effective, serves the patient well, and should be utilized more. The rights of optometrists and opticians are defined in Finnish law, but working methods could be developed within the framework of these laws.

An aging patient will need more help from other professionals over time. In practice, every professional takes care of their field. In such a treatment model, the whole may be overlooked. A cooperation group from different fields would be the ideal solution. This action could keep older people more able to exercise and be independent. Here, the patient, the most important of all, would benefit the most. In Finland, no law obliges aging people to have regular eye examinations. A change to this aim and operating model will be sought. Mikhailova et al. (2023) have proposed vision as part of routine health examinations of aging people. They also think a collegial group of ophthalmologists, optometrists, and nursing professionals could form a unit that works together. Before this change takes place, it is suitable for optometrists to provide guidance and advice in this matter.

Based on this study, optometrists should be more interested in older people's everyday lives. A thorough mapping of the patient's social situation and history will show the appropriate needs and give a better view of the patient's situation. Timetable in practice is often challenging. Usually, there are about 20-30 minutes available for every patient. Older people's moving can be slower, and doing things takes time. This could be solved by booking, for example, 2 x 20 minutes for the elderly patient. The calm and unhurried examination includes necessary assessments. As a good thing, many examinations already include an incumbent comprehensive eye examination guideline in Finland. Nevertheless, as a result of this project, there is a need for primarily geriatric patient eye examination guidelines. Management and counselling are crucial for the aging patient.

This thesis project had some limitations. The topic was so extensive that it had to be precisely defined to be appropriate in scope. A recommendation for further study could be testing this guideline in Finnish optometric practice. Is the guideline usable and informative, and does it meet the desired demand? In this project, eye diseases have been discussed as age-related. One interesting point of view would be researching systemic conditions, for example, diabetes' effect on age-related eye diseases. These systemic diseases are increasing rapidly. The patient may have many underlying conditions, which can also predispose to age-related eye disease and form a vicious circle that must be tackled. One valuable further development could be utilizing this study in nursing homes. That could increase knowledge about patients' vision problems and help nurses understand their patients' everyday lives. A family member's caregiver could also benefit from this. Furthermore, when the created statement of ocular examination included in the comprehensive health care service enters into force, this kind of guideline could be informative for every care

professional. Seeing is a problem that other people do not see head-on. It can cause awkward situations and misunderstandings.

## **6 CONCLUSIONS**

In this study, there were two purposes to determine when assessing and managing a geriatric patient. The first purpose was to resolve the main elements that should be included in geriatric patients' eye examinations. Geriatric patient guidance and its meaning were the second purpose of this study.

Aging affects the eye and vision closely, and optometrists are usually the first professionals to be asked for a solution to vision problems. Because of that, the optometrist should do a comprehensive eye examination on all over 65 years old. By doing this, it is possible to find age-related eye changes, also asymptomatic. The patient obtains the appropriate treatment in time. The comprehensive eye examination requires understanding the patient's background and examining the anterior and posterior structures of the eye. Patient counselling is an essential part of the eye examination. Patients need to be aware of the health of the eyes. This helps to understand the vision's importance and impact on quality of life. Geriatric patient monitoring is vital. Regular eye examination has to be done annually or more often as recommended. That is a significant way to keep older people independent and preserve quality for the rest of life.

## 7 TIMETABLE AND BUDGET

This project was started in the Fall of 2021 when the thesis topic was confirmed. In the beginning, much time was spent searching for and reviewing the research material. The planning phase was also in 2021. The writing of the text began in February 2023 and was completed in August 2023.

<b>Fall 2021 – Spring 2022</b>
-Thesis topic
-Starting of literature search
-Planning phase with the mentor

<b>Fall 2022 – Winter 2022 / 2023</b>
-Literature search
-Deciding the research question
-Student – Supervisors -meeting

<b>Spring 2023 – Summer / Autum 2023</b>
-Writing theoretical background
-Student – Supervisors -meeting
-Writing results, discussion, conclusions and creating a guideline
-Student – Supervisors -meeting
-Finalising the thesis

This thesis is a part of the Master's Degree in Health Care, Clinical Optometry degree program, so no financial support was needed.

## **8 ACKNOWLEDGEMENTS**

I want to thank my supervisors, Dr. Robert Andersson and Tuomas Juustila, for advising and encouragement with this project.

Thanks to Aki Rintala for mentoring me at the start of the planning phase.

Thanks to NÄE ry and SOA (Suomen Optometrian Ammattilaiset ry) also for the Bror Biese - grant.

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## **APPENDIX 1: ABBREVIATIONS**

PAL: Progressive additional lenses

PVD : Posterior vitreous detachment

RPE : Retinal pigment epithelium

AMD : Age-related macular degeneration

PACG : Primary open-angle glaucoma

PACG : Primary angle-closure glaucoma

IOP : Intraocular pressure

UVR : Ultraviolet radiation

DED : Dry eye disease

OCT : Optical coherence tomography

PAL : Progressive additional lenses

## APPENDIX 2: COMPREHENSIVE EYE EXAMINATION FOR GERIATRIC PATIENT

### GUIDELINE

This guideline is intended for optometrists for eye examination of aging people. The guidelines gives instruction for the ocular assesments and patient counseling and monitoring.

## Comprehensive Eye Examination for the Geriatric Patient

### CONTENT

- 1 Brief of age-related eye diseases
- 2 How to assess the patient's vision status and what examinations are required?
- 3 Guidance for ocular treatment and monitoring
- 4 Eye examination pathways for the geriatric patient

## 1 Age-Related Eye Diseases



### Age-Related Macular Degeneration

Age-related macular degeneration is generally progressive eye disease with no cure. Changes in the foveal area causes central vision loss and reading and recognition of faces is difficult.

### Glaucoma in the Elderly

Glaucoma is an irreversible eye disease. This eye disease can destroy peripheral vision and progress to tunnel vision. It can be mainly asymptomatic. Peripheral vision loss causes physical challenges in daily life such as collisions with objects and obstacle detection decreases.

### Age-Related Cataract

Cataract is an opacity of the lens in the eye. It can be cured with surgery. Blurred vision and changes in color vision are common. Glare and light scattering can lower the quality of life.

### Dry Eye in the Elderly

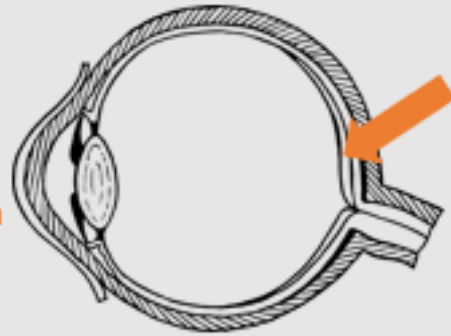
Dry eye syndrome is a multifactorial tear film and ocular surface disorder. Dry eye causes ocular discomfort and may change visual acuity. Treatment is prescribed according to the severity of the disease.

## Age-Related Eye Diseases

### Age-Related Macular Degeneration



Age-related macular degeneration patients' central vision is gradually blurred.



#### Hallmarks

##### Dry form:

- drusens (hard/soft)
- pigmentary changes

##### Wet form:

##### Intermediate or late state

- hemorrhage
- neovascularization
- RPE detachment
- geographic atrophy

#### Risk factors

- age
- race
- smoking
- blue iris
- elevated blood pressure
- hyperlipidemia
- atherosclerosis
- increased body mass index

#### Changes in vision

- no vision changes
- gradually blurred central vision
- decreased contrast sensitivity
- difficulties in reading and recognizing faces

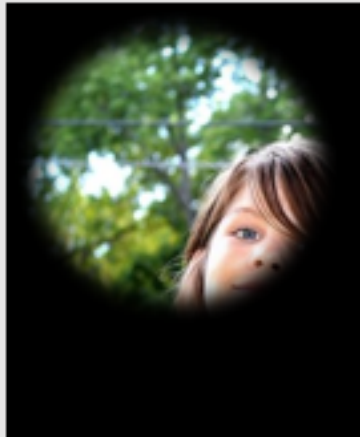
- difficulties in reading and recognizing faces
- metamorphopsia
- rapid onset of vision loss
- scotomas
- blind spots

#### Management

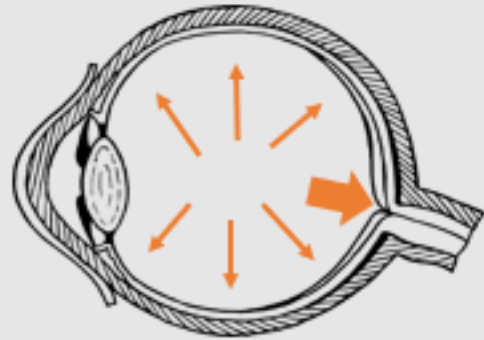
- healthy diet
- active lifestyle
- losing weight
- smoking cessation
- AREDS2
- VEGF-therapy

## Age-Related Eye Diseases

### Glaucoma In the Elderly



Glaucoma patients' visual field is decreased.



#### Hallmarks

- asymptomatic
- optic nerve head changes
- increased intraocular pressure
- structural changes in trabecular meshwork
- PACG: shallow or blocked anterior chamber
- hazy cornea
- conjunctival injection
- mid-dilated pupil

#### Risk factors

- age
- race, black or hispanic
- family history
- myopia
- trauma
- systemic disease (diabetes, thyroid disease, hypotension, hypertension)
- sleep apnea
- pseudoexfoliation
- increased intraocular pressure
- corticosteroid

#### Changes in vision

- visual field defects (early stage)
- tunnel vision
- blindness (late stage)
- cognitive and activity levels decrease

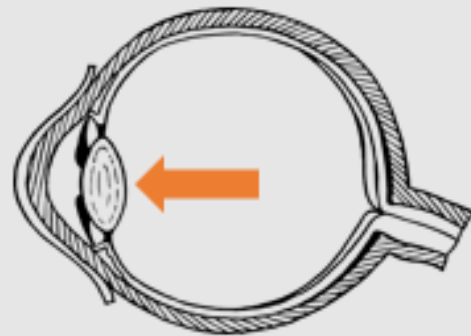
- PACG: pain and halos

#### Management

- glaucoma drops (prostaglandin analogues, beta-blockers, alpha-adrenergic, and carbonic anhydrase inhibitors)
- laser therapy or surgery
- PACG: ophthalmologist immediately

## Age-Related Eye Diseases

### Age-Related Cataract



Cataract affect color vision, and the image is blurred.

#### Hallmarks

- lens thickening
- vacuoles
- lens opacity and clouding
- lens turns yellow or brown
- myopia

#### Changes in vision:

- glare
- blurred vision
- color changes in vision
- far sight decrease
- a scatter of light

#### Risk factors

- age
- smoking
- sunlight exposure
- female gender
- high body mass index
- pseudoexfoliation
- diabetes
- corticosteroids

#### Management

- glasses or contact lens
- cataract surgery

## Age-Related Eye Diseases

### Dry Eye In the Elderly



Dry eye patients' vision may vary from clear to blurry.

#### Hallmarks

- ocular discomfort
- redness
- foreign body sensation
- dryness
- light sensitivity
- discharge
- epiphora
- fatigue of the eye
- pain

#### Risk factors

- age
- meibomian gland dysfunction
- lacrimal gland dysfunction
- conjunctivochalasis
- previous eye surgery
- corticosteroids
- systemic diseases (diabetes, rheumatoid arthritis, rosacea or thyroid disease)
- systemic or topical medication
- reduced immune deficiency
- decreased blinking
- demodex mites
- hormonal changes

#### Changes in vision

- visual acuity fluctuation
- reduced visual acuity
- reduced contrast sensitivity

#### Management

- artificial tears
- lid cleaning and hygiene
- warm compress
- environment and room humidity
- topical non-steroid anti-inflammatory drugs
- intense pulsed light therapy (IPL)
- tea tree oil
- dietary supplements

## 2 How to assess the patient's vision status, and what examinations are required?

1

### Patient history

- demography
- visual problem and duration
- general health and social history
- visual and ocular history
- visual and ocular history of family
- medications and vitamin supplements
- other health care providers

2

### Ocular assessment

- visual acuity, monocular, binocular, pinhole
- refraction, autorefraction
- ocular motility, binocularity
- the visual field with confrontation
- Amsler grid

3

### Anterior assessment

- eyelid margin, position and lashes
- tear film
- conjunctiva
- sclera
- the cornea
- pupil size and response
- anterior chamber
- iris
- lens
- anterior vitreous
- intraocular pressure

4

### Posterior assessment

- mid and posterior vitreous
- fundus structures
- vasculature
- macula
- optic nerve

### 3 Guidance for ocular treatment and monitoring

#### Discussions with patient

- **Patient must be informed the current and accurate situation of vision.**
- **Chief complaint is clarified, and options are explained to the patient.**
- **Need for an ophthalmologist is determined and, if necessary, referrals are made.**
- **Patient's general conditions observe; is there a necessity to refer to other professional examinations**

#### Glasses and other device recommendations

- glasses or contact lenses
- power change max  $\pm 0.75$  D
- cylinder axis 0.75 D or under, changes max 10 degree
- cylinder 0.75 or greater, changes max 5 degree
- several glasses for different purposes
- lens type is the same as previous glasses
- magnifying glasses
- eye protection from the UV radiation outside
- sunglasses
- absorption lenses
- audio reading

#### Challenges in daily tasks

- changes in color vision
- reduced adaptation in different lighting conditions
- glare and scattering of light
- reduced contrast sensitivity and adaptation in different lighting condition.
- hyperopic: increased image size, and myopic: decreased image size
- gradual or sudden vision loss effect on the quality of life; driving, walking and hobbies.
- risk of falling increase
- cognitive impairments and their connection to the vision

#### Patient's self-care instructions

- hygiene of eyelids and margins
- lubrication and artificial drops or gels
- guidance on putting the drop in the eye, if medicine drops are used, guidance and counselling
- importance of regularity
- healthy diet
- environment and room humidity
- effect of systemic diseases and medications on vision

## 4 Eye Examination Pathways for the Geriatric Patient



**No eye health problems**



**Vision correction and counselling. Annual monitoring at an optometrist.**



**Suspected eye disease**



**Ophthalmologist and vision correction. Annual monitoring at ophthalmologist or optometrist or more often if so recommended.**

**Diagnosed eye disease**



**Ophthalmologist and vision correction. Annual monitoring at ophthalmologist or more often so recommended. Cataract or glaucoma can be monitored by optometrists in private sector; however, ophthalmologist is always supervised. (more on: [www.hoitopolkusuositukset/silmäterveyspalvelut.fi](http://www.hoitopolkusuositukset/silmäterveyspalvelut.fi))**