ORIGINAL ARTICLE

CONTENTS

Pseudoexfoliation syndrome: modern concepts of morphological and clinical manifestations, classification and treatment

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ABSTRACT

Aim: To develop an updated and refined classification of pseudoexfoliation syndrome (PEX) in the context of its complication by pseudoexfoliation glaucoma (PEXG), taking into account the current understanding of the morphological and clinical criteria of PEX and its treatment methods.

Materials and Methods: The study analyzed and systematized the scientific publications regarding the modern understanding of PEX and PEXG from PubMed and Scopus databases. The publications analyzed mainly for the period 2015-2024 concerned existing classifications of PEX, as well as descriptions of PEX and PEXG symptoms, and surgical methods of their treatment. Analytical and bibliographic methods were employed.

Conclusions: A comprehensive approach is required for the clear identification of PEX signs and early diagnosis of PEXG. Involvement of all tissues of the anterior segment leads to a range of intraocular complications that are significant for the treatment strategy. PEX is not designated as a separate nosological entity in the International Classification of Diseases; however, several classifications of PEX exist, none of which are used in practice. We propose an original classification of PEX that takes into account morphological and clinical changes of the anterior segment of the eye (the pattern of pseudoexfoliative material distribution, pupil diameter, degree of iridodonesis and phacodonesis, presence of lens or intraocular lens dislocation) and simultaneously implies the appropriate surgical intervention.

Careful monitoring of PEX symptoms is necessary to prevent complications and to ensure timely initiation of appropriate medical and surgical glaucoma treatment, taking into account the risk of operative complications. The developed, modern, improved classification of PEX can be used in the training and clinical practice of ophthalmologists.

KEY WORDS: ophthalmology, pseudoexfoliation syndrome, glaucoma, classification, treatment

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INTRODUCTION

Pseudoexfoliation is a complex, progressive, systemic age-related disorder. The early stage of extracellular fibrillar material deposition on ocular and extraocular tissues is referred to as pseudoexfoliation syndrome (PEX). The severe advanced stage of this syndrome is known as pseudoexfoliation glaucoma (PEXG), which manifests with elevated intraocular pressure (IOP) and optic nerve damage [1]. As early as 1987 it was recognized that PEX is common and possibly responsible for a larger proportion of glaucoma cases than previously thought [2]. It is estimated that PEX may occur in 10–20% of the global population over 60 years old (approximately 70 million people). The prevalence of PEX is increasing worldwide, and many patients with this condition may remain undiagnosed [3].

The pseudoexfoliative material (PEXM) that forms in PEX mostly accumulates on various structures of the anterior segment of the eye. The nature of this material is predominantly fibrillar, consisting of fibers made up of microfibrils coated with amorphous material. The composition of these fibrils is diverse, including components of the basement membrane as well as enzymes involved in extracellular matrix maintenance [4]. Accumulation of PEXM contributes to early diffuse decompensation of the corneal endothelium, and the severity of PEX is significantly associated with a reduction in corneal endothelial cell density [5]. Through the accumulation of PEXM, local inflammation of the ocular surface increases, leading to stenosis of the lacrimal puncta [6].

Interest in PEX is also driven by the fact that it is a systemic condition and a risk factor for other diseases.

PEX is statistically significantly associated with a history of angina pectoris, hypertension, or a combined history of angina, acute myocardial infarction, or stroke. Signs of PEX detected with a slit-lamp can identify individuals with increased vascular risk, highlighting vascular associations with PEX in the context of the widespread elastosis affecting many tissues, including the walls of blood vessels [7].

Thus, the main complication of PEX is undoubtedly open-angle glaucoma, although angle-closure glaucoma can also occur due to pupillary or ciliary block [8]. The prevalence of PEX increases markedly with age. Individuals with PEX tend to have thinner and flatter corneas; however, no differences have been found in cataract characteristics or age-related macular degeneration compared to those without PEX [9].

The various manifestations of PEX need to be investigated and systematized, as knowledge of them can help improve the classification of PEX and thus pave the way for better-targeted treatment of both PEX and PEXG.

AIM

To develop an updated and refined classification of PEX in the context of its complication by PEXG, taking into account current understanding of the morphological and clinical criteria of PEX and its treatment methods.

MATERIALS AND METHODS

The study analyzed and systematized global and domestic scientific literary sources and electronic resources regarding the modern understanding of PEX and PEXG from the scientometric databases PubMed and Scopus. The search for publications was carried out using keywords and their logical combinations: ophthalmology, PEXG, PEX classification, symptoms and treatment of PEX. A total of 35 sources were analyzed, mainly from the period 2015-2024 (only 7 of them were published earlier). The inclusion criteria were the presence of existing PEX classifications in the publications, as well as a description of the symptoms of PEX and PEXG, surgical methods of their treatment. Analytical and bibliographic methods were employed.

REVIEW AND DISCUSSION

Clinical and histopathological manifestations of PEX involve damage to the lens, the zonular apparatus, the ciliary body, the iris, the trabecular meshwork, and the cornea [10]. PEX is not limited to the anterior segment of the eye. Information exists about histopathological characteristics of PEX in various structures – fibrillar and eosinophilic deposits on the anterior lens capsule, as well as on the eyelid and conjunctiva – indicating systemic distribution of PEXM. Understanding the systemic consequences of PEX for ocular and extraocular tissues may lead to more comprehensive treatment strategies for patients with this condition [11].

PEX has been associated with ocular surface diseases, specifically chronic eyelid redness caused by the long-term use of multiple glaucoma medications (with or without preservatives), due to the more aggressive disease course and late-stage glaucoma [12].

Purely clinical evaluation is insufficient for the clear identification of PEX and PEXG signs. The level of IOP and the degree of trabecular dysfunction correlate significantly with the amount of pigmentation and PEXM in the anterior segment of the eye [13]. Indices of peripheral blood related to systemic immune inflammation – including the systemic immune-inflammation index (SII), systemic inflammatory response index (SIRI), and aggregate index of systemic inflammation (AISI) – were elevated in patients with PEX compared to healthy control individuals. Therefore, these indices could serve as simple, practical, and cost-effective tools for assessing the degree of systemic inflammation in PEX patients, potentially guiding treatment [14].

The presence of PEX is associated with an increased risk of nuclear cataract [15]. The prevalence of PEX was significantly higher in older patients with mature cataract. The mean IOP was significantly higher in eyes with PEX than in those without it [16]. However, other data indicate that only a small percentage of eyes with PEX had elevated IOP, and even fewer had glaucomatous optic neuropathy. Thus, no correlation was found between elevated IOP and the stage of PEX. Additionally, in eyes with early-stage PEX, good pupillary dilation was observed [17].

Damage to all tissues of the anterior segment of the eye leads to a spectrum of intraocular complications that are significant for the treatment strategy. Intraocular complications occurring during or after ocular surgery in the context of PEX include phacodonesis, lens dislocation, and an increased frequency of vitreous loss during extracapsular cataract extraction. Other possible complications include pseudo-uveitis, anterior chamber hypoxia, hemorrhage in the iris stroma, dispersion of pigment epithelial melanin, and poor or asymmetric pupillary dilation. Due to the involvement of all cellular layers of the iris, posterior synechiae may form [8].

PEX is not designated as a separate nosological entity and thus is not included in the International Classification of Diseases (ICD-10 or ICD-11), unlike PEXG, which is classified as a form of secondary glaucoma. Several classifications of PEX have been proposed, but

Table 1. Classification of PEX

PEX Stage	Biomicroscopic Criteria	Pupil Diameter	Iridodonesis / Phacodonesis	Lens or IOL Dislocation	Preferred Surgical Appro
1	PEXM on the pupillary margin and anterior lens surface during mydriasis	≥8 mm	Absent	Absent	Standard phacoemulsification with IOL implantation
2a	PEXM on pupillary margin and anterior lens surface during mydriasis, also in the anterior chamber angle, on the iris and corneal endothelium	5-8 mm	Mild, not requiring fixation devices	Absent	Phacoemulsification at physiological IOP, no nucleus rotation, low vacuum, IOL implanted without fixation device
2b	PEXM on pupillary margin and anterior lens surface during mydriasis, also in the anterior chamber angle, on the iris and corneal endothelium	5-8 mm	Clinically and intraoperatively pronounced; require fixation devices (e.g., capsular tension ring)	Absent	Phacoemulsification at physiological IOP, no nucleus rotation, low vacuum, IOL implantation with fixation device (e.g., capsular tension ring)
3	PEXM on pupillary margin and anterior lens surface during mydriasis, also in the anterior chamber angle, on the iris and corneal endothelium	<5 mm	Clinically and intraoperatively pronounced; require fixation devices (e.g., capsular tension ring)	Absent	Phacoemulsification at physiological IOP, no nucleus rotation, low vacuum, IOL implantation with fixation device (e.g., capsular tension ring)
4	PEXM on pupillary margin and anterior lens surface during mydriasis, also in the anterior chamber angle, on the iris and corneal endothelium	<5 mm	Clinically and intraoperatively pronounced	Partial or complete dislocation of the lens or IOL	Phacoemulsification at physiological IOP, no nucleus rotation, low vacuum, IOL implantation with scleral or iris fixation

Source: compiled by the authors of this study

they are not used in clinical practice. PEX is considered a systemic disease, in which PEXM can deposit in the skin, heart, lungs, liver, kidneys, and other organs. Both unilateral and bilateral manifestations are possible. Myocardial infarction, cerebrovascular events, and systemic hypertension have also been associated with PEX. However, PEX was first described based on characteristic findings of white-gray flakes on the anterior lens capsule [18].

One review article on PEX presented a classification based on light biomicroscopy data, distinguishing four stages of qualitative changes [19]: from initial manifestations of PEX as punctate deposits on anterior segment structures at Stage I to disturbances of the spatial relationships of anterior segment structures at Stage IV. Another classification divides PEX into three grades based on the pattern of PEXM distribution: mild (partial involvement of the pupil margin), moderate (entire pupil margin), and severe (entire pupil margin and the surface of the iris) [5].

A different classification concerns phenotypic variants of PEX: the *pigmented* form (thin radial pigmented lines on the lens surface, often not involving the pupil), the *classic* form (a "dandruff-like" appearance of deposits on the lens capsule, pupillary margin, or iris), and the *combined* form, which combines features of both previous types and is characteristic of a more advanced stage of PEX. In a study of eyes with PEX of different phenotypes, glaucoma with significant IOP changes, with or without optic disc damage, was observed in 32% of eyes with the pigmentary form, 39% with the classic form, and 50% with the combined form of PEX. Different phenotypic variants of PEX were associated with a 30% risk of developing ocular hypertension and a 50% risk of developing glaucoma [20].

The treatment approach for patients with PEX, particularly the choice of surgical intervention, depends on the severity of degenerative changes in the iris, capsule, and zonular apparatus of the lens. Therefore, we propose an original classification of PEX (Table 1) that takes into account the morphological and clinical changes in the anterior segment of the eye (the pattern of PEXM distribution, pupil diameter, degree of iridodonesis and phacodonesis, and the presence of lens or intraocular lens [IOL] dislocation) and simultaneously prescribes the corresponding surgical intervention. This classification is the result of an analysis of 67 ophthalmic surgeries performed from December 2024 through April 2025 on patients with various stages of PEX: 22 eyes with stage 1, 20 with stage 2a, 13 with stage 2b, 11 with stage 3, and 1 eye with stage 4 of PEX [21].

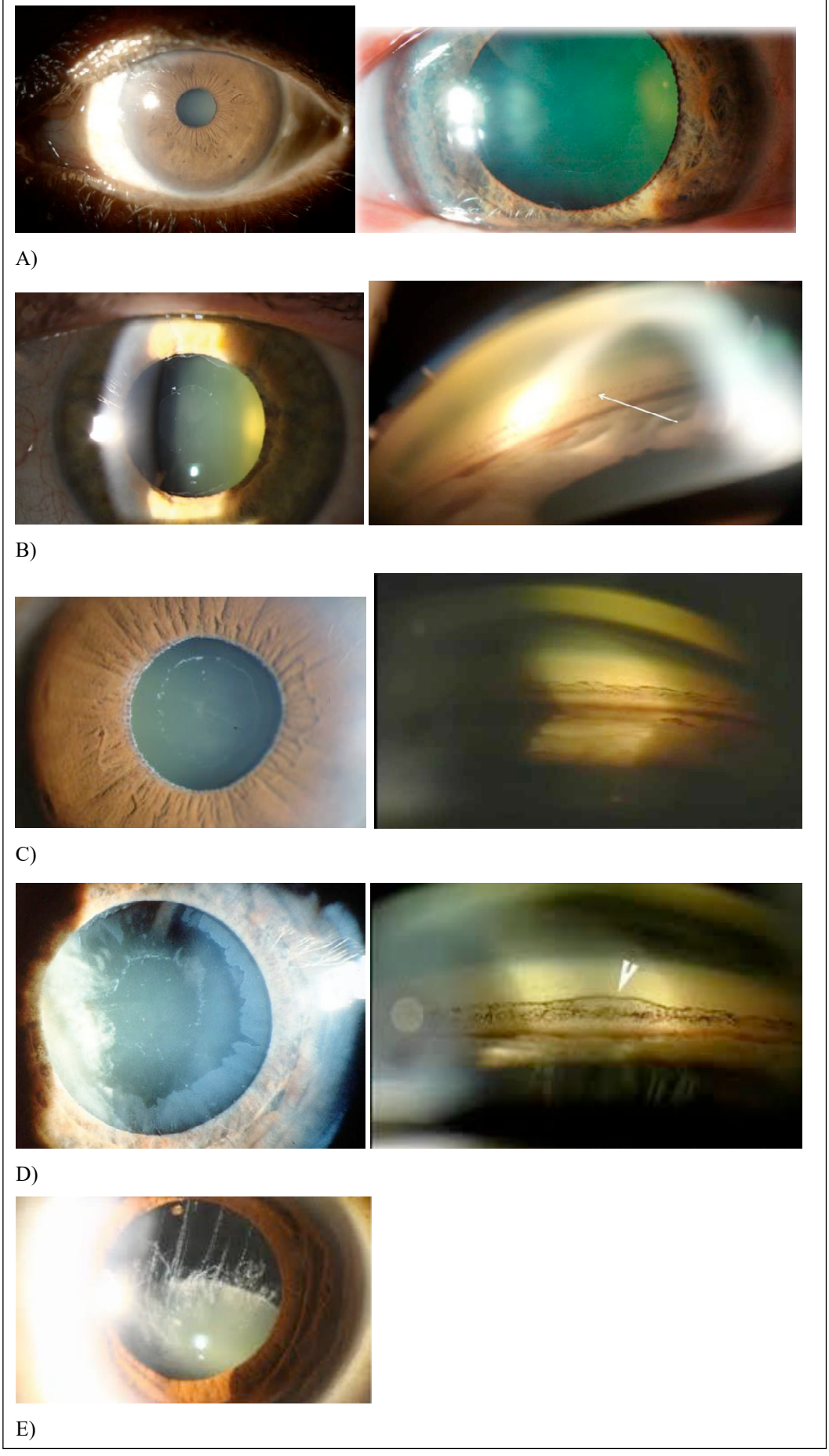

Fig. 1. The photos of eyes with different stages of PEX: A) PEX 1; B) PEX 2a; C) PEX 2b; D) PEX 3; E) PEX 4
Source: compiled by the authors based on [21]

The photos of eyes with different stages of PEX, taken using a slit lamp, are presented in Fig. 1.[21].

Thanks to the proposed classification, it is possible to predict the extent of the necessary surgical intervention. All classification criteria (maximum pupil width, extent of pseudoexfoliation spread, presence or absence of phacodonesis, and presence of lens dislocation in stage 4) are identified during the preoperative diagnostic stage. The scope and complexity of surgical treatment, as well as the need for additional IOL fixation devices, depend on the stage of PEX as defined in this classification. By determining the PEX stage according to this system, one can anticipate the volume, complexity, duration, and risk of potential postoperative complications. This creates a basis for determining the required level of surgical expertise, estimating the cost of the procedure, calculating the number of necessary consumables, and planning the involvement of additional resources (such as hospitalization or an anaesthesiologist). Moreover, this classification provides information to the patient (as well as to insurance companies, administrative or legal bodies, etc.) about the causes of complications and adverse outcomes.

An advantage of this classification is the ability to scientifically systematize results in clinical studies. Patients with different stages of PEX are expected to have differing risks of developing glaucoma. The availability of a clear and easily implementable patient grading system enables broad multicenter studies, in which all investigators can follow a unified principle of patient stratification, thereby contributing to the understanding and prevention of glaucoma onset and progression.

Patients with PEX and PEXG require continuous monitoring and individualized treatment, taking into account the specifics of their medical history. In one population-based study of PEX patients, 16% required treatment following evaluation [10]. The use of topical medications in PEX patients usually leads to poor long-term outcomes, but various surgical methods have been proposed for treating PEX, such as argon laser or selective laser trabeculoplasty. When examining patients with PEX and/or PEXG, all relevant factors must be considered to determine the most appropriate treatment strategy. Patients should also be informed about the increased risk of potential complications [22]. Phacoemulsification for cataract removal results in significant IOP reduction and visual improvement, making it a more effective option for treating PEXG [23], particularly in cases with preoperative IOP below 20 mmHg [24].

PEXG is characterized by larger IOP fluctuations and is more resistant to topical therapy than primary open-angle glaucoma. Therefore, first-line prostaglandin monotherapy is important for better control of elevated IOP and the tendency toward progressive glaucomatous vision loss. Timely selective laser trabeculoplasty and/or various micro-invasive glaucoma surgery (MIGS) procedures are also indicated for PEXG when other treatment methods prove ineffective. In particular, combined cataract surgery with translimbal trabeculotomy under gonioscopic guidance is highly effective in reducing IOP in PEXG (possibly by washing out PEXM from the anterior chamber and trabecular meshwork) [25]. Managing patients with concomitant PEXG and cataract is a complex task due to its worse prognosis compared to other types of glaucoma and the increased risk associated with surgical intervention for cataract [26].

Compared to primary open-angle glaucoma, PEXG demonstrates more pronounced optic nerve damage and a weaker response to medical therapy. The effects of argon laser therapy and filtering surgery are similar for these two types of glaucoma, but primary laser trabeculoplasty has been shown to yield better results in PEXG than in primary open-angle glaucoma [27].

Laser trabeculoplasty and medical treatment of PEXG are equally effective, but both lose effectiveness over several years. It is also necessary to monitor the IOP in the contralateral eye, given the potential development of glaucoma in it. A significantly high risk of complications (capsular rupture, vitreous loss, lens nucleus dislocation, and IOL dislocation) has been reported following cataract surgery in eyes with PEX. The use of modern phacoemulsification techniques and devices for capsular support substantially reduces these risks [28].

Due to zonular damage associated with pseudoexfoliation, cataract surgery on eyes with PEX carries an increased risk of surgical complications [29]. Phacodonesis and lens subluxation may occur, as well as late dislocation of an in-the-bag IOL even years after an uncomplicated cataract surgery [30]. The frequency of cataract surgery complications did not differ statistically between patients with bilateral PEX and those with clinically unilateral PEX [31]. Intraoperative difficulties occurred in 27,4% of operated eyes with PEX, with the most common problems being poor pupillary dilation and zonular dehiscence [32].

PEXG is a more progressive disease than primary open-angle glaucoma, with higher IOP levels and greater diurnal fluctuation. Cases of PEXG usually require more aggressive antiglaucoma treatment, so glaucoma surgery is often performed in these patients [33]. Certain complications occurred more frequently in

the PEXG group compared to the primary open-angle glaucoma group. For example, postoperative best-corrected visual acuity of ≥20/40 was achieved in 20% of PEXG eyes versus 40% of primary glaucoma eyes; nonetheless, both groups experienced improvements in vision-related quality of life [34].

It is worth noting the need to study MIGS methods. It has been reported that most surveyed ophthalmology residents in the United States intend to treat glaucoma surgically in their future practice, but training in such procedures is not mandatory in ophthalmology residency programs [35].

CONCLUSIONS

PEX is a complex and prevalent ocular pathology that is difficult to diagnose and treat; it can lead to glaucoma and, ultimately, to blindness. Thorough monitoring of patients with PEX is essential for continuous control of IOP and other PEX symptoms, as well as for the timely initiation of appropriate medical and surgical glaucoma treatments while taking into account the risk of surgical complications.

A review of global experience regarding PEX manifestations, complications, and treatment methods has led to the development of a modern, refined classification of PEX that can be used in the education and clinical practice of ophthalmologists. In particular, the new classification provides the ability to predict the volume and complexity of the necessary surgical intervention, determine the required level of surgeon expertise, estimate the cost of the procedure, and assess the risks of potential postoperative complications. Additionally, this classification opens up the possibility of systematic categorization of patients in clinical research.

REFERENCES

1. Kapuganti RS, Alone DP. Current understanding of genetics and epigenetics in pseudoexfoliation syndrome and glaucoma. Mol Aspects Med. 2023;94:101214. doi: 10.1016/j.mam.2023.101214. DOI
2. Prince AM, Streeten BW, Ritch R et al. Preclinical Diagnosis of Pseudoexfoliation Syndrome. Arch Ophthalmol. 1987;105(8):1076–1082. doi: 10.1001/archopht.1987.01060080078032. DOI
3. Yüksel N, Yılmaz Tuğan B. Pseudoexfoliation Glaucoma: Clinical Presentation and Therapeutic Options. Turk J Ophthalmol. 2023;53(4):247-256. doi: 10.4274/tjo.galenos.2023.76300. DOI
4. Elhawy E, Kamthan G, Dong CQ, Danias J. Pseudoexfoliation syndrome, a systemic disorder with ocular manifestations. Hum Genomics. 2012;6(1):22. doi: 10.1186/1479-7364-6-22. DOI
5. Aoki T, Kitazawa K, Inatomi T et al. Risk Factors for Corneal Endothelial Cell Loss in Patients with Pseudoexfoliation Syndrome. Sci Rep. 2020;10(1):7260. doi: 10.1038/s41598-020-64126-w. DOI
6. Eroglu FC, Sekeroglu MA, Ceran TH et al. Evaluation of lacrimal drainage system in Pseudoexfoliation syndrome. Eye (Lond). 2022;36(11):2094-2098. doi: 10.1038/s41433-021-01799-1. DOI
7. Mitchell P, Wang JJ, Smith W. Association of pseudoexfoliation syndrome with increased vascular risk. Am J Ophthalmol. 1997;124(5):685-687. doi: 10.1016/s0002-9394(14)70908-0. DOI
8. Naumann GO, Schlötzer-Schrehardt U, Küchle M. Pseudoexfoliation syndrome for the comprehensive ophthalmologist. Intraocular and systemic manifestations. Ophthalmology. 1998;105(6):951-968. doi: 10.1016/S0161-6420(98)96020-1. DOI
9. Rumelaitiene U, Speckauskas M, Tamosiunas A et al. Exploring association between pseudoexfoliation syndrome and ocular aging. Int Ophthalmol. 2023;43(3):847-857. doi: 10.1007/s10792-022-02486-0. DOI
10. Jeng SM, Karger RA, Hodge DO et al. The risk of glaucoma in pseudoexfoliation syndrome. J Glaucoma. 2007;16(1):117-121. doi: 10.1097/01.ijg.0000243470.13343.8b. DOI
11. Stejar LD, Istrate-Ofițeru AM, Tofolean IT et al. Histopathological Analysis of Pseudoexfoliation Material in Ocular Surgeries: Clinical Implications. Diagnostics (Basel). 2024;14(19):2187. doi: 10.3390/diagnostics14192187. DOI
12. Dermenoudi M, Matsou A, Keskini C, Anastasopoulos E. Ocular Surface Disease Signs and Symptoms in Patients with Pseudoexfoliative Glaucoma: A Case-Control Study. Vision (Basel). 2022;6(1):11. doi: 10.3390/vision6010011. DOI
13. Iwanejko M, Turno-Kręcicka A, Tomczyk-Socha M et al. Evaluation of the anterior chamber angle in pseudoexfoliation syndrome. Adv Clin Exp Med. 2017;26(5):795-801. doi: 10.17219/acem/64023. DOI
14. Özer Ö, Güçlü ES. Evaluation of pseudoexfoliation syndrome patients with systemic immune indexes. BMC Ophthalmol. 2024;24(1):494. doi: 10.1186/s12886-024-03767-1. DOI
15. Kanthan GL, Mitchell P, Burlutsky G et al. Pseudoexfoliation syndrome and the long-term incidence of cataract and cataract surgery: the blue mountains eye study. Am J Ophthalmol. 2013;155(1):83-88.e1. doi: 10.1016/j.ajo.2012.07.002. DOI
16. Kalaycı M. Pseudoexfoliation Syndrome Prevalence in Somali Patients with Senile Cataract. İstanbul Med J. 2020;21(5):380-383. doi: 10.4274/imj.galenos.2020.12269. DOI

17. Philip SS, John SS, Simha AR et al. Ocular clinical profile of patients with pseudoexfoliation syndrome in a tertiary eye care center in South India. Middle East Afr J Ophthalmol. 2012;19(2):231-236. doi: 10.4103/0974-9233.95259. DOI
18. Bora RR, Prasad R, Mathurkar S et al. Cardiovascular Manifestations of Pseudoexfoliation Syndrome: A Narrative Review. Cureus. 2024;16(1):e51492. doi: 10.7759/cureus.51492. DOI
19. Kozariychuk N, Sykyrytska T. Psevdoeksfoliatyvnyi syndrom – suchasni aspekty (ohliad literatury). [Pseudoexfoliation syndrome – contemporary aspects]. Klinichna ta eksperymental'na patolohiya. 2017;16(1):168-172. doi: 10.24061/1727-4338.XVI.1.59.2017.38. (Ukrainian) DOI
20. Rao A, Padhy D, Sahay P et al. Clinical spectrum of pseudoexfoliation syndrome-An electronic records audit. PLoS One. 2017;12(10):e0185373. doi: 10.1371/journal.pone.0185373. DOI
21. Palamar BI, Melnyk VO. Certificate of Copyright Registration (Ukraine) # 136593. Tvir naukovo-praktychnoho kharakteru «Klasyfikatsiia Psevdoeksofoliatyvnoho syndrome». [Scientific and Practical Work «Classification of Pseudoexfoliative Syndrome»]. Ukrainian National Office for Intellectual Property and Innovations (UANIPIO). Ofitsiinyi elektronnyi biuleten «Avtorske Pravo i Sumizhni Prava». 2025;90:455. (Ukrainian)
22. Plateroti P, Plateroti AM, Abdolrahimzadeh S, Scuderi G. Pseudoexfoliation Syndrome and Pseudoexfoliation Glaucoma: A Review of the Literature with Updates on Surgical Management. J Ophthalmol. 2015;2015:370371. doi: 10.1155/2015/370371. DOI
23. Azaripour E, Khakpour Y, Soltani-Moghadam R et al. Outcomes of Phaco-viscocanalostomy in Primary Open Angle Glaucoma versus Pseudoexfoliation Glaucoma. J Ophthalmic Vis Res. 2021;16(4):566-573. doi: 10.18502/jovr.v16i4.9746. DOI
24. Carolan JA, Liu L, Alexeeff SE et al. Intraocular Pressure Reduction after Phacoemulsification: A Matched Cohort Study. Ophthalmol Glaucoma. 2021;4(3):277-285. doi: 10.1016/j.ogla.2020.10.002. DOI
25. Hynes A. Contemporary pseudo-exfoliation glaucoma management and treatment options. Can J Optom. 2024;86(2):7-34. doi: 10.15353/cjo.v86i2.5585. DOI
26. Kang E, Park JH, Yoo C et al. Comparison of intraocular pressure fluctuation and glaucoma progression rate between phakic and pseudophakic eyes in pseudoexfoliation glaucoma. Sci Rep. 2024;14:6. doi: 10.1038/s41598-023-49099-w. DOI
27. Drolsum L, Ringvold A, Nicolaissen B. Cataract and glaucoma surgery in pseudoexfoliation syndrome: a review. Acta Ophthalmol Scand. 2007;85(8):810-821. doi: 10.1111/j.1600-0420.2007.00903.x. DOI
28. Fontana L, Coassin M, Iovieno A et al. Cataract surgery in patients with pseudoex-foliation syndrome: current updates. Clin Ophthalmol. 2017;11:1377-1383. doi: 10.2147/OPTH.S142870. DOI
29. Konstas AGP, Holló G, Teus MA, Ritch R. Exfoliation Syndrome and Glaucoma. In: Samples J, Schacknow P, eds. Clinical Glaucoma Care. New York (NY): Springer; 2014, p. 345-359. doi: 10.1007/978-1-4614-4172-4_17. DOI
30. European Glaucoma Society Terminology and Guidelines for Glaucoma, 5th Edition. Br J Ophthalmol. 2021;105(1):1-169. doi: 10.1136/bjophthalmol-2021-egsguidelines. DOI
31. Jammal H, Abu Ameera M, Al Qudah N et al. Characteristics of Patients with Pseudoexfoliation Syndrome at a Tertiary Eye Care Center in Jordan: A Retrospective Chart Review. Ophthalmol Ther. 2021;10(1):51-61. doi: 10.1007/s40123-020-00319-w. DOI
32. Joshi RS, Singanwad SV. Frequency and surgical difficulties associated with pseudoexfoliation syndrome among Indian rural population scheduled for cataract surgery: Hospital-based data. Indian J Ophthalmol. 2019;67(2):221-226. doi: 10.4103/ijo.IJO_931_18. DOI
33. Tekin K, Inanc M, Elgin U. Monitoring and management of the patient with pseudoexfoliation syndrome: current perspectives. Clin Ophthalmol. 2019;13:453-464. doi: 10.2147/OPTH.S181444. DOI
34. Turalba A, Cakiner-Egilmez T, Payal AR et al. Outcomes after cataract surgery in eyes with pseudoexfoliation: Results from the Veterans Affairs Ophthalmic Surgery Outcomes Data Project. Can J Ophthalmol. 2017;52(1):61-68. doi: 10.1016/j.jcjo.2016.07.019. DOI
35. Halenda KM, Lee TJ, Sharma A et al. Survey of Microinvasive Glaucoma Surgery and Other Glaucoma Surgical Experience among United States Ophthalmology Residency Programs. J Acad Ophthalmol (2017). 2021;13(2):e108-e113. doi: 10.1055/s-0040-1721072. DOI

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

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