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Capsular Glaucoma and Other Ophthalmic Complications of Pseudoexfoliation Syndrome

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Summary: Pseudoexfoliation syndrome is an age-related disorder of the extracellular matrix, characterized by the deposition of pathological fibrillar material in the structures of the anterior segment of the eye and in extraocular tissues. The accumulation of pseudoexfoliative material leads to damage and impaired function of tissues such as the lens zonules, the iris, or the drainage angle. Pseudoexfoliation syndrome is a disease entity with a multifactorial pathogenesis, involving both genetic and environmental factors, among which LOXL1 gene polymorphisms, exposure to UV radiation, and oxidative stress play a particularly significant role. Pseudoexfoliation syndrome is the most common cause of secondary open-angle glaucoma, which is characterized by a more severe course and a poorer prognosis compared to primary open-angle glaucoma. Secondary open-angle glaucoma is associated with higher intraocular pressure values and its greater diurnal fluctuations. The treatment of secondary open-angle glaucoma involves the same methods as those used for primary open-angle glaucoma; however, the specific features of glaucoma in this patient group must be taken into account. Pseudoexfoliation syndrome also predisposes to cataract formation and intra- and postoperative complications, such as poor pupillary dilation, corneal decompensation, or lens dislocation, as well as systemic diseases. Due to its prevalence and clinical significance, Pseudoexfoliation syndrome represents a major diagnostic and therapeutic challenge in contemporary ophthalmology.

Key words: pseudoexfoliation syndrome, glaucoma, cataract surgery, exfoliation syndrome.

Introduction

Pseudoexfoliation syndrome (PEX) is an extracellular matrix disorder associated with aging. It involves the production of abnormal, fibrillar material, followed by its accumulation in ocular tissues as well as other tissues and organs. It is the most common identifiable cause of secondary open-angle glaucoma (SOAG). In some regions of the world, it represents the most frequently diagnosed form of glaucoma. PEX carries an increased risk of complications during intraocular surgeries. The secondary glaucoma associated with it (PEXG), often referred to as "capsular glaucoma", is linked to a more severe clinical course and a poorer prognosis than primary open-angle glaucoma (POAG) [1]. Due to its significant clinical relevance and high prevalence, PEXG warrants particular attention and vigilance from ophthalmology specialists.

The first description of pseudoexfoliation syndrome was presented in 1917 by Finnish ophthalmologist John Gustaf Lindberg, who, in his doctoral dissertation, presented an observational study describing characteristic "white-gray flakes" on the anterior lens capsule and pupillary border. He interpreted these findings as hyaline degeneration of the pupillary margin and discoloration of the visible edge of the posterior iris layer. Lindberg also noted a link between this phenomenon and the occurrence of glaucoma, as 30 out of the 60 glaucomatous eyes he examined showed signs of pseudoexfoliation syndrome.

Subsequent researchers who investigated the anterior segment changes first described by Lindberg included Alfred Vogt, Birger Malling, and Archimede Busacca.

The term "pseudoexfoliation" was first introduced in the 1950s by Georgiana Dvorak-Theobald to distinguish between true exfoliation (defined as separation of the superficial layer of the lens capsule from deeper layers due to prolonged exposure to high temperatures, as reported in glassblowers) and the presence of fibrillar deposits of unknown origin in the anterior segment structures of the eye, which she termed "pseudoexfoliation" [2]. Nevertheless, due to the rarity of true exfoliation and limited awareness of its historical context, the terms "pseudoexfoliation" and "exfoliation" are often used interchangeably in specialist literature.

Methods

An analysis of the available scientific literature on pseudoexfoliation syndrome and pseudoexfoliative glaucoma was conducted. To this end, a review of the PubMed and Google Scholar databases was performed using the following search terms: pseudoexfoliation syndrome, exfoliation syndrome, glaucoma, pathogenesis, epidemiology, clinical characteristics, systemic manifestations, management strategies. Review articles, original research papers, and meta-analyses were included. The retrieved publications were assessed and selected by the lead author.

Epidemiology

PEX is the most commonly identified cause of SOAG. It is estimated that between 15% and 26% of eyes with PEX develop PEXG within five years [3]. PEX is diagnosed globally, with prevalence varying depending on the population studied: from 1% of individuals to over 40% among people over the age of 80 in high-risk populations [4]. The highest prevalence of PEX has been observed in Scandinavian countries, Russia, Greece, and parts of Southern Africa, while relatively low rates have been reported in certain Asian populations. The prevalence of PEX increases with age and is most often diagnosed in individuals over 60, however, cases of PEX have been reported in younger people, including among Australian Aborigines and the Pondo tribe in South Africa. The effect of sex on the development of PEX remains inconclusive; however, some studied populations have shown a higher prevalence in men.

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Men previously diagnosed with PEX also appear to have a higher risk of developing glaucoma compared to women with the same diagnosis. A higher incidence of PEX has also been noted among rural populations, which is likely linked to increased exposure to ultraviolet radiation, recognized as one of the risk factors for PEX development. PEX is considered to be a disease entity with a substantial proportion of cases remaining undiagnosed. Diagnosis of PEX – particularly in early or subclinical stages – often requires clinical experience, full mydriasis, and gonioscopy. Furthermore, research conducted to date has revealed considerable methodological variation. As a result, the true prevalence of PEX is difficult to determine and remains a controversial topic in ophthalmic literature [5].

Pathogenesis

The pathogenesis of PEX is a complex process characterized by stress-induced elastosis, in which excessive production and pathological cross-linking of microfibrils lead to the formation of fibrous aggregates and their deposition in both intraocular and extraocular tissues. This process is multifactorial in nature, involving the interaction of genetic, epigenetic, and environmental factors [6].

Pseudoexfoliative material

Pseudoexfoliative material is a complex substance whose structure and composition indicate a close association with components of elastic fibers and basement membranes. Under light microscopy, the deposits show eosinophilic properties and are rich in carbohydrates, as confirmed by Periodic Acid-Schiff (PAS) staining. Electron microscopy reveals fibrils, 25–45 nm thick, arranged chaotically within an amorphous ground substance, displaying transverse striations reminiscent of elastic myofibrils. In immunohistochemical studies, pseudoexfoliative material shows the presence of multiple basement membrane antigens, such as fibronectin and laminin, as well as elastic fiber markers, including fibrillin-1 and transforming growth factor type beta–binding proteins (TGF-β). In the anterior segment of the eye, pseudoexfoliative deposits accumulate on surfaces exposed to aqueous humor: the anterior lens capsule, ciliary zonule, corneal endothelium, trabecular meshwork, and iris – including within its stroma, where perivascular deposits appear early. Pseudoexfoliative material found in extraocular locations differs in composition from intraocular deposits, suggesting that its formation processes may vary depending on anatomical site [7].

Genetic factors

Population-based and family studies conducted to date have shown that PEX is inherited in an autosomal dominant manner with incomplete penetrance and late onset. It is suspected that multiple genes are involved in its pathogenesis; however, the most significant are considered to be polymorphisms in the gene encoding lysyl oxidase-like 1 (*LOXL1*), an enzyme essential for the synthesis and homeostasis of elastic fibers, and crucial for the formation of cross-links in tropoelastin. It has been demonstrated that *LOXL1* expression in tissues affected by PEX is significantly dysregulated, with transient overexpression occurring in the early stages of the condition. *LOXL1* participates in the formation of abnormal fibrous aggregates deposited in the tissues of PEX patients; consequently, it constitutes a significant component both intraocularly and extraocularly. Moreover, a shift in *LOXL1* substrate specificity in abnormal fibrillar deposits has been demonstrated; in these deposits, it most often co-occurs not with fibulin-5, its normal binding partner, but with fibrillin-1. In the later stages of the disease, *LOXL1* expression decreases below the threshold required to maintain elastin stability. This can lead to disturbances in its metabolism and elastotic changes, including in the lamina cribrosa, which in turn may predispose to the development of glaucoma in eyes with PEX [8].

Genome-wide association studies (GWAS) have also identified associations between PEX and other genes. One of these is the gene encoding contactin-associated protein-like 2 (*CNTNAP2*) – a neuronal membrane protein that is likely involved in the transport of potassium channels and interacts with cytoskeletal components [9]. It has also been demonstrated that in patients with PEX, the expression of functionally impaired variants of cytochrome P450 39A1 (*CYP39A1*), which metabolises 24(S)-hydroxycholesterol into 24(S)-7α,24-dihydroxycholesterol, is significantly reduced across all ocular structures, particularly in the ciliary body and retina. Reduced *CYP39A1* activity disrupts lipid homeostasis within cells, as well as cholesterol balance and transport, leading to its excessive accumulation in extracellular clusters of pseudoexfoliative material [10]. A link to PEX has also been demonstrated for the gene encoding the α1 subunit that forms the pores of voltage-gated P/Q-type calcium channels (*CACNA1A*). The presence of *CACNA1A* in the human eye has been identified in the ciliary body, iris, anterior lens epithelium, optic nerve glial cells, vascular endothelial cells, and the retina. Calcium channel activity has been linked to the formation of pseudoexfoliative material. High concentrations of calcium have been detected within its deposits, where it is used in the process of forming stable fibrillin aggregates. Dysfunction of calcium channels may therefore contribute to the accumulation of pseudoexfoliative material [11]. It has been suggested that the pathogenesis of PEX involves microRNAs, which influence protein metabolism and lead to cell apoptosis [12], as well as small nucleolar RNAs (snoRNAs), whose direct role in PEX pathogenesis remains unclear [13].

Research into the genetic foundations of PEX not only enhances our understanding of its pathogenic mechanisms, but also lays the groundwork for developing new therapeutic approaches targeting specific genes. An example is a GWAS study that, through deep resequencing of the *LOXL1* gene, identified a rare variant – *p.Tyr407Phe* – which exhibits a strong protective effect against PEX [14].

UV radiation

Among the environmental factors influencing the development of PEX, UV radiation appears to play a key role. It contributes to the production of pathological pseudoexfoliative material through mechanisms including oxidative stress induction, modulation of extracellular matrix signaling pathways, and potential effects on the expression of risk genes. For this reason, PEX may be considered an ophthalmoheliosis (a sun-related eye disease). Extensive epidemiological data indicate a higher risk of developing PEX in populations living in areas with high levels of sunlight exposure. Spending more time outdoors during summer is associated with increased risk, whereas wearing sunglasses is linked to a reduced risk of PEX. Another significant risk factor is working near reflective surfaces such as water or snow. Interestingly, studies on Greenlandic Inuit and Peruvian populations have shown that despite their high UV exposure, there is no increased prevalence of PEX among these groups. This phenomenon is attributed to the relatively greater iris thickness observed in these populations, which may mitigate the effects of UV radiation [15].

Oxidative stress

Oxidative stress is also thought to play a significant role in the pathogenesis of PEX. It results from the intracellular production of reactive oxygen species (ROS) in the tissues of the eye's anterior segment and can be further triggered by environmental factors such as UV light, cigarette smoke, and other toxins. Thro-

ugh damage to proteins, lipids, and DNA, ROS intensify inflammatory processes and disrupt extracellular matrix remodeling. Interactions between oxidative stress and other factors involved in PEX pathogenesis (such as *LOXL1* and TGF-β) contribute to the formation of pseudoexfoliative deposits. Furthermore, oxidative stress leads to dysfunction of trabecular meshwork proteins, impaired aqueous humor outflow, and vascular changes resulting in optic nerve ischemia, all of which contribute to the development of PEXG (Fig. 1) [16].

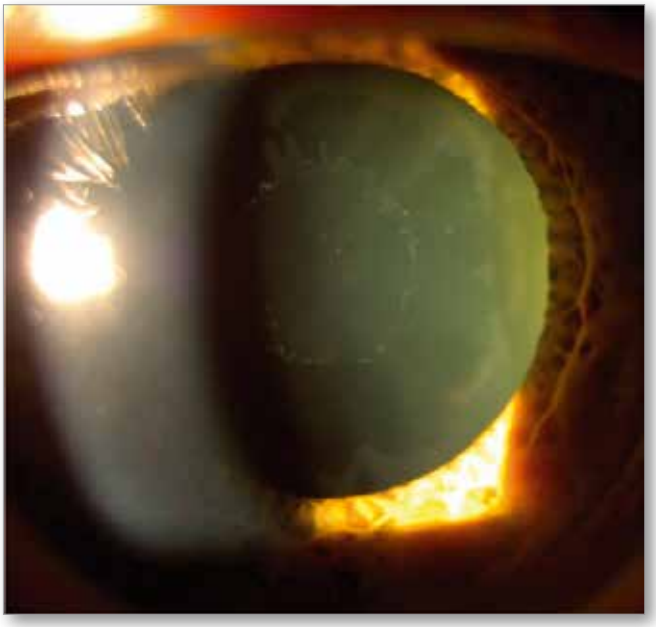

Fig. 1. Characteristic pattern of pseudoexfoliative material deposits on the anterior lens capsule.

Clinical presentation

PEX is an ophthalmic condition of considerable clinical significance; however, a large proportion of patients with PEX remain asymptomatic. Diagnosis of PEX relies primarily on slit-lamp biomicroscopic examination. In affected individuals, characteristic deposits of pseudoexfoliative material can be observed as whitish, fibrous aggregates, which become more evident following pupil dilation. On the anterior lens capsule, PEX material deposits typically form concentric patterns, including a central disc, a clear zone, and an outer ring of deposits. In pseudophakic patients, pseudoexfoliative material may accumulate on the surface of the intraocular lens as well as on the vitreous body. PEX material deposits are also visible on the corneal endothelium, together with pigment deposits, and along the pupillary margin. PEX material also accumulates on the lens zonules and ciliary processes, leading to their laxity and increased susceptibility to lens subluxation or dislocation. In the iris, loss of the pigmented epithelium over the sphincter muscle may occur, accompanied by atrophic changes producing the characteristic "moth-eaten" appearance of the pupillary margin. In patients with PEX, the iris frequently exhibits reduced reactivity to light and difficulty in dilation. The development of posterior synechiae may further impede pupillary dilation. An important consequence of PEX is damage to the iris vasculature, leading to ischemia and disruption of the blood–aqueous barrier, which results in reduced oxygen levels in the anterior chamber of the eye. PEX material also accumulates within the drainage angle. Gonioscopic examination reveals trabecular hyperpigmentation, most prominent in the inferior section, as well as a wavy line of dense pigmentation on the corneal endothelium along Schwalbe's line – known as Sampaolesi's line [17, 18]. Studies suggest that PEX may contribute to reduced retinal nerve fiber layer (RNFL) thickness, decreased vascular density in the optic disc and macular regions, increased risk of central retinal vein occlusion (CRVO), epiretinal membrane formation, and vitreous detachment. PEX is also associated with reduced corneal sensitivity, which is linked to decreased epithelial cell and subepithelial nerve density, impaired tear secretion and stability, as well as Meibomian gland dysfunction. Eyes affected by PEX are also characterized by elevated intraocular pressure (IOP) and greater diurnal fluctuations. Following pupillary dilation, IOP levels in PEX patients generally rise, likely due to the release of large amounts of pigment [17]. The disease may initially present unilaterally; however, despite characteristic manifestations in one eye, early-stage PEX often develops in the fellow eye and, with advancing age, frequently progresses to a bilateral condition (Fig. 2) [1].

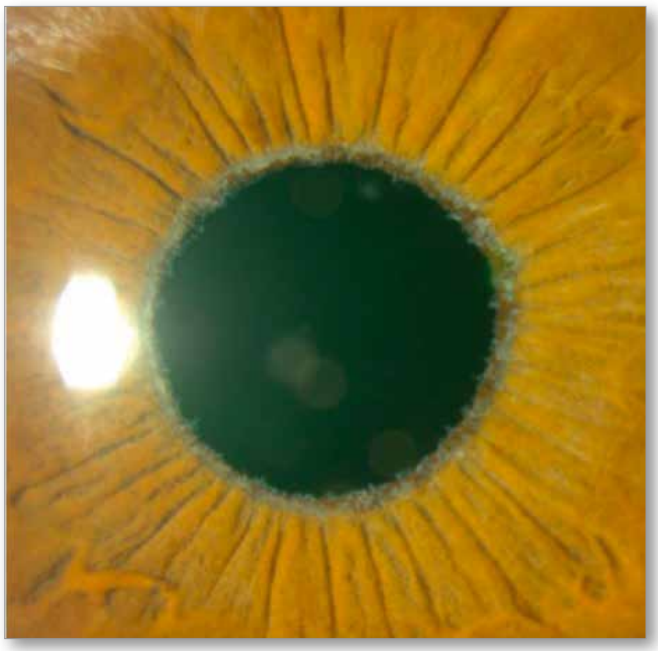

Fig. 2. Pseudoexfoliative material present at the pupillary margin.

Pseudoexfoliative glaucoma

PEXG is the most common form of SOAG. Its prevalence varies significantly across geographic regions, closely reflecting the distribution of PEX itself. Compared to POAG, PEXG is characterized by an earlier onset of symptoms, a higher incidence of unilateral presentation, elevated IOP at the time of diagnosis, greater diurnal fluctuations in IOP, a stronger correlation between optic nerve damage and IOP levels, more pronounced visual field deterioration and optic disc cupping, faster progression, increased risk of vision loss, greater treatment challenges, and a higher rate of complications [6, 17].

The increase in IOP in the course of PEX results from the accumulation of pseudoexfoliative material and pigment within the trabecular meshwork and Schlemm's canal, as well as structural and functional damage to these tissues caused by oxidative stress and disturbances in extracellular matrix metabolism. As a result of these changes, mechanical obstruction of the aqueous outflow pathway occurs, leading to a gradual increase in outflow resistance [6, 17].

An increase in IOP, on the other hand, leads to disturbances in ocular and retrobulbar circulation as well as microcirculation of the optic nerve. Combined with lamina cribrosa elastosis, this results in gradual ischemia and damage to optic nerve fibers [17].

Interestingly, in patients with unilateral high-tension PEXG, the fellow eye carries a high risk of glaucomatous optic nerve damage, even if its IOP remains within normal limits [19].

In patients with bilateral PEX, each eye carries a higher risk of developing PEXG compared to patients diagnosed with PEX in only one eye. Bilateral diagnosis is more common in older patients, which may be associated with up to a 70% risk of developing bilateral PEX in individuals previously diagnosed with the unilateral form of the disease. It is also worth noting that the clinical presentation of the disease in patients with bilateral PEX is typically more advanced than in those with unilateral PEX [20].

Patients with PEX may present with capsular glaucoma in one eye and POAG in the fellow eye. In a prospective study by Pusk, it was observed that over a 10-year period, 32% of patients with unilateral PEX developed PEXG in the affected eye, 38% showed PEX changes in the fellow eye, and 3.5% developed POAG in the fellow eye [21].

Normal-tension glaucoma in pseudoexfoliation syndrome

Although glaucoma associated with PEX most commonly presents as high-tension open-angle glaucoma with significant IOP fluctuations, other forms may also occur. One such variant is normal-tension glaucoma (NTG). In the Polish population, the prevalence of NTG associated with PEX has been reported at 18.6%, a rate comparable to that observed in primary open-angle glaucoma [22]. Elevated IOP is not the sole factor contributing to glaucoma development in the course of PEX. Damage to the optic nerve also occurs due to impaired blood supply and weakening of the lamina cribrosa – mechanisms that play a significant role in the development of NTG. Studies have shown that eyes with the low-tension form of PEXG have a thinner central corneal thickness (CCT) and a thinner lamina cribrosa compared to eyes with high-tension PEXG. Moreover, it has been observed that in NTG associated with PEX, optic nerve fiber loss progresses more rapidly than in primary NTG [23].

Angle-closure glaucoma in pseudoexfoliation syndrome

Angle-closure glaucoma (ACG) in patients with PEX presents clinical features that distinguish it from either condition occurring independently. In a prospective multicenter study by Fu et al., it was diagnosed in 7.2% of glaucoma patients, with a clear predominance among older individuals – affecting up to 38.1% of those aged 71–80 years [24]. Characteristic features of ACG in the context of PEX include biphasic diurnal fluctuations in IOP, asymmetric involvement of the drainage angle associated with the distribution of pseudoexfoliative material, impaired pupillary constriction, and progressive anterior displacement of the lens caused by weakening of its zonular apparatus. ACG coexisting with PEX is characterized by an aggressive course, with visual field deterioration progressing at twice the rate observed in patients with isolated pathologies. Accordingly, early diagnosis and the initiation of both pharmacological and surgical treatment are essential. In the pharmacological management of ACG associated with PEX, the most effective strategy combines prostaglandins with alpha-2 agonists. Surgically, phacoemulsification combined with minimally invasive glaucoma surgery (MIGS) is a cornerstone of therapy (Fig. 3, 4) [24].

Fig. 3, 4. Gonioscopy view of pseudoeksfoliation syndrome. The photos show a heavily pigmented trabecular meshwork and Sampaolesi's line.

Treatment of glaucoma in pseudoexfoliation syndrome

The management of glaucoma associated with PEX follows principles similar to those applied in POAG, with the primary goal being the reduction of mean IOP. However, several aspects specific to PEXG must be taken into account. Despite greater difficulty in achieving sufficiently low IOP, patients with PEX – due to higher peak IOP values and greater fluctuations – require a more substantial reduction in IOP and its tighter diurnal control than patients with POAG. Attention should also be paid to IOP spikes induced by pupillary dilation, which necessitate IOP monitoring 1–2 hours after dilation or prophylactic administration of topical IOP-lowering agents. Since patients with PEX are typically elderly individuals, it is important to consider their reduced systemic tolerance to beta-blockers, as well as the high prevalence of ocular surface diseases in this age group. Moreover, achieving the desired IOP level through pharmacotherapy, laser procedures, or surgery may only have a temporary effect. As PEX material continues to accumulate and the disease progresses, a sudden or gradual increase in IOP may occur again. Therefore, regular monitoring is crucial in the management of PEXG, even for eyes that appear to be well controlled [25].

Pharmacotherapy

Pharmacological management of PEXG is based on all primary classes of antiglaucoma medications commonly used in the treatment of POAG. Monotherapy is often insufficient to achieve target IOP levels, which in patients with PEXG must be particularly low to prevent disease progression. This is why combination therapy is typically necessary, as it achieves a greater reduction in IOP and maintains lower mean IOP levels. Recommended treatment includes fixed combinations of 0.5% timolol with prostaglandin analogues, such as latanoprost (0.005%), travoprost (0.004%), bimatoprost (0.03%), or tafluprost (0.0015%). Therapy with these drug combinations offers greater convenience and results in a more pronounced reduction in IOP, along with reduced exposure to preservatives, compared to treatment with separate formulations of the same active substances [25].

Laser and surgical treatment

Due to the frequent inadequacy of pharmacotherapy, laser and surgical interventions play a major role in managing PEXG.

Among laser-based approaches, selective laser trabeculoplasty (SLT) and argon laser trabeculoplasty (ALT) are most commonly used. Both methods appear to be equally effective in lowering IOP in patients with PEX [26]. However, it is suggested that the SLT procedure is better tolerated by patients, and eyes after SLT are less prone to IOP spikes [27]. Surgical treatment is initiated when pharmacotherapy and laser procedures prove insufficient. Surgical treatment of PEXG involves the same methods used in the management of POAG. The most commonly performed procedure is trabeculectomy, which is relatively inexpensive and has a high success rate. Patients with PEX are at increased risk of complications due to lens zonule laxity and disruption of the blood-ocular barrier. The management of PEXG also includes the use of glaucoma drainage devices. Another surgical approach in PEXG involves procedures targeting the drainage angle to restore the natural outflow of aqueous humor, such as ab interno trabeculectomy, trabecular aspiration, viscanalostomy, or gonioscopy-assisted transluminal trabeculotomy (GATT) [27]. A 24-month follow-up study demonstrated that GATT effectively reduced IOP in patients with PEXG and lowered the amount of eye drops needed to maintain target pressure. Moreover, GATT proved to be a safe procedure: among 103 operated eyes, no serious complications were reported, and hyphema observed on the first postoperative day resolved within two weeks after surgery [28]. Cataract surgery also plays an important role in the treatment of PEXG, either as a standalone procedure or in combination with glaucoma interventions. Isolated cataract surgery has been shown to effectively reduce IOP in patients with PEXG, with a more pronounced effect than in cases of POAG [29].

PEX endotheliopathy

PEX significantly affects the corneal endothelium, which has important clinical implications. Patients with PEX exhibit reduced endothelial cell density (ECD), which decreases even further in those with PEXG. As a result of the diminished density of corneal endothelial cells – and the consequent loss of a substantial portion of them – the remaining cells enlarge and lose their characteristic hexagonal shape. It has been hypothesized that the degenerative impact of PEX on the cornea may be driven by several mechanisms, including the penetration of PEX material through the endothelium toward Descemet's membrane and the promotion of cellular apoptosis, anterior chamber hypoxia resulting from vascular changes in the iris, oxidative stress, elevated IOP, and alterations in cytokine and growth factor concentrations within the anterior chamber and cornea [30]. Such a condition may ultimately lead to corneal decompensation [17]. This is particularly relevant for intraocular procedures such as cataract surgery, which in patients with PEX carry a significantly higher risk of postoperative corneal decompensation compared to the general population (Fig. 5) [31].

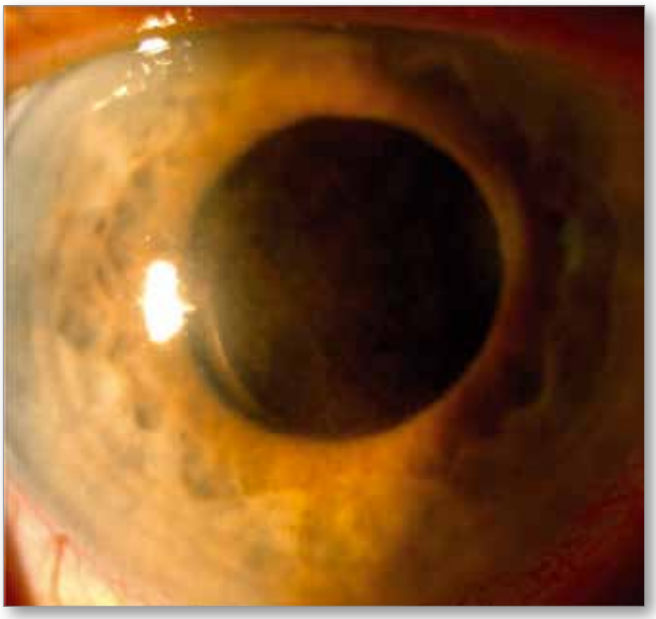

Fig. 5. Keratopathy in pseudoexfoliation syndrome – visible pigment on the posterior surface of the cornea.

PEX and cataract development and surgery

PEX is a risk factor for the earlier onset of cataract. It is believed that this may be due to altered lens metabolism resulting from changes in the composition of the aqueous humor, caused by vascular disturbances in the iris and disruption of the blood–aqueous barrier. PEX is also associated with an increased risk of intraoperative and postoperative complications during cataract surgery. Poor pupillary dilation in PEX may be associated with iris atrophy, mechanical hindrance of pupil dilation due to deposition of PEX material in the iris stroma, as well as accumulation of PEX material on the iris pigment epithelium and the lens capsule. Poor pupillary dilation may result in a smaller capsulorhexis diameter, thereby increasing the risk of intraoperative damage to the lens zonules. To prevent this, the use of pupil retractors, viscomydriasis, or other pupil expansion techniques may be necessary. PEX also leads to weakening of the lens zonules, which is associated with the accumulation of PEX material and subsequent degeneration. This zonular instability increases the risk of misdirection of irrigation fluid during surgery, fluctuations in anterior chamber depth, as well as intraoperative or postoperative dialysis and dislocation of the lens. Patients with PEX undergoing cataract surgery are also at elevated risk of corneal decompensation, IOP spikes, anterior capsule contraction syndrome, and posterior capsule opacification (Fig. 6) [31].

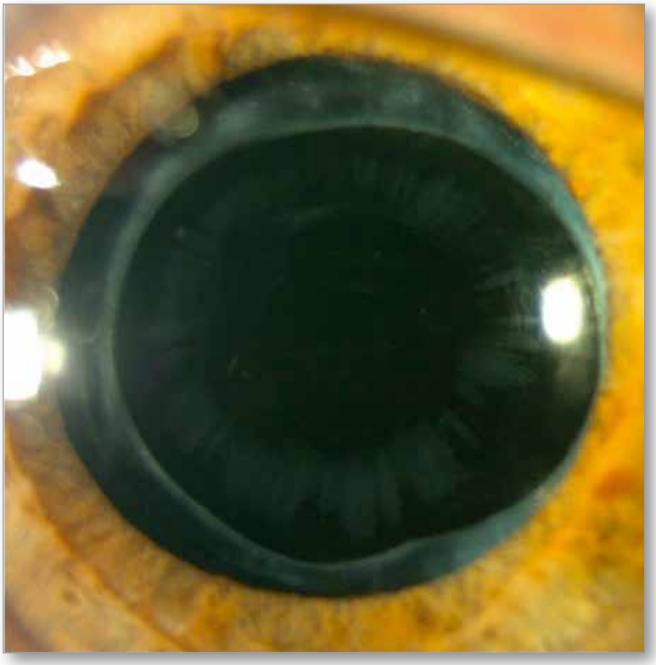

Fig. 6. Pseudoexfoliative material on the anterior surface of the intraocular lens.

PEX as a systemic disease

Although PEX is considered a disease affecting only the organ of vision, fibrillar material found in the anterior segment of the eye also accumulates in other organs. Deposits of pseudoexfoliative material have been identified, among other locations, in blood vessels, skin, liver, gallbladder, kidneys, lungs, heart, meninges, and the inner ear, indicating the systemic nature of PEX. Patients

with PEX have been shown to have a significantly increased risk of cardiovascular diseases such as arterial hypertension, coronary artery disease, peripheral circulatory impairment, and renal artery stenosis. Probable pathomechanisms include deposition of pseudoexfoliative material in blood vessels, endothelial dysfunction, increased insulin resistance, elevated levels of homocysteine, anticardiolipin antibodies, and other proinflammatory proteins. An increased co-occurrence of PEX with Alzheimer's disease and sensorineural hearing loss has also been reported. According to current research, PEX does not significantly affect life expectancy. However, it should be considered a potential marker of increased cardiovascular risk, and patients diagnosed with PEX should undergo internal medicine evaluation [32].

Conclusions

Pseudoexfoliation syndrome is a complex condition with multifactorial pathogenesis, influenced by both genetic and environmental factors. PEX affects a significant portion of the population and has a considerable impact on the ocular condition of patients. It is not only the most common cause of SOAG with a more severe course and poorer prognosis, but it also predisposes to ophthalmic complications such as lens subluxation or dislocation and corneal decompensation. PEX has been the subject of numerous published scientific articles describing various aspects of the disease; however, further research is needed to better understand its pathogenesis and to develop the most effective therapeutic strategies. Practicing ophthalmologists should give special consideration to the specific diagnostic and therapeutic challenges presented by patients with PEX. Given the systemic implications of PEX, patients diagnosed with the condition should be monitored by internal medicine specialists, especially for vascular complications.

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